UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ECONOMIA, ADMINISTRAÇÃO E CONTABILIDADE DE RIBEIRÃO PRETO
DEPARTAMENTO DE ECONOMIA
PROGRAMA DE PÓS-GRADUAÇÃO EM ECONOMIA - ÁREA: ECONOMIA APLICADA

GIULIANO DE QUEIROZ FERREIRA

Fundamental sources of risk and the decline of carry trade returns

ORIENTADOR: PROF. DR. ALEX LUIZ FERREIRA

RIBEIRÃO PRETO
2023

Carlos Gilberto Carlotti Junior
Reitor da Universidade de São Paulo

Fábio Augusto Reis Gomes
Diretor da Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto

Milton Barossi Filho
Chefe do Departamento de Economia

Luciano Nakabashi
Coordenador do Programa de Pós-Graduação em Economia

GIULIANO DE QUEIROZ FERREIRA

Fundamental sources of risk and the decline of carry trade returns

Tese apresentada ao Programa de Pós-Graduação em Economia - Área: Economia Aplicada da Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto da Universidade de São Paulo, para obtenção do título de Doutor em Ciências. *Versão Corrigida. A original encontra-se disponível na FEA-RP/USP.*

ORIENTADOR: PROF. DR. ALEX LUIZ FERREIRA

RIBEIRÃO PRETO
2023

FICHA CATALOGRÁFICA

Ferreira, Giuliano de Queiroz
Fundamental sources of risk and the decline of carry trade returns. Ribeirão Preto, 2023.
163 p. : il. ; 30 cm

Tese de Doutorado, apresentada à Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto/USP. Área de concentração: Economia Aplicada.
Orientador: Luiz Ferreira, Alex.

1. Carry Trade. 2. Currency Excess Returns. 3. Exchange Rates. 4. Interest Rates. 5. Stock Markets.

ACKNOWLEDGMENTS

This work is the result of the support and support of many people who were and are part of a trajectory built over these years of academic and professional training. I cannot fail to mention the contribution of my family, my supervisor, friends, teachers and employees, the funding received and, above all, God.

To my parents Aurea and Anibal, to my brothers, especially Paulo, Marcus, Leandro and Denise, my pillars on this journey. This achievement reflects a joint effort and is the materialization of support, understanding, patience and support given by them.

To all my friends, especially to all colleagues at PPGE FEA-RP who helped me during the PHD course.

To PPGE FEA-RP and my supervisor, Alex Ferreira, for all the support and commitment that were essential for the conclusion of this research. I also thank Professors Miguel Léon-Ledesma and Rory Mullen for their contributions to this work.

I would also like to thank all the professors who were part of my academic career for all the knowledge passed on and the FEA-RP Postgraduate team for all the assistance provided, especially Selma from the Economics Department Office.

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

Fontes fundamentais de risco e o declinio dos retornos do carry trade

Resumo

A busca por uma conexão entre as flutuações macroeconômicas e os movimentos nos preços dos ativos é um tema de pesquisa que tem recebido atenção crescente na literatura financeira. A importância de explorar esse tema se estende não apenas aos formuladores de políticas, mas também ao setor financeiro. Nesse contexto, esta pesquisa buscou investigar a relação entre as fontes fundamentais de risco e a precificação de ativos internacionais. Encontramos evidências de que as flutuações na tecnologia específica de investimento, na eficiência marginal do investimento e no crescimento do estoque de moeda são fontes chaves de risco cambial. Desenvolvemos um modelo DSGE de economia aberta no qual esses três processos se tornam fatores de risco que impulsionam os retornos excessivos da moeda. Esses novos fatores provam ser empiricamente relevantes para precificar retornos em excesso de moeda. Os preços de risco associados a estes fatores são positivos e significativos. Descobrimos que moedas de países com baixos níveis de tecnologia específica de investimento, baixos níveis de eficiência marginal de investimento e altas taxas de crescimento monetário obtêm retornos excedentes mais altos. Além disso, mostramos que moedas de países com baixa exposição ao componente global dos três processos obtêm maiores retornos em excesso. Nossa evidência empírica considera tanto a seção cruzada de retornos excessivos médios (portfólios) quanto os retornos de moedas individuais. Finalmente, também encontramos algumas evidências de que nossos fatores de risco propostos também podem explicar o excesso de retornos de ações estrangeiras.

Palavras chave: Carry Trade, Excesso de Retorno Moeda, Taxa de Câmbio, Taxa de Juros, Mercado de Ações.

Fundamental sources of risk and the decline of carry trade returns

Abstract

The search for a connection between macroeconomic fluctuations and movements in asset prices is a research topic that has received growing attention in the finance literature. The importance of exploring this theme extends not only to policymakers, but also to the financial industry. In this context, this research sought to investigate the relationship between the fundamental sources of risk and the pricing of international assets. We find evidence that fluctuations in the investment-specific technology, the marginal efficiency of investment and the growth of money stock are key sources of currency risk. We develop an open economy DSGE model in which these three processes become risk factors that drive currency excess returns. These new factors prove to be empirically relevant for pricing currency excess returns. The risk prices associated with these factors are positive and significant. We find that currencies from countries with low levels of investment-specific technology, low levels of the marginal efficiency of investment and high money growth rates earn higher excess returns. Furthermore, we show that currencies from countries with low exposure to the global component of the three processes earn higher excess returns. Our empirical evidence accounts for both the cross-section of average excess returns (portfolios) and individual currency payoffs with the US Dollar. We also find some evidence that our proposed risk factors can also explain foreign equity excess returns.

Keywords: Carry Trade, Currency Excess Returns, Exchange Rates, Interest Rates, Stock Markets.

DECLARATION

A paper version of Chapters 2 and 3, co-authored with Dr. Alex Ferreira, Dr. Miguel L'eon-Ledesma, and Dr. Rory Mullen, titled "Currency Returns and Fundamental Sources of Risk," was presented in the XXIII Brazilian Finance Meeting, in July 2023.

Contents

List of Figures

List of Tables

Introduction

What are the fundamental sources of risk that drive asset prices? Are these sources also important for consumption and savings decisions? Risky assets often display a substantial level of price volatility, evident through price fluctuations in stock and foreign exchange markets. Standard economic theory predicts that macroeconomic shocks act as the primary drivers behind consumption and savings. Additionally, it posits that the prices of risky assets are contingent on agents' choices regarding consumption and savings. Given the significance of this fundamental sequence of associations, investigating this relationship becomes crucial. This thesis investigates the link between the fundamental sources of risk and the agents' consumption and investment decisions.

Neoclassical growth models predict conditional convergence toward a steady-state income, implying that poor countries should catch up with richer ones. Studies conducted in the 1990s, however, did not identify a trend of poorer nations catching up with their wealthier counterparts. In fact, these works found that rich countries grow faster than poor ones. Recently, there has been a growing body of literature reevaluating the convergence issue. Using up-to-date information, they found opposite results (see, e.g., Roy et al. (2016), Patel et al. (2021), and Kremer et al. (2022)). Analyzing data from the 1990s onwards, they found a trend towards unconditional convergence across countries.[1] Kremer et al. (2022) argue that this trend can be attributed to both faster catch-up growth and a decelerated growth rate of the frontier. During the same period, many of the determinants of growth - capital formation, population growth, human capital, policies, institutions, and culture - have also converged among countries towards those with higher incomes. Low-income countries have been catching up with higher-income countries.

As emphasized by Bhatti and Moosa (2016), the integration of the global financial market has evolved rapidly since the 1980s. The growing importance of foreign markets, the increased use of domestic currencies outside the home country, and the dissemination of financial product innovations have facilitated the integration of countries' capital markets. Furthermore, Boamah (2018) emphasizes the role of heightened international trade and financial liberalization in fortifying interconnections between countries and promoting global financial integration. Additionally, there has been a substantial increase in financial development and macroeconomic stability worldwide.

Financial development and macroeconomic stability play an important role in economic growth. Additionally, macroeconomic stability fosters the expansion and advancement of the financial sector. Functioning as an intermediary, the financial sector allocates resources from savers (households) to investors (firms), thus driving output growth through the redirection of resources toward the most profitable investments. The prospective advantages of international financial integration are widely acknowledged within policy-making circles. Specifically, capital flows from advanced countries to developing nations can exert a positive impact on economic growth in the latter and foster income convergence across countries. As emphasized by Eichengreen et al. (1998), flows from capital-abundant (low MPK) to capital-scarce countries (high MPK) have the potential to increase welfare in both the source and recipient countries. Gourinchas and Jeanne (2006) argue that capital flows can redistribute global savings to the most productive ventures. These authors analyze the importance of international financial integration for economic growth and income convergence across countries. They claim that international financial integration can equalize the marginal return to capital between countries without narrowing the difference in productivity and income between them. Nonetheless, Gourinchas and Jeanne (2006) point to the

[1] Unconditional convergence differs from conditional convergence, as the latter concept pertains to convergence between countries based on determinants of steady-state income. It is important to note that the average growth rate of Gross Domestic Product (GDP) has been higher in developing countries than in developed economies in recent decades.

promising role of international financial integration in generating welfare gains, provided that it effectively enhances the productivity of developing nations. This enhancement can be driven by technological advancements stemming from foreign investments and more effective allocation of domestic savings facilitated by financial liberalization.

Standard macroeconomic models link real interest rates with macroeconomic aggregates such as consumption, investment, and output. Hamilton et al. (2016) and Clarida et al. (2002) emphasize that in an open economy framework, the real interest rate is a function of domestic and world output, with the weight on the rest of world being proportional to the share of imported goods in consumption. Therefore, in a context of growing international trade, it is natural to expect an increasing importance of world output in the determination of real interest rates across countries.[2] Given the theoretical connection between macroeconomic aggregates and real interest rates, policymakers might find interest in comprehending the implications of real interest rates for welfare. Similarly, real interest rates can significantly influence investors' choices regarding fund allocation. Consequently, the ramifications of income convergence, along with the growth of financial and trade integration, on real interest rates hold broad-ranging significance for both policymakers and investors. As emphasized by Bhatti and Moosa (2016), understanding the behavior of interest rates is crucial for comprehending various macroeconomic relationships and policies. For instance, the interplay between domestic and foreign real interest rates, prompted by financial and goods markets, can restrict the scope of domestic monetary policy actions (Rey, 2015). Moreover, if countries maintain equalized real interest rates, a deficiency in domestic savings might not curtail the level of domestic investment, thereby weakening the linkage between domestic savings and the investment proposed by Feldstein and Horioka (1980). Finally, real interest rates are often part of open economy macroeconomic models of exchange rate determination (see, e.g., Dornbusch (1976), and Frankel (1979)). Exchange rate fluctuations can affect several macroeconomic variables such as inflation and returns on foreign exchange (FX) assets.

Downward Trend of Nominal and Real Interest Rates. Several recent papers have documented a decline in nominal and real interest rates since the 1980s. Many of these studies project the persistent nature of this downward trend (see, for example, Bernanke (2005), Summers (2014), and Eggertsson et al. (2019)). They emphasize the importance of both lower demand for investment and increased desire of savings. Despite the consensus on the declining trajectory of real interest rates, Hamilton et al. (2016) suggest that there's no compelling reason to assume that interest rates will remain low for several decades. They argue that the evidence for a near-zero stagnation of the real interest rate prior to the 2008 crisis is weak. Following the crisis, the real interest rate persisted at a low level due to a slower-than-expected recovery triggered by factors such as excess housing supply, household and bank deleveraging, and fiscal retrenchment.After these headwinds receded in early 2014, US GDP growth gained momentum, surpassing its potential. Consequently, the real interest rate should deviate from the low levels witnessed between 2008 and 2014. Hamilton et al. (2016) also scrutinize cross-country data concerning GDP growth and real interest rates and identify some evidence of a positive connection between these two variables, albeit a modest one. The authors deduce that other factors, like changes over time in subjective discount rates and inflation trends over time, have exerted significant influence on fluctuations in real interest rates in recent decades.

Holston et al. (2017) argue for the presence of global factors influencing the trend growth of both GDP and real interest rates across countries. Their findings suggest that the fall in real interest rates is an international phenomenon and therefore largely stems from developments that are common to many countries. These global forces are at work in both developed and emerging economies, pushing real interest rates down since the 1980s, as argued by Rachel and Smith (2015). The more financially integrated an economy is, the more likely it will be influenced by global variables. One example of a global factor can be found in the saving glut hypothesis (Bernanke, 2005) which posits that the increase in desired savings in emerging economies depressed real interest rates globally. The literature has put forth a list of other global factors contributing to the decline in the real interest rate: i) a decrease in the investment rate, a reduction in capital intensity, a decline in the relative price of capital/investment goods,

[2]Indeed, the increase in international trade in recent decades is remarkable. The World Trade Organization reports the following annual figures of international trade in goods (in billions of USD): 2.036, 3.489, 6.454, 15.302, and 19.004, for the respective years 1980, 1990, 2000, 2010, and 2019.

and a technological slowdown (Gordon, 2012; Summers, 2014; Gourinchas and Rey, 2019; Eggertsson et al., 2019); ii) a high desired savings rate driven by increasing life expectancy, declining population growth, and higher income inequality within countries (Krueger and Ludwig, 2007; Carvalho et al., 2016; Rachel et al., 2017; Eggertsson et al., 2019). All these factors suggest that the decrease in real interest rates results from the dynamic interplay of savings and investment. However, alternative explanations have been proposed by other authors. For example, the role of financial flows and monetary policy (specifically, changes in monetary regimes) in explaining the persistent decline in real interest rates is emphasized by Borio et al. (2017). Furthermore, Caballero and Farhi (2014) and Caballero et al. (2016) argue that the decrease in real interest rates signifies a growing scarcity of safe assets - a gap between the supply and demand for safe assets - which leads to the suppression of yields on these assets. This scarcity became particularly pronounced after the onset of the Global Financial Crisis (GFC) in 2008.

Evidence from the sample of countries included in our investigation indicates that, in addition to the decrease in real interest rates, there has been a reduction and convergence of nominal interest rates across countries. As we will demonstrate, this decline was accompanied by decreases in both real interest rates and inflation rates. Two noteworthy observations emerge upon initial examination: i) the decline in inflation rates was particularly pronounced during the 1980s and 1990s, especially among developing economies; and ii) real interest rates exhibited a consistent decline among developed countries from 1980 to 2019 and among developing economies since the mid-1990s. The evidence also suggests a convergence of real interest rates across countries.

Real Interest Parity. To what extent are interest parity conditions influenced by both the convergence of income and the convergence of nominal/real interest rates across countries? The real interest parity hypothesis (RIP) states that when goods and financial markets are globally integrated, real returns on similar assets in different countries tend to be equal (Bhatti and Moosa, 2016). Based on this hypothesis, the nominal interest rate differential should directly respond to the inflation differential, thus maintaining consistent real interest rates across countries over time (Cumby et al., 1984; Mishkin, 1984; Evans et al., 1994; Goldberg et al., 2003; Ferreira and León-Ledesma, 2007; Bhatti and Moosa, 2016).

If we assume that both the Fisher's (1930) relation and the *ex-ante* relative Purchasing Power Parity (PPP) condition hold, then real interest rates between countries will be equalized if the Uncovered Interest Parity condition (UIP) holds. The latter relationship implies the efficiency of domestic and foreign capital markets. However, if UIP does not hold, first, real interest rates may differ between countries and second, a profitable investment in the FX market emerges: the carry trade (CT).

The UIP Relation and Carry Trade. CT is an investment strategy that involves borrowing in currencies with low interest rates and investing in currencies with high interest rates. CT is worthwhile only if earnings from interest rate differentials are not completely canceled out by exchange rate movements. The prevalence of CT profits constitutes a violation of the UIP condition. This condition asserts that any discount in foreign interest rates will be exactly offset by the expected appreciation of the foreign currency over the same period. If this parity condition holds, there is no scope for exploitable profit opportunities in CT investments. Empirically, however, the UIP does not, in general, hold true. Most empirical studies find that low-interest-rate currencies do not systematically appreciate over time as suggested by the UIP (see, e.g., Fama (1984), Evans and Lewis (1995), Lustig and Verdelhan (2007), and Frankel and Poonawala (2010)). In fact, they tend to depreciate and create profit opportunities. The failure of the UIP led the finance and international economics literature to seek explanations for CT returns. Understanding how interest and exchange rates fluctuate is essential for policymakers to design macroeconomic policies. Investors, meanwhile, are concerned with interest rates and currency movements in as much as they affect their decisions over portfolio allocation and risk.

As discussed above, the literature documented a process of decline and convergence in nominal/real interest rates. Some authors advocate that this trend will persist over the next decades (see, e.g., Summers (2014), and Gourinchas and Rey (2019)). Another part of the literature argues that there is no reason to believe the trend will continue for long periods ahead (see, e.g., Hamilton et al. (2016)). If the magnitude of UIP deviations is related to the cross-country convergence in interest rates, policymakers and investors could use this information to help identify the future long-term trend of CT returns and deviations the UIP condition. They might also be interested in the short-term fluctuations of the components of CT returns (the elements of the UIP relation): nominal interest and exchange rates. This interest may arise due to the connection between interest rates and exchange rates with business cycle fluctuations (see, e.g., Clarida et al. (2002)). Policymakers might be concerned about the effects of business cycle fluctuations on household welfare. Investors might be concerned about the effects of business cycle fluctuations on nominal interest and exchange rates, given the short-term nature of CT investments.

Carry Trade and Fundamentals. This thesis aims to answer the following question: what fundamental macroeconomic sources of risk can explain CT returns in both the short and long term? This thesis focuses on CT, the investment strategy most employed by professionals in the FX market. We explore the relationship between cross-country convergence in nominal/real interest rates and CT returns, with a specific focus on the period between 1980 and 2019. **Then, building upon the analysis of factors identified in the literature as determinants of nominal/real interest rate convergence, we identify three key fundamental sources of macroeconomic fluctuations: Investment Specific Technology (IST), Marginal Efficiency of Investment (MEI), and the growth rate of money (MON).** These sources are directly linked to the underlying forces driving the decline in real interest rates: the dynamics of savings and investment, monetary policy, and the dynamics of supply and demand for safe assets. Moreover, they are stochastic processes inherently tied to CT returns, as they directly influence nominal interest and exchange rates. We concurrently examine the temporal evolution of these processes and CT returns. We demonstrate that innovations in these sources can give rise to fluctuations in business cycles, leading to short-term shifts in nominal/real interest and exchange rates. These shocks ultimately become fundamental risk factors capable of explaining CT returns. Additionally, we explore the ability of these risk factors to price equity returns.

We contribute to a growing literature that investigates basic insights from asset pricing theory to show that UIP violations reflect *risk premium* (see, e.g., Lustig and Verdelhan (2007), Lustig and Verdelhan (2011), Lustig et al. (2014), Corte et al. (2016), and Colacito et al. (2020)). To the best of our knowledge, our study is the first to look for a link between the long-term trend of CT returns with risk factors derived from fundamental sources of macroeconomic fluctuations. We also add to the literature that examines the downward trend and convergence in the nominal interest rates, inflation rates, and the MPK (see, e.g., Ferreira (2011), Gordon (2012), Juselius and Takáts (2015), Caballero et al. (2016), Carvalho et al. (2016), Arslan et al. (2016), Borio et al. (2017), Rachel et al. (2017), and Glick (2020)). Our study explores the channels through which the IST, MEI, and MON processes can help explain this convergence process across countries.

Researchers exploring asset pricing in the foreign exchange market focus on two main areas of investigation: the first is based on macroeconomic fundamentals (see, e.g., Brunnermeier et al. (2008), Hassan (2013), Colacito and Croce (2013), Farhi and Gabaix (2015), Hoffmann and Studer-Suter (2017), Colacito et al. (2018), and Colacito et al. (2020)) and the second attempts to identify risk factors associated with financial variables and moments of exchange rates distributions (see, e.g., Lustig et al. (2011), Burnside (2011a), Menkhoff et al. (2012b), Menkhoff et al. (2012a), Lustig et al. (2014), Corte et al. (2016), Kremens and Martin (2019), Jiang et al. (2019), and Della Corte et al. (2022)). While the latter approach yields extensive empirical support for a risk-return relationship in foreign exchange markets, it does not satisfactorily address the issue associated with the connection between risk factors and macroeconomic risks. In contrast, the first strand of the literature, also known as the Macro-Finance approach, explores different assumptions about market structures and household preferences to explain asset pricing behavior within a business cycle context (Cochrane, 2017).

This thesis is directly associated with the first strand of literature. We follow the Macro-Finance approach, by focusing on business cycle fluctuations as drivers of variation in currency returns. This allows us to analyze the structure of macroeconomic risks priced in FX markets. The Macro-Finance approach can improve the comprehension of the macroeconomic roots of currency risk. Therefore, helping to filter the "zoo of factors" (Cochrane, 2011) through the macroeconomic standpoint, unfolding a connection between macroeconomic fundamentals and currency excess returns. Despite advances in the modelling of asset pricing in the FX market (see, e.g., Brunnermeier et al. (2008), Menkhoff et al. (2012b), Hassan (2013), Lustig et al. (2014), and Farhi and Gabaix (2015)) and in the identification of risk factors associated with CT investments (see, e.g., Lustig and Verdelhan (2007), Lustig et al. (2011), Menkhoff et al. (2012a), Berg and Mark (2018a), Della Corte et al. (2022), and Gonçalves et al. (2022)) the question of the role played by macroeconomic fundamentals in the pricing of assets in the FX market remains open.

To answer this question, we begin by looking at the main findings and issues raised by the related literature. In this chapter, we explore the literature associated with: i) income convergence among countries; ii) asset pricing in foreign exchange markets; iii) decline and convergence of nominal interest rates, inflation rates, and the MPK; and iv) the IST, MEI, and MON processes. Subsequently, we delve into the behavior of CT returns during the period of diminishing and converging nominal/real interest rates, considering a broad set of developed and developing countries. We focus on the interval between 1980 and 2019 for two reasons. First, due to the lack of reliable data on several countries prior to this date. Second, to include a period marked by increasing financial openness. We begin this part of the thesis by trying to answer the following question: have CT returns reflected the decline and convergence of nominal/real interest rates? Specifically, have CT returns increased, decreased or remained constant over time? If CT returns decreased, this would indicate stronger arbitrage forces and lower UIP deviations. Overall, we find a downward trend in CT returns between 1980 and 2019.

Income Convergence, Declining Interest Rates, and Macroeconomic Shocks. As previously mentioned, the growth literature suggests several factors that could explain the long-term convergence of income across countries, such as capital formation, policies, and institutions. These factors exert a direct influence on the dynamics of production factor utilization within economies, affecting variables like the quantity of capital and labor employed in production. It is important to note that the growth literature primarily concentrates on long-term economic growth, distinct from the fluctuations inherent in business cycles. Another strand of the literature highlights various factors that contribute to the downward trajectory of real interest rates, including influences such as monetary policy adjustments and the decline in the relative prices of investment goods. Thus, a natural question that emerges in this context refers to the existence of macroeconomic shocks that can help explain simultaneously income convergence and the downward trend in interest rates and CT returns. We find evidence that shocks to the IST, MEI, and MON processes emerge as promising candidates for explaining these intertwined trends.

We show that these three fundamental macroeconomic processes closely tied to output growth, interest rates, inflation rates, currency fluctuations, and the MPK, have undergone a similar process of long-term convergence across countries. The literature on business cycle models formally connects these three shocks with output growth, interest rates, inflation rates, currency fluctuations, and the MPK (see, e.g., Cooley and Hansen (1989), Greenwood et al. (1992), Greenwood et al. (1997a), and Justiniano et al. (2011)). Our findings indicate a convergence between developing and developed countries in terms of IST, MEI, and MON values.

Chapter 2 also shows that inflation rates and the MPK have converged since the 1980s. In addition, we identify a reduction in exchange rate returns from CT investments. Lastly, we show that the average growth rate of capital has been higher in developing countries than in developed economies in recent decades. Are these changes related? We discuss how shocks in these shock processes can trigger fluctuations in business cycles and drive the long-term dynamics of production factors and prices. In our analysis, we examine the dynamic behavior of the first and second moments of the sampling distribution of the three macroeconomic processes, considering four groups of countries: developed, developing, G-10 countries, and the US. We conduct a similar analysis regarding interest rates, exchange rates, inflation rates, and the MPK. Subsequently, we compare these findings with the patterns observed in CT returns during the same period. To summarize, we identify a downward trend in CT returns between 1980 and 2019. We then establish that this trend is attributed to a reduction in interest rate differentials between countries and diminished exchange rate returns. Simultaneously, we uncover a parallel trend in the growth rates of the IST, MEI, and MON processes.

Open Economy Macroeconomic Model. These empirical observations raise a second research question that this thesis seeks to answer. **What can we learn from a Dynamic General Stochastic (DSGE) model that incorporates these three fundamental macroeconomic shocks?** The importance of addressing this issue is twofold. First, modern macroeconomics relies heavily on DSGE models of the economy to perform macroeconomic analysis. This is because these models incorporate dynamics (time dimension), deal with stochastic uncertainty and study general equilibrium effects. The latter implies that macroeconomic models need to be built based on microfoundations to adequately describe the path of the economy. Second, by evaluating the DSGE model we can inspect the mechanism behind the connection between the fundamental macroeconomic shocks and CT returns. It allows us to analyze business cycle fluctuations, perform hypothetical policy experiments, and predict the future course of the economy.

We formulate an open economy model that encompasses the three fundamental macroeconomic shocks, allowing us to investigate the dynamic responses of macroeconomic variables to these shocks. Subsequently, we incorporate these three shocks as risk factors within the asset pricing model derived from our open economy framework. This model provides an explanation for the connection between these fundamental macroeconomic sources of risk and currency excess returns. The key to determining whether CT returns will increase in the future hinges on discerning whether the cross-country differentials in the rates of IST, MEI, and MON growth will widen once more. Through a DSGE model, we demonstrate that these three shocks have the potential to trigger fluctuations in business cycles and account for gains from CT. Lastly, we evaluate the ability of our three proposed risk factors to explain currency excess returns.

Unifying Risk-Based Explanation. An important topic explored in the finance literature concerns the identification of risk factors capable of explaining the excess returns of various asset types, such as stocks, bonds, and more. In this context, Burnside (2011a) investigates whether traditional Capital Asset Pricing Model (CAPM) risk factors, based on the three factors of Fama and French (1992), and the extended CAPM with industrial production and US stock market volatility can explain currency excess returns. The study reveals that none of these models exhibit satisfactory explanatory power. In addition, jointly estimated models containing currency and equity portfolios are also rejected, confirming that the conventional risk factors that have success in explaining stock returns fail to explain currency returns. This leads Burnside (2011a) to the conclusion that there is no unifying risk-based explanation for excess returns in the stock and FX markets. A parallel conclusion is drawn by Sarno et al. (2012) through the estimation of a multicurrency term structure model. Their empirical analysis uncovers that the model with superior accuracy in pricing bonds falls short in explaining currency returns, and vice versa, the model best suited to price currency returns struggles with bond returns.

A related topic explored in the literature concerns the nature of correlation between returns in equity and currency markets. Hau and Rey (2006) develop a model in which the rebalancing of stock portfolio triggers exchange rate fluctuations. The main prediction of their model is that higher returns in the domestic stock market (in national currency) relative to foreign market translate into a depreciation of the national currency. This negative correlation is triggered by portfolio rebalancing and is known as the Uncovered Equity Parity (UEP) condition. Hau and Rey (2006), and Camanho et al. (2022) report empirical evidence in favor of the UEP condition. In contrast, Curcuru et al. (2014), and Fuertes et al. (2019) find evidence in favor of deviations from the UEP condition.

The lack of a unifying risk-based explanation for the equity and currency market returns and the lack of consensus on UEP deviations remain to date. **Motivated by this gap in the literature, we raise the third question of this thesis: what is the explanatory power of our three proposed risk factors in the stock market?** Our objective is to examine whether our proposed risk factors reflect common sources of systematic risk in equity and currency markets. We answer this question by estimating our asset pricing model considering a large set of foreign stock market indices. The following is a brief review of the next chapters of this thesis.

Literature Review. This section presents the literature review examined in Chapter 1 of this thesis. Initially, we delve into the literature concerning the decrease in nominal/real interest rates and the convergence of income among countries. Subsequently, we dissect the key advancements within the finance literature that pertain to currency excess returns. Lastly, we review studies that consider our three fundamental macroeconomic shocks within DSGE models.

Chapter 1 scrutinizes the contributions of various works in the finance literature related to FX markets. We begin with an early contribution to the literature given by Lustig and Verdelhan (2007). The primary focus of these authors was to elucidate CT profits using the Consumption Capital Asset Pricing Model

(CCAPM). Subsequently, we delve into studies that investigate the significance of economic and financial risk factors in elucidating currency excess returns. These papers propose plausible explanations for the behavior of CT returns. Nevertheless, they do not consider a framework where currency excess returns can be directly propelled by fundamental macroeconomic shocks within a DSGE model.

Since currency excess returns depend on nominal interest and exchange rate variations, we also assess the contributions of various studies exploring both currency excess returns and the behavior of these two components (see, e.g., Lustig and Verdelhan (2007), Brunnermeier et al. (2008), Lustig et al. (2011), Menkhoff et al. (2012b), Menkhoff et al. (2012a), Hassan (2013), Lustig et al. (2014), Farhi and Gabaix (2015), and Della Corte et al. (2022)). Generally, empirical studies have highlighted a global downward trend in nominal interest rates. The literature attributes this trend to various factors, including demographic shifts, declines in the price of capital, and amplified desired savings from emerging economies (see, e.g., Bernanke (2005), Gordon (2012), Summers (2014), Caballero and Farhi (2014), Rachel and Smith (2015), Carvalho et al. (2016), Holston et al. (2017), Borio et al. (2017), Gourinchas and Rey (2019), and Eggertsson et al. (2019)). Another line of research has also observed that inflation rates and the MPK declined during the same period. These investigations point to a convergence across countries in nominal interest rates, inflation rates, and the MPK (see, e.g., Busetti et al. (2006), Mishkin and Hebbel-Schmidt (2007), Gonçalves and Salles (2008), Walsh (2009), and Lopez and Papell (2012) for inflation rates and Lucas (1990), Stulz (2005), Caselli and Feyrer (2007), Alfaro et al. (2008), Chatterjee and Naknoi (2010), and Ferreira (2011) for the MPK contributions).

The final part of Chapter 1 is devoted to reviewing the literature related to the three macroeconomic processes that drive the dynamics of our Model Economy: the IST, MEI, and MON shocks. In our Model Economy, innovations in these three processes affect the economy through the traditional channels of business cycle models and through the agents' time preference shock. The latter is a combination of the differential between domestic and foreign shocks associated with the three processes. Our model connects domestic and foreign shocks with news about investment and consumption. Thus, consumption growth together with the three shocks play a central role in determining asset prices. The model has two sources of risk derived from the Euler equation. The first source is the standard consumption growth risk inherent in the CCAPM model. The second is the change in agents' time preference shock process. This latter source of risk is called "Valuation risk" in the asset pricing literature (Albuquerque et al., 2016; Chen and Yang, 2019).

The Connection Between CT Returns and Fundamental Sources of Risk. We begin Chapter 2 by presenting the essence of CT investments. We discuss violations of the UIP condition and connect CT returns with cross-country differences in the MPK and inflation rates, coupled with fluctuations in exchange rates. Subsequently, we examine our series of CT returns. We show that CT returns declined between 1980 and 2019. This downward trend can be attributed to shifts in nominal interest rates and exchange rates. Furthermore, we provide the rationale behind our selection of the three fundamental macroeconomic shocks that drive the dynamics of the economy: the IST, MEI, MON.

In the second part of this chapter, we explore the behavior of nominal interest rates, inflation, and the MPK across a diverse range of developed and developing countries. Overall, we find a downward trend in nominal interest rates and inflation rates in recent decades, aligning with the insights from existing literature. The MPK of developing countries exhibits a similar downward trend. Additionally, we scrutinize the growth rate and standard deviation of exchange rates.

The final section of this chapter scrutinizes the dynamics of the IST, MEI, and MON processes spanning the last four decades. We establish that their behaviors align with the observed downward trend in CT returns. Our analysis extends to the study of cross-country capital stock and US consumption growth. Notably, we illustrate that the growth rate of the capital stock in developing countries has outpaced that of developed countries in recent times. Lastly, our findings offer some preliminary evidence linking the IST, MEI, and MON processes with US consumption growth.

The Model Economy. Chapter 3 introduces the Model Economy and outlines the intertemporal asset pricing model, integrating the three structural shocks into "Beta" representation. It turns out that the differences between countries in the growth rate of the IST, MEI, and MON processes emerge as risk factors within a linear asset pricing framework. Additionally, we introduce the mechanism that connects

CT returns with consumption growth. In the model, CT is risky and agents demand compensation for taking risks associated with unexpected changes in the three fundamental sources of risk. The *risk premium* is associated with consumption growth and changes in time preference.

The final part of Chapter 3 presents the empirical results and final conclusions. We estimate a DSGE Model and present the results from various exercises involving the reactions of economic variables within the economy to innovations in our three structural shocks. We also estimate the *risk premium* using the three structural shocks as a basis for constructing the risk factors. We employ asset pricing estimation techniques considering a large set of portfolios formed by currencies of developed and developing countries. Subsequently, we discuss the empirical results and present the main concluding remarks.

Fundamental Sources of Risk and Equity Market. We begin Chapter 4 of this thesis by exploring the literature that establishes a link between stock returns and exchange rate fluctuations. We introduce the notion of the Uncovered Equity Parity condition and delve into recent findings highlighted by literature concerning empirical deviations from this parity condition. Subsequently, we scrutinize our series of foreign stock market returns. On the whole, our analysis reveals a downward trend in these returns spanning from 1980 to 2019.

The final section of this chapter delves into the examination of our proposed risk factors' ability to explain a cross-section of foreign stock market returns. We proceed to estimate the *risk premium* by utilizing the three structural shocks as a foundation for formulating the risk factors. Our analysis encompasses an extensive range of portfolios consisting of stock market indices from both developed and developing countries. Subsequently, we engage in a discussion of the empirical findings and present the primary concluding remarks.

Chapter 1

Literature Review

1.1 Cross-country Income Convergence

The fundamental question concerning economic growth is why countries grow at different rates. Existing literature presents numerous explanations, including factor accumulation, resource endowments, degree of macroeconomic stability, financial development, educational level, institutional development, and international trade (Khan and Senhadji, 2003). Starting in the late 1980s, the issue of cross-country income convergence began receiving more attention from researchers. Two main reasons stand out behind this interest. First, the existence of convergence across countries could be used as as means to assess the validity of modern theories of economic growth. Second, estimates of the speeds of convergence could provide information on a key parameter of economic growth theory: the share of capital in the production function (Sala-i Martin, 1996). Furthermore, the availability of GDP data for a substantial number of countries emerged during the 1980s, enabling dynamic comparisons among nations. As highlighted by Sala-i Martin (1996), the neoclassical growth model (Solow, 1956; Koopmans, 1963; Cass, 1965) predicts income convergence when the sole disparity between countries lies in their initial capital levels. This convergence hinges on capital accumulation while accounting for diminishing returns to capital. In contrast, the initial generation of endogenous growth models (Romer, 1986; Rebelo, 1991) rests upon externalities, increasing returns, and the absence of non-accumulable inputs. Consequently, endogenous growth models lack the convergence characteristic inherent in the neoclassical model.

Early contributions to the literature reveal a lack of unconditional convergence across countries (Baumol, 1986; Barro, 1991). In contrast, Sala-i Martin (1996) provides empirical evidence in favor of unconditional convergence among Organization for Economic Cooperation and Development (OECD) countries using data from 1950 to 1990. However, the same study does not find similar evidence for a larger set of countries (110 countries). Sala-i Martin (1996) suggests that the degree of similarity in initial conditions across countries can help explain income convergence over time. Their findings align with the *club convergence* hypothesis (Quah, 1993; Durlauf and Johnson, 1995). Subsequent studies on convergence applied diverse methodologies, leading to different conclusions (see, e.g., Liu and Stengos (1999), Durlauf et al. (2001), Banerjee and Duflo (2003), Cunado et al. (2006), Fischer and Stumpner (2008), and Henderson (2010)).

More recent studies have conducted empirical exercises with updated datasets and have yielded different results. Johnson and Papageorgiou (2020) analyze data from 1950 to 2010, covering 182 countries, and find no evidence of broad convergence across countries. However, they argue that the gap between advanced economies and South and East Asian countries has narrowed. In contrast, (Roy et al., 2016) use data from 1950 to 2015, considering a large set of countries, and find evidence of unconditional convergence since the late 1980s. Furthermore, the authors do not identify any evidence of a "Middle Income Trap".[1] These results are supported by Patel et al. (2021), who employ a similar dataset spanning the period from 1960 to 2019. They conclude that the main driver of convergence stems from persistent and less volatile accelerated economic growth in the developing world. In addition, the authors find that middle-income countries experienced higher growth rates than other countries since the mid-1980s.

[1] The literature associates this trap with two peculiarities of economic growth. The first is that middle-income countries start to grow more slowly than the average country, depending on their income level. The second is that once a country enters the middle-income group, it becomes very difficult to move into the high-income group.

Kremer et al. (2022) investigate unconditional income convergence in a large set of countries, covering the period from 1960 to 2019. To study the convergence trend, they regress the ten-year growth in income *per capita* on income *per capita*. The authors find that during the 1960s, the convergence trend was initially flat (neither convergence nor divergence), followed by a divergence trend in the late 1970s and early 1980s. In contrast, a steady trend towards convergence started in the late 1980s and increased from 2000 onwards. They also show that the richest quartile of countries had the fastest growth in the 1980s, followed by flat and declining growth trends in the 1990s and 2000s, respectively. On the other hand, the other three quartiles experienced increasing growth throughout the 1990s and early 2000s. Finally, the authors highlight that convergence becomes stronger when the lower quartile of the income distribution is excluded from the dataset. Kremer et al. (2022) argue that this trend can be explained by both the faster growth of catch-up and slower growth of the frontier, which is consistent with neoclassical growth models. During the same period, many of the determinants of economic growth explored by the literature - capital formation, population growth, human capital, policies, institutions and culture - also converged across countries in alignment with what is observed in higher-income countries.

In an open economy growth model, capital mobility can play a pivotal role in income convergence. If real rates of return on capital differ across countries, capital mobility should work towards equalizing these returns across countries, thereby fostering income convergence (Sachs et al., 1995; Johnson and Papageorgiou, 2020). The work of Sachs et al. (1995) highlights that open economies tend to experience convergence, unlike closed economies. They argue that trade liberalization is a pivotal factor in promoting economic convergence, as it enables poorer countries to import capital and modern technologies from more advanced economies. In a similar vein, Gourinchas and Jeanne (2006) analyze the impact of international financial integration on growth and convergence. They stress that international financial integration has the potential to equalize the marginal return on capital between countries, without necessarily narrowing the disparities in productivity and income between them. Both Sachs et al. (1995) and Gourinchas and Jeanne (2006) propose that international financial integration can yield greater welfare benefits if it increases the productivity of developing countries. This increase can be fueled by technological advancements fueled by foreign investments and a more efficient allocation of national savings encouraged by financial liberalization.

Standard macroeconomic models connect real interest rates with macroeconomic aggregates such as consumption, investment, and output. For example, Clarida et al. (2002) and Hamilton et al. (2016) work with open economy models wherein the real interest rate is a function of both domestic and global output, with the weight assigned to the rest of the world being proportional to the share of imported goods for consumption. In this setting, the dynamic behavior of the RIP and UIP becomes crucial to understand the effects of income convergence and financial and trade integration on macroeconomic variables (e.g., nominal interest rates, inflation rates, exchange rates) and asset prices (e.g., bonds, equity). From one point of view, our work complements this literature by exploring the indirect effect of income convergence on currency excess returns. We construct an open economy model where international trade in both goods and assets is a central driver of macroeconomic fluctuations. We then investigate the connection between economic variables that are directly influenced by the income convergence process (such as, interest rates, exchange rates, and inflation rates) and currency excess returns.

1.2 Asset Pricing in FX Markets

The literature highlights various factors that account for the disparity in growth rates among countries, including macroeconomic stability, financial development, factor accumulation, and international trade. In our model, these factors are associated with the IST, MEI, and MON processes. Additionally, innovations within these processes exert a direct influence on the behavior of interest rates and exchange rates, driving currency excess returns. In this context, it becomes to provide an overview of the pertinent research concerning the RIP and the UIP, two parity relationships that establish connections between interest rates and exchange rates. The failure of the UIP gives rise to profitable investments in the FX market, such as the CT.

In summary, the empirical literature reports mixed results regarding the failure of the RIP. The emergence of a “global financial cycle factor” can contribute to increase the international convergence both goods and capital markets. This, in turn, may increase the convergence of inflation, and nominal interest rates across countries. In addition, cross-country capital flows, triggered by changes in the global financial cycle, can affect asset prices. Overall, the empirical literature reports the rejection of the UIP. Recently, the finance literature has focused attention on a risk-based explanation for UIP deviations. Researchers have introduced various risk factors to account for currency excess returns. Another recent topic explored by the finance literature revolves around the significance of countries' heterogeneous exposure to global risk factors. The following section presents an overview of the pertinent literature in this context.

RIP Hypothesis. As highlighted by Bhatti and Moosa (2016), several factors motivate researchers to focus on the analysis of the RIP hypothesis. They argue that the behavior of interest rates is essential to comprehend several macroeconomic relationships and policies. For example, the connection between domestic and foreign real interest rates induced by financial and goods markets can constrain domestic monetary policy actions. On the other hand, if countries have equalized real interest rates, a shortage of domestic saving may not constrain the level of domestic investment, weakening the connection between home savings and investment of Feldstein and Horioka (1980). Furthermore, real interest rates are often part of open economy macroeconomic models of exchange rate determination (see, e.g., Dornbusch (1976), and Frankel (1979)). Several studies have tested the RIP hypothesis since the early works of Mishkin (1984), and Cumby et al. (1984). Overall, the literature has found mixed empirical results on the failure of the RIP hypothesis (see, e.g., Gagnon and Unferth (1995), Fujii and Chinn (2001), Ferreira and León-Ledesma (2007), Camarero et al. (2010), Su et al. (2013), and Albulescu et al. (2016)).

As emphasized by Ferreira and León-Ledesma (2007), empirical evidence regarding RIP is crucial, given that deviations from RIP can serve as an indicator of international integration in both goods and capital markets. RIP depends on the extent to which UIP, PPP, and the Fisher's relation hold in domestic and foreign countries. Thus, it can also be viewed as a broader indicator of the convergence of inflation and nominal interest rates ((Holmes, 2002; Bacchetta et al., 2022)). Miranda-Agrippino and Rey (2021) argue that the emergence of a "global financial cycle factor" may contribute to enhancing this convergence. This global factor stems from the side effects of changes in the monetary policy of the main central banks (US Federal Reserve (FED) and European Central Bank (ECB)). They show that this global factor can account for a significant portion of gross capital flows between countries and fluctuations in global asset prices. The authors also provide evidence that monetary policy shocks originating from the FED, ECB, and the People's Bank of China play a pivotal role in explaining fluctuations in international trade, economic output, and commodity prices. Similarly, Bacchetta et al. (2022) apply principal component analysis on a dataset of real interest rates across 17 countries. heir findings indicate that the share of data variance explained by the first principal component, referred to as the "global factor", increased from 50% in the period 1960-1990 to 80% in the period 1990-2020.

UIP Hypothesis. Closely linked to the RIP and the growing integration of the global financial market is the UIP hypothesis. This hypothesis assumes the absence of barriers to capital mobility between countries. Therefore, if capital can move freely between countries and UIP does not hold, other forces may be at play preventing this parity relationship from holding.

Many papers have documented the rejection of UIP in the data (see, e.g., Fama (1984), Engel (1996), Flood and Rose (2002), Ahmad et al. (2012), and Aysun and Lee (2014)). In fact, there is a common underlying reason for these rejections: exchange rates in countries with high interest rates do not depreciate enough to offset interest rate differentials. Several studies have explored explanations for UIP deviations. They belong to two main strands of literature. The first strand associates the failure with errors in the market participants' expectations (see, e.g., Bacchetta and Van Wincoop (2010) and Engel and Wu (2018)). The second strand states that the *forward premium* puzzle component is attributed to a *risk premium* (see, e.g., Lustig and Verdelhan (2007), Lustig and Verdelhan (2011), Lustig et al. (2014), Corte et al. (2016), Ismailov and Rossi (2018), and Colacito et al. (2020)). They argue that the UIP failure occurs when currency excess returns are not zero. This happens when risk-averse investors demand a *risk premium* to hold risk-free foreign bonds, leading the forward exchange rate to differ from its future spot rate.[2]

[2]The literature provides alternative explanations for UIP deviations, including the "Peso Problem", institutional factors, and transaction costs arising from hedging activities (see, e.g.,Carlson et al. (2008), Burnside et al. (2010), and dos Santos

In recent decades, the notion that currency returns can be determined by a *risk premium* has attracted considerable attention in the finance literature. In this thesis, we complement this literature and reveal the existence of a risk premium associated with three fundamental macroeconomic shocks: the IST, MEI, and MON. We augment the CCAPM models by incorporating a risk factor associated with these three shocks. To our knowledge, this is the first study to investigate the *risk premium* associated with these shocks in the FX market.

One of the main objectives of asset pricing theory is systematic risk assessment. Asset pricing models are used to estimate *risk premia* associated with various risk factors.Among these, two prominent ones are highlighted in the literature: the CAPM and the CCAPM. The former assesses the risk of the asset using the stock market return the risk factor (Sharpe, 1964; Lintner, 1965). The latter quantifies asset risk using the consumption growth rate as the risk factor (Lucas, 1978; Breeden, 1979). The primary distinction between them is their theoretical foundation. The CAPM emanates from the portfolio theory developed by Markowitz (1952). In contrast, the CCAPM is derived from the maximization of agents' utility.

Despite the role played by the CAPM in the literature, Mankiw and Shapiro (1986) argue that the CCAPM should be favored due to its connection with traditional economic theory. Firstly, because the CCAPM takes into account the intertemporal implications of saving decisions. Secondly, the model accommodates alternative sources of wealth beyond stocks, such as investments in the FX market. However, considerable debate surrounds the explanatory power of the CCAPM when applied to the stock market. Much of the existing literature questions the ability of the CCAPM to explain equity returns (see, e.g., Kocherlakota et al. (1996) and Campbell (1996)). Conversely, Yogo (2006) shows that the CCAPM is able to partially explain the equity *risk premium*, provided that not only consumption of non-durable goods, but also of durable goods is included in the model. Recently, this issue has also become the focus of attention in the literature that seeks to explain currency excess returns (see, e.g., Burnside (2011b) and Hoffmann and Studer-Suter (2017)).

Currency Excess Returns. Most of the studies that analyze asset pricing in the FX market focuses on two primary research areas. The first seeks to explain changes in asset prices through fluctuations in macroeconomic variables. This approach, also known as Macro-Finance, typically employs a model rich enough to explain the interactions among economic agents and asset pricing (Cochrane, 2017). The second is mainly guided by the quest for new risk factors capable of explaining currency returns. This approach focuses on the empirical examination of asset pricing models, in which risk factors are usually associated with financial variables and moments of exchange rate distributions.

An early contribution to the literature is provided by Lustig and Verdelhan (2007). They investigate currency excess returns using the modified CCAPM model developed by Yogo (2006). While Yogo (2006) focus on the US stock market, Lustig and Verdelhan (2007) explore the explanation power of consumption growth of durable and non-durable goods within the context of the FX market. They construct baskets of currencies ranked by nominal interest rates for a large set of countries and find evidence in favor of the UIP failure. They argue that consumption growth contains relevant information for pricing currency portfolio returns. On the contrary, Burnside (2011b) find evidence that consumption growth risk factors are not able to explain profits from currency portfolios. In complementary work, Burnside (2011a) shows that standard CAPM risk factors, the three factors of Fama and French (1992), and the CAPM extended with industrial production and US stock market volatility also fail to explain currency portfolio returns. Our work complements this literature by extending the CCAPM with a risk factor associated to changes in household time preference. From our open economy model, we derive the CCAPM with two factors associated with the growth rate of consumption and time preference. The latter depends on household expectations regarding the future economic developments of domestic and foreign countries, which, in turn, depend on the IST, MEI, and MON shocks.

The methodological innovation introduced by the work of Lustig et al. (2011) has become a standard used by the literature that investigates asset pricing in the FX market. They construct currency portfolio returns sorted by nominal interest rates and apply factor analysis to extract two principal components from this dataset. The authors show that these two latent factors account for a significant portion of the data variance and are highly correlated with two risk factors derived from currency portfolios. The first

et al. (2016)).

risk factor is the average return across all currencies. The second risk factor is calculated as the difference between the return of portfolio six and that of portfolio one. Portfolio six consists of currencies with the highest interest rates, while portfolio one comprises currencies with the lowest interest rates. Then Lustig et al. (2011) construct a no-arbitrage model of exchange rates featuring a specific factor and a global factor. They show that this model can replicate the behavior of the two risk factors. Additionally, the authors find that a world measure of stock market volatility has explanatory power in pricing currency excess returns. In a complementary work, Menkhoff et al. (2012a) apply the same methodology developed by Lustig et al. (2011) and report similar results for a world measure of exchange rate volatility. These works provide empirical evidence that currencies of countries with high interest rates offer lower returns during moments of high volatility in the stock market and the FX market. Our study also contributes to this literature by identifying a new stylized fact in the FX market: a downward trend in CT returns in recent decades. We demonstrate that the behavior of both components of CT returns - the cross-country difference between countries in nominal interest rates and changes in the nominal exchange rate - drives this downward trend.

Several papers have proposed various explanations for profits from CT. For instance, Bansal and Shaliastovich (2013) employ the long-run risk model of Bansal and Yaron (2004), and show that the *risk premium* in foreign currency investments are compensations for differences in the time-varying conditional volatilities of expected inflation and consumption between countries. From a different perspective Burnside et al. (2010) explores the relation between CT returns and the the "Peso Problem" in the FX market. The author shows that CT returns are larger during non-peso periods than in peso periods. Furthermore, Hassan (2013) suggests that bonds from economies with high fractions of global wealth are better at hedging consumption risk, leading to lower nominal interest rates in these economies compared to less wealthy ones. The author argues that this distinction is underlies the deviations from the UIP. In a related vein, Ferreira and Moore (2015) explore the role of foreign bonds in providing insurance against variations in prices of imported goods. Ferreira and Matos (2020) go further and argue that precautionary savings in foreign bonds is associated with the variability of future consumption.

In their model, Berg and Mark (2019) develop a two-country DSGE model to investigate three empirical regularities observed in currency markets: the forward premium bias, the CT return, and the long-run risk reversal. They consider both a complete and incomplete markets setup and show that heterogeneity between countries in TFP processes can generate the systematic risk priced in currency returns. In their model, monetary policy rules can act to amplify or dampen the *risk premium*. With a focus on the role of monetary policy, Backus et al. (2013) develop a two-country complete markets endowment economy model. Their objective is to examine which specification of Taylor's rule can resolve the *forward premium puzzle*. Similar to Berg and Mark (2019), they find that heterogeneity between countries is necessary to explain currency excess returns. Specifically, the currency of the country with the most pro-cyclical Taylor rule earns a positive excess return.

Lustig et al. (2014) propose the "dollar carry trade" investment. In this strategy, the investor takes a long position in a portfolio of foreign currencies and a short position in the US dollar whenever the average foreign nominal interest rate is above the US nominal interest rate, while shorts all foreign currencies and takes a long position in the US dollar otherwise. The authors extend the no-arbitrage model of exchange rates introduced by Lustig et al. (2011) allowing the risk price associated with the common factor to be contingent on world and country-specific factors. Lustig et al. (2014) find that the "dollar carry trade" generates a Sharpe ratio around 0.50. Using their no-arbitrage model, they show that currency excess returns function as compensation to US investors for taking a long position in foreign currencies when the US pricing kernel is more volatile than the foreign counterpart.

The connection between a world factor and currency excess returns is also analyzed by Colacito et al. (2018). They construct a multi-country endowment economy to investigate the link between currency excess returns and the heterogeneous exposure of countries to global endowment long-run growth news shocks. Within their framework, they conduct regressions of GDP growth rates on lagged values of country's price-dividend ratios. The estimated innovations from this regression represent the measure of long-run growth news shocks. Focusing on G-10 countries, they demonstrate that heterogeneous exposure plays a significant role in shaping currency and interest rate movements. The authors argue that these heterogeneous exposures capture the differences between countries in terms of size, commodity intensity, monetary policy rules and financial development. By applying alternative strategies, Fratzscher et al. (2018) analyze the linkage between CT returns and central bank interventions in currency markets. Similarly, Ready et al. (2017) explore the relationship between currency returns and international trade. Meanwhile, Berg and Mark (2018a) examine whether differences in the unemployment rate gap across countries can account for CT returns. On the other hand, Berg and Mark (2018b) investigate the role of news-based macroeconomic uncertainty on currency excess returns.

Recent papers have directed their focus towards the relationship between CT returns and the international repercussions of coordinated monetary policy by major central banks, particularly in the aftermath of the Lehman bankruptcy (Calomiris and Mamaysky, 2019). Other studies explore the link between CT returns and fluctuations in sovereign credit default swaps (Della Corte et al., 2022), the influence of business cycles as measured by the output gap (Colacito et al., 2020), and gross capital formation (Jamali et al., 2023). The international finance literature has yielded two crucial insights regarding currency returns: i) the differences between macroeconomic fundamentals are essential for understanding currency *risk premium* (Backus et al., 2013; Berg and Mark, 2018a, 2019; Colacito et al., 2020); and ii) both country specific risk and global risks are rewarded in foreign exchange markets (Lustig et al., 2011; Atanasov and Nitschka, 2014; Lustig et al., 2014; Colacito et al., 2018; Verdelhan, 2018). In general, the literature has associated changes in global risks with various economic variables (e.g., macroeconomic fluctuations, shifts in risk aversion, changes in expectations, catastrophic episodes, etc.). Our work complements this literature by providing a risk-based explanation for CT returns derived from: i) cross-country differences in the local IST, MEI, and MON shocks; and ii) heterogeneous exposure of countries to global IST, MEI, and MON shocks. Most importantly, we reconcile exchange rate risk factors with these three sources of macroeconomic fluctuations, which is new in the literature.

1.3 Downward Trend and Convergence of Interest Rates

As will be shown in the next chapter,our analysis begins by dissecting currency excess returns into two components: the differential in nominal interest rates and the change in exchange rates. To help identify the fundamental sources of risk in the FX market, we explore the behavior of the two components of the nominal interest rate: the real interest rate and the inflation rate. We use insights from this analysis to substantiate our choice of the IST, MEI, and MON processes as the main drivers of fluctuations in business cycles and asset prices. Given that interest rate differentials constitute a pivotal aspect of CT returns, a review of the literature investigating interest rate behavior becomes imperative to contextualize the forthcoming findings.

In general, the literature documents a downward trend and convergence of nominal interest rates, real interest rates, and inflation rates among countries in recent decades. Moreover, a significant number of studies provide empirical evidence for the growing significance of a “global factor” in shaping the behavior of these variables. In what follows, we present a summary of the key findings highlighted in the relevant literature.

Nominal and Real Interest Rates. An significant portion of CT returns is determined by differences in nominal interest rates. Thus, our study is also connected to an expanding literature that investigates the dynamics of nominal and real interest rates. Numerous studies highlight a declining pattern in nominal and real interest rates over recent decades. These papers have additionally delved into identifying the primary drivers underpinning this phenomenon.

According to Bernanke (2005), an increase in desired savings from emerging economies has exerted downward pressure on international interest rates, leading to a “global savings glut”. Alternatively, some researchers propose that a decline in investment spending resulting from reduced opportunities for profitable investment and a decrease in the price of capital, along with a heightened demand for safe assets, is responsible for the decrease in interest rates (Gordon, 2012; Caballero et al., 2016; Glick, 2020). In contrast, Gourinchas and Rey (2019) establish a link between low levels of the consumption-wealth ratio and extended periods of low real interest rates. Their analysis begins with a country’s budget constraint to derive an expression in which changes in the consumption-wealth ratio are contingent on the return on wealth and the growth of aggregate consumption. They find that just before the onset of the 1929 and 2008 crisis, the consumption-wealth ratio declined. Most importantly, both episodes were followed by periods of depressed real interest rates.

According to Rachel et al. (2017), the demographic changes pointed out by Carvalho et al. (2016)[3] and the increasing level of social inequality are key factors in explaining the fall in both developed and developing countries. Conversely, drawing on empirical findings from G-7 economies, Del Negro et al. (2019) establish that the decline has been primarily propelled by an escalation in convenience yields (the return that investors forego to hold liquid and secure assets). This increase underscores a growing imbalance between the global demand and supply for safety and liquidity, particularly evident from around the mid-1990s onwards (Bernanke, 2005; Caballero et al., 2015; Gourinchas and Rey, 2016). They argue that country idiosyncratic trends have been vanishing since the 1970s leading to a cross-country convergence of interest rates towards the US rate. They also recognize the importance of the demographic factors documented by Carvalho et al. (2016), Favero et al. (2016), and Lunsford and West (2019).

Borio et al. (2017) question the prominent role given to the rise of the marginal propensity to save and the backlash of demand for investments. They recognize that these forces may have some importance in explaining the slowdown in real interest rates over the past 30 years. However, the authors assert that when considering a broader historical span, changes in monetary regimes (such as the gold standard period, post-Bretton Woods era, interwar period, etc.) appear to be the primary driver of this trend. Furthermore, Borio et al. (2017) find that interest rate fluctuations in emerging economies predominantly reflect shifts in the monetary policies of central countries, rather than a hypothetical global inclination towards reducing investment rates or an upsurge in the inclination to save.

The co-movement and convergence of nominal and real interest rates across countries has also been explored by many papers in the literature. Singh and Banerjee (2006) analyze the behavior of real interest rates in emerging markets. They employ money market time series data spanning from 1991 to 2001 for 14 emerging markets. The world real interest rate is computed as a weighted average of the real interest rates of Japan, Germany, and the US, with the countries' respective shares of world GDP serving as the weights. Their findings indicate some evidence of long-term convergence of real interest rates in emerging countries towards the global real interest rate.

A recent contribution to the literature is provided by Hofmann and Takáts (2015), who examine the spillover effect of US monetary policy actions on a set of emerging markets and small advanced open economies, spanning the period from 2000 to 2014. Their findings demonstrate that the nominal short-term and long-term interest rates of these countries are influenced by changes in the US monetary policy rate. This result is in line with Gray (2013), Takáts and Vela (2014), and Edwards (2015).[4]

Hördahl et al. (2016) propose the existence of two global drivers of co-movement and convergence in nominal interest rates. Countries' real interest rates (the natural "long-term" rate) would be driven by the "world interest rate". In contrast, nominal short-term interest rates would be primarily influenced by the US policy rate. Similarly, Bacchetta et al. (2022) also provide evidence of the decline and convergence of real interest rates. They perform a principal component analysis on a 30-year rolling window of data on real interest rates from 17 countries. They find that the share of data variance explained by the first principal component, interpreted as a "global factor", increased from 50% in 1960-1990 to 80% in 1990-2020. They propose two drivers behind this convergence process: first, the growing integration in international financial markets, and second, the emergence of a "global cycle" in line with the work of Miranda-Agrippino et al. (2015). This result is supported by the empirical evidence reported by Riedel (2020) among G7 countries, Frömmel and Kruse (2015) among countries in the European Union and Canarella et al. (2022) among developed countries (France, Germany, the Netherlands, Italy, Japan, Spain, the UK, and the US). Our study contributes to this body of literature in two significant ways. Firstly, we analyze a comprehensive set of countries and demonstrate that the decline in nominal interest rates is a trend affecting not only developed economies but also developing ones. Secondly, we identify a process of convergence in interest rate levels across countries from 1980 to 2019. The gap between developing and developed countries narrowed during this period. Lastly, we explore the implications of

[3]These authors emphasize the significant role of demographic transitions in the global population in the trend decline of interest rates. Factors such as increased longevity (leading to longer retirement periods) and reduced population growth (resulting in a higher capital per-worker ratio and a lower marginal productivity of capital) exert downward pressure on interest rates. However, these demographic shifts also elevate the dependency ratio (the ratio of retirees to workers), as retirees save less than workers, which in turn exerts upward pressure on interest rates.

[4]In general, the literature agrees on the international effects of US monetary policy on long-term interest rates. However,results regarding the impact on short-term interest rates are mixed (see, e.g., Turner (2014), Obstfeld and Ito (2015), and Chen et al. (2016)).

this trend for CT returns.

Inflation Rates. In general, world inflation experienced a decline from the early 1980s to the 2000s, and then maintained stability until 2019. This decrease was more pronounced in developing countries compared to developed ones, resulting in a convergence of inflation rates. Various policy factors have been proposed to explain this downward trajectory, including the implementation of economic reforms, the adoption of inflation targeting regimes, increased trade openness, the introduction of a single currency within European countries, and more effective monetary policies (Singh et al., 1998; Borio and Filardo, 2007; Mishkin and Hebbel-Schmidt, 2007; Gonçalves and Salles, 2008; Bernanke et al., 2009; Walsh, 2009; Lopez and Papell, 2012; Arestis et al., 2014; Arslan et al., 2016). Other studies suggest that shifts in age structure have played a significant role in this inflation trend (Juselius and Takáts, 2015; Arslan et al., 2016). For instance, population aging can lead to lower inflation pressures by reducing expectations of future economic growth (Juselius and Takáts, 2015).

The ongoing processes of financial and trade integration in Europe have prompted numerous researchers to evaluate the convergence of inflation rates among members of the European Union and the Eurozone. As highlighted by Rogers (2007), inflation convergence is related to tax policy harmonization, convergence of income and labor costs, liberalization of international flows of goods and factors of production, and the coherence of the monetary policy across countries. The author identifies a growing level of price level co-movement across 25 European countries. In a similar vein, Busetti et al. (2006) investigate inflation convergence among European Union countries during the period 1980-2004. They find evidence of convergence for the interval 1980-1997. However, for the period 1998-2004, they detect the emergence of two distinct clusters: the first characterized by lower inflation (e.g., Germany and France) and the second marked by higher inflation (e.g., Spain and Greece).

Applying an alternative framework, Cavallero (2011) demonstrates that inflation converged among European Union members between 1979 and 2006. The author decomposes inflation rates into trend and cyclical components. Despite the structural differences between high and low-inflation members, the trend component of inflation converged across countries over time. Cavallero (2011) argues that the introduction of the euro facilitated both trend and cyclical convergence. In general, most studies on inflation among European Union and Eurozone members support the idea of convergence (Kočenda et al., 2006; Siklos, 2010; Lopez and Papell, 2012; Brož and Kočenda, 2018), some provide evidence against convergence (Giannellis, 2013) or yield mixed results (Cuestas et al., 2016).

Another line of research examines the influence of common "global factors" on the downward trend and convergence of inflation rates across countries (Pain et al., 2006; Borio and Filardo, 2007; Ciccarelli and Mojon, 2010; Mumtaz and Surico, 2012; Arslan et al., 2016; Kamber and Wong, 2020). Growing trade and financial integration reinforces the role of global forces in shaping domestic inflation. These studies provide extensive empirical support in favor of a downward trend and convergence in inflation rates among countries. For instance, by applying principal components analysis to inflation data from 22 OECD countries, Ciccarelli and Mojon (2010) show that about 70% of their common variance is due to a common factor. They also report a sharp decline in inflation rates since the 1980s. This result is in line with the common stochastic trend for inflation rates identified by Crowder and Phengpis (2014) among the G-7 countries.

An example of such a "global factor" is the global output gap proposed by Borio and Filardo (2007). The authors utilize an augmented Phillips curve equation that incorporates a measure of the global output gap to investigate inflation rate dynamics. The global output gap, which represents a weighted average of international output gaps, serves as a proxy for a "global factor" associated with inflation. Their study considers a set of 16 advanced economies and spans the period from 1972 to 2005. They report a growing influence of the global output gap on the determination of domestic inflation. In contrast, Ihrig et al. (2010) and Eickmeier and Pijnenburg (2013) find weak empirical evidence to support foreign GDP gap as an important factor in determining domestic inflation. On the other hand, Milani (2010) argues that global output exerts a significant impact on domestic aggregate demand. The author employs a two-country open economy model in which aggregate demand is positively related to both domestic and foreign output. This study finds empirical support among G-7 countries, suggesting that domestic inflation can indeed be influenced by global output. The literature has also highlighted alternative "global factors", including import prices, commodity prices, and global interest rates (Eickmeier and Pijnenburg, 2013; Mikolajun and Lodge, 2016).

Arslan et al. (2016) document a decline in inflation rates across emerging markets over the past few decades. They highlight the increasing trade integration of these countries as a key factor contributing to the fall in inflation rates. The authors argue that heightened trade integration leads to lower prices of tradable goods due to heightened competitive pressures. Furthermore, they demonstrate that trade integration has amplified the influence of "global factors" in driving inflation tends in emerging markets. By decomposing inflation into a permanent (trend) and transitory (gap) component, Kamber and Wong (2020) find evidence of asymmetric effects of global shocks on inflation of developed and developing countries. Their analysis encompasses seven developed and twenty-one emerging economies, spanning the period from 1980 to 2018. The results reveal that global shocks have a more significant impact on trend inflation in emerging markets compared to developed economies. This finding contributes to understanding the reduction in the inflation gap that has occurred between developing and developed countries in recent decades. Liu and Lee (2021) investigate the convergence of inflation considering 98 countries spanning the period from 1970 to 2016. They report a general trend towards convergence, with the exceptions of Japan, Poland, Chile, Sweden, and Burundi. The authors also found that countries with increasing levels of globalization tend to experience faster convergence. Our study further demonstrates that inflation rates have declined in both developed and developing countries. The latter group of countries experienced not only a significant reduction in inflation but also a decrease in its standard deviation. In Chapter 2, we reveal that the gap in inflation rates between developed and developing countries, as well as between these countries and the US, narrowed from 1980 to 2019. In summary, through an analysis of a set of 60 countries, we provide additional evidence in support of inflation convergence across economies.

The Marginal Product of Capital. Our work is also related to the literature that examines the behavior of the MPK across countries. In a world with free capital mobility, capital would flow from low to high return markets, thereby reducing the gap between *per capita* MPK levels across economies (see, e.g., Lucas (1990) and Alfaro et al. (2008)). The literature investigating the existence of a MPK convergence across countries has focused on the Lucas's (1990) insights ("Lucas Paradox").[5] Overall, there are two theoretical explanations for this paradox. The first explanation focuses on the assessment of the differences in fundamentals that affect an economy's production structure (e.g., technological gap, government policies, institutional arrangements, etc.). The second explanation directs attention to market imperfections (e.g., sovereign risk[6], information asymmetries, etc.). Under these circumstances, despite the high return on capital yielded in developing markets, foreign investment flows may not be capable of completely eliminating the gap relative to developed countries (Alfaro et al., 2008). Empirical studies that address the determinants of capital allocation across countries have focused on analyzing both external ("push") and internal ("pull") factors (Alfaro et al., 2008). Low interest rates faced by US investors would be an external factor directing resources to developing countries.[7] Equivalently, government size, political stability, the degree of financial openness, and institutional structure would constitute the primary internal factors.[8]

On the other hand, Caselli and Feyrer (2007) argue that when the estimate of the MPK is adjusted to the value of "true" capital (by excluding the share of natural capital from reproducible capital) and corrected by the relative price of capital in terms of consumer goods, the MPK for rich countries is higher than for poor economies. Ferreira (2011), using data from 1950 to 2003 for the same set of countries explored by Caselli and Feyrer (2007), finds empirical support for the decline in the output-capital ratio differential across countries, especially when compared to the US. The author provides a risk-based explanation for the decline in the output-capital ratio differential and suggests that cross-border capital flows may be behind this convergence. We push this literature one step forward by developing a macroeconomic model in which the MPK is driven by the IST and MEI shocks. Then, by analysing data from the IST and MEI processes for a broad set of countries, we establish a link between the long-term

[5]Lucas (1990) claims that if the traditional neoclassical model were true, India's MPK would be 58 times higher than that of the US in 1988. Nevertheless, the effective capital flows from the US to India is less than what should be observed, given the difference in the returns on capital between the two countries. Lucas (1990) then suggests that new premises are needed to explain this paradox.

[6]See Reinhart and Rogoff (2004) and Ferreira (2011)

[7]See Calvo et al. (1996).

[8]See Edwards (1990), Stulz (2005), and Alfaro et al. (2008).

trend of the shock processes and the MPK over the last few decades. The issue we raise in this study seems to have been largely overlooked by the literature: the role of the IST and MEI shocks in driving cross-country differences in the MPK.

1.4 Fundamental Macroeconomic Shocks and Business Cycles

The macroeconomic literature highlights the importance of the IST, MEI, and MON shocks in explaining business cycle fluctuations. These shocks are part of closed and open economy macroeconomic models. They are also used to address specific topics in the international macroeconomic literature, such as equity home bias, international capital flows, and the Backus-Smith puzzle. The finance literature has also started to integrate these shocks into asset pricing models. The following presents a survey of this literature.

IST, MEI, and MON Processes. One of the most contentious issues among macroeconomists concerns the origins of business cycle fluctuations. The debate focuses on identifying the most relevant shocks capable of explaining the variability of output, and hours worked at business cycles. In open economy models, the international flow of goods and capital are also important drivers for the transmission of these disturbances. The enduring recession starting from the GFC revitalized the debate over the sources of business cycle movements. Justiniano et al. (2011) argue that investment shocks appear to be a more promising way to explain macroeconomic fluctuations than the traditional total factor productivity, especially for reconciling the events triggered by the GFC. They develop a business cycle model where the capital accumulation process can be influenced by two distinct shocks. The IST shock affects the transformation of consumption into investment goods, while the MEI shock impacts the transformation of investment goods into physical capital. In their model, the IST process is defined as the ratio between the price of consumption and the price of investment (relative price of investment). They also posit that the MEI shock might be linked to disturbances in the financial system's intermediation capacity (e.g., the credit spread between the returns on high-yield and AAA corporate bonds). Justiniano et al. (2011) find that the MEI shock explains between 60% and 85% of the variance of output, hours and investment at business cycle frequencies.[9]

An early contribution to the analysis of the importance of investment shocks as driving forces of macroeconomic fluctuations is provided by Greenwood et al. (1988). In contrast to the view that cycles are generated by exogenous shocks to the production function, they argue that it is shocks to the marginal efficiency of investment that are important in generating fluctuations in output. In their model, positive shocks to the marginal efficiency of investment are associated with reductions in the cost of capital accumulation and trigger the production of new more efficient physical capital. The relevance of investment shocks was later reinforced by Greenwood et al. (1997b) and Greenwood et al. (2000). In both of these studies, physical capital is categorized into two types: structures and equipment. The second type is subjected to IST shocks, which are specific to the production of investment goods. In their analysis, Greenwood et al. (1997b) examine US data concerning aggregate investment in equipment and the relative price of equipment to consumption. They cover the period from 1950 to 1990 and find a negative correlation between the two variables. The authors argue that technological advances reduced the price of equipment, triggering its accumulation. They suggest two possible interpretations for the IST process: i) it can represent the cost of producing a new unit of equipment in terms of output; and ii) it can represent the productivity of a new unit of equipment. In their framework, the IST process is defined as the ratio between the price of consumption and the price of investment. Greenwood et al. (1997b) find that the IST shock can account for 60% of long-term growth in output per hours worked. Greenwood et al. (2000) analyze the impact of IST shocks in the US business cycle. They employ a DSGE model calibrated with data spanning from 1954 to 1990. The outcomes of their study indicate that IST shocks contribute to approximately 30% of output fluctuations in the US.

Since the works of Greenwood et al. (1988), Greenwood et al. (1997b), and Greenwood et al. (2000)

[9] The IST shock makes a negligible contribution to the variance of macroeconomic variables. This stems from the fact that, in the model, Justiniano et al. (2011) impose the restriction that the IST process is equal to the inverse of the relative price of investment. In a broader context, without this constraint, the IST shock can account for a significant portion of the fluctuations in output, hours worked, and investment in the US (Justiniano et al., 2010).

several papers incorporated investment shocks in their DSGE models in order to: i) analyze business cycle fluctuations (Eusepi and Preston, 2009; Liu et al., 2011; Khan and Tsoukalas, 2011; Hirose and Kurozumi, 2012; Furlanetto et al., 2013; Moura, 2018); ii) explore long-run macroeconomic trends (Chen and Wemy, 2015); iii) derive restrictions from DSGE models for use in the estimation of Structural Vector Autoregressive (SVAR) models (Fisher, 2006; Braun and Shioji, 2007); and iii) explain the historical changes in labor and capital share (Karabarbounis and Neiman, 2014).

The literature on international real business cycles has also incorporated the IST and MEI shocks in order to explore macroeconomic fluctuations and the dynamics of the balance of payments. An early contribution is provided by Finn (1999), who develops an open economy model to analyze the high degree of co-movement between the nominal and real exchange rates. The author incorporates the investment shock introduced by Greenwood et al. (1988) and offers an explanation for the co-movement between nominal and real exchange rates. In Finn (1999)'s model, a positive technology shock triggers a drop in prices and the real exchange rate. This drop is sufficient to cause a decrease in the nominal exchange rate, resulting in a co-movement between these variables. Boileau (2002) analyzes the role of the IST shocks in driving the cross-country correlation of output and the volatility of the terms of trade among G7 countries. Letendre and Luo (2007) set up a small open economy business cycle model calibrated with quarterly Canadian data. In their model, the main drivers of macroeconomic fluctuations are IST and TFP shocks. Both shocks are necessary to adequately match the second moments of macroeconomic variables generated by their model (variance and correlation of consumption, hours worked, investment, trade balance, and current account with output) with data.

More recently, Jacob and Peersman (2013) estimate a two-country DSGE model and find that the MEI shock is the source of nearly 50% of the variance in the US business cycle fluctuations. They also show that IST shocks can have a deteriorating effect on the trade balance. Their results are in line with those of Raffo (2010). Although the two models have different features and transmission channels for investment shocks, a local positive investment shock generally leads to the following impacts on the domestic economy: i) increased output, investment, consumption, and imports; and ii) appreciation of the terms of trade (increase in domestic prices). As a result, the investment shock is associated with a trade deficit. Dogan (2019) explores the spillover effect of IST shocks originating in advanced economies (the US) on emerging countries (Mexico). The author develops a two-country economy and assumes that IST shocks originates in the advanced economy, and technology in the emerging country's investment sector slowly adjusts to this shock through imports of investment goods. Dogan (2019) finds that IST shocks in the US explains roughly 44% to 60% of the variability in output, investment, and consumption in Mexico. Numerous other studies also incorporate investment shocks in their open economy frameworks. For example, Smets and Wouters (2007), Liu et al. (2011), Khan and Tsoukalas (2012), and Miyamoto and Nguyen (2020) estimate Bayesian DSGE models with several real and nominal frictions to investigate the role played by investment shocks in macroeconomic fluctuations.

Investment shocks are also employed to investigate specific issues associated with the international macroeconomic literature. For instance, Coeurdacier et al. (2010) delve into equity home bias, the dynamics of foreign asset positions, and international capital flows. Conversely, Mandelman et al. (2011) focus on resolving puzzles within international real business cycle models (the "quantity, international co-movement, Backus-Smith and price puzzles"). In a different vein, Basu and Thoenissen (2011) question the ability of the inverse of the relative price of investment to work as a proxy to measure the IST in an open economy setting. We contribute to this literature by introducing an additional transmission channel for the IST and MEI shocks, via their influence on the time preference of households. Within our open economy model, this channel reflects changes in the expectations of Ricardian households and bears significant implications for macroeconomic fluctuations and asset prices.

Investment shocks are also fundamental components in asset pricing models derived from closed economy frameworks. The work of Papanikolaou (2011) uses the IST and MEI shocks to explain differences in *risk premium* between firms in the consumer and investment goods sectors. The author develops a DSGE model and derives an asset pricing equation where the expected equity excess return depends on the covariance of asset returns with the stochastic discount factor. The stochastic discount factor, in turn, is correlated with two sources of uncertainty arising from two productivity shocks: i) the consumption productivity shock (shock in the consumer sector); and ii) the investment shock (shock in the investment goods sector). Furthermore, Papanikolaou (2011) shows that, in general, a calibrated version of the model can provide key moments (volatility and correlation) of real macroeconomic aggregates (consumption, investment, output and hours worked) and asset returns consistent with those observed in the data for the US between 1951 and 2008. When estimating the asset pricing model, the author employs two empirical proxies for the investment shock. The first is the inverse of the relative price of investment. The second is the difference between the stock returns of firms in the investment and consumer good sectors. Papanikolaou (2011) builds a large set of portfolios of weekly US stock returns sorted by: i) their past sensitivities to investment shocks; and ii) the firms book-to-market ratios. In summary, the estimates of the *risk premium* associated with the investment shock ranged from -0.14% to -1.52% (annualized values). As highlighted by Papanikolaou (2011), this result is consistent with the prediction of the model: investors value more firms that benefit most from good investment opportunities (derived from positive investment shocks) and are, therefore, willing to accept a lower risk premium to hold these stocks.

Kogan and Papanikolaou (2014) also explore the connection between IST shocks and the cross-section of stock returns. hey construct a partial equilibrium model to scrutinize the link between firms' asset values, growth opportunities, and IST shocks. In their framework, the value of the firm can be broken down into the value of assets in place and the value of growth opportunities. Firms with greater growth opportunities are more dependent on new capital goods. Therefore, positive IST shocks have a greater positive impact on them. In their empirical analysis, Kogan and Papanikolaou (2014) sort firms according to their sensitivities to IST shocks to build equity return portfolios. Utilizing weekly data on US stocks spanning from 1964 to 2008, they estimate *risk premiums* ranging from -0.98% to -1.09% (annualized values). Consistent with Papanikolaou (2011), Kogan and Papanikolaou (2014) find that IST shocks are a systematic risk factor that carries a negative *risk premium*.

Building on the work of Papanikolaou (2011) and Kogan and Papanikolaou (2014), Kogan and Papanikolaou (2013) construct a structural model connecting five firm characteristics - investment rates, Tobin's q, price-earnings ratios, idiosyncratic volatility, and market beta - to the ratio of growth opportunities to firm value. Employing principal components analysis, they extract an empirical risk factor from the cross-section of equity portfolio returns and demonstrate its connection to IST shocks. Similar to Papanikolaou (2011), they find that firms associated with high growth opportunities are more sensitivity to IST shocks. They suggest that heterogeneity in firms' exposure to IST shocks may explain the observed behavior of the five firm characteristics.

IST shocks are also employed by the empirical finance literature: Yang (2013) examines the link between IST shocks and commodity basis spread. Li (2018) investigates the connection between investment shocks and equity momentum returns. Li et al. (2019) extract the time series of four latent shocks from a DSGE model (TFP, IST, monetary policy, and risk shocks). They then use these shocks in their asset pricing exercises. The authors find that IST shocks stand out as one of the most important risk factors in the US stock market. Dissanayake et al. (2019) provide evidence on the effect of IST shocks on stock returns considering a large cross-section of stocks from more than thirty countries. Meanwhile, Garlappi and Song (2020) introduce a novel methodology to constructing firms' return exposure to IST shocks that is not based on empirical proxies of IST shocks, but on the firm's expected investment cost. In contrast with Papanikolaou (2011) and Kogan and Papanikolaou (2014), their model generates a positive *risk premium* associated with IST shocks. Unlike these works, our study focus on the connection between currency excess returns and country characteristics related to the the IST and MEI processes. To our knowledge, our study is the first to use the IST and MEI based risk factors to analyze currency excess returns.

Our study is also related to the literature that examines the role of changes in money stock in business cycle fluctuations. In general, changes in the money stock can arise from shifts in household demand or from supply shocks coordinated by the monetary authority (monetary policy). Models that investigate the impacts of monetary policy on macroeconomic variables and asset pricing typically operate within a framework where monetary shocks originate from either an interest-rate rule equation or a money supply equation. Households' demand for money arises from a money-in-utility function (Sidrauski, 1967), a shopping-time approach (Saving, 1971), or a cash-in-advance constraint (Lucas Jr and Stokey, 1987). Money-in-utility function and shopping-time models assume that holding money generates a benefit for agents (e.g., provides transaction services, reduces transaction costs, shorten shopping time, and increase leisure). Cash-in-advance models assume the need for money to buy goods. On the other hand, models that explore the role of money demand employ a framework where money enters the utility function and is affected by an exogenous shock process.

Chadha et al. (2014) find that money convey relevant information to the central bank when there are shocks to credit supply. Andrés et al. (2009) and Castelnuovo (2012) show that the inclusion of money demand in the utility function and in the central bank's reaction function improves the model's fit when compared with the standard New-Keynesian model. There are several other papers that consider money demand as a source of fluctuation in output and inflation in New-Keynesian models (see, e.g., Nelson (2002), Ireland (2004), Arestis et al. (2010), Canova and Menz (2011), Benchimol and Fourçans (2012), Benchimol and Fourçans (2017), and Benchimol and Qureshi (2020)).[10] Unlike these works, we consider the role of money demand in an open economy scenario. Our analysis explores the domestic effects of money demand shocks and their spillovers abroad, which is knew in the literature.

The finance literature employs various methodologies to analyze the explanatory power of real money growth as a risk factor in asset markets. An ongoing debate within the literature revolves around the sign of the *risk premium* associated with money in the stock market. Chan et al. (1996) use a cash-in-advance model of a monetary economy to derive a model where money becomes a component of the asset pricing equation. Instead of using the money supply, they employ a measure of inside money to construct their risk factor. In their model, certain goods can only be acquired with money. Consequently, inside money holdings are equal to the consumer good that requires cash in advance to be purchased. Therefore, the authors use inside money growth instead of consumption growth to define the stochastic discount factor. They find that inside money growth is priced in the stock market. In contrast, Balvers and Huang (2009) include money in the utility function, assuming that it is held to reduce transaction costs. They extend the CAPM and the CCAPM by including real money growth as an additional risk factor, in a partial equilibrium setup. Balvers and Huang (2009) end up with two different asset pricing models. In the first, consumption and money are the risk factors. In the second, market return and money are the risk factors.

Gu and Huang (2013) extend the work of Balvers and Huang (2009) by applying Epstein and Zin (1991) preferences. They arrive at an asset pricing model with three risk factors: consumption, money, and market returns. Interestingly, Balvers and Huang (2009) demonstrate that money earns a positive *risk premium* in a cross-section of stock returns, while Gu and Huang (2013) find a negative premium. These studies focus on the role of money growth in explaining stock market returns. Our study complements this literature by analyzing the sign and magnitude of the *risk premium* associated with money growth in the foreign exchange market. We show that the risk factor derived from money growth is priced in a broad cross-section of currency excess returns. We also find that the *risk premium* associated with money growth is large and positive.

[10]There are also many empirical studies that find significant effects of monetary aggregates on business cycle (see, e.g., Leeper and Roush (2003), Sims and Zha (2006), Hafer and Jones (2008), Favara and Giordani (2009), Šustek (2010), El-Shagi et al. (2015), and Benchimol and Fourçans (2017)).

Chapter 2

The Connection Between CT Returns and Fundamental Sources of Risk

Uncovered Interest Rate Parity Condition. For what follows, it is important to start by introducing the mechanics of CT investments. Standard economic theory predicts that when the foreign country's nominal interest rate is higher than the home country's nominal interest rate, rational investors should expect a depreciation of the foreign currency to exactly offset the difference in interest rates. Therefore, the home investor should expect to earn zero profit by borrowing at home and investing in foreign bonds. However, empirical evidence points out that investors commonly make profits by investing in currencies with high interest rates. This strategy is only profitable due to UIP violations that generate investment opportunities in the foreign exchange market (see, e.g., Hansen and Hodrick (1980), Fama (1984), Evans and Lewis (1995), Lustig and Verdelhan (2007), Frankel and Poonawala (2010)).[1] The excess return, RX_{t+1}, obtained by buying a unit of foreign currency in the forward market at t and subsequently selling it in the spot market at $t+1$ is given by:

$$RX_{t+1} \equiv f_t - s_{t+1}, \tag{2.1}$$

where f_t is the log of the forward exchange rate and s_{t+1} is the log of the spot exchange rate, both denominated in units of foreign currency per home currency. An increase in s_t represents an appreciation of the home currency. An alternative definition of currency excess return is as follows: $RX_{t+1} \equiv f_t - s_t - \Delta s_{t+1}$. Generally, forward exchange rates satisfy the Covered Interest Rate Parity (CIP) condition: $f_t - s_t \approx i_t^* - i_t$, where i_t^* and i_t are the foreign and domestic risk-free nominal interest rates, paid by a bond with the same maturity of the currency forward contract (Lustig and Verdelhan, 2009).[2] Therefore, the currency excess return is approximately equal to the interest rate differential between the foreign and home countries, net of foreign currency depreciation:[3]

$$RX_{t+1} \approx i_t^* - i_t - \Delta s_{t+1}, \tag{2.2}$$

where $\Delta s_{t+1} \approx \frac{S_{t+1} - S_t}{S_t}$. As highlighted by Gonçalves et al. (2022), CT consists of taking long positions in currencies with high nominal interest rates and short positions in currencies with low nominal interest rates. This strategy yields a positive return if the depreciation of the high-interest rate currency is not sufficient to offset the interest rate differential.

The Fisher's Relation. Given the connection between interest rate differentials and CT returns, a natural starting point for analyzing these returns is Fisher's (1930) *ex-ante* equation. We associate CT returns with the MPK and inflation rate differentials between countries, along with exchange rate changes.

[1] The literature has suggested several risk factors associated with the non-diversifiable risk of foreign exchange investments (Lustig and Verdelhan, 2007; Lustig et al., 2011; Menkhoff et al., 2012a; Kremens and Martin, 2019; Colacito et al., 2020).

[2] Throughout this thesis, we use the asterisk superscript to denote variables and parameters of the foreign economy.

[3] It is important to point out that the CIP typically holds until the outbreak of the GFC (see, e.g., Akram et al. (2008)), but its deviations have increased since then (see, e.g., Andersen et al. (2019)). In the latter case, the forward discount accounts for both interest rate differentials and CIP deviations (Colacito et al., 2020).

To formulate the basic argument, we follow Fisher (1930) and decompose the nominal interest rate into a real interest rate and an inflation rate:

$$r_t \equiv i_t - \mathbb{E}_t\pi_{t+1} \quad \text{and} \quad r_t^* \equiv i_t^* - \mathbb{E}_t\pi_{t+1}^*, \tag{2.3}$$

where r_t and r_t^* represent the home and foreign risk-free real interest rates, respectively; $\mathbb{E}_t$ is the expectation operator; and π_{t+1} and π_{t+1}^* denote the home and foreign inflation rates, respectively. Equation (2.3) describes the relationship between nominal interest rates, real interest rates, and expected inflation. Now consider the standard neoclassical one-sector model with a constant return production function and perfectly competitive capital markets. In this setting, the rental rate of capital (real interest rate) equals MPK net of physical depreciation.[4] Thus, the nominal interest rate can be linked to the MPK, the depreciation rate, and inflation. The rearranged *ex-post* version of equation (2.3) yields the following expressions:

$$i_t \equiv MPK_t - \delta + \pi_{t+1} \quad \text{and} \quad i_t^* \equiv MPK_t^* - \delta^* + \pi_{t+1}^*, \tag{2.4}$$

where MPK_t and MPK_t^* stand for the home and foreign MPK, respectively; δ and δ^* are the respective home and foreign depreciation rate of physical capital. Note that i_t (i_t^*) and the MPK_t (MPK_t^*) are known at t; π_{t+1} (π_{t+1}^*) is the change in the general price level between t and $t+1$, whose value is revealed only at $t+1$. By combining equations (2.2) and (2.4) we obtain the following expression:

$$RX_{t+1} \approx (MPK_t^* - MPK_t) + (\pi_{t+1}^* - \pi_{t+1}) - \Delta s_{t+1}. \tag{2.5}$$

where we assume that $\delta = \delta^*$ to preserve the parsimony of our analysis. In light of equation (2.5), a possible explanation for CT returns is that they reward individuals for taking risks associated with changes in domestic and foreign macroeconomic fundamentals. These changes can affect cross-country differentials in the MPK and inflation rates, as well as trigger currency fluctuations.

There are three important aspects of equation (2.5) worth highlighting. First, although this equation is an *ex-post* expression of currency excess returns, in reality π_{t+1} is not know by domestic agents at t. This implies that real currency excess return, which is what matters to investors, is unknown at t, even if there is no change in the exchange rate. Therefore, there is a risk associated with changes in prices between period t and $t+1$. Second, if $\Delta s_{t+1} = 0$, currency excess returns are given by the difference between foreign and home nominal interest rates. Otherwise, the magnitude of currency excess returns depends on the growth rate of exchange rates. Third, currency excess returns decrease with: i) the reduction of the MPK differential and the inflation rate differential between the foreign and home country; and ii) the appreciation of the home currency. These three aspects are important because, as will be shown in the following, the downward trend in CT returns identified in the data is generally associated with a decline: i) in the nominal interest rate differentials across countries; and ii) in the growth rate of countries' exchange rates. Furthermore, in our model, the macroeconomic shocks that shape business cycle fluctuations and currency excess returns, also affect inflation, exchange rates, and nominal interest rates.

In our model, the fundamental determinants of inflation, exchange rates, and interest rates are technology and money demand shocks. Therefore, it is natural to expect that these shocks can also explain the behavior of CT returns. A combination of the IST, MEI, and MON shocks can drive changes in inflation, exchange rates, and interest rates which can help explain short-term fluctuations and the long-term trend of CT returns. The connection between the IST and MEI shocks with nominal interest

[4] Note that market power can create a wedge between the MPK and the real interest rate. However, market power is not observable. Recent literature has chosen the least dubious measure to investigate market power: the markup over marginal cost. Different methodologies have been applied to obtain empirical estimates (Hall, 2018; Barkai, 2020; De Loecker et al., 2020). However, as emphasized by Basu (2019), the estimates reported by the literature cannot be reconciled with patterns found in recent US data. The author shows why many studies find implausible markup estimates. The main reasons are the unreal assumptions applied by the authors, the implausible estimation procedures, and the difficulty in calculating the values of variables necessary to compute the markup (e.g., economic profits, market value of capital, etc.). Consequently, recent empirical estimates vary substantially across studies. Basu (2019) shows that the markup estimates found in the literature would imply: i) a much larger increase in markups than would be necessary to explain the reduction in labor share; ii) negative technological progress in the US in recent decades; iii) that about 70% of US GDP is derived from pure economic profit; and iv) an increase, rather than a decrease, in US inflation rate over recent decades. Due to the difficulty of measuring markups, we do not analyze their evolution over time and abstract from their possible implications for CT returns.

rates is straightforward, as the realization of these shocks boosts investment in physical capital. This, in turn, can affect the MPK and inflation rates through changes in the capital stock and the supply of goods, respectively. The motivation for including money demand shocks in our model stems from the central role played by changes in the money stock in models of exchange rate determination. For example, in Dornbusch's (1976) overshooting model, unanticipated changes in the money stock generate fluctuations in nominal interest rates and exchange rates. Next, we will discuss the mechanism by which the three shocks can affect both nominal interest rates and exchange rates in the short and long run.

We start by analyzing data on CT returns and our proxies for the IST, MEI, and MON processes between 1980 and 2019. We find that, in general: i) CT returns decrease over time; ii) the growth rate of the IST, MEI, and MON processes also trends downwards; and iii) nominal interest rates, inflation rates, and the MPK follow a similar downward trend.

2.1 Carry Trade Returns and Fundamental Shocks

In our model, there are two types of households: Rule-of-thumb (ROT) and Optimizing (OPT). The first type does not have access to financial markets and spend all its disposable income on consumption. The second type has access to capital and financial markets and allocates income optimally between consumption and savings. The IST, MEI, and MON shocks are the fundamental sources of risk that affect the consumption and saving decisions of OPT households. Furthermore, these shocks drive currency excess returns through changes in nominal interest rates and the exchange rate.

Next, we investigate the behavior of CT returns and their components: i) nominal interest rate differentials; and ii) exchange rate variations. We also examine the first and second moments of the following variables: i) inflation, nominal interest rates, the MPKs and exchange rates; ii) the IST, MEI, and MON processes; iii) the growth rate of capital stock; and iv) the growth rate of US consumption. We aim to evaluate the evolution over time of these variables in order to explore the link between CT returns and the IST, MEI, and MON processes.

We work with a broad panel of developed and developing countries. The developed group consists of the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. The other countries in the sample are: Bangladesh, Bolivia, Brazil, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Ecuador, Egypt, Hong Kong, Hungary, India, Indonesia, Israel, Lithuania, Malaysia, Mexico, Morocco, Paraguay, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Sri Lanka, Thailand, Tunisia, Turkey, Ukraine, and Uruguay. We also highlight in our analysis the set of G-10 countries: Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland and the United Kingdom. We work with monthly, quarterly and annual data from various sources. When necessary, we annualized the data to facilitate analysis (e.g., monthly data is multiplied by twelve). Appendix A.1 provides a description our dataset.

Our study consider a sample of 60 countries and covers the period between 1980 and 2019. As pointed out by Lustig and Verdelhan (2007), the conditions derived from Euler's equation on the joint distribution of exchange rates and interest rates are consistent only if foreign investors are given unrestricted permission to buy local assets. Increased global financial integration, fueled by lower capital controls, has led to significant growth in cross-country asset trading (Lane and Ferretti, 2003). Most of the reduction in impediments to international trade in assets occurred from the 1980s onwards (Coeurdacier and Rey, 2013). Several studies provide empirical evidence of the growth in cross-border financial diversification in recent decades (Tesar and Werner, 1995; Lane and Ferretti, 2003; Lane and Milesi-Ferretti, 2003, 2007; Coeurdacier and Rey, 2013). Therefore, we believe that our sample period is adequate for our investigation.

CT returns are computed according to equation 2.2, from the perspective of a US investor who goes long in countries with higher nominal interest rates than the US or short otherwise. We use monthly nominal interest rates and end-of-month nominal exchange rates. Due to the nature of investments in foreign exchange markets, we had to implement two additional adjustments to our dataset: i) the exclusion of countries during periods when they experience states of very low international financial openness or sovereign default; and ii) the exclusion of European countries in their month of entry into the Eurozone, due to the change in the denomination of their currency. Appendix A.1 provides a detailed description of these refinements.

Most data on nominal interest rates are from the International Monetary Fund (IFS). The choice of interest rates used to compute CT returns was as follows. First, we used treasury bill rates whenever available. Second, in the absence of treasury bill rates, we worked with money market rates. Third, if these two alternative were not available, we used government bond rates. Lastly, in the absence of these three options, we employed deposit rates. CT are typically short-term investments, which explains our choice.[5]

To compute the MPK, we employed the standard neoclassical one-sector model with labor and physical capital as the only inputs. We also assumed a production function with constant returns and perfectly competitive capital markets. As emphasized by Caselli and Feyrer (2007), under these conditions, the rental rate of capital is equal to the MPK. This implies that the aggregate rental rate of capital is equal to the MPK multiplied by K, where K is the capital stock. Hence, if α is the capital share in real GDP, denoted by Y_t, then $\alpha = MPK_t \times \frac{K_t}{Y_t}$. We can then obtain the MPK by: $MPK_t = \alpha \frac{Y_t}{K_t}$.

We followed Caselli and Feyrer (2007), and computed the capital share as 1 minus the estimate of the labor share in total income. Data for Y and K are from version 10.0 of the Penn World Table (Feenstra et al., 2015). Y and K are the respective measures of GDP and the capital stock in purchasing power parity (PPP) in 2011. We used the labor share computed by Guerriero (2019). This author proposes an adjustment in the formulae employed by Bernanke and Gürkaynak (2001), and Gollin (2002) to calculate the labor share in income. Guerriero (2019) provides average values per decade for a total of 151 countries, spanning the period from 1970 to 2015. α_w values vary across decades, but are equal for all years of the same decade. As the table produced by Guerriero (2019) does not provide data for all decades, we used the nearest available values to fill the gaps. For example, in the absence of information for the 1980s, we used data provided for the 1990s.[6]

We followed Greenwood et al. (1992), Greenwood et al. (1997a), and Justiniano et al. (2011), and used the relative price of investment as a proxy for the IST process: $IST_t = \frac{P_t^c}{P_t^i}$, where P_t^c is the consumer price index and P_t^i is the price of investment. We obtained the investment and consumer prices from the PWT 10, which provides annual measures for all countries in our sample. To obtain the relative price of investment that a domestic producer faces, we followed Karabarbounis and Neiman (2014). We divided the relative investment price of each country by the relative investment price of the US. We then multiplied this ratio by the ratio of the US investment price deflator to the US personal consumption expenditure deflator, obtained from the Bureau of Economy Analysis (BEA). Karabarbounis and Neiman (2014) show that this adjusted measure calculated from the PWT dataset is consistent with other alternative measures, effectively capturing the behavior of the relative price of investment in recent decades. They compare the relative price of investment obtained from the PWT with two alternative measures. First, they construct a country-level measure based on data from the World Bank's Development Indicators. Second, they employ the EU KLEMS dataset to calculate the relative price of investment at the country level. They demonstrate that: i) the behavior of the three measures is very similar between 1970 and 2010; and ii) overall, the three measures exhibit a high degree of correlation (ranging between 0.60 and 0.75).

As emphasized by Justiniano et al. (2011), the financial system plays a crucial role in the process of producing physical capital. They argue that the MEI shock might reflect fundamental disturbances in the ability of the financial system to intermediate capital investments. To measure the MEI process, they

[5]We filled in the missing values from the IFS database with data from the OECD and the ECB. We used OECD 3-month money market rate data for the following countries: Canada (2017:M05 to 2019:M12), Japan (2017:M07 to 2019:M12), Sweden (2017:M06 to 2019:M12), Belgium (2017:M12 to 2019:M12), Finland (2018:M02 to 2019:M12), France (2017:M06 to 2019:M12), Ireland (2017:M04 to 2019:M12), Lithuania (2017:M06 to 2019:M12), Luxembourg (2017:M06 to 2019:M12), Netherlands (2019:M07 to 2019:M12), Portugal (2017:M06 to 2019:M12), and Paraguay (2017:M04 to 2019:M12). We used 3-month money market rate data from the ECB for the following countries: Croatia (2014:M02 to 2019:M12) and India (1991:M01 to 2004:M12).

[6]Penn World Table (PWT) 10 also publishes annual figures for the labor share in income for many countries. We also used the labor shares reported by the PWT 10 to calculate the MPK values. We found very similar results when compared with the benchmark estimates computed from the values of Guerriero (2019). As no information on labor shares for India and Indonesia is provided by Guerriero (2019), we used values reported by the PWT 10. Additionally, neither Guerriero (2019) nor PWT 10 provide estimates for Bangladesh's labor share. Therefore, we used annual cross-sectional averages including all sample countries as Bangladesh's labor share.

use the external finance premium, proxied by the spread between high-yield and AAA corporate bond returns. We used a broader measure as a proxy for the MEI process, the Index of Financial Development (IFD) developed by the IMF (Svirydzenka, 2016). The IFD considers in its composition not only the typical empirical measures of financial development, such as the ratio of private credit to GDP and the stock market capitalization to GDP, but also a set of nine sub-indicators that summarize the depth, access, and efficiency of financial institutions and financial markets.

As a proxy for the MON process, we chose to use both M1 and M3 as measures of the money stock. By utilizing a narrow and a broad money measure, we can assess whether the difference in liquidity plays a role in our asset pricing exercises.[7]

2.2 Carry Trade Returns

To establish our claims, we begin by analyzing our CT return series. Figure (2.1) presents the evolution of the 10-year moving average of CT returns by country groups (All, Developed, Developing, and G10) and CT portfolios. Panels (a) and (b) consider the entire dataset. Panels (c) and (d) consider only Germany as a country adopting the euro, therefore we exclude all Eurozone countries after their date of entry into the membership. The portfolio returns shown in Panels (b) and (d) are obtained by applying the high-minus-low strategy for constructing CT portfolios, following the methodology applied by Lustig et al. (2011), Menkhoff et al. (2012a), Corte et al. (2016), and Colacito et al. (2020). In this case, currency excess returns are constructed from sorting countries based on nominal interest rates and dividing them into six portfolios: portfolio one with countries having the lowest interest rates and portfolio six with countries having the highest interest rates. The returns of CT portfolios correspond to the difference between the return of each portfolio (portfolios two to six) and the return of portfolio one (high-minus-low). We apply the same methodology to analyze CT returns of a sample formed only by developed countries. Due to the smaller number of countries, we form five portfolios and only display the result of the CT portfolio formed by the difference between the return of portfolio five and that of portfolio one (denoted as "P5-P1" in the figure).

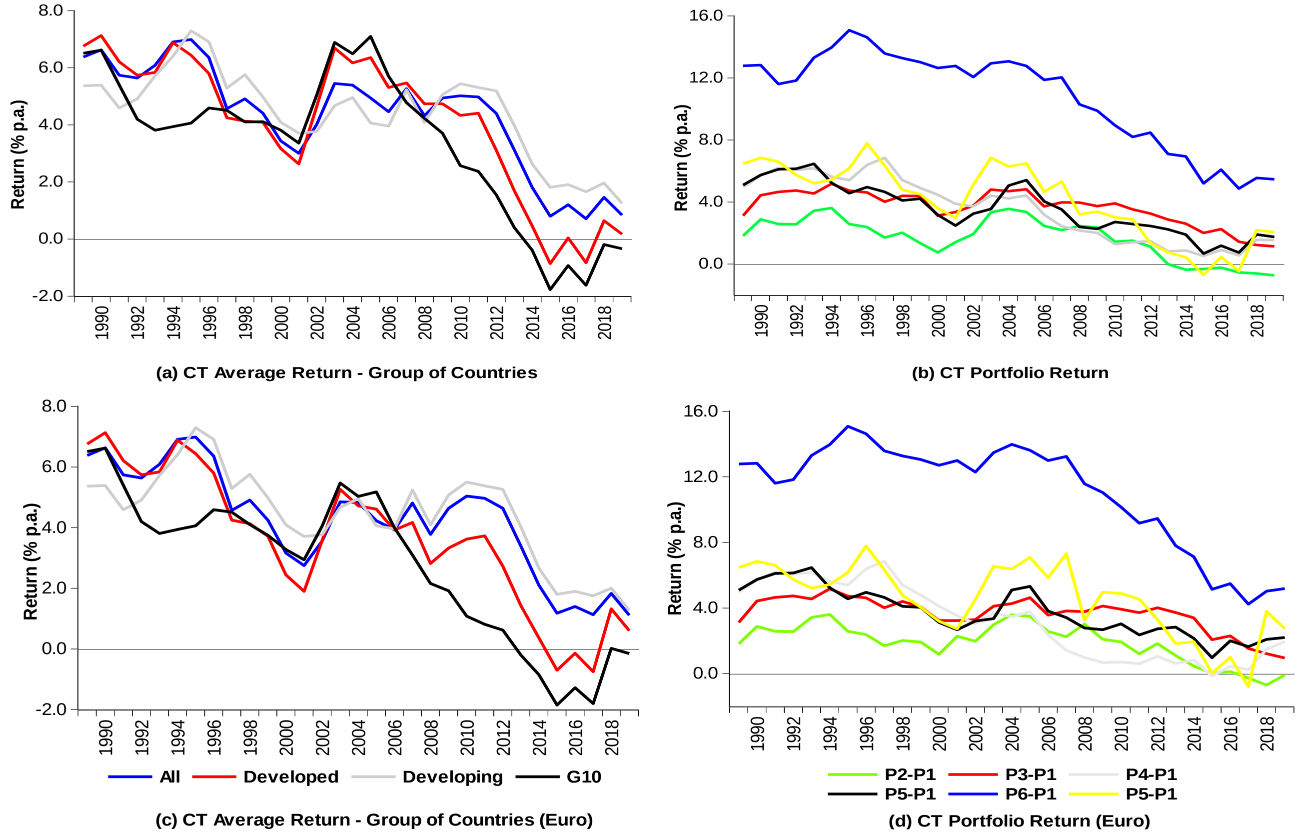
The most significant feature of Figure (2.1) is the clear downward trend in CT returns observed between 1980 and 2019. Panels (a) and (c) illustrate that the high average returns in the 1980s (close to 7% p.a.) collapse to approximately zero in the late 2010s. The qualitative result displayed in Panels (b) and (d) of the figure is consistent with that presented in Panels (a) and (c), showing a decline in CT returns over recent decades. For example, average returns decrease from around $12\% - 15\%$ p.a. in the 1980s to approximately $4\% - 6\%$ p.a. in the late 2010s. As will be discussed below, this reduction is accompanied by a decline in nominal interest rates differentials across countries and a decrease in the growth rate of exchange rates.

Table (2.1) provides a comprehensive summary of the 5-year average of CT returns by country groups (All, Developed, Developing, and G10) and the high-minus-low (HML) portfolio strategy (portfolio return six minus portfolio return one). The table reveals that, in general, the average of CT returns decreases over time. However, it is worth noting that CT returns across all country groups experience a sharp increase in 2002 and 2003. It is informative to compare the returns of these two years with those reported in the table. CT returns reached $11.12\%, 16.31\%, 7.89\%$ and 10.70% in 2002 and $14.70\%, 17.29\%, 13.08\%$ and 14.44% in 2003, for the respective groups of All, Developed, Developing, and G10 countries. The increase in returns over the period 2000-2004 can be attributed to these two unconventional years. This is important because if we remove these two years from our sample, the downward trend in CT returns becomes even clearer.

To complement our analysis, we also conducted a time-series linear regression of annualized CT returns by group of countries on a constant and a time trend. We find that in all cases the estimated trend parameter is statistically significant at the 1% level. The parameter estimates and the adjusted R^2s values from the regressions are as follows: i) -0.16 and 0.66 (All countries); ii) -0.21 and 0.63 (Developed); iii) -0.12 and 0.53 (Developing); and iv) -0.21 and 0.56 (G10). This implies a reduction in CT returns

[7] Our choice of M1 and M3 over M0 and M2 is motivated by two reasons: i) M3 is less liquid than M2, allowing us to better capture liquidity differences by comparing the results between M1 and M3; and ii) we were unable to find M0 data for our period of investigation.

ranging from 0.12% to 0.21% per year or equivalently, a reduction ranging from approximately 4.80% to 8.40% over four decades. These results align with the findings reported in Table (2.1).



(a) CT Average Return - Group of Countries

(b) CT Portfolio Return

(c) CT Average Return - Group of Countries (Euro)

(d) CT Portfolio Return (Euro)

Figure 2.1: CT Return. The figure shows the evolution over time of the 10-year moving average of CT returns. Panels (a) and (b) consider the entire dataset. Panels (c) and (d) consider only Germany as a country adopting the euro, therefore we exclude all Eurozone countries after their dates of entry into the membership. Portfolio returns - Panels (b) and (d) - are obtained from the high-minus-low strategy of building CT portfolios (Lustig et al., 2011; Menkhoff et al., 2012a; Corte et al., 2016; Colacito et al., 2020). To obtain the 10-year moving average values, we first computed the cross-sectional mean of the monthly data for each group of countries (All, Developed, Developing, and G10) and portfolios. We then used these values to calculate the average annual returns. Lastly, we employed these annual values to obtain the 10-year moving average. Monthly returns are annualized (multiplied by twelve). The sample period is 1980-2019.

As discussed earlier, CT returns come from two sources: the nominal interest rate differential and changes in the exchange rate. To gain a better understanding the downward trend in CT returns, it is crucial to examine the behavior of both sources over the period investigated. Table (2.2) provides a breakdown of CT returns into their components: the nominal interest rate differential (denoted by ‘IR’) and the exchange rate return (denoted by ‘FX’). Two main findings emerge from this table. First, reading down the columns of the table, we observe a decrease in average ‘IR’ returns across all country groups. Second, we find that average ‘FX’ returns increased between the periods of 1980-1999 (with an average of -8.42% p.a.) and 2000-2019 (with an average of -1.39% p.a.) for the group of Developing countries. The surge in ‘FX’ returns during the 2002-2003 interval played a significant role in driving atypical returns during that period. Moreover, the average returns of the 2000-2004 period were greatly influenced by the rise in ‘FX’ returns in both developed and developing countries compared to previous periods. For instance, in developed countries, ‘FX’ returns increased from 2.00% p.a. to 6.65% p.a. between 1995-1999 and 2000-2004.

Table 2.1
Descriptive Statistics - CT Returns

The table shows the mean and standard deviation of CT returns considering a five-year data window. The figures in each panel are five-year averages and standard deviations of the means of the cross-sectional values for each group of countries (All, Developed, Developing, and G10). We also included in the last two columns of the table the average and standard deviation of CT returns from the high-minus-low (HML) investment strategy. Monthly CT returns are annualized (multiplied by twelve). The sample period is 1980-2019.

	All		Developed		Developing		G10		HML	
Period	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**
1980-1984	4.14	12.17	4.01	14.96	4.36	10.60	8.10	19.00	9.27	22.60
1985-1989	8.52	14.59	9.43	18.30	6.29	8.50	4.88	10.61	16.15	17.31
1990-1994	5.29	18.86	4.31	28.46	6.53	8.36	2.99	28.37	11.76	13.06
1995-1999	3.51	9.10	3.85	7.98	3.41	14.56	5.22	14.67	14.27	33.83
2000-2004	7.26	13.84	8.48	22.64	6.51	10.73	7.76	20.38	11.85	18.45
2005-2009	2.61	23.86	0.99	29.69	3.61	21.18	-0.33	28.46	7.91	24.50
2010-2014	0.99	23.49	-0.06	27.29	1.63	21.78	-0.43	23.40	5.95	13.59
2015-2019	0.68	9.65	0.40	14.23	0.85	11.55	-0.24	16.92	4.95	25.27

Third, reading across the rows of the table, we find that, in general, the absolute values of the average 'IR' and 'FX' returns are higher in developing countries than in Developed and G10 countries.

Table 2.2
CT Return Decomposition

The table shows the decomposition of CT returns between the FX return (denoted by 'FX') and the nominal interest rate differential (denoted by 'IR') considering a five-year data window. The figures in each panel are the five-year average of the cross-sectional means for each group of countries (All, Developed, Developing, and G10). Monthly CT returns are annualized (multiplied by twelve). The sample period is 1980-2019.

	All		Developed		Developing		G10	
Period	**IR**	**FX**	**IR**	**FX**	**IR**	**FX**	**IR**	**FX**
1980-1984	6.07	-1.93	3.65	0.36	10.19	-5.83	3.29	4.81
1985-1989	7.78	0.74	4.82	4.61	13.01	-6.72	2.66	2.22
1990-1994	10.18	-4.89	4.72	-0.41	16.27	-9.74	3.45	-0.46
1995-1999	9.48	-5.97	1.85	2.00	14.59	-11.18	1.91	3.31
2000-2004	5.30	1.96	1.83	6.65	7.56	-1.05	1.57	6.19
2005-2009	3.24	-0.63	2.05	-1.06	3.87	-0.26	1.49	-1.82
2010-2014	3.36	-2.37	1.69	-1.75	4.16	-2.53	0.93	-1.36
2015-2019	2.64	-1.96	1.23	-0.83	3.43	-2.58	1.12	-1.36

Figure (2.2) provides further insights into the decomposition of CT returns between 'IR' and 'FX'. In all panels of this figure, the left axis represents changes in the All and Developing groups, while the right axis represents changes in the Developed and G10 groups. Panels (a) and (b) present the 10-year moving average of 'IR' and 'FX' returns, respectively. Panel (a) reveals that 'FX' returns are almost always negative and increase over time in developing countries. Conversely, in Developed and G10 countries, 'FX' returns are generally positive and decline over time. Notably, there is a downward trend in 'FX' returns until 2001, followed by a peak of approximately 7% around 2002 and 2003, and then a new downward trend. Panel (b) of the figure confirms the decline in CT returns associated with nominal interest rate differentials for all groups of countries. Importantly, Panels (a) and (b) reveal a downward trend in both 'FX' and 'IR' returns in absolute terms between 1980 and 2019. These findings emphasize the significance of both 'IR' and 'FX' returns in explaining the behavior of CT returns over the analyzed period.

Panels (c) and (d) of the figure display the 10-year moving averages of the cross-sectional standard deviations of 'FX' and 'IR' returns by group of countries. These figures were obtained by calculating the cross-sectional standard deviations using monthly data from each country group and then averaging them over a 10-year window. Panel (c) provides insights into the behavior of the standard deviation of ‘FX’ returns. It shows a decreasing trend in the standard deviation for both Developed and G10 countries between 1990 and 2019. Additionally, for developing countries, there is a noticeable decline in the standard deviation of ‘FX’ returns from around 2000 onwards. In Panel (d), the standard deviation of ‘IR’ returns is examined. The results indicate a decrease in the standard deviation of ‘IR’ returns for all groups of countries. Overall, the findings from Panels (c) and (d) suggest that the downward trend in CT returns is accompanied by a convergence in the values of ‘FX’ and ‘IR’ returns across countries. This convergence is reflected in the decreasing standard deviations of both ‘FX’ and ‘IR’ returns.

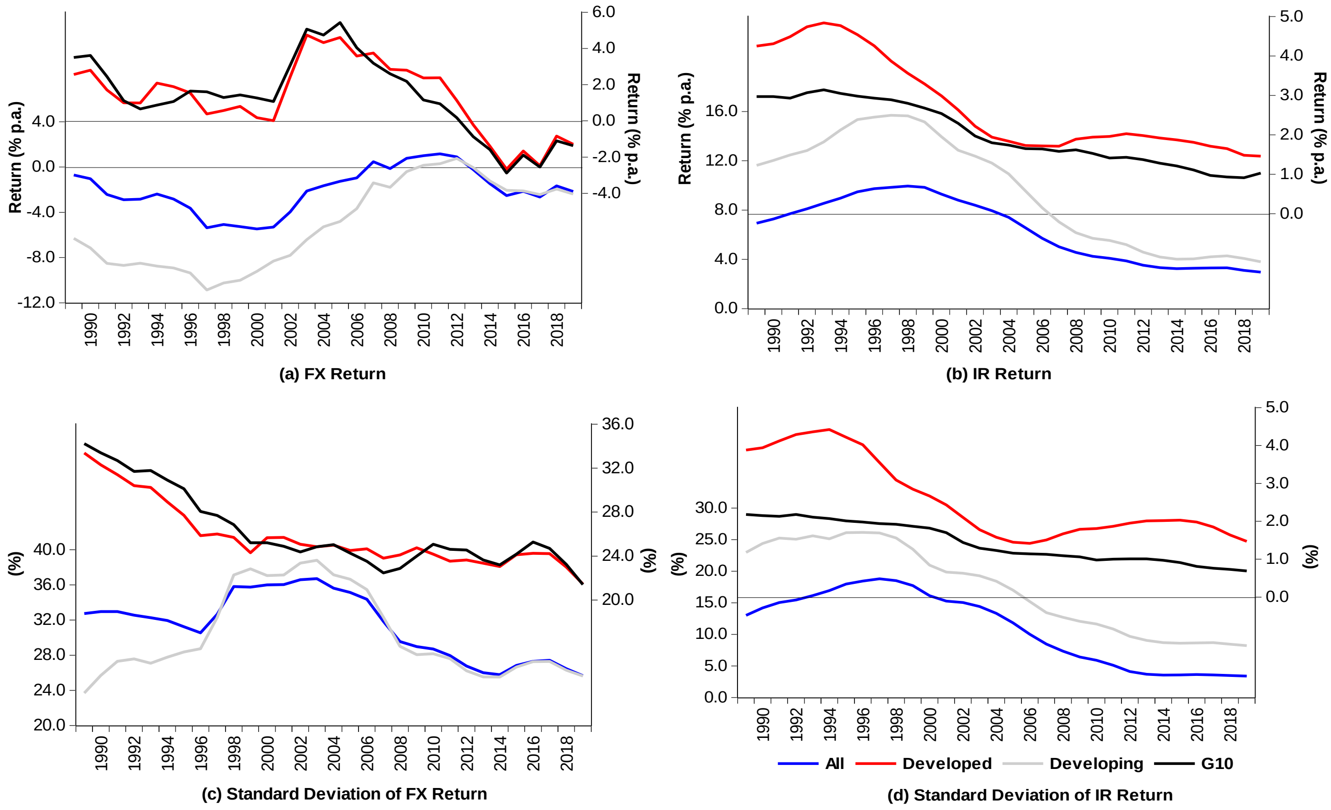


Figure 2.2: Decomposition of CT Returns. The figure shows the 10-year moving averages of the decomposition of CT returns between FX and ‘IR’ returns (Panels (a)) and (b)) and of the cross-sectional standard deviations of ‘FX’ and ‘IR’ returns by group of countries (Panels (c) and (d)). In all panels of this figure, the left axis represents changes in the All and Developing groups, while the right axis represents changes in the Developed and G10 groups. To obtain the 10-year moving average values of ‘FX’ and ‘IR’ returns, we first computed the cross-sectional mean of the monthly data for each group of countries (All, Developed, Developing, and G10). We then used these values to calculate the average annual ‘FX’ and ‘IR’ returns by country groups. Lastly, we employed these annual values to obtain the 10-year average. To obtain the figures of Panels (c) and (d), we first computed the cross-sectional standard deviations of ‘FX’ and ‘IR’ returns using monthly data from each group of countries. We then averaged these values considering data from a 10-year window. Monthly ‘FX’ and ‘IR’ returns are annualized (multiplied by twelve). The sample period is 1980-2019.

We also computed the 10-year moving average of the percentage of countries that experienced positive annual ‘FX’ returns between 1980 and 2019. Developed and G10 countries consistently maintained a stable range of $50\% - 55\%$ positive ‘FX’ returns throughout the period. In contrast, the number Developing countries with positive ‘FX’ returns increased from approximately 10% in 1990 to 45% in 2019. Additionally, Figure (A.2.1) in Appendix A.2 reproduces the empirical distribution of monthly CT returns for each group of countries considering two intervals: 1980 to 1999 and 2000 to 2019. The main points to be taken from this figure are as follows: i) across all groups of countries, the distribution of returns shows a heavier right tail in the period 2000-2019 compared to the period 1980-1999; ii) the mean of the distribution of returns for Developed countries is lower in the period 2000-2019 compared to the period 1980-1999; and iii) negative returns are more frequent in the distribution of Developed and

G10 countries in the period 2000-2019 compared to the period 1980-1999. These changes in the empirical distribution reflect the overall decline in CT returns between 1980 and 2019.

Overall, our findings provide empirical evidence supporting the downward trend in CT returns. The evolution over time of 'FX' and 'IR' returns helps explain this downward trend. In what follows, we reveal the existence of a similar trend for nominal interest rates, inflation rates, MPKs and exchange rate growth rates. Lastly, we analyze the crucial aspect of the growth rates of the IST, MEI, and MON processes in recent decades.

2.3 Nominal Interest Rates, Inflation and the Marginal Product of Capital

Table (2.3) presents the means and standard deviations of nominal interest rates (Panel (a)), inflation rates (Panel (b)), and MPKs (Panel (c)). The table reveals that from 1980 to 2019, nominal interest rates

Table 2.3
Nominal Interest Rates, Inflation and the MPK

The table shows the mean and standard deviation of nominal interest rates, inflation and the MPK considering a five-year data window. The figures in each panel are five-year averages and standard deviations of the means of cross-sectional values by country groups. Inflation rates were computed as the log difference of the consumer price index. Monthly nominal interest rates and inflation are annualized (multiplied by twelve). We excluded nominal interest rates and annual inflation rates greater than 500% p.a., as these amounts are inherently associated with periods of extreme turmoil in the country of origin (for example, hyperinflation episodes, sovereign defaults, etc.). These episodes are so chaotic that general economic theorems are no longer valid, which prevents any useful analysis (see Reinhart (2010)). The sample period is 1980-2019.

	All		**Developed**		**Developing**		**G10**		**US**	
Period	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**
Panel (a): Nominal Interest Rates										
1980-1984	18.41	3.26	11.82	0.81	27.14	7.65	10.40	1.12	10.92	2.59
1985-1989	19.43	3.61	10.57	0.69	29.47	7.63	7.71	0.95	6.81	1.04
1990-1994	18.42	4.20	9.22	1.89	26.17	7.24	7.74	1.70	4.73	1.69
1995-1999	14.01	2.75	5.29	1.08	19.75	4.05	4.09	0.94	5.01	0.36
2000-2004	7.45	1.66	3.77	0.91	9.77	2.22	2.93	0.65	2.65	1.89
2005-2009	5.23	0.81	3.61	1.00	6.23	0.83	2.56	0.91	2.78	1.82
2010-2014	3.43	0.29	1.75	0.41	4.44	0.29	0.98	0.29	0.07	0.04
2015-2019	2.75	0.17	0.61	0.14	4.06	0.25	0.08	0.12	1.06	0.85
Panel (b): Inflation Rates										
1980-1984	19.66	3.77	10.53	3.46	27.43	6.99	7.13	2.93	6.15	4.87
1985-1989	22.76	9.33	5.79	2.23	36.16	15.86	3.09	2.06	3.60	2.58
1990-1994	23.91	6.62	4.18	2.18	36.99	10.54	3.37	2.59	3.43	2.58
1995-1999	9.25	3.82	1.93	1.74	13.69	5.71	1.46	1.60	2.34	2.00
2000-2004	4.85	2.36	2.07	2.52	6.54	3.16	1.61	2.30	2.45	3.64
2005-2009	3.99	2.38	2.15	3.11	5.10	2.65	1.50	2.92	2.52	6.57
2010-2014	3.04	1.83	1.70	3.15	3.85	1.86	1.32	2.45	1.67	3.87
2015-2019	2.36	1.54	1.23	2.90	3.04	1.63	1.15	2.59	1.80	3.09
Panel (c): Marginal Product of Capital										
1980-1984	14.39	0.68	6.23	0.15	20.45	1.09	5.21	0.08	6.18	0.13
1985-1989	13.01	0.42	6.11	0.08	18.13	0.72	5.26	0.04	6.46	0.07
1990-1994	10.84	0.52	5.64	0.31	14.00	0.66	4.92	0.29	6.84	0.08
1995-1999	10.02	0.28	5.64	0.37	12.67	0.67	4.98	0.34	7.16	0.16
2000-2004	10.20	0.05	7.05	0.09	12.10	0.09	6.12	0.10	7.58	0.07
2005-2009	9.58	0.72	6.33	0.68	11.54	0.75	5.42	0.56	7.56	0.18
2010-2014	8.52	0.19	5.02	0.30	10.63	0.16	4.43	0.22	8.12	0.10
2015-2019	8.17	0.09	4.92	0.13	10.14	0.09	4.26	0.07	8.51	0.11

and inflation rates exhibited a downward trend across all groups of countries. Among Developing countries, the MPK also experienced a decline over the period. The behavior of the MPK among Developed and G10 countries is less straightforward. It initially decreased from 1980 to 1999, then peaked in the 2000-2004 period, and subsequently resumed a downward trajectory. In contrast, the US MPK exhibited an overall increase during the same period.

Figure (2.3) displays the spread between each group of countries and the US in terms of the nominal interest rates (Panel (a)), inflation rates (Panel (b)) and MPKs (Panel (c)). Examining the three panels together is informative, as we have established a direct connection between inflation rates and the MPK with nominal interest rates in the previous section. As we can see in the figure, the spread between Developing countries and the US decreases between 1980 and 2019, for all three variables. This trend indicates a convergence between Developing countries and the US in terms of nominal interest rates, inflation rates, and MPKs. In the Developed and G10 groups, three key observations can be made from the figure: i) between 1980 and 1995, the interest rate spread is almost always positive, and it appears to be primarily driven by fluctuations in the inflation rate spread; ii) between 1996 and 2007, the interest rate spread remains mostly positive, and it appears to be influenced by the reduction in the spread of the MPK (in absolute terms); and iii) starting from 2008, the interest rate spread decreases and eventually becomes negative at the end of the period. This is accompanied by an increase in the spread of the MPK (in absolute terms) and an inflation rate spread close to zero. These findings have important implications for understanding CT returns. Since the nominal interest rate differential is a component of CT returns and is closely connected to inflation and the MPK, fundamental shocks impacting inflation and the MPK

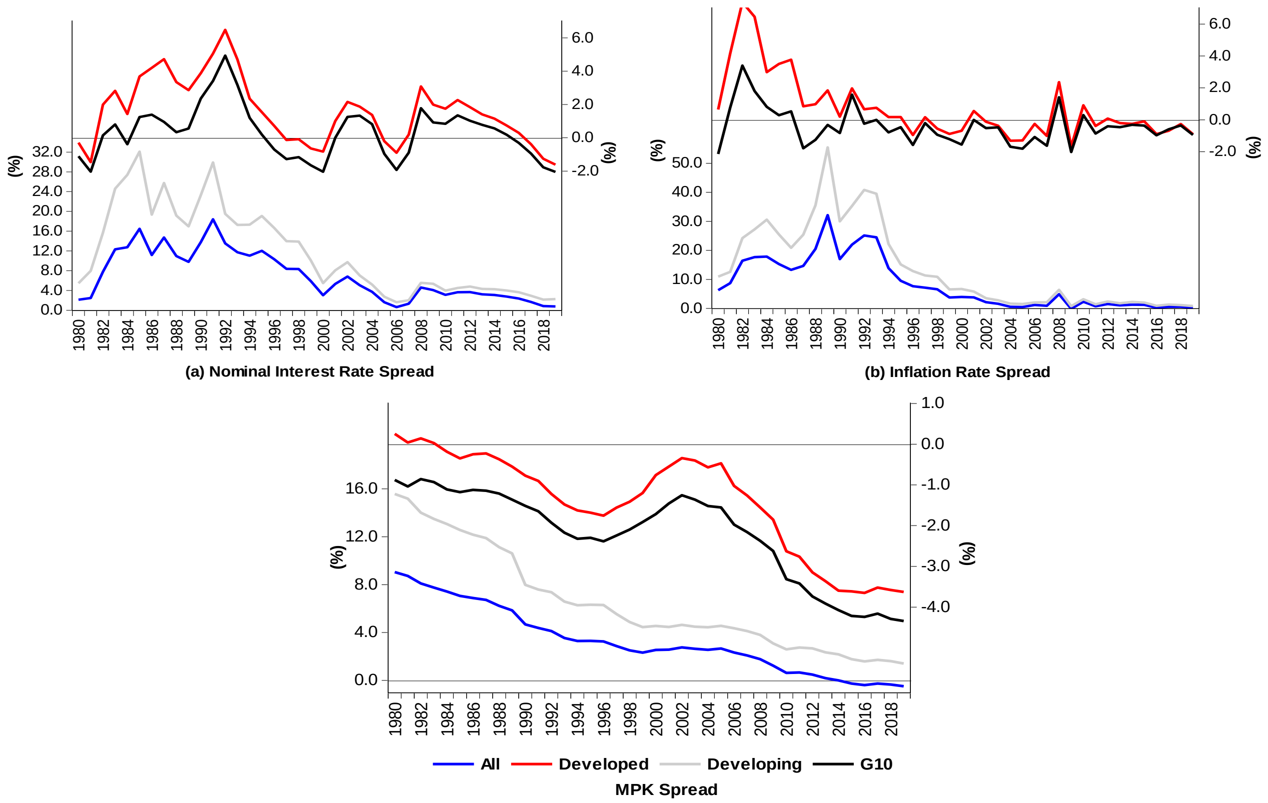


Figure 2.3: Nominal Interest Rate, Inflation and the MPK Spreads. The figure shows the values of spreads between each group of countries and the US relative to: the nominal interest rate (Panel (a)), the inflation rate (Panel (b)) and the MPK (Panel (c)). In all panels, the left axis represents values for the All and Developing groups, while the right axis represents values for the Developed and the G10 groups. The spread is the difference between the value of the respective variable for each group of countries (All, Developed, Developing, and G10) and the US. Inflation rates were computed as the log difference of the consumer price index. To obtain the spread, we first calculated the difference between each country and the US. We then averaged these results for each group of countries. As in Table (2.3), we excluded nominal interest rates and annual inflation rates in excess of 500% p.a. The sample period is 1980-2019.

can provide insights into the behavior of CT returns. In the next analysis, we delve into the behavior of currency fluctuations, which represents the other component of CT returns.

2.4 Exchange Rates

We start by examining the descriptive statistics on the growth rate of nominal exchange rates (an increase in the nominal exchange rate means an appreciation of the US Dollar). Table (2.4) provides the means and standard deviations for both the growth rate of exchange rates (Panel (a)) and the growth rate of absolute values of exchange rates (Panel (b)) for each group of countries. It is important to note that CT returns systematically respond to changes in exchange rates. However, the profitability or loss resulting from these changes depends on the specific position taken by investors in each currency (long or short).

In CT investments, the decision to take a long or short position is determined *ex-ante* by comparing home and foreign nominal interest rates. The results of the table can be influenced by the aggregation of our data into groups of countries. Within each group, there may be variations in the nominal interest rates, with some countries having higher rates than the US and others having lower rates. This is particularly relevant for the Developed and G10 countries. Consequently, the growth rate of absolute values of exchange rates (Panel (b)) can be seen as an upper bound on the potential returns derived from exchange rate changes in CT investments. It provides an indication of the maximum potential gain or loss that can result from fluctuations in exchange rates, depending on the specific positions taken by investors.

Table 2.4
Nominal Exchange Rates

The table shows the mean and standard deviation of both the exchange rate growth and the absolute value of the growth rate of exchange rates considering a five-year data window. The figures in each panel are five-year averages and standard deviations of the means of cross-sectional values by group of countries. The exchange rate growth was computed as the log difference of the exchange rate between $t+1$ and t. Monthly exchange rate growth are annualized (multiplied by twelve). To obtain the values in the table, we first computed the cross-sectional average of the monthly data for each group of countries. We then used these values to obtain mean and standard deviation over a five-year data window. As in Table (2.3), we excluded nominal growth rates of exchange rates in excess of 500% p.a. The sample period is 1980-2019.

	All		Developed		Developing		G10	
Period	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**
Panel (a): Exchange Rate Growth								
1980-1984	17.72	15.41	15.09	27.04	19.77	10.61	11.85	29.56
1985-1989	8.49	18.81	-6.73	34.20	20.28	10.54	-9.25	37.14
1990-1994	14.15	17.16	0.30	31.64	23.75	12.01	-0.53	34.00
1995-1999	8.26	14.58	2.37	21.38	11.53	12.79	1.80	23.06
2000-2004	0.26	15.55	-4.15	26.33	1.65	12.74	-4.15	25.66
2005-2009	-0.67	23.32	0.52	29.85	-1.05	21.78	-0.52	28.82
2010-2014	2.73	21.69	1.76	26.54	3.05	20.43	2.06	25.08
2015-2019	2.61	15.75	1.58	20.36	2.97	14.84	1.44	20.53
Panel (b): Absolute Values of Exchange Rate Growth								
1980-1984	23.20	8.01	29.08	15.06	18.69	7.53	29.06	16.53
1985-1989	27.15	10.05	32.10	19.45	20.74	7.37	33.16	21.05
1990-1994	28.13	11.18	27.03	20.48	27.91	9.81	28.63	21.81
1995-1999	20.91	7.65	20.11	12.05	21.89	8.14	21.91	12.80
2000-2004	16.70	6.06	13.92	7.19	18.99	6.73	15.33	8.41
2005-2009	18.84	12.66	15.20	10.50	21.12	14.27	16.95	11.21
2010-2014	17.34	9.57	13.26	8.15	19.67	10.74	15.15	9.10
2015-2019	15.16	5.93	11.65	5.53	17.13	6.84	13.35	7.17

Panel (a) of the table indicates that, on average, the growth rate of exchange rates tend to decrease in Developing countries, while it does not exhibit a clear trend in Developed and G10 countries. However, Panel (b) highlights that the absolute value of exchange rate growth in Developed and G10 countries declines between 1980 and 2019. This suggests a decrease in the magnitude of exchange rate fluctuations in these countries over time.

Figure (2.4) complements the analysis of exchange rates growth. In all panels of this figure, the left axis represents values for the All and Developing groups, while the right axis represents values for the Developed and G10 groups. Panels (a) and (b) present the 10-year moving averages of both the exchange rate growth and the absolute value of the exchange rate growth. These panels provide further insights into the results presented in Table (2.4). Notably, the moving average of the absolute value of exchange rate growth has exhibited a significant decline in Developed and G10 countries (from around 32.00% in the 1990s to around 14% in the late 2010s) and a moderate decline in developing countries (from about 25.00% in the mid-1990s to approximately 17% in the late 2010s). Overall, these findings align with the decrease in 'FX' returns of Developed and G10 countries and the decline in the absolute values of 'FX' returns of developing countries, as documented in Table (2.2) and Figure (2.2).

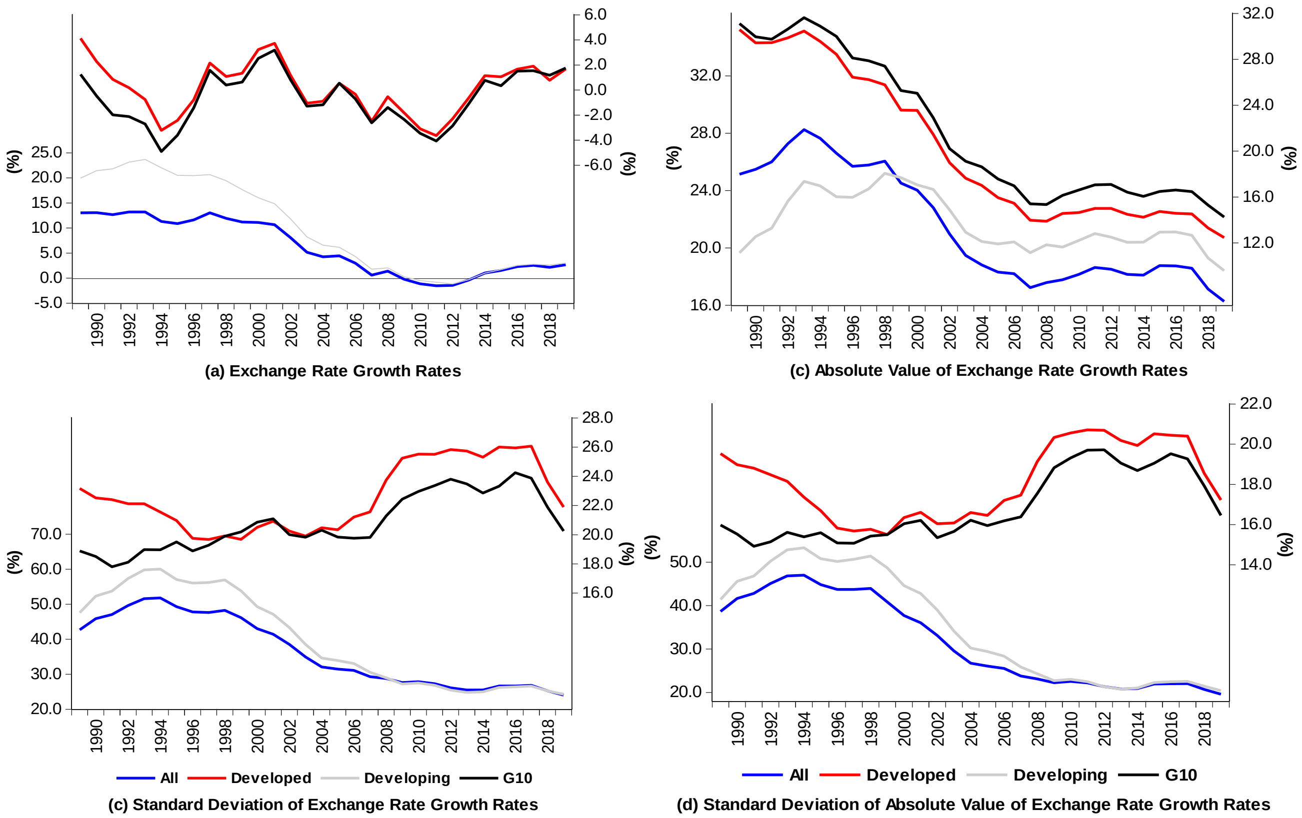


Figure 2.4: Exchange Rate Growth. The figure shows the behavior of the 10-year moving average of the exchange rate growth (Panel (a)), the absolute value of the exchange rate growth (Panel (b)) and their respective standard deviations (Panels (c) and (d)). In all panels of this figure, the left axis represents values for the All and Developing groups, while the right axis represents values for the Developed and G10 groups. Exchange rate growth were computed as the log difference of the exchange rate between the periods $t+1$ and t. To obtain the 10-year moving average values, we first computed the cross-sectional mean of the monthly data by group of countries. We then used these values to calculate the average annual exchange rate growth by country groups. Lastly, we employed these annual values to obtain the 10-year average. The sample period is 1980-2019.

To generate Panels (c) and (d) of the figure, we applied the same methodology used to produce the respective Panels (c) and (d) in Figure (2.2). A closer inspection of the panels reveals that, in general: i) the standard deviation of exchange rate growth and the absolute values of exchange rate growth rate decrease in Developing countries; ii) the standard deviation of exchange rate growth and the absolute values of exchange rate growth in Developed and G10 countries increase from the mid-2000s to the mid-2010s and start to decline thereafter; and iii) changes in standard deviation are smaller in the Developed and G10 groups compared to the Developing group. For instance, Panel (c) indicates that the standard deviations range between approximately 15% and 21% in the Developed and G10 groups, while it decreases from approximately 50% to 20% in the Developing group.

In our model, we connect currency excess returns with the IST, MEI, and MON shocks. We have already explored the evolution over time of CT returns and their components, namely the nominal interest rate differential and exchange rate changes. Now, it is of utmost importance to analyze the behavior of these shock processes during the period under investigation.

2.5 IST, MEI, and MON Processes

In what follows, we examine the behavior of the IST, MEI, and MON processes in recent decades. An increase in the consumption-to-investment price ratio represents a positive shock to the IST, leading to an immediate rise in the marginal return on investment in physical capital. Similarly, a positive shock to the MEI occurs with an increase in the level of financial development within a country, reducing investment adjustment costs. Both the IST and MEI shocks directly influence the growth rate of investment in physical capital. Furthermore, an increase in money demand corresponds to a positive shock to the MON, resulting in a boost to the money stock.

We follow the literature and provide results in terms of the inverse of the IST process (P_t^i/P_t^c). Throughout this section, we use the term 'IST' to mean the inverse of the IST. Table (2.5) reports the mean and standard deviation of the IST (Panel (a)), MEI (Panel (b)) and MON (Panels (c) and (d)) by group of countries considering a five-year data window. Money growth rates were computed as the log difference of money stocks M1 and M3 between periods $t+1$ and t.[8]

Overall, when reading down the columns of Panel (a) (Panel (b)), the IST (MEI) values decrease (increase) over time for all country groups. Panel (c) and (d) show a significant level of uncertainty regarding the direction of changes in money growth over the period 1980 to 2019. On the one hand, the mean (standard deviation) of Developing countries declines sharply from 25.69% and 29.21% (5.16% and 4.17%) in 1980-1984 to 10.09% and 7.41% (2.25% and 1.32%) in 2015-2019, for the M1 and M3 growth rates, respectively. On the other hand, the US M1 growth rate increases from -0.68% (standard deviation of 3.33%) in 1995-1999 to a peak of 10.87% (standard deviation of 5.80%) in 2010-2014. The M1 growth rate of the Developed and the G10 groups fluctuates over the period without a clear trend. However, overall, all groups of countries show a decline in the rate of M3 growth.

The behavior of the three processes can be better evaluated through graphical analysis, as they demonstrate the evolution of values gradually over time. We begin by looking at the IST spread (between the IST value of each country and the value of the US) shown in Panel (a) of Figure (2.5). It is noteworthy that the IST spread in the Developing group declines from a peak of 1.20 to a low of approximately 0.20. On the other hand, the IST spreads in the Developed and G10 groups fluctuate around the zero line without a clear trend. Overall, the 'Total Spread (abs)' - which represents the sum of the absolute values of the spreads in Developed and Developing countries - also decreases from the 1980s to the 2010s.

To generate Panel (b) of Figure (2.5), we followed the same methodology used in constructing Panel (c) of Figure (2.2). In this panel, the left axis represents the standard deviation of the IST process for the All and Developing groups, while the right axis represents values for the Developed and G10 groups. Overall, the standard deviation for all groups decreases from the 1980s through the early 2000s and then remains relatively stable. It is important to note that this decline is similar to the observed patterns in the standard deviations of 'FX' and 'IR' returns shown in Panels (c) and (d) of Figure (2.2).

[8] Our dataset of M1 and M3 comprises quarter data from OECD for the following countries: Australia (1980:Q1-2019:Q4), Brazil (1995:Q1-2019:Q4), Canada (1980:Q1-2019:Q4), Chile (1986:Q3-2019:Q4), Colombia (1982:Q1-2019:Q4), Costa Rica (2001:Q3-2019:Q4), Czech Republic (1992:Q2-2018:Q4), Denmark (1980:Q1-2019:Q4), Hungary (1992:Q3-2019:Q4), Iceland (1980:Q1-2019:Q4), India (1980:Q1-2019:Q4), Indonesia (1990:Q3-2018:Q4), Israel (1987:Q3-2019:Q4), Japan (1980:Q1-2019:Q4), Mexico (1980:Q1-2018:Q4), New Zealand (1980:Q1-2018:Q4), Norway (1980:Q1-2019:Q4), Poland (1989:Q3-2019:Q4), Russia (1996:Q1-2018:Q4), South Africa (1980:Q1-2019:Q4), South Korea (1984:Q4-2019:Q4), Sweden (1998:Q3-2018:Q4), Switzerland (1980:Q1-2018:Q4), Turkey (1980:Q1-2019:Q4), the United Kingdom (1984:Q4-2019:Q4), and the US (1980:Q1-2019:Q4). We complemented our dataset with information from the Federal Reserve Bank (Fred St. Louis) for the following countries: France (1984:Q4-1998:Q4), Germany (1980:Q1-1998:Q4), Saudi Arabia (1993:Q2-2017:Q4), and Spain (1980:Q1-1998:Q4). We included the euro from 1999:Q2 to 2019:Q4 (data from the Fred St. Louis).

Table 2.5
IST, MEI, and MON Processes

The table shows the mean and standard deviation of the IST, MEI, and MON processes considering a five-year data window. To obtain the values, we first computed the cross-sectional mean of the annual data by country group. We then used these values to calculate the mean and standard deviation considering a five-year data window. Money growth rates were computed as the log difference of money stocks M1 and M3 between periods $t+1$ and t. M1 and M3 growth rates are annualized. The sample period is 1980-2019 (IST and MEI).

	All		**Developed**		**Developing**		**G10**		**US**	
Period	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**
Panel (a): Investment Specific Technology										
1980-1984	1.97	0.03	1.38	0.04	2.35	0.03	1.41	0.05	1.25	0.06
1985-1989	1.90	0.04	1.25	0.04	2.35	0.06	1.29	0.03	1.12	0.01
1990-1994	1.64	0.09	1.06	0.07	1.95	0.10	1.12	0.07	1.05	0.05
1995-1999	1.42	0.06	1.01	0.05	1.63	0.12	1.06	0.04	1.03	0.04
2000-2004	1.39	0.04	1.14	0.05	1.51	0.04	1.18	0.04	1.03	0.04
2005-2009	1.24	0.04	0.98	0.05	1.36	0.04	1.04	0.04	0.93	0.02
2010-2014	1.15	0.03	0.87	0.03	1.29	0.03	0.92	0.02	0.88	0.03
2015-2019	1.08	0.02	0.81	0.01	1.21	0.02	0.87	0.01	0.94	0.01
Panel (b): Marginal Efficiency of Investment										
1980-1984	0.27	0.02	0.31	0.02	0.23	0.01	0.38	0.03	0.36	0.06
1985-1989	0.34	0.02	0.44	0.03	0.25	0.01	0.51	0.03	0.52	0.05
1990-1994	0.36	0.02	0.48	0.03	0.26	0.01	0.55	0.04	0.61	0.06
1995-1999	0.42	0.03	0.60	0.06	0.30	0.02	0.69	0.06	0.84	0.05
2000-2004	0.48	0.01	0.68	0.01	0.34	0.01	0.77	0.01	0.89	0.01
2005-2009	0.53	0.02	0.73	0.02	0.39	0.02	0.81	0.02	0.88	0.02
2010-2014	0.53	0.00	0.71	0.01	0.40	0.00	0.81	0.01	0.89	0.01
2015-2019	0.54	0.00	0.70	0.01	0.41	0.00	0.81	0.01	0.90	0.00
Panel (c): Money Growth Rate (M1)										
1980-1984	15.50	2.90	11.31	2.88	25.69	5.16	6.16	4.20	7.52	4.45
1985-1989	20.14	3.93	13.43	3.82	30.28	7.72	9.89	6.40	7.00	6.06
1990-1994	14.93	3.02	6.71	3.12	23.58	5.79	4.88	2.94	7.54	4.44
1995-1999	14.03	3.68	9.00	2.96	18.08	5.16	8.52	3.29	-0.68	3.33
2000-2004	13.18	2.37	8.77	3.20	16.65	3.04	7.79	3.56	4.18	4.55
2005-2009	11.73	2.68	9.43	3.13	13.78	3.88	7.28	4.58	4.12	7.02
2010-2014	9.25	2.80	4.91	2.13	12.18	4.73	6.06	2.11	10.87	5.80
2015-2019	9.00	2.02	7.27	2.22	10.09	2.25	6.71	1.68	6.26	3.24
Panel (d): Money Growth Rate (M3)										
1980-1984	18.52	2.10	13.70	2.26	29.21	4.17	7.58	1.45	18.52	3.50
1985-1989	19.02	3.26	11.25	1.91	31.83	6.64	8.08	1.70	18.98	2.80
1990-1994	15.73	2.71	5.84	2.21	26.38	4.08	4.44	2.74	17.45	1.85
1995-1999	14.34	2.03	6.06	1.73	21.62	3.31	5.41	2.25	14.77	1.93
2000-2004	10.47	2.18	6.65	1.75	13.68	3.45	5.12	1.75	12.16	2.62
2005-2009	11.80	3.43	8.62	3.93	14.38	3.30	6.30	2.74	11.55	2.89
2010-2014	7.37	1.29	3.92	2.02	10.18	1.44	3.64	1.11	8.83	3.00
2015-2019	6.12	1.08	4.65	1.19	7.41	1.32	4.56	1.34	6.94	1.69

Panel (c) displays 10-year moving averages of cross-sectional means of the IST growth rate by group of countries. The left axis represents IST growth rates and the right axis represents 'Total' and 'Total (abs)'. 'Total (abs)' represents the sum of the absolute values of the IST growth rates of Developed and Developing countries. 'Total Spread (abs)' represents the sum of the absolute values of the difference in the IST growth rates between Developed and Developing countries and the growth rate of the US. This panel shows that the IST growth rate in developing countries decreases between 1990 and 1999 and then increases from 2000 ownwards. The growth rates of developed and the G10 countries fluctuate over the period. It is informative to compare Panel (c) of Figure (2.5) with Panel (a) of Figure (2.1). Overall, both panels point to similar downward trends in CT returns and in ‘Total Spread (abs)’. This comparison is important because in our model currency excess returns are associate with IST growth rates.

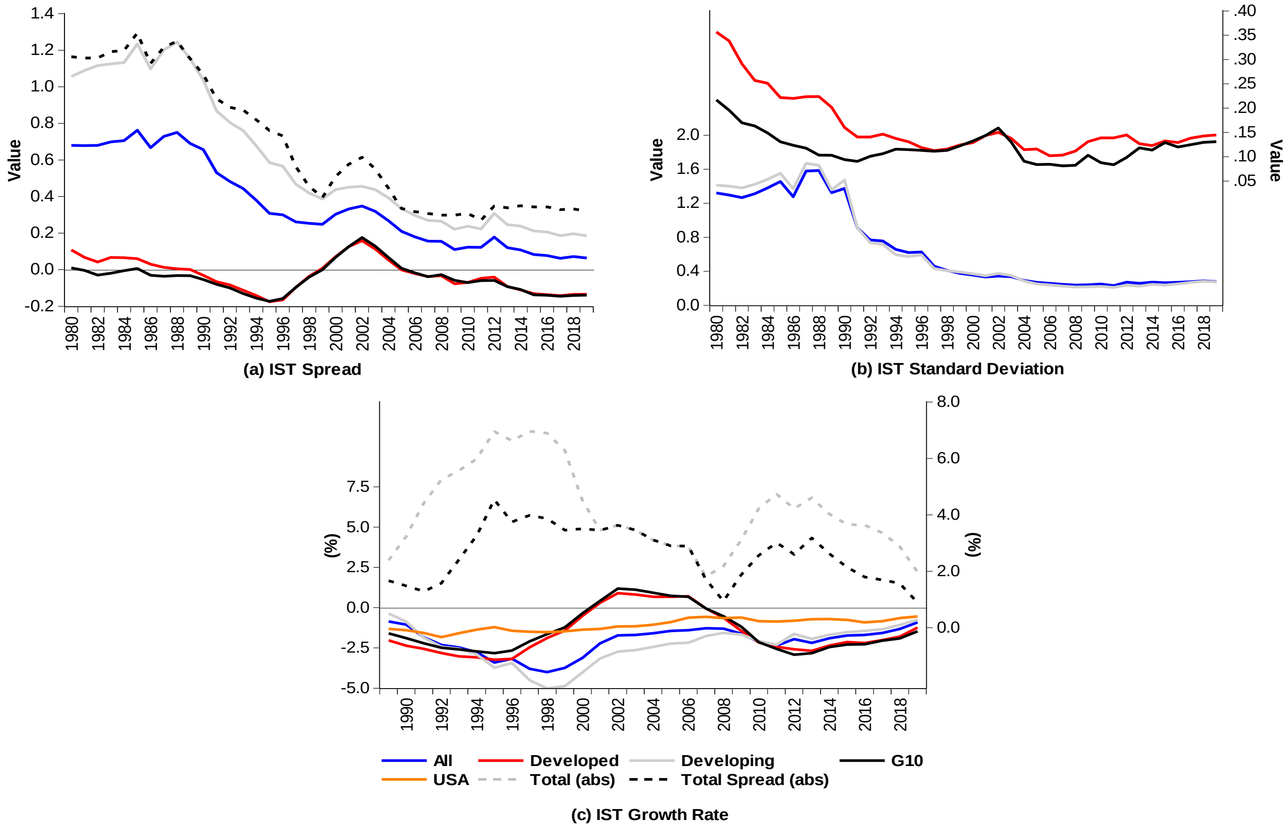


Figure 2.5: Evolution of IST. The figure shows the evolution of the spread (Panel (a)), cross-sectional standard deviation (Panel (b)) and growth rate (Panel (c)) of the IST process by group of countries. The spread is the difference between each country’s value (IST value and IST growth rate) and that corresponding to the US. The values in Panel (a) are cross-sectional averages by group of countries. The values in Panel (b) are cross-sectional standard deviation by group of countries. Panel (c) values are 10-year moving averages of the cross-sectional averages of the IST growth rate by group of countries. IST growth rates were computed as the log difference between periods $t+1$ and t. In Panel (b), the left axis depicts values for the All and Developing groups, while the right axis corresponds to values for the Developed and G10 groups. In Panel (c), the left axis represents values for country groups (All, Developing, Developed, and G10), while the right axis represents values for Total (abs) and Total Spread (abs). The sample period is 1980-2019.

Panels (a) to (c) of Figure (2.6) were generated using the same methodology as Panels (a) to (c) of Figure (2.5). As can be seen from Panel (a), the MEI spread increases from 1980 to the late 1990s, decreases from then until the end of the 2000s, and stabilizes thereafter for all groups of countries. However, the most significant finding is the downward trend depicted in Panel (c) for the ’Total Spread (abs)’ variable. A comparison between this panel and Panel (a) of Figure (2.1) reveals that from the early 1990s through 2002, both ‘Total Spread (abs)’ and CT returns are large and decreasing. Between 2003 and the late 2000s, we observe a hump-shaped increase in both ‘Total Spread (abs)’ and CT returns. From the end of the 2000s, both variables decline sharply. Furthermore, it is important to note that the growth rate of MEI in the US and in Developed countries decreased over the period. This downward trend has also been observed in Developing countries since the mid-2000. Assuming that the Financial Development Index is an appropriate proxy for the MEI process, the results of Panel (c) imply a reduction in the magnitude of the shocks associated with this process. Once again, this comparison is important because, in our model, currency excess returns are also associated with MEI growth rates.

Overall, Panel (b) of Figure (2.6) documents a decline (rise) in the cross-sectional standard deviation of the MEI process for Developed and G10 (Developing) countries from 1980 to the early 2000s, followed by a period of slight increase (decrease) until 2019.

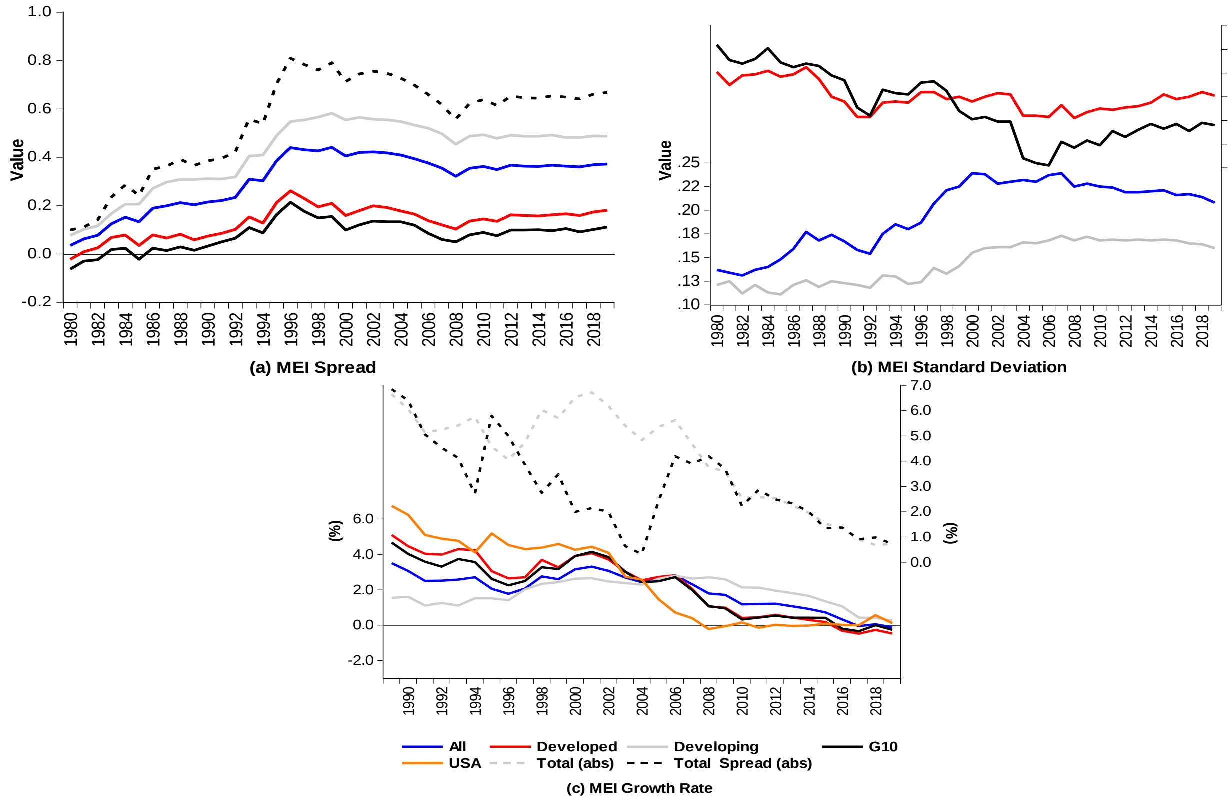


Figure 2.6: Evolution of MEI. The figure shows the evolution of the spread (Panel (a)), cross-sectional standard deviation (Panel (b)) and growth rate (Panel (c)) of the MEI process, by group of countries. The spread is the difference between the US value (MEI value and MEI growth rate) and that corresponding to each country. The values in Panel (a) are cross-sectional averages by group of countries. The values in Panel (b) are cross-sectional standard deviation by group of countries. Panel (c) values are 10-year moving averages of the cross-sectional averages of the MEI growth rate by group of countries. MEI growth rates were computed as the log difference between periods $t+1$ and t. In Panel (b), the left axis depicts values for the All and Developing groups, while the right axis corresponds to values for the Developed and G10 groups. In Panel (c), the left axis represents values for country groups (All, Developing, Developed, and G10), while the right axis represents values for Total (abs) and Total Spread (abs). The sample period is 1980-2019.

As a robustness exercise, we constructed an alternative to the Financial Development Index proposed by Svirydzenka (2016). We applied the methodology developed by Svirydzenka (2016) to the World Bank Financial Development and Structure dataset. However, instead of using nine indicators as in Svirydzenka (2016), we employed the thirty-one indicators available in the World Bank dataset. These indicators aim to capture the size, activity, and efficiency of financial intermediaries and markets (Beck et al., 2010). Covering 213 countries with annual frequency between 1960 and 2017, allowing for a comprehensive comparison of countries' financial development over time. The sources and methodology for constructing the indicators are described in Beck et al. (2000) and Beck et al. (2010). We constructed our index for the 60 countries included in our sample (see Figure A.2.2 in Appendix A.2). Overall, we find results similar to those reported above for the Financial Development Index of Svirydzenka (2016).

Panels (a) to (d) of Figure (2.7) were generated using the same methodology applied as Panels (a) to (c) of Figure (2.5). Panel (a) reveals that the decline in the money growth rate in Developing countries since 1990 and the increase in the US money growth rate since the late 1990s are the primary drivers behind the downward trend in 'Total Spread (abs)' over the period. The panel also shows that between 1984 and the end of the 1990s, the growth rate of money in Developed countries gradually slows down and then stabilizes. Panel (c) of the figure shows that the main difference between the behavior of M3 and M1 growth rates is associated with the US. The M3 growth rate of Developed countries is consistently lower than that of the US. Moreover, Panels (a) and (c) reveal that 'Total Spread (abs)' follows a similar downward trend to that of CT returns displayed in Panel (a) of Figure (2.1). Moving on to the other two panels, we observe that: i) overall, the standard deviation of M1 (Panel (b)) and M3 (Panel (d)) growth rates in Developing countries decreases over the period; and ii) the standard deviation of M1 and M3 growth rates in Developed countries trend downwards until the end of the 1990s, followed by an increase from that period until the late 2000s, and then subsequent decline until 2019.

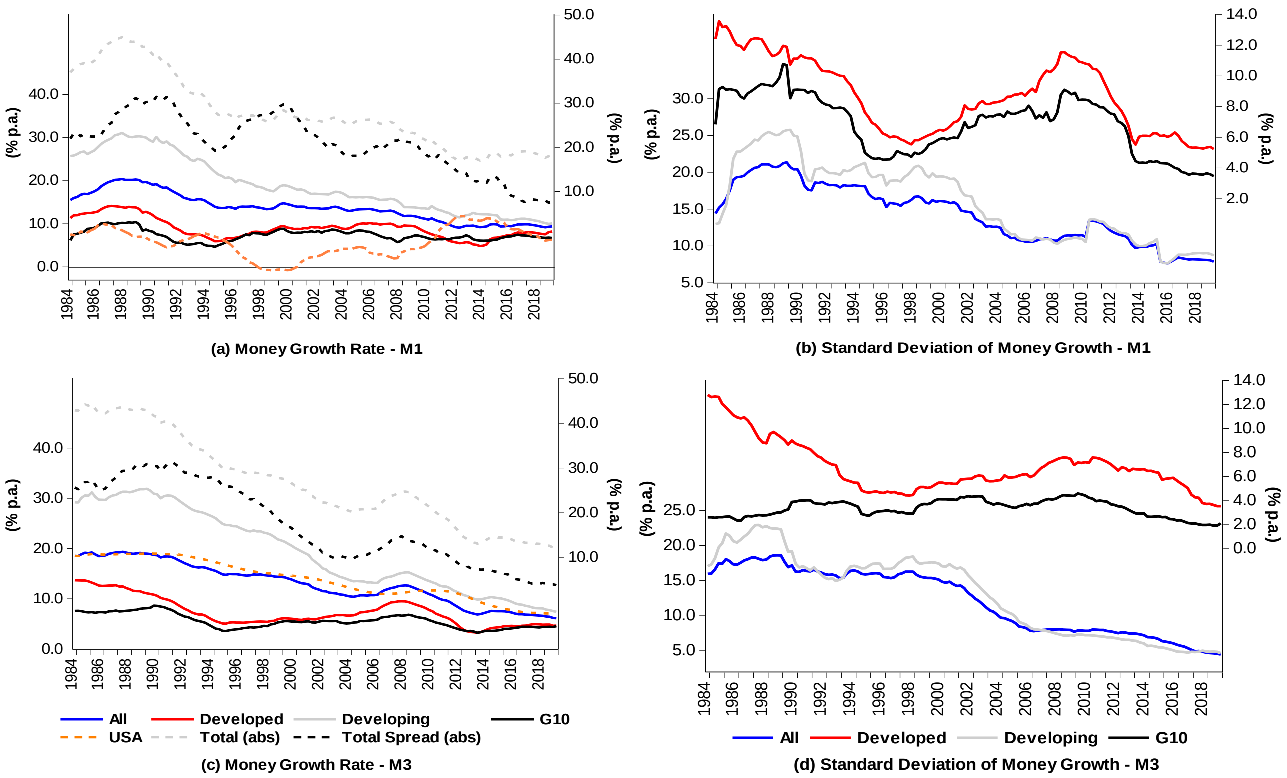


Figure 2.7: Evolution of MON. The figure presents the evolution of the money growth rate (Panels (a) and (c)) and its standard deviation (Panels (b) and (d)). In Panel (a) and (c), the left axis depicts the growth rate of money for country groups (All, Developing, Developed, and G10) and the right axis represents values for the 'Total (abs)' and 'Total Spread (abs)'. The spread is the difference between each country's growth rate of money and that corresponding to the US. The values in Panel (a) and (c) are 20-quarter moving averages of the cross-section means of the growth rate of money. The values in Panel (b) and (d) are 20-quarter moving averages of the cross-sectional standard deviation of the growth rate of money. Money growth rates were computed as the log difference between periods $t+1$ and t. The sample period is 1980-2019.

The results presented thus far suggest that there may be a common underlying factor driving the variation in macroeconomic variables, including the nominal interest rate, inflation rate, and exchange rate. This implies that a global factor could potentially account for part of the fluctuations observed in these variables. The same reasoning applies to the IST, MEI, and MON processes. Motivated by these findings, we we conducted principal component analysis to assess the covariance matrix of each shock process dataset.

In our analysis, two notable findings emerge. First, a small number of factors can account for a significant portion of the variation observed in the data. The first two factors explain 76.58% and 78.43% of the total variance in the IST and MEI data, respectively. For the growth rates of M1 and M3, the first five factors explain 50.85% and 52.56% of the total variance, respectively. This suggests that a relatively small number of factors can capture the main sources of variation in these shock processes.

Second, there is a considerable dispersion in the communality values across countries. The communality, which represents the proportion of each country's shock process that can be explained by the identified factors, varies widely. For the IST, the communality ranges from 3.94% to 98.48%, while for the MEI it varies between 5.94% and 99.54%. In the case of M1, the communality ranges from 8.61% to 69.97%, and for M3 it varies between 21.08% and 72.85%. These results suggest the existence of a global component in each shock process. Furthermore, the dispersion in communality values suggests that the role played by the global component of the shocks varies across countries. In our model, the IST, MEI, and MON shocks are driven by both local and global components, which is crucial for explaining currency excess returns.

2.6 Capital Stock and Consumption Growth

In our model, changes in capital stock and consumption are determined by the IST, MEI, and MON shocks. Therefore,it becomes crucial to scrutinize the temporal evolution of these variables. We begin by examining the growth rate of capital stock, as presented in Table (2.6). In general, the growth rate of the capital stock (both aggregate and *per capita*) of Developing countries is higher than that of other groups of countries during the period 1980-2019.

The growth of the capital stock is directly influenced by the growth of capital investment. Our previous data analysis revealed two important findings: i) overall, Developing countries generally exhibit IST growth rates that are lower than or equal to those of Developed countries, the G10, and the US (see Figure (2.5)); and ii) since the mid-2000s, Developing countries have higher MEI growth rates compared to Developed countries, the G10, and the US (see Figure (2.6). These results point to a positive relationship between the growth rate of these two shock processes (IST and MEI) and the capital stock. Our model also aims to reproduce this salient feature of the data. It connects positive innovations in these fundamental shocks with increases in capital investment. By incorporating these dynamics, the model provides insights into the relationship between shock processes and capital accumulation.[9]

Table 2.6
Growth Rate of Capital Stock

The table presents the average growth rates of the capital stock and the capital stock *per capita* by group of countries and the US. Growth rates of capital stock are calculated as the log difference of aggregate capital stock between periods $t+1$ and t. For each period, we compute a simple average with five annual data points. All values in the table are presented in % p.a. The data are from PWT. The sample period is 1980-2019.

	Growth Rate of Capital Stock					Growth Rate of Capital Stock *per capita*				
Period	**All**	**Developed**	**Developing**	**G10**	**US**	**All**	**Developed**	**Developing**	**G10**	**US**
1980-1984	4.51	2.97	5.65	2.47	2.61	2.35	2.28	2.63	2.01	1.67
1985-1989	3.41	2.76	3.89	2.60	2.99	1.92	2.11	1.14	2.04	2.05
1990-1994	3.06	2.32	3.53	2.18	2.20	1.80	1.58	1.55	1.52	1.22
1995-1999	3.26	2.39	3.78	1.81	2.78	1.88	1.73	2.23	1.43	1.57
2000-2004	2.78	2.23	3.12	1.60	2.63	1.59	1.53	1.73	1.11	1.67
2005-2009	3.50	2.17	4.31	1.52	2.06	1.75	1.31	2.73	0.89	1.13
2010-2014	2.91	1.18	3.96	1.04	1.16	1.10	0.49	2.35	0.40	0.36
2015-2019	2.67	1.54	3.35	1.19	1.48	1.36	0.96	2.12	0.79	0.84

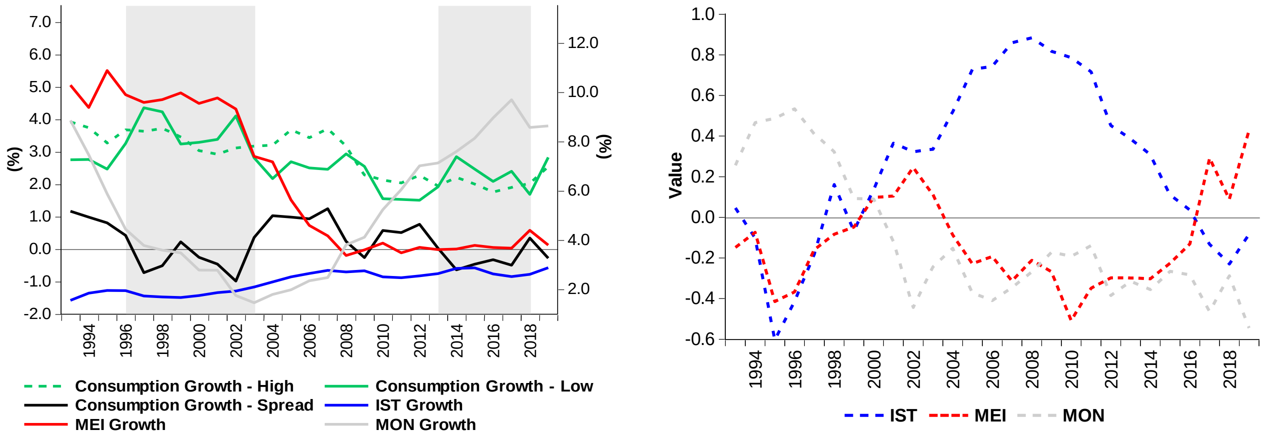
Figure (2.8) shows: i) in Panel (a), the 10-year moving average of the US consumption growth rate alongside the US growth rate of the IST, MEI, and MON processes; and ii) in Panel (b), the time-varying correlation, using a 10-year data window, between the US relative consumption and the variation in the IST, MEI, and MON spreads. The terms'C Growth - High' and 'C Growth - Low' refer to the growth in consumption by households in the first quintile (top 20% of highest-income households in the US) and fifth quintile (top 20% of lowest-income households in the US) of the income distribution, respectively. We also present the difference between growth rate of consumption of high and low-income households ('C Growth - Spread'). Relative consumption was computed as the ratio between the consumption of the

[9] A similar analysis can be conducted between Developed countries and the US. Note that the spread between Developed countries and the US in terms of the growth rates of the three shock processes varies over time. In certain periods, the spread is larger in the US compared to developed countries, while in other periods, it is smaller. This fluctuation may help to explain why, in certain intervals, the growth rate of the capital stock is higher in the US than in developed countries. For instance, in the 2000-2004 interval, the growth rate of the US capital stock is 2.63% p.a., whereas that of developed countries is 2.23% p.a. On the contrary, in other intervals, we observe the opposite pattern. For example, in the 1990-1994 interval, the growth rate of the US capital stock is 2.20% p.a., while that of developed countries is 2.32% p.a.

first and the fifth income groups. The variations of the IST, MEI, and MON spreads were calculated as the first-difference of the spreads. The spreads for the IST, MEI, and MON processes were obtained by taking the difference between the average of the group consisting of all countries and the US. In both panels, the MON process is proxied by M1. In panel (a) the right axis represents 'MON Growth', while the left axis represents the other variables.[10]

We acknowledge that household consumption can be significantly influenced by factors other than the three shocks we analyze, such as expansionary fiscal policies (tax cuts), social programs for low-income families, migration issues, changes in household preferences, and international trade barriers. However, it is worth comparing the shaded and unshaded areas in Panel (a) of the figure. Both shaded areas correspond to periods when the consumption growth of low-income households exceeded that of high-income households. During the period 1997-2003, the first shaded area, the US experienced high growth rates of the MEI and IST (in absolute terms), while the growth rate of US M1 ranged from around 4.00% to 2.00%. In the period 2013-2018, the second shaded area, the growth rate of the MEI was close to zero and the growth rate of the IST (in absolute terms) was low. Conversely, the US M1 growth rate peaked at around 10.00% during this period. The unshaded area represents a period when the consumption growth of high-income households outpaced that of low-income households.

These findings suggest that during periods of high MEI, MON, and IST (in absolute terms) growth rates, the consumption growth spread tends to be negative. Conversely, during periods of lower growth rates in these shocks, the consumption growth spread becomes positive. However, it is important to note that due to the influence of factors other than the three shocks on household consumption, the turning points between positive and negative consumption growth spreads are not precise. Panel (b) of the figure highlights that, for the most part, there is a negative correlation between relative consumption and the variation in the MEI and MON spreads, while there is a positive correlation with the variation in the IST spread. These correlations are particularly evident after the early 2000s.



(a) US Consumption Growth and Shocks

(b) Correlation: Relative Consumption x Variation of Shock Spreads

Figure 2.8: Consumption Growth and Shocks. The figure shows: i) the 10-year moving average of the US growth rate of consumption and the US growth rate of the IST, MEI, and MON processes (Panel (a)); and ii) the time-varying correlation considering a 10-year data window between the US relative consumption and the IST, MEI, and MON spreads (Panel (b)). The growth rate of the IST, MEI, and MON processes and consumption were calculated as the log difference between periods $t+1$ and t. Consumption data by income group is from the US Bureau of Economic Analysis. The sample period is 1984-2019.

The analysis of Figure (2.8) is important because in our model there are two types of consumers: ROT and OPT. ROT consumers are typically associated with low-income households, while OPT consumers are associated with high-income households. The consumption and investment decisions of OPT households depend on home and foreign IST, MEI, and MON shocks. Home OPT consumption is negatively

[10] US consumption data is from the US Bureau of Economic Analysis (BEA). BEA data on US consumption by income group are annual and only available from 1984 onwards. Therefore, the 10-year moving average starts in 1994.

correlated with home positive IST, MEI, and MON shocks. Conversely, positive home IST and MEI shocks boost home ROT consumption. Additionally, our model predicts that the consumption of both types of home households falls after a positive home MON shock. Moreover, the difference between foreign and home shocks in the IST, MEI, and MON processes is key to determining the consumption patterns of both types of households. By capturing the differential impact of these shocks, our model aims to provide insights into the dynamics of household consumption for both low-income (ROT) and high-income (OPT) households, accounting for the specific influences of foreign and domestic factors.

2.7 Concluding Remarks

We can summarize our main findings for the period between 1980 and 2019 as follows:

1. We observed a downward trend in CT returns across different country groups and portfolios. This was accompanied by a reduction in the values and standard deviation of both components of CT returns, namely 'FX' and 'IR'.

2. Nominal interest rates, inflation rates, and MPKs showed a downward trend, particularly among Developing countries. We also found a convergence process between Developed/Developing countries and the US, with a narrowing gap in nominal interest rates and inflation rates. The gap between Developing countries and the US in terms of the MPK also decreased.

3. The exchange rate growth displayed a decreasing pattern in Developing countries between 1980 and 2019. Likewise, the absolute value of exchange rate growth experienced a decline in both Developed countries (from 1980 to 2019) and Developing countries (from the mid-1990s to 2019).

4. The relative price of investment experienced a downward trend across all country groups, accompanied by a narrowing gap between Developed and Developing countries. Furthermore, the IST growth rate spread (in absolute terms) between Developing/Developed countries and the US decreased.

5. The MEI process showed an upward trend across all country groups from 1980 to 2019. The gap between Developed and Developing countries in terms of MEI values increased until the late 1990s, then decreased until the late 2000s, and has remained relatively constant since. Additionally, the MEI growth rate spread (in absolute terms) between Developing/Developed countries and the US declined.

6. The M1 and M3 growth rates of Developing countries exhibited a downward trend from 1980 to 2019. Generally, there was a decline in the M1 and M3 growth rate spreads (in absolute terms) between Developing/Developed countries and the US.

7. Capital stock and capital stock *per capita* increased between 1980 and 2019, particularly among Developing countries. However, the growth rate of capital stock and capital stock *per capita* decreased across all country groups during this period.

8. The consumption growth of low and high income households in the US seems to be related to fluctuations in the IST, MEI, and MON processes.

The results presented in this chapter highlight several stylized facts related to CT returns, macroeconomic variables (such as consumption, investment, nominal interest rates, exchange rates, inflation rates, and the MPK), and the IST, MEI, and MON processes. The aim was to establish a connection between CT returns, macroeconomic variables, and shock processes by analyzing their evolution in recent decades. Our key findings suggest that the IST, MEI, and MON shocks play a crucial role in explaining the downward trend observed in CT returns. These shocks operate through various channels in the economy, leading to fluctuations in macroeconomic variables and shaping currency excess returns in both the short and long term. In the following section, we present an open economy DSGE model that incorporates the IST, MEI, and MON shocks as the main drivers to account for fluctuations in macroeconomic variables and currency excess returns.

Chapter 3

The Model Economy

Motivated by the initial data analysis, we present a model for the world economy characterized by N open economies. The basic setup is the open economy New Keynesian model developed by Benigno (2009), extended with elements from several papers within the related literature (see, e.g., Mendoza (1991), Greenwood et al. (1992), Greenwood et al. (1997a), Heathcote and Perri (2002), Nelson (2002), Schmitt-Grohé and Uribe (2003), Gali et al. (2007), Gali and Monacelli (2005), Andrés et al. (2009), Coeurdacier et al. (2010), Justiniano et al. (2011), Canova and Menz (2011), and Landi (2021), among others). Our framework allows for the introduction of an asset pricing model that incorporates our proposed risk factors into a traditional CCAPM.

There are N symmetric economies characterized by perfect competition in the final-goods sector and monopolistic competition in the intermediate-goods sector. In each period, each economy produces a country-specific internationally tradable good. Financial markets are incomplete. Following Gali et al. (2007), we assume that a fraction of households have access to capital and financial markets (the optimizing households or OPT), where they can trade physical capital, domestic and foreign bonds. The remaining fraction of households have no assets or liabilities and only consume their current income (the rule-of-thumb households or ROT). Both households can consume domestic and imported goods. Firms set prices in their own currency (producer currency pricing), and the law of one price holds. It turns out that the exchange rate pass-through is complete. However, due to home bias in consumption, purchasing power parity (PPP) does not hold.

Following Justiniano et al. (2011), we assume that households are exposed to random shocks arising from innovations in the investment-specific technology (IST), and marginal efficiency of investment (MEI). Furthermore, agents are subject to money demand (MON) innovations as in Nelson (2002), and Andrés et al. (2009). Households are also affected by total factor productivity, government spending and monetary shocks. The IST, MEI, and MON processes are disturbed by both local shocks and global shocks. Local shocks stem from domestic changes in each of the three processes, while global shocks emanate from global changes in each of the three processes. Global shocks are common to all countries, but their impact in each country may differ due to heterogeneity in countries' sensitivity to the shocks.

In our model, the time preference parameter used to discount the future utility of OPT households is affected by OPT households' expectations regarding the future economic development of countries. The agents use the current state of the growth rate of the IST, MEI, and MON processes to form their expectations. This can trigger further increases or decreases in consumption and investment. Therefore, the only source of heterogeneity between countries stems from the exposure of households in each country to IST, MEI, and MON shocks.

We assume that total factor productivity shocks are local disturbances with perfect positive correlation across all countries. Thus, there is no heterogeneity between countries' exposure to total factor productivity. We also assume that the government maintains a balanced budget financed by raising taxes on households. Thus, OPT households do not consider that government shocks convey relevant information for the formation of expectations about the future economic development of countries. On the monetary side, in our model, monetary policy decisions follow an adjusted Taylor rule. Monetary policy shocks reflect factors that affect the nominal interest rate beyond those related to the targets included in our Taylor rule (inflation, GDP, and money demand). However, OPT households cannot accurately measure and identify monetary shocks.[1] Therefore, they are unable to infer the importance of such shocks for the formation of expectations. As a result, central bank changes in rule-based nominal interest rate affect the dynamics of the economy, but OPT households do not consider monetary shocks when forming their expectations about the future evolution of the economies.

Since all countries are symmetrical, we restrict our analysis to two countries (denoted by Home and Foreign). Incorporating shocks to the time preference introduces a new source of risk. IST, MEI, and MON shocks are sources of business cycle fluctuations and drive foreign currency returns. Their emergence holds the potential to prompt shifts in nominal interest rates and exchange rates. Through the application of our model, we can also conjecture on the effects of IST, MEI, and MON shocks on the long-term trend of foreign currency returns.

Environment. Consider that there are N open economies, where $N = 0, 1, 2....$ Time is discrete and indexed by $t = 0, 1, 2....$ All economies are characterized by incomplete financial markets and have symmetric technologies, preferences, and market structures, even though the disturbances affecting each economy may differ. In each country, households consume a bundle consisting of two final goods. One of the final goods is produced by perfectly competitive final-good firms in the Home country, while the other is produced by perfectly competitive final-good firms in the Foreign country. Within each country, the final good is formed by aggregating differentiated intermediate goods. These intermediate goods are produced by intermediate firms that operate under monopolistic competition and are subject to price adjustment costs. Output can be either consumed or transformed into capital using a linear technology. The two final goods are imperfect substitutes.

In all countries, a floating exchange rate system is in place, and there are barriers to international trade in goods (we assume the existence of consumption home bias), which implies that PPP does not hold.[2]

Households. A fraction Φ of households are rule-of-thumb consumers who simply consume their respective disposable income each period. The remaining fraction $(1 - \Phi)$ of households are optimizing consumers who have access to both financial and capital markets. In each country, OPT households own local firms and the local stock of capital. OPT households choose the level of capital utilization and lease "capital services" to the firms. Additionally, we assume that the depreciation rate is a function of the level of capital utilization. This structure implicitly assumes that foreign households cannot hold the local capital stock. OPT households are risk averse and make decisions regarding consumption, labor, investment, and bond holdings to maximize their lifetime utility. Each consumer type consists of infinitely lived identical households. The OPT agent is born in period $t = 0$ with an initial endowment of capital, cash, Home bond, and Foreign bond. In addition, all individuals receive a unit of productive time in each period t, which can be allocated to either work or leisure.

In each period, OPT households receive income from various sources, including wages, profits from intermediate-good firms, and capital rents. They also make payments for government taxes, union fees, and pay or receive interest from the bond market. They can either spend their income on a consumption basket or invest in a portfolio of assets. This portfolio includes the capital stock, which is rented out to domestic intermediate-good firms, and bonds that can be issued domestically or abroad. Similarly, ROT

[1] As highlighted by Miranda-Agrippino and Ricco (2021), analyzing the effect of monetary policy is a difficult exercise. Most of the variation in the nominal interest rates is accounted for by how policy itself responds to the state of the economy, rather than by random shocks to the central bank's reaction function. They argue that in order to track the causal effects of monetary policy, it is necessary to: i) isolate unexpected exogenous changes in monetary policy instruments that are not due to the systematic policy response to current or forecast economic conditions (Sims, 1992, 1998); ii) generate responses of macroeconomic variables over time using an econometric model that can summarize the dynamic interaction among such variables. There is a vast literature exploring different identification schemes and empirical specifications. In general, they obtain conflicting results (see, e.g.,Ramey (2016), Champagne and Sekkel (2018), and Miranda-Agrippino and Ricco (2021) for a discussion on measuring and identifying monetary policy shocks).

[2] Indeed, there is a large body of literature that aims to explain both consumption and asset home bias. Various factors have been proposed to account for these biases, such as transaction costs in international trading of assets and goods, lack of information about foreign assets, capital controls, moral hazard, etc. (see, e.g.,French and Poterba (1991), Gehrig (1993), Tesar and Werner (1995), Lewis (1999), Pesenti and van Wincoop (2002), Engel and Matsumoto (2005), and Daude and Fratzcher (2005)). Furthermore, the literature has uncovered empirical evidence regarding both consumption and asset home bias. Research conducted by Lewis (1999), Sorensen et al. (2007), Fidora et al. (2007), and Coeurdacier and Rey (2013), among others, has shed light on the empirical evidence of home bias in both consumption and asset allocation.

households receive wages and pay government taxes. They allocate their resources on a consumption basket made up of domestically produced and imported goods. To access consumer goods, OPT and ROT households have the option to engage in barter trading or make purchases using cash. The use of money reduces the transaction and search costs associated with barter trading. Furthermore, real balances enter the utility function of OPT households to provide for emergencies (e.g., illness, accidents etc.).[3].

Following Gali et al. (2007), our model assumes a monopolistic competitive labor market. Workers provide differentiated labor types that are sold by unions to perfectly competitive labor packers. Monopolistic competitive firms hire labor pooled by packers to produce differentiated intermediate goods. Wages are centrally set by unions. Hours worked are determined by firms, rather than optimally chosen by households, based on the wage set by unions. Households provide the amount of labor demanded by firms, given that wages are always above households' marginal rate of substitution. As in Furlanetto (2011), we do not explicitly model the wage negotiation process. Instead, we assume that wage adjustments are costly, reflecting the fact that unions expend economic resources during wage negotiations with firms. The greater the wage increase sought by unions, the more effort they would need exert in the negotiation process, as emphasized by Furlanetto (2011).

OPT households are subject to exogenous shocks that have the potential to affect their allocations of consumption, labor supply, and savings. They construct their asset portfolios to smooth intertemporal consumption and to hedge against adverse fluctuations prompted by the shocks (precautionary and purchasing power motives). As households of each type are identical, we can assume, without loss of generality, that there is only one representative household of each type in each country.

Firms. The production sector of the economy consists of two components: the intermediate-goods sector and the final-goods sector. The intermediate-goods sector comprises numerous firms, each producing a differentiated good under monopolistic competition. In each period intermediate-good firms face a two-step problem. they are required to employ local labor and lease capital in order to minimize their real production costs. In the second step, they need to determine their selling price that maximizes discounted real profits, subject to the demand conditions prevailing in the final-goods sector. In addition, intermediate firms incur adjustment costs whenever they make price changes relative to the inflation target set by the monetary authority. The adjustment cost reflect the negative consequences of price changes on the relationship between the firm and its customers. The costs account for factors such as the disruption in customer-firm relationships and potential adjustment frictions.

In the final-goods sector, there exists a large number of identical firms. These firms aggregate the intermediate goods produced by the intermediate-goods sector into a single final good, utilizing a specific technology. The final good can be sold at Home, exported to foreign markets, or invested locally to expand the capital stock. The inclusion of two distinct production sectors, each characterized by different technologies and market structures, is essential for capturing and explaining the comovement of macroeconomic variables in response to fundamental shocks within our model. This framework allows us to analyze how these shocks propagate through the economy, affecting the production and consumption decisions of households and firms, as well as currency excess returns.

Government and Monetary Authority. Local government enters the economy with three main roles: i) to receive bond transaction costs from the foreign country; ii) collect lump-sum taxes from households, which may differ between OPT and ROT; and iii) consume exclusively domestically produced goods. Local government spending is fully funded by transaction costs received from the foreign country and lump-sum taxes levied on both types of households. This implies that the local government maintains a balanced budget constraint in each period. Following Nelson (2002) and Andrés et al. (2009), we assume that the monetary authority operates under a set of rules, whereby the current nominal interest rate depends on the past value of the nominal interest rate, current output values, inflation and nominal money growth relative to the equilibrium value of interest rate (natural interest rate), potential output, an inflation target and a nominal money growth target. Therefore, the monetary authority sets the nominal interest rate according to an adjusted Taylor rule.

[3]The inclusion of money in the utility function has been explored in various studies, including Brock (1974) and Feenstra (1986).These studies provide additional insights and rationale for incorporating money as a utility-enhancing factor in economic models.

Financial markets. Bonds are issued by households in the debtor's home currency. They are default risk-free, one-period zero-coupon bonds that pay with certainty one currency unit at maturity. These bonds can be purchased by both local and foreign investors. However, the yield on foreign bonds held by home investors is known only on the redemption date, at time $t+1$ when the exchange rate is revealed.

For simplicity, we abstract from population growth. Next, we present the model with a focus on the Home country. Identical expressions apply to the Foreign country.

3.1 Households

There is a continuum of infinitely lived households. A fraction $1-\Phi$ of households have access to capital markets where they can engage in bond trading and buy and sell physical capital (OPT households). The remaining fraction Φ of households consume their disposable income each period and do not possess any assets or liabilities (ROT households). A typical household consumes the composite good C_t^i, which is a constant elasticity of substitution (CES) aggregate of Home-produced and Foreign exports goods:

$$C_t^i = \left[(1-\gamma)^{\frac{1}{\eta}} \left(C_{h,t}^i \right)^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} \left(C_{f,t}^i \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{3.1}$$

$$C_t^{i,*} = \left[\gamma^{*\frac{1}{\eta}} \left(C_{h,t}^{i,*} \right)^{\frac{\eta-1}{\eta}} + (1-\gamma^*)^{\frac{1}{\eta}} \left(C_{f,t}^{i,*} \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{3.2}$$

where $C_{h,t}^i$ is the Home country consumption of Home final good; $C_{f,t}^i$ represents the Home country consumption of Foreign final good; $i \in \{o, r\}$ denotes the type of household - OPT or ROT, respectively; η is the elasticity of substitution between the two goods (trade elasticity); γ denotes the share of consumption spending with the Foreign good. Following Coeurdacier and Rey (2013), we assume an exogenous consumption home bias, therefore $0 < \gamma < \frac{1}{2}$. The investment bundles are defined analogously:

$$I_t^o = \left[(1-\gamma)^{\frac{1}{\eta}} \left(I_{h,t} \right)^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} \left(I_{f,t} \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{3.3}$$

$$I_t^{o,*} = \left[\gamma^{*\frac{1}{\eta}} \left(I_{h,t}^* \right)^{\frac{\eta-1}{\eta}} + (1-\gamma^*)^{\frac{1}{\eta}} \left(I_{f,t}^* \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}. \tag{3.4}$$

In our environment, both the Home consumption and investment bundles are aggregates of Home and Foreign produced goods. As we assume that both trade elasticity and local bias for consumption and investment are identical, their respective price indices are also identical within each country. The consumer price indices (CPI) that corresponds to the preferences for both consumption and investment bundles are given by:

$$P_t = \left[(1-\gamma) \left(P_{h,t} \right)^{1-\eta} + \gamma \left(P_{f,t} \right)^{1-\eta} \right]^{\frac{1}{1-\eta}}, \tag{3.5}$$

$$P_t^* = \left[\gamma^* \left(P_{h,t}^* \right)^{1-\eta} + (1-\gamma^*) \left(P_{f,t}^* \right)^{1-\eta} \right]^{\frac{1}{1-\eta}}, \tag{3.6}$$

where P_t, $P_{h,t}$ and $P_{f,t}$ denote Home consumer price index (CPI), the price of Home-produced goods and Foreign-produced goods, respectively. We assume that the law of one price holds, thus $P_{f,t} = S_t P_{f,t}^*$ and $P_{h,t} = S_t P_{h,t}^*$. Where S_t indicates the nominal exchange rate, defined as the price of one unit of Foreign currency in terms of Home currency and $P_{f,t}^*$ is the price of the Foreign-produced good in Foreign currency. The solutions to the cost minimization problem of purchasing the least-cost combination of Home-and-Foreign produced goods are as follows:

$$C_{h,t}^i = (1-\gamma) \left(\frac{P_{h,t}}{P_t} \right)^{-\eta} C_t^i, \qquad C_{f,t}^i = \gamma \left(\frac{P_{f,t}}{P_t} \right)^{-\eta} C_t^i. \tag{3.7}$$

$$C_{h,t}^{i,*} = \gamma^* \left(\frac{P_{h,t}^*}{P_t^*} \right)^{-\eta} C_t^{i,*}, \qquad C_{f,t}^{i,*} = (1-\gamma^*) \left(\frac{P_{f,t}^*}{P_t^*} \right)^{-\eta} C_t^{i,*}. \tag{3.8}$$

The investment baskets are defined analogously for the OPT household. Define $p_{h,t} = \frac{P_{h,t}}{P_t}$ and $p_{f,t} = \frac{P_{f,t}}{P_t}$ as the price of Home and Foreign goods in terms of the Home CPI. If we assume the same definitions for $P^*_{h,t}$ and $P^*_{f,t}$ we obtain:

$$C^i_{h,t} = (1-\gamma)p_{h,t}^{-\eta}C^i_t, \qquad C^i_{f,t} = \gamma p_{f,t}^{-\eta}C^i_t.$$

$$C^{i,*}_{h,t} = \gamma^* {p^*_{h,t}}^{-\eta}C^{i,*}_t, \qquad C^{i,*}_{f,t} = (1-\gamma^*){p^*_{f,t}}^{-\eta}C^{i,*}_t.$$

$$1 = \left[(1-\gamma)p_{h,t}^{1-\eta} + \gamma p_{f,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}, \qquad 1 = \left[\gamma^* {p^*_{h,t}}^{1-\eta} + (1-\gamma^*){p^*_{f,t}}^{1-\eta}\right]^{\frac{1}{1-\eta}}. \tag{3.9}$$

Similar expressions hold for the demand for investment of the OPT household. We can define the terms of trade (tot_t) and the real exchange rate (Q_t) as follows:

$$tot_t = \frac{p_{f,t}}{p_{h,t}}, \tag{3.10}$$

$$Q_t = \frac{S_t P^*_t}{P_t}. \tag{3.11}$$

As the law of one price holds $p_{f,t} = Q_t p^*_{f,t}$ and $p_{h,t} = Q_t p^*_{h,t}$.

In the second step the OPT household problem is to maximize:

$$u^o_t = E_0 \sum_{t=0}^{\infty} \theta_t \kappa_t U^o(C^o_t, \iota_t M^o_t/P_t, L^o_t) - MAC_t, \tag{3.12}$$

$\theta_0 = 1,$

$\theta_{t+1} = \beta^c(\Delta\tilde{C}_t)\theta_t \qquad$ for all t > 0,

$\beta^c(\Delta\tilde{C}_t) = \beta(1+\nu_1\Delta\tilde{C}_t)^{-\nu_2},$

$$MAC_t = \frac{d1}{2}\left\{\exp\left(d2\left[\frac{m^o_t}{m^o_{t-1}} - 1\right]\right) + \exp\left(-d2\left[\frac{m^o_t}{m^o_{t-1}} - 1\right]\right) - 2\right\}.$$

where $I\!E_0$ is the conditional expectation operator; $\beta(\Delta\tilde{C}_t)$ is the endogenous discount factor; $\Delta\tilde{C}_t$ represents the change in average per capita consumption between periods t and $t-1$, which the individual household takes as given, $\Delta\tilde{C}_t = \frac{\tilde{C}_t - \tilde{C}_{t-1}}{\tilde{C}_{t-1}}$; β, ν_1 and ν_2 are positive parameters and $\beta^c_{\Delta c} < 0$ is the first derivative with respect to $\Delta\tilde{C}_t$[4]; κ_t stands for the time preference shock; $m^o_t = M^o_t/P_t$ are real balances (M^o_t is cash in nominal terms)[5]; ι_t is the money demand (MON) shock; L^o_t represents hours devoted to work; MAC_t denotes portfolio adjustment costs of real assets with positive parameters, $d1$ and $d2$; U^o is the period utility function.

Note that the functional form of the portfolio adjustment cost in our model is based on the formulation proposed by Andrés et al. (2009). They argue that these costs are not necessarily transaction costs, but they can be rationalized, for example, by viewing money as a contingency reserve. By adopting this functional form, our model incorporates a forward-looking money demand that aligns with empirical evidence from various studies (Andrés et al., 2009). Furthermore, Andrés et al. (2009) show that even in New-Keynesian models with separability between consumption and money in the utility function, this functional form of adjustment costs allows money to play a significant role in macroeconomic dynamics. The capital stock evolves according to the following equation of motion:

[4]Note that in equilibrium, individual and average per capita variables are identical, that is, $C_t = \tilde{C}_t$ (Schmitt-Grohé and Uribe, 2003).

[5]We assume household's real money holding generates utility at the end of period t, after they finish purchasing consumption goods as in Walsh (2017).

$$K_t^o = (1-\delta(u_{t-1}))K_{t-1}^o + \left[1 - \frac{\Xi_I}{2}\left(\frac{I_t^o}{\mu_t I_{t-1}^o} - 1\right)^2\right]\psi_t I_t^o, \tag{3.13}$$

where K_t^o is the stock of capital; $\delta(u_{t-1})$ is the depreciation rate that is a function of capital utilization, u_t; I_t^o represents investment; and Ξ_I is a non-negative parameter that represents the investment adjustment cost in terms of units of the consumption index. We assume that capital is built with the same shares of varieties of Home and Foreign consumption goods as the final consumption basket described by equation (3.7). Therefore, the price index associated with the capital stock is also given by P_t. The evolution of capital accumulation described by equation (3.13) can be affected by two types of disturbances: the IST and MEI shocks, denoted by ψ_t and μ_t, respectively. The IST shock has a direct effect on investment, while the MEI shock affects the value of investment adjustment costs.

External adjustment costs arise when firms seek a supply of physical capital that is perfectly elastic. However, in the real world, the availability of capital goods varies in terms of speed and depends on numerous factors. One critical factor in this process is the financial system. When capital producers rely on loans to carry out their activities, the production of capital goods becomes influenced by their ability to secure financing and the effectiveness of the financial system in allocating loans (Justiniano et al., 2011). Although our model does not explicitly include financial intermediation agents, the conversion of real savings into physical capital is influenced by MEI process. Negative shocks to the MEI have the effect of reducing the amount of effective physical capital that can be obtained per unit of forgone consumption. This implies an increase in the adjustment cost of investment, as the efficiency of converting savings into productive capital decreases. By incorporating the impact of MEI shocks on investment adjustment costs, our model captures the relationship between investment decisions, savings, and the overall efficiency of capital allocation. Therefore, a possible interpretation of the MEI process is as a proxy for the effectiveness of the financial sector in directing household savings towards the production of physical capital. As discussed later, we use a measure of country's financial development as a proxy for the MEI process in our asset pricing exercises.

In our model, the MEI process performs a similar function to that of entrepreneurs' net worth in Carlstrom and Fuerst (1997). In their model, entrepreneurs borrow funds from households to finance the production of physical capital, but lenders are uncertain about the individual productivity of the entrepreneurs. As a consequence, monitoring costs arise due to the need to oversee the projects undertaken by the entrepreneurs. This results in a partial loss of investment goods, which represents a leakage in the capital production process. Similarly, in our model, the MEI process captures the inefficiencies and frictions associated with the transformation of savings into physical capital, resulting in a potential loss or leakage in the capital production operation. In their model, the capital evolves according to the following equation:

$$K_t = (1-\delta)K_{t-1} + (1-\Upsilon_t)I_t,$$

where Υ_t is the aggregate amount of new capital lost by the monitoring activity. As noted by Justiniano et al. (2011), Carlstrom and Fuerst (1997) emphasize that their framework "is isomorphic to a model in which there are costs to adjusting the capital stock", if net worth is held constant. In a recent paper, Hirose and Kurozumi (2012) found that investment fluctuations in Japan are primarily driven by investment adjustment cost shocks. The estimated a series of investment adjustment cost shocks from their model, and interestingly, these shocks showed a high correlation with the Financial Position Diffusion Index reported by the "Tankan" survey, which is an economic survey conducted among Japanese firms. This finding provides additional support for the link between the MEI process and financial constraints for investment spending.

In our economy, there is variable capital utilization, and the depreciation rate is contingent upon this factor. OPT Households can choose the level of utilization and lease "capital services" to firms. The cost of capital utilization is faster depreciation. Define $\widehat{K_t^o} \equiv u_t K_t^o$ as capital services, the depreciation rate is defined as follows:

$$\delta(u_t) = \delta_0 + \Xi_1(u_t - 1) + \frac{\Xi_2}{2}(u_t - 1)^2, \tag{3.14}$$

$\delta_0 \in [0,1]$ is the depreciation rate in steady state, when $u_t = 1$; and Ξ_1 and Ξ_2 are positive parameters..

The representative OPT household faces the following sequential budget constraint:

$$P_tC_t^o + B_{h,t}^o + S_tB_{f,t}^o + P_tI_t^o + M_t^o + \frac{\Xi_b}{2}S_tP_t^*\left(\frac{B_{f,t}^o}{P_t^*} - \bar{b}_f\right)^2 = P_tW_tL_t^o + P_tr_t^ku_{t-1}K_{t-1}^o + R_{t-1}B_{h,t-1}^o +$$

$$S_tR_{t-1}^*B_{f,t-1}^o + M_{t-1}^o - P_tT_t^o - P_tZ_t + P_t\Gamma_t^o, \tag{3.15}$$

where $B_{h,t}^o$ and $B_{f,t}^o$ represent the respective quantities of internationally traded Home and Foreign bonds paying out next period one unit of the currency of the issuing country (we maintain the convention that positive values of $B_{h,t}^o$ and $B_{f,t}^o$ denote bond holdings); R_t and R_t^* are the Home and Foreign gross nominal return on bonds purchased in period t; W_t denotes the real wage and r_t^k is the real rental rate of capital; T_t^o represents lump-sum tax paid to the government, Z_t is a membership fee paid to the unions; and Γ_t^o denotes profits distributed by intermediate firms. We assume that there is a quadratic cost in changing the real asset position in the foreign bond market $\left(\frac{\Xi_b}{2}S_tP_t^*\left(\frac{B_{f,t}^o}{P_t^*} - \bar{b}_f\right)^2\right)$ with respect to a constant value, denoted by $\bar{b}_f$.[6] This cost is paid to the Foreign government. Ξ_b is a non-negative parameter that represents this cost in terms of units of the consumption index.

The representative OPT household takes $\{S_t, W_t, P_t, R_t, R_t^*, r_t^k, T_t^o, Z_t, \Gamma_t^o\}_{t=0}^{\infty}$ as given and for all $t \geq 0$ solves the following problem:

$$\max_{\left\{C_t^o, \iota_t M_t^o/P_t, L_t^o, I_t^o, K_t^o, u_t, B_{h,t}^o, B_{f,t}^o\right\}_{t=0}^{\infty}} u_t^o = \mathbb{E}_0\sum_{t=0}^{\infty}\theta_t\kappa_tU^o(C_t^o, \iota_tM_t^o/P_t, L_t^o) - MAC_t \tag{3.16}$$

s.t

$$P_tC_t^o + B_{h,t}^o + S_tB_{f,t}^o + P_tI_t^o + M_t^o + \frac{\Xi_b}{2}S_tP_t^*\left(\frac{B_{f,t}^o}{P_t^*} - \bar{b}_f\right)^2 - P_tW_tL_t^o - P_tr_t^ku_{t-1}K_{t-1}^o - R_{t-1}B_{h,t-1}^o -$$

$$S_tR_{t-1}^*B_{f,t-1}^o - M_{t-1}^o + P_tT_t^o + P_tZ_t - P_t\Gamma_t^o = 0,$$

$$K_t^o = (1-\delta(u_{t-1}))K_{t-1}^o + \left[1 - \frac{\Xi_I}{2}\left(\frac{I_t^o}{\mu_tI_{t-1}^o} - 1\right)^2\right]\psi_tI_t^o,$$

$C_t^o, K_t^o, W_t, P_t, M_t^o, \geq 0, \qquad 0 \leq L_t^o \leq 1,$

$\theta_0 = 1,$

Given K_{-1}, $B_{h,-1}^o$, $B_{f,-1}^o$, M_{-1}^o.

Households are subject to an individual borrowing constraint, which prevents Ponzi schemes. The representative household selects her portfolio, consumption, and labor supply that maximize her lifetime utility (3.12), while satisfying the budget constraint (3.15). The budget constraint of the OPT household problem can be rewritten in terms of the domestic CPI:

$$C_t^o + \frac{B_{h,t}^o}{P_t} + \frac{S_t}{P_t}\frac{P_t^*}{P_t^*}B_{f,t}^o + I_t^o + \frac{M_t^o}{P_t} + \frac{\Xi_b}{2}\frac{S_tP_t^*}{P_t}\left(\frac{B_{f,t}^o}{P_t^*} - \bar{b}_f\right)^2 = W_tL_t^o + r_t^ku_{t-1}K_{t-1}^o + \frac{R_{t-1}B_{h,t-1}^o}{P_t}\frac{P_{t-1}}{P_{t-1}} +$$

$$\frac{S_t}{P_t}\frac{P_t^*}{P_t^*}P_{t-1}^*\frac{R_{t-1}^*B_{f,t-1}^o}{P_{t-1}^*} + \frac{M_{t-1}^o}{P_{t-1}}\frac{P_{t-1}}{P_t} - T_t^o - Z_t + \Gamma_t^o.$$

Substituting price terms by inflation, we obtain:

$$C_t^o + b_{h,t}^o + Q_tb_{f,t}^o + I_t^o + m_t^o + \frac{\Xi_b}{2}Q_t\left(b_{f,t}^o - \bar{b}_f\right)^2 = W_tL_t^o + r_t^ku_{t-1}K_{t-1}^o + \frac{R_{t-1}b_{h,t-1}^o}{\pi_t} + Q_t\frac{R_{t-1}^*b_{f,t-1}^o}{\pi_t^*} +$$

[6] This assumption ensures a stationary solution and determinate steady state. See Schmitt-Grohé and Uribe (2003), and Boileau and Normandin (2008) for a thorough analysis on this issue.

$$\frac{m_{t-1}^o}{\pi_t} - T_t^o - Z_t + \Gamma_t^o,$$

where $b_{h,t}^o = \frac{B_{h,t}^o}{P_t}$; $b_{f,t}^o = \frac{B_{f,t}^o}{P_t^*}$; $\pi_t = \frac{P_t}{P_{t-1}}$; and $\pi_t^* = \frac{P_t^*}{P_{t-1}^*}$. The Lagrangian corresponding to the utility maximization problem of the representative OPT household is as follows:

$$L^c = E_0 \sum_{t=0}^{\infty} \theta_t \Bigg\{ \kappa_t U^o(C_t^o, \iota_t M_t^o/P_t, L_t^o) - MAC_t - \vartheta_t \lambda_t \Bigg[K_t^o - (1-\delta(u_{t-1}))K_{t-1}^o - \left(1 - \frac{\Xi_I}{2}\left(\frac{I_t^o}{\mu_t I_{t-1}^o} - 1\right)^2\right) \psi_t I_t^o \Bigg] - \lambda_t \Bigg[C_t^o + b_{h,t}^o + Q_t b_{f,t}^o + I_t^o + m_t^o + \frac{\Xi_b}{2} Q_t \left(b_{f,t}^o - \bar{b}_f\right)^2 - W_t L_t^o - r_t^k u_{t-1} K_{t-1}^o - \frac{R_{t-1} b_{h,t-1}^o}{\pi_t} - Q_t \frac{R_{t-1}^* b_{f,t-1}^o}{\pi_t^*} - \frac{m_{t-1}^o}{\pi_t} + T_t^o + Z_t - \Gamma_t^o \Bigg] \Bigg\},$$

where λ_t is the Lagrangian multiplier associated with the budget constraint and $\vartheta_t \lambda_t$ is the Lagrangian multiplier associated with installed capital. ϑ_t is the marginal Tobin's Q. We assume that the OPT representative household has the period utility function given by:

$$U_t^o = \frac{(C_t^o)^{1-\gamma_c}}{1-\gamma_c} + \chi_m \frac{\iota_t (M_t^o/P_t)^{1-\gamma_m}}{1-\gamma_m} - \chi_l \frac{(L_t^o)^{1+\gamma_l}}{1+\gamma_l}. \tag{3.17}$$

where $\gamma_c > 0$ is the risk aversion coefficient; $\gamma_m > 0$ denotes the inverse of the elasticity of money holdings with respect to interest rate; $\gamma_l > 0$ is the inverse of the Frisch elasticity; χ_m and χ_l represent the utility parameter for real cash balances and labor, respectively. Real cash holdings depend positively on consumption with an elasticity equal to γ_c/γ_m and negatively on nominal interest rate. The necessary first-order conditions for the OPT household decision problem are given by equation (3.15) together with the following equations:
First-order condition for consumption:

$$\frac{\partial L}{\partial C_t^o} = 0; \quad C_t^o = \left(\frac{\lambda_t}{\kappa_t}\right)^{-\frac{1}{\gamma_c}}. \tag{3.18}$$

First-order condition for real money:

$$\frac{\partial L}{\partial m_t^o} = 0; \quad m_t^o = \iota_t (\kappa_t \chi_m)^{\frac{1}{\gamma_m}} \Bigg\{ \lambda_t - \beta^c(\Delta\tilde{C}_t) E_t \left(\frac{\lambda_{t+1}}{\pi_{t+1}}\right) + \frac{d1}{2} \Bigg\{ \frac{d2}{m_{t-1}^o} \exp\left(d2\left[\frac{m_t^o}{m_{t-1}^o} - 1\right]\right) - \frac{d2}{m_{t-1}^o} \exp\left(-d2\left[\frac{m_t^o}{m_{t-1}^o} - 1\right]\right) \Bigg\} + \beta^c(\Delta\tilde{C}_t) E_t \frac{d1}{2} \Bigg\{ d2 \frac{m_{t+1}}{(m_t^o)^2} \exp\left(-d2\left[\frac{m_{t+1}^o}{m_t^o} - 1\right]\right) - d2 \frac{m_{t+1}}{(m_t^o)^2} \exp\left(d2\left[\frac{m_{t+1}^o}{m_t^o} - 1\right]\right) \Bigg\} \Bigg\}^{-\frac{1}{\gamma_m}}. \tag{3.19}$$

First-order condition for investment:

$$\frac{\partial L}{\partial I_t^o} = 0; \quad 1 = \psi_t \vartheta_t \left[1 - \frac{\Xi_I}{2}\left(\frac{I_t^o}{\mu_t I_{t-1}^o} - 1\right)^2 - \Xi_I \left(\frac{I_t^o}{\mu_t I_{t-1}^o}\right)\left(\frac{I_t^o}{\mu_t I_{t-1}^o} - 1\right) \right] + \beta^c(\Delta\tilde{C}_t) E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \vartheta_{t+1} \psi_{t+1} \Xi_I \left[\left(\frac{I_{t+1}^o}{\mu_{t+1} I_t^o}\right)^2 \left(\frac{I_{t+1}^o}{\mu_{t+1} I_t^o} - 1\right) \right] \right\}. \tag{3.20}$$

First-order condition for capital:

$$\frac{\partial L}{\partial K_t^o} = 0; \quad 1 = \beta^c(\Delta\tilde{C}_t) E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \frac{\left[r_{t+1}^k u_{t+1} + (1-\delta(u_t))\vartheta_{t+1}\right]}{\vartheta_t} \right\}. \tag{3.21}$$

First-order condition for capital utilization:

$$\frac{\partial L}{\partial u_t} = 0; \quad \vartheta_t(\Xi_1 + \Xi_2(u_t - 1) = r_t^k. \tag{3.22}$$

First-order condition for Home bond:

$$\frac{\partial L}{\partial b_{h,t}^o} = 0; \quad 1 = \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left(\frac{\lambda_{t+1}}{\lambda_t}\frac{R_t}{\pi_{t+1}}\right). \tag{3.23}$$

First-order condition for Foreign bond:

$$\frac{\partial L}{\partial b_{f,t}^o} = 0; \quad 1 + \Xi_b\left(b_{f,t}^o - \bar{b}_f\right) = \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left(\frac{\lambda_{t+1}}{\lambda_t}\frac{Q_{t+1}}{Q_t}\frac{R_t^*}{\pi_{t+1}^*}\right). \tag{3.24}$$

ROT households fully consume their disposable current labor income and do not engage in consumption smoothing. Their period utility is as follows:

$$\max_{\{C_t^r, L_t^r\}_{t=0}^{\infty}} u_t^r = \mathbb{E}_t\sum_{t=0}^{\infty}\theta_t\kappa_t\left(\frac{(C_t^r)^{1-\gamma_c}}{1-\gamma_c} - \chi_l\frac{(L_t^r)^{1+\gamma_l}}{1+\gamma_l}\right), \tag{3.25}$$

s.t

$C_t^r = W_t L_t^r - T_t^r - Z_t.$

Since ROT households simply consume their current income, we can obtain their consumption directly from the budget constraint.

3.2 Final-Good Producers

The final-good producers function as retail firms, where they aggregate a large quantity of intermediate goods to produce the final output. We assume a perfect competition market structure in the final-good sector. Consequently, the intermediate goods serve as inputs in the production process of the final-good producers. The result is an aggregate good that is sold to households. Moreover, we assume that each intermediate good is indexed within the unit interval [0,1]. Thus, the final good is produced by perfectly competitive final-good producers, who combine the intermediate inputs to create a final output denoted as $Y_{h,t}$. This production process follows a constant return to scale technology:

$$Y_{h,t} = \left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}}, \tag{3.26}$$

where $Y_{h,t}(i)$ is an intermediate input produced by the intermediate firm i, whose price is $P_{h,t}(i)$. Final-good firms maximize profits subject to the production function (3.26), taking as given all prices of intermediate goods $P_{h,t}(i)$ and the price of the final good $P_{h,t}$. Since all final-good firms are identical, we can proceed by considering a representative final-good firm that faces the following maximization problem:

$$\max_{Y_{h,t}, \{Y_{h,t}(i)\}_{i\in[0,1]}} P_{h,t}Y_{h,t} - \int_0^1 P_{h,t}(i)Y_{h,t}(i)di, \tag{3.27}$$

s.t

$$Y_{h,t} = \left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}}.$$

We can rearrange the problem by combining the objective function and the budget constraint:

$$\max_{\{Y_{h,t}(i)\}_{i\in[0,1]}} P_{h,t}\left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}} - \int_0^1 P_{h,t}(i)Y_{h,t}(i)di.$$

The first-order condition for the input i is as follows:

$$P_{h,t}\left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{1}{\epsilon-1}}Y_{h,t}(i)^{-\frac{1}{\epsilon}} = P_{h,t}(i),$$

$$P_{h,t}Y_{h,t}^{\frac{1}{\epsilon}}Y_{h,t}(i)^{-\frac{1}{\epsilon}} = P_{h,t}(i),$$

$$Y_{h,t}(i) = \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{-\epsilon}Y_{h,t}, \tag{3.28}$$

where $p_{h,t}(i) = \frac{P_{h,t}(i)}{P_t}$. Next we derive the equilibrium price level $P_{h,t}$ as a function of the price of intermediate goods $P_{h,t}(i)$. Note that the price level is defined as the price of one unit of the final good. Therefore, it can be obtained from solving the following problem:

$$P_{h,t} = \min_{\{Y_{h,t}(i)\}_{i\in[0,1]}}\left(\int_0^1 P_{h,t}(i)Y_{h,t}(i)di\right), \tag{3.29}$$

s.t

$$Y_{h,t} = 1. \tag{3.30}$$

We can rearrange the problem and set up the Lagrangian function:

$$L^{fg} = \int_0^1 P_{h,t}(i)Y_{h,t}(i)di - \zeta\left[\left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}} - 1\right],$$

where ζ_t is the Lagrangian multiplier associated with the production constraint. The first-order condition for the input i is given by:

$$P_{h,t}(i) = \zeta Y_{h,t}(i)^{\frac{1}{\epsilon}}\left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{1}{\epsilon-1}},$$

$$P_{h,t}(i)^{\epsilon} = \zeta^{\epsilon}Y_{h,t}(i)^{-1},$$

$$Y_{h,t}(i) = \zeta^{\epsilon}P_{h,t}(i)^{-\epsilon}. \tag{3.31}$$

We can find an expression for ζ by using the production constraint:

$$\left(\int_0^1 Y_{h,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}} = 1,$$

$$\left(\int_0^1 \zeta^{\epsilon-1}P_{h,t}(i)^{1-\epsilon}di\right)^{\frac{\epsilon}{\epsilon-1}} = 1,$$

$$\zeta = \left(\int_0^1 P_{h,t}(i)^{1-\epsilon}di\right)^{\frac{1}{1-\epsilon}}. \tag{3.32}$$

Inserting $Y_{h,t}(i)$ from equation (3.28) and ζ from equation (3.32) in the objective function (3.29) we obtain an expression for the price level as a function of the price of intermediate goods.

$$P_{h,t} = \left(\int_0^1 P_{h,t}(i)^{1-\epsilon}di\right)^{\frac{1}{1-\epsilon}}. \tag{3.33}$$

Given the assumptions imposed on final-good firms, the total cost of production equals output, which yields zero profit for all $t \geq 0$.

3.3 Intermediate-Good Producers

There is a continuum of firms indexed by $i \in [0,1]$. Each firm employs an identical technology to produce a differentiated good. All firms face an identical demand curve and take the aggregate price level P_t and aggregate consumption index C_t as given. Each intermediate-good firm i produces a differentiated domestic input using the following technology:

$$Y_{h,t}(i) = A_t \left(\widehat{K^o}_{t-1}(i)\right)^{\alpha} (L_t(i))^{1-\alpha}, \tag{3.34}$$

where A_t is the total factor productivity; and $\alpha \in (0,1)$. $L_t(i)$ is an aggregator of the different labor varieties indexed by j:

$$L_t(i) = \left(\int_0^1 L_t(i,j)^{\frac{\epsilon_w - 1}{\epsilon_w}} dj\right)^{\frac{\epsilon_w}{\epsilon_w - 1}},$$

$L_t(i,j)$ represents the amount of labor variate j used by firm i; and ϵ_w is the elasticity of substitution between labor types. We follow Gali et al. (2007), and assume that the fraction of ROT an OPT consumers is uniformly distributed across worker types and therefore across unions. Firms allocate labor demand in a proportional manner accordingly.

Firms operate under monopolistic competition, implying that they possess some level of market power. They set their prices based on the demand from final-good firms (see equation (3.28)). Due to the downward-sloping nature of their demand curves, firms always face marginal revenue curves that lie below their demand curves. Consequently, the solution to the firms' profit maximization problem leads to prices that exceed marginal cost. As emphasized by Rotemberg (1982), changing prices incurs various costs. These costs include administrative expenses associated with modifying price lists, informing clients, and other related tasks. Additionally, there is an implicit cost resulting from clients' negative reactions to significant price changes. Clients may prefer small and frequent price adjustments over infrequent large ones (Rotemberg, 1982). Therefore, in line with Rotemberg (1982), we assume that firms face a nominal price adjustment cost relative to the benchmark $\overline{\pi}$:[7]

$$PAC_t(i) = \frac{\Xi_p}{2}\left(\frac{P_{h,t}(i)}{P_{h,t-1}(i)} - \overline{\pi}\right)^2 P_{h,t} Y_{h,t}.$$

Taking input prices W_t and r_t^k as given, intermediate-good firms hire labor and rent capital in perfectly competitive factor markets. They also determine the price of the intermediate good that maximizes discounted real profits. The problem, expressed in terms of the domestic CPI, can be formulated as follows:

$$\max_{\left\{P_{h,t}(i), L_t(i), \widehat{K^o}_{t-1}(i), Y_{h,t}(i)\right\}_{t=0}^{\infty}} I\!E_0 \left\{\sum_{t=0}^{\infty} \theta_t \frac{\lambda_t}{\lambda_0}\left[\frac{P_{h,t}(i)}{P_t} Y_{h,t}(i) - W_t L_t(i) - r_t^k \widehat{K^o}_{t-1}(i) - \frac{PAC_t(i)}{P_t}\right]\right\}, \tag{3.35}$$

s.t

$$Y_{h,t}(i) = \left(\frac{P_{h,t}(i)}{P_{h,t}}\right)^{-\epsilon} Y_{h,t},$$

[7] The two most widely used approaches in modeling price setting are the Rotemberg (1982) and Calvo (1983) ones. Under the Calvo approach, firms face an exogenously fixed probability of adjusting their prices each period, while under the Rotemberg approach, firms incur a quadratic adjustment cost for changing prices. Up to a first-order approximation the two frameworks provide identical expressions for the New Keynesian Phillips Curve, leading to observationally equivalent dynamics for inflation and output (Rotemberg, 1987; Roberts, 1995). We choose the Rotemberg model for pricing due to three important reasons. First, in the presence of trend inflation, the long-run relationship between inflation and output is negative in the Calvo model and positive in the Rotemberg model, which is in line with most of the empirical evidence. Second, unlike the Calvo model, an increase in trend inflation in the Rotemberg model expands the region of determinacy for steady states in models with monetary and fiscal policy rules. This means that a wider range of implementable monetary and fiscal rules can be accommodated under Rotemberg pricing (Schmitt-Grohé and Uribe, 2007; Ascari and Rossi, 2012). Third, the Rotemberg model generates more volatility at the Zero Lower Bound compared to the Calvo model, which helps to explain the fluctuations observed in the US data during the GFC (Richter and Throckmorton, 2016).

$$Y_{h,t}(i) = A_t\left(\widehat{K^o}_{t-1}(i)\right)^{\alpha}(L_t(i))^{1-\alpha}.$$

Combining the constraints we can write the Lagrangian function as follows:

$$L^{ig} = \mathbb{E}_0\left\{\sum_{t=0}^{\infty}\theta_t\frac{\lambda_t}{\lambda_0}\left[\frac{P_{h,t}(i)}{P_t}\left(\frac{P_{h,t}(i)}{P_{h,t}}\right)^{-\epsilon}Y_{h,t} - W_tL_t(i) - r_t^k\widehat{K^o}_{t-1}(i) - \frac{\Xi_p}{2}\left(\frac{P_{h,t}(i)}{P_{h,t-1}(i)} - \overline{\pi}\right)^2\frac{P_{h,t}Y_{h,t}}{P_t}\right.\right.$$
$$\left.\left. - mc_t(i)\left[\left(\frac{P_{h,t}(i)}{P_{h,t}}\right)^{-\epsilon}Y_{h,t} - A_t\left(\widehat{K^o}_{t-1}(i)\right)^{\alpha}(L_t(i))^{1-\alpha}\right]\right]\right\},$$

where mc_t is the Lagrangian multiplier, which can be interpreted as the marginal cost of producing an additional unit of output. The first-order conditions for this problem are:
First-order condition for capital:

$$r_t^k = mc_t(i)\alpha A_t\left(\widehat{K^o}_{t-1}(i)\right)^{\alpha-1}(L_t(i))^{1-\alpha}. \tag{3.36}$$

First-order condition for labor:

$$W_t = mc_t(i)(1-\alpha)A_t\left(\widehat{K^o}_{t-1}(i)\right)^{\alpha}(L_t(i))^{-\alpha}. \tag{3.37}$$

First-order condition for $P_{h,t}(i)$:

$$(1-\epsilon)\frac{1}{P_t}\left(\frac{P_{h,t}(i)}{P_{h,t}}\right)^{-\epsilon}Y_{h,t} - \frac{\Xi_p}{P_{h,t-1}(i)}\left(\frac{P_{h,t}(i)}{P_{h,t-1}(i)} - \overline{\pi}\right)\frac{P_{h,t}Y_{h,t}}{P_t} + \epsilon mc_t(i)\frac{Y_{h,t}}{P_{h,t}}\left(\frac{P_{h,t}(i)}{P_{h,t}}\right)^{-\epsilon-1} +$$
$$\beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[\frac{\lambda_{t+1}}{\lambda_t}\Xi_p\frac{P_{h,t+1}(i)}{P_{h,t}(i)^2}\left(\frac{P_{h,t+1}(i)}{P_{h,t}(i)} - \overline{\pi}\right)\frac{P_{h,t+1}Y_{h,t+1}}{P_{t+1}}\right] = 0. \tag{3.38}$$

Within a symmetric equilibrium, firms opt for identical inputs, outputs, and prices. As a result, by enforcing this symmetric equilibrium, the production function and the first-order conditions emerge as follows:

$$Y_{h,t} = A_t\left(\widehat{K^o}_{t-1}\right)^{\alpha}(L_t)^{1-\alpha}. \tag{3.39}$$

$$r_t^k = mc_t\alpha\frac{Y_{h,t}}{\widehat{K^o}_{t-1}}. \tag{3.40}$$

$$W_t = mc_t(1-\alpha)\frac{Y_{h,t}}{L_t}. \tag{3.41}$$

$$\frac{(1-\epsilon)Y_{h,t}}{P_t} - \frac{\Xi_p}{P_{h,t-1}}\left(\frac{P_{h,t}}{P_{h,t-1}} - \overline{\pi}\right)\frac{P_{h,t}Y_{h,t}}{P_t} + \frac{\epsilon mc_tY_{h,t}}{P_{h,t}} +$$
$$\beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[\frac{\lambda_{t+1}}{\lambda_t}\Xi_p\frac{P_{h,t+1}}{P_{h,t}^2}\left(\frac{P_{h,t+1}}{P_{h,t}} - \overline{\pi}\right)\frac{P_{h,t+1}Y_{h,t+1}}{P_{t+1}}\right] = 0. \tag{3.42}$$

We can rearrange the pricing condition to obtain:

$$(1-\epsilon) - \Xi_p\frac{P_{h,t}}{P_{h,t-1}}\left(\frac{P_{h,t}}{P_{h,t-1}} - \overline{\pi}\right) + \epsilon\frac{mc_t}{p_{h,t}} + \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[\frac{\lambda_{t+1}}{\lambda_t}\Xi_p\frac{P_{h,t+1}}{P_{h,t}}\left(\frac{P_{h,t+1}}{P_{h,t}} - \overline{\pi}\right)\frac{p_{h,t+1}Y_{h,t+1}}{p_{h,t}Y_{h,t}}\right] = 0,$$

$$(1-\epsilon) - \Xi_p\pi_{h,t}(\pi_{h,t} - \overline{\pi}) + \epsilon\frac{mc_t}{p_{h,t}} + \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[\frac{\lambda_{t+1}}{\lambda_t}\Xi_p\pi_{h,t+1}(\pi_{h,t+1} - \overline{\pi})\frac{p_{h,t+1}Y_{h,t+1}}{p_{h,t}Y_{h,t}}\right] = 0,$$

$$\pi_{h,t}\left(\pi_{h,t}-\overline{\pi}\right)=\beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[\frac{\lambda_{t+1}}{\lambda_t}\pi_{h,t+1}\left(\pi_{h,t+1}-\overline{\pi}\right)\frac{p_{h,t+1}Y_{h,t+1}}{p_{h,t}Y_{h,t}}\right]+\frac{\epsilon}{\Xi_p}\left(\frac{mc_t}{p_{h,t}}-\frac{\epsilon-1}{\epsilon}\right). \tag{3.43}$$

where $\pi_{h,t}=\frac{P_{h,t}}{P_{h,t-1}}=\frac{p_{h,t}}{p_{h,t-1}}\pi_t$. Note that ϵ is the elasticity of substitution between differentiated goods. In the extreme case where $\epsilon\to\infty$, intermediate goods are perfect substitutes, all firms are price takers, turning off the effect of monopolistic competition in the model. Real profits for intermediate firms in a symmetrical equilibrium are as follows:

$$\Gamma_t=p_{h,t}Y_{h,t}-W_tL_t-r_t^k\widehat{K^o}_{t-1}-\frac{\Xi_p}{2}\left(\pi_{h,t}-\overline{\pi}\right)^2p_{h,t}Y_{h,t}. \tag{3.44}$$

3.4 Packers and Unions

Workers supply differentiated types of labor, which are sold by unions to perfectly competitive labor packers. These labor packers assemble the different types of labor and sell homogeneous labor to intermediate-goods firms. Packers use the following technology to aggregate labor:

$$L_t=\left(\int_0^1 L_t(j)^{\frac{\epsilon_w-1}{\epsilon_w}}dj\right)^{\frac{\epsilon_w}{\epsilon_w-1}}, \tag{3.45}$$

where $L_t(j)$ is labor of type j. Packers maximize profits subject to the aggregation function (3.45), taking as given the wage paid for each type of work performed. Since all packers are identical, we can proceed by considering a representative packer that faces the following maximization problem:

$$\max_{L_t,\{L_t(j)\}_{j\in[0,1]}} P_tW_tL_t-\int_0^1 P_tW_t(j)L_t(j)dj, \tag{3.46}$$

s.t

$$L_t=\left(\int_0^1 L_t(j)^{\frac{\epsilon_w-1}{\epsilon_w}}dj\right)^{\frac{\epsilon_w}{\epsilon_w-1}}.$$

As the representative packer's maximization problem is similar to that of the representative final-good producer, we follow the same steps presented above to obtain the first-order condition with respect to the generic labor type j:

$$L_t(j)=\left(\frac{W_t(j)}{W_t}\right)^{-\epsilon_w}L_t. \tag{3.47}$$

Similarly, the wage index is given by:

$$W_t=\left(\int_0^1 W_t(j)^{1-\epsilon_w}dj\right)^{\frac{1}{1-\epsilon_w}}. \tag{3.48}$$

There is a continuum of unions, each representing a continuum of workers, according to the fraction of worker type (OPT and ROT). Each union sets the wage rate for its members, who satisfy the labor demand of any firm at the chosen cost. Workers within each union perform the same type of work, regardless of their worker type (OPT or ROT), which is different from the type of work performed by workers of other unions. Following Gali et al. (2007), we assume that the union takes into account the fact that firms allocate labor demand across different workers of type j, regardless of their worker type. Thus, in the aggregate, $L_t^r=L_t^o=L_t$ for all t. As a result, all workers earn the same wages and work the same number of hours. Each union sets nominal wages for its members by maximizing their utility, taking into account the downward-sloping demand and quadratic adjustment costs (Rotemberg (1982)). We assume that unions face adjustment costs relative to the benchmark $\overline{\pi}$ and charge each member lump-sum fees to cover the adjustment costs. Following Furlanetto (2011), we assume that the adjustment cost is proportional to the aggregate wage bill in the economy, as follows:

$$UAC_t(j) = \frac{\Xi_w}{2}\left(\frac{P_t}{P_{t-1}}\frac{W_t(j)}{W_{t-1}(j)} - \overline{\pi}\right)^2 P_t W_t L_t,$$

where Ξ_w governs the size of the adjustment costs. Note that $Z_t(j){=}UAC_t(j)$ for all t. Each period, a typical union sets the wage for its workers by solving the following problem:

$$\max_{\{W_t(j)\}_{t=0}^{\infty}} \mathbb{E}_0\left\{\sum_{t=0}^{\infty}\theta_t\left[UM_t\left(\frac{P_tW_t(j)L_t(j)}{P_t} - \frac{UAC_t(j)}{P_t}\right) - \frac{\chi_l L_t(j)^{(1+\gamma_l)}}{1+\gamma_l}\right]\right\}, \tag{3.49}$$

s.t

$$L_t(j) = \left(\frac{W_t(j)}{W_t}\right)^{-\epsilon_w} L_t,$$

where $UM_t = \frac{\Phi}{(C_t^r)^{\gamma_c}} + \frac{1-\Phi}{(C_t^o)^{\gamma_c}}$. As consumption generally differs between OPT and ROT consumers, the union weighs labor income with their respective marginal utility of consumption (Furlanetto, 2011). The first-order condition is given by:

$$UM_t\left[(1-\epsilon_w)\left(\frac{W_t(j)}{W_t}\right)^{-\epsilon_w} L_t - \Xi_w\left(\frac{P_t}{P_{t-1}}\frac{W_t(j)}{W_{t-1}(j)} - \overline{\pi}\right)\frac{P_t}{P_{t-1}}\frac{W_t}{W_{t-1}(j)}L_t\right] - \chi_l\left[\left(\frac{W_t(j)}{W_t}\right)^{-\epsilon_w} L_t\right]^{\gamma_l}$$

$$\left[-\epsilon_w\left(\frac{W_t(j)}{W_t}\right)^{(-1-\epsilon_w)}\frac{L_t}{W_t}\right] + \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[UM_{t+1}\Xi_w\left(\frac{P_{t+1}}{P_t}\frac{W_{t+1}(j)}{W_t(j)} - \overline{\pi}\right)\frac{P_{t+1}}{P_t}\frac{W_{t+1}W_{t+1}(j)}{W_t(j)^2}L_{t+1}\right] = 0. \tag{3.50}$$

In a symmetric equilibrium, the first-order condition can be written as follows:

$$UM_tW_t\left[(\epsilon_w - 1) + \Xi_w\left(\pi_t\pi_t^w - \overline{\pi}\right)\pi_t\pi_t^w\right] - \chi_l\epsilon_w L_t^{\gamma_l} - \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\Bigg[UM_{t+1}\Xi_w\left(\pi_{t+1}\pi_{t+1}^w - \overline{\pi}\right)\pi_{t+1}\pi_{t+1}^w$$
$$\frac{L_{t+1}}{L_t}W_{t+1}\Bigg] = 0,$$

where $\pi_t^w = \frac{W_t}{W_{t-1}}$. Rearranging terms we obtain the New-Keynesian Phillips Curve for wage inflation:

$$\pi_t\pi_t^w\left(\pi_t\pi_t^w - \overline{\pi}\right) = \beta^c(\Delta\tilde{C}_t)\mathbb{E}_t\left[\frac{UM_{t+1}}{UM_t}\left(\pi_{t+1}\pi_{t+1}^w - \overline{\pi}\right)\pi_{t+1}(\pi_{t+1}^w)^2\frac{L_{t+1}}{L_t}\right] + \frac{\epsilon_w}{\Xi_w}\left(\frac{L_t^{\gamma_l}\chi_l}{UM_tW_t} - \frac{\epsilon_w - 1}{\epsilon_w}\right). \tag{3.51}$$

3.5 Government and Monetary Authority

The Home government funds public expenditures G_t by levying lump-sum taxes on both types of households and receiving bond transaction fees from the Foreign country:

$$p_{h,t}G_t = T_t + \frac{\Xi_b}{2}\left(b_{h,t}^{o,*} - \overline{b}_h^*\right)^2. \tag{3.52}$$

Since both types of households pay lump-sum taxes:

$$T_t = (1-\Phi)T_t^o + \Phi T_t^r. \tag{3.53}$$

As the Ricardian equivalence property does not hold due to the presence of ROT households, the following fiscal policy rule determines the path for taxes:

$$T_t^o = \overline{T^o} + \phi_g\left(G_t - \overline{G}\right), \quad T_t^r = \overline{T^r} + \phi_g\left(G_t - \overline{G}\right),$$

where $\overline{T^o}$ and $\overline{T^r}$ are steady-state values of OPT and ROT lump-sum taxes, respectively; $\phi_g > 0$; and $\overline{G}$ is the steady-state value of government spending. We follow Andrés et al. (2009) and Castelnuovo (2012), and assume that the monetary authority sets the nominal interest rate according to the following modified Taylor rule:

$$\frac{R_t}{\overline{R}} = \left(\frac{R_{t-1}}{\overline{R}}\right)^{\rho_r} \left[\left(\frac{\pi_t}{\overline{\pi}}\right)^{\phi_\pi} \left(\frac{gdp_t}{\overline{gdp}}\right)^{\phi_{gdp}} \left(\frac{mg_t}{\overline{mg}}\right)^{\phi_m}\right]^{1-\rho_r} \exp(gc_t), \tag{3.54}$$

where $gdp_t = p_{h,t} Y_{h,t}$; $mg_t = \frac{M_t}{M_{t-1}}$; $\overline{R}$, $\overline{gdp}$, and $\overline{mg}$ are the respective equilibrium nominal interest rate (natural interest rate), potential output, and target rate of money growth (steady-state values of the variables); ϕ_π, ϕ_{gdp}, and ϕ_m are positive parameters chosen by the monetary authority with the objective of driving the variables towards their respective targets; $\rho_r > 0$ controls the monetary policy *inertia*; and gc_t is an exogenous monetary policy shock whose evolution will be described below. As emphasized by Andrés et al. (2009), the response by the monetary authority to money growth can be justified by both the usefulness of money in forecasting inflation and by considering that the variability of money growth appears in the central bank's loss function. In our specification, we include a lagged nominal interest rate term, which allows for interest rate smoothing. This implies a gradual adjustment of policy rates towards their benchmark level.

3.6 Aggregation and Market Clearing

Aggregate consumption, investment, capital, and hours are given by a weighted average of the corresponding variables for each type of household:

$$C_t = (1-\Phi) C_t^o + \Phi C_t^r, \quad L_t = (1-\Phi) L_t^o + \Phi L_t^r,$$

$$B_{h,t} = (1-\Phi) B_{h,t}^o, \quad B_{f,t} = (1-\Phi) B_{f,t}^o, \quad M_t = (1-\Phi) M_t^o, \quad K_t = (1-\Phi) K_t^o,$$

$$\Gamma_t = (1-\Phi) \Gamma_t^o, \quad I_t = (1-\Phi) I_t^o. \tag{3.55}$$

The market clearing condition for the Home good is as follows:

$$Y_{h,t} = C_{h,t} + I_{h,t} + G_t + C_{h,t}^* + I_{h,t}^* + \frac{\Xi_p}{2} (\pi_{h,t} - \overline{\pi})^2 Y_{h,t} + \frac{\Xi_w}{2} (\pi_t \pi_t^w - \overline{\pi})^2 W_t N_t. \tag{3.56}$$

The assumption of zero net supply in the bond market implies that:

$$b_{h,t} + b_{h,t}^* = 0, \quad b_{f,t} + b_{f,t}^* = 0. \tag{3.57}$$

The trade balance is defined as the difference between exports and imports:

$$TB_t = EXP_t - IMP_t. \tag{3.58}$$

$EXP_t = p_{h,t}\left(C_{h,t}^* + I_{h,t}^*\right)$ and $IMP_t = p_{f,t}\left(C_{f,t} + I_{h,t}\right)$. To derive the equilibrium in the trade balance we combine the real budget constraints of both types of households and the aggregate condition (3.55) with equations (3.44), (3.52), and (3.53) to obtain:

$$C_t + I_t + p_{h,t} G_t + b_{h,t} + Q_t b_{f,t} + m_t = \frac{R_{t-1} b_{h,t-1}}{\pi_t} + Q_t \frac{R_{t-1}^* b_{f,t-1}}{\pi_t^*} + \frac{m_{t-1}}{\pi_t} + \frac{\Xi_b}{2}\left(b_{h,t}^{o,*} - \overline{b}_h^*\right)^2 -$$

$$\frac{\Xi_b}{2} Q_t \left(b_{f,t} - \overline{b}_f\right)^2 + p_{h,t} Y_{h,t} - \frac{\Xi_p}{2} (\pi_{h,t} - \overline{\pi})^2 p_{h,t} Y_{h,t} - \frac{\Xi_w}{2} (\pi_t \pi_t^w - \overline{\pi})^2 W_t N_t. \tag{3.59}$$

In order to derive an expression for the trade balance, we need to adjust equation (3.59) to account for changes in Foreign money holdings:

$$C_t+I_t+p_{h,t}G_t+b_{h,t}+Q_tb_{f,t}+m_t-Q_tm_t^*=\frac{R_{t-1}b_{h,t-1}}{\pi_t}+Q_t\frac{R^*_{t-1}b_{f,t-1}}{\pi_t^*}+\frac{m_{t-1}}{\pi_t}-Q_t\frac{m^*_{t-1}}{\pi_t^*}+$$

$$\frac{\Xi_b}{2}\left(b^{o,*}_{h,t}-\bar{b}^*_h\right)^2-\frac{\Xi_b}{2}Q_t\left(b_{f,t}-\bar{b}_f\right)^2+p_{h,t}Y_{h,t}-\frac{\Xi_p}{2}\left(\pi_{h,t}-\overline{\pi}\right)^2p_{h,t}Y_{h,t}-\frac{\Xi_w}{2}\left(\pi_t\pi_t^w-\overline{\pi}\right)^2W_tN_t. \quad (3.60)$$

Using the market clearing conditions, the identities $C_t=p_{h,t}C_{h,t}+p_{f,t}C_{f,t}$ and $I_t=p_{h,t}I_{h,t}+p_{f,t}I_{f,t}$ together with the definitions of exports and imports, we obtain the adjusted budget constraint of the economy:

$$p_{h,t}\left[C_{h,t}+I_{h,t}+G_t+\frac{\Xi_p}{2}\left(\pi_{h,t}-\overline{\pi}\right)^2p_{h,t}Y_{h,t}+\frac{\Xi_w}{2}\left(\pi_t\pi_t^w-\overline{\pi}\right)^2W_tN_t-Y_{h,t}\right]+p_{f,t}(C_{f,t}+I_{f,t})=$$

$$\frac{R_{t-1}b_{h,t-1}}{\pi_t}+Q_t\frac{R^*_{t-1}b_{f,t-1}}{\pi_t^*}+\frac{m_{t-1}}{\pi_t}-Q_t\frac{m^*_{t-1}}{\pi^*}-b_{h,t}-Q_tb_{f,t}-m_t+Q_tm_t^*+\frac{\Xi_b}{2}\left(b^*_{h,t}-\bar{b}^*_h\right)^2-$$

$$\frac{\Xi_b}{2}Q_t\left(b_{f,t}-\bar{b}_f\right)^2. \quad (3.61)$$

Applying the definitions of exports and imports, we can derive an expression for the trade balance as follows:

$$-EXP_t+IMP_t=\frac{R_{t-1}b_{h,t-1}}{\pi_t}-b_{h,t}+Q_t\frac{R^*_{t-1}b_{f,t-1}}{\pi_t^*}-Q_tb_{f,t}+\frac{m_{t-1}}{\pi_t}-m_t-Q_t\frac{m^*_{t-1}}{\pi_t^*}+Q_tm_t^*+$$

$$\frac{\Xi_b}{2}\left(b^*_{h,t}-\bar{b}^*_h\right)^2-\frac{\Xi_b}{2}Q_t\left(b_{f,t}-\bar{b}_f\right)^2. \quad (3.62)$$

$$TB_t=b_{h,t}-\frac{R_{t-1}b_{h,t-1}}{\pi_t}+Q_tb_{f,t}-Q_t\frac{R_{*t-1}b_{f,t-1}}{\pi_t^*}+m_t-\frac{m_{t-1}}{\pi_t}-Q_tm_t^*+Q_t\frac{m^*_{t-1}}{\pi_t^*}+\frac{\Xi_b}{2}\left(b^*_{h,t}-\bar{b}^*_h\right)^2-$$

$$\frac{\Xi_b}{2}Q_t\left(b_{f,t}-\bar{b}_f\right)^2. \quad (3.63)$$

The current account is the sum of the trade balance with interest income received from the Foreign country:

$$CA_t=TB_t+b_{h,t-1}\left(\frac{R_{t-1}}{\pi_t}-1\right)+Q_tb_{f,t-1}\left(\frac{R^*_{t-1}}{\pi_t^*}-1\right)+\frac{\Xi_b}{2}\left(b^*_{h,t}-\bar{b}^*_h\right)^2-\frac{\Xi_b}{2}Q_t\left(b_{f,t}-\bar{b}_f\right)^2. \quad (3.64)$$

Note that, due to the presence of money holdings in the economy budget constraint, the economy is subject to temporary current account imbalances. However, in the steady state, current account equals the financial account, restoring equilibrium to the balance of payments.

3.7 Intertemporal Asset Pricing Model

If we subtract equation (3.23) from (3.24) we obtain the following no-arbitrage condition:

$$TC_t=\mathbb{E}_t\left[\frac{\kappa_{t+1}}{\kappa_t}\left(\frac{C^o_{t+1}}{C^o_t}\right)^{-\gamma_c}\frac{P_t}{P_{t+1}}\left(\frac{S_{t+1}}{S_t}R_t^*-R_t\right)\right], \quad (3.65)$$

where $TC_t=\Xi_b\left(b^o_{f,t}-\bar{b}_f\right)/\beta^c(\Delta\tilde{C}_t)$. When the expression in the second parentheses inside the brackets of equation (3.65) equals zero, the UIP condition holds. Otherwise, it gives rise to currency excess returns.

If we multiply this term by $\frac{P_t}{P_{t+1}}$ we arrive at an Euler's equation with real excess returns earned by a Foreign bond in terms of a Home bond, net of currency depreciation:

$$TC_t = \mathbb{E}_t \left[\frac{\kappa_{t+1}}{\kappa_t} \left(\frac{C^o_{t+1}}{C^o_t} \right)^{-\gamma_c} RX_{t+1} \right], \tag{3.66}$$

where $RX_{t+1} = \frac{P_t}{P_{t+1}} \left(\frac{S_{t+1}}{S_t} R^*_t - R_t \right)$. Equation (3.66) is crucial for asset pricing, since it shows that the expected excess returns discounted by the stochastic discount factor are zero. The representative household will exhaust all discounted profit opportunities. The risks associated with foreign bonds result from the covariance between excess returns with consumption growth and time preference changes. This is what we now formally demonstrate.

3.8 Beta Representation

Breeden and Litzenberger (1978) demonstrate that the consumption of agents is an increasing function of aggregate consumption in economies where unrestricted Pareto-optimal consumption allocation is allowed. Assume that all OPT agents have the same subjective discount rate. In this case, each marginal utility of the OPT agent's optimal consumption at a given t is equal to a scalar multiplied by a monotonically decreasing aggregate consumption function, $f(C)$. Breeden et al. (1989) demonstrate that in a Pareto-efficient capital market, the growth rate of the marginal utility of consumption would be identical for all agents and equal to the growth rate of the aggregate marginal utility of consumption at equilibrium:

$$\frac{U^o_c(C^o_{t+1}, M^o_{t+1}/P_{t+1}, L^o_{t+1})}{U^o_c(C^o_t, M^o_t/P_t, L^o_t)} = \frac{f(C_{t+1})}{f(C_t)}. \tag{3.67}$$

Using a first order Taylor expansion around C^o_t, we can rewrite equation (3.67) as:

$$\frac{U^o_c(C^o_{t+1}, M^o_{t+1}/P_{t+1}, L^o_{t+1})}{U^o_c(C^o_t, M^o_t/P_t, L^o_t)} = \frac{f(C^o_{t+1})}{f(C^o_t)} = \frac{f(C^o_t) + f'(C^o_t)(C^o_{t+1} - C^o_t)}{f(C^o_t)} = 1 - \left[-C^o_t \frac{f'(C^o_t)}{f(C^o_t)} \right] \Delta C^o_{t+1}. \tag{3.68}$$

The term in brackets is the aggregate coefficient of relative risk aversion evaluated at C^o_t. Assuming the power period utility function given by equation (3.17), we can rearrange equation (3.68) in the following manner:

$$\frac{U^o_c(C^o_{t+1}, M^o_{t+1}/P_{t+1}, L^o_{t+1})}{U^o_c(C^o_t, M^o_t/P_t, L^o_t)} = 1 - \gamma_c \Delta C^o_{t+1}, \tag{3.69}$$

where ΔC^o_{t+1} is the growth rate of aggregate per capita consumption of OPT households. Combining equations (3.66) and (3.69) yields the subsequent expression:

$$\mathbb{E}_t \left[\frac{\kappa_{t+1}}{\kappa_t} (1 - \gamma_c \Delta C^o_{t+1}) RX_{t+1} \right] = TC_t. \tag{3.70}$$

We derive the beta representation of equation (3.70) by following Cochrane (2005) and Bohrnstedt and Goldberger (1969):[8]

$$\mathbb{E}_t \left[\kappa^p_{t+1} (1 - \gamma_c \Delta C^o_{t+1}) \right] \mathbb{E}_t(RX_{t+1}) + \mathrm{Cov}_t \left(\kappa^p_{t+1}, RX_{t+1} \right) + \mathrm{Cov}_t \left(-\kappa^p_{t+1} \gamma_c \Delta C^o_{t+1}, RX_{t+1} \right) = TC_t,$$

$$-\mathbb{E}_t(RX_{t+1}) \mathbb{E}_t \left[\kappa^p_{t+1} (1 - \gamma_c \Delta C^o_{t+1}) \right] = \mathrm{Cov}_t \left(\kappa^p_{t+1}, RX_{t+1} \right) - \left[\mathbb{E}_t(\kappa^p_{t+1}) \mathrm{Cov}_t \left(\gamma_c \Delta C^o_{t+1}, RX_{t+1} \right) \right.$$

$$\left. + \mathbb{E}_t(\gamma_c \Delta C^o_{t+1}) \mathrm{Cov}_t(\kappa^p_{t+1}, RX_{t+1}) \right] + TC_t,$$

[8] To compute the covariance of the products of our three random variables we followed Bohrnstedt and Goldberger (1969), and assumed that these three variables are multivariate normal distributed. As emphasized by Bohrnstedt and Goldberger (1969) the expression for the covariance term of these random variables are asymptotic approximations of the exact covariance.

$$\mathbb{E}_t(RX_{t+1}) = \frac{\mathbb{E}_t(\kappa^p_{t+1})\,\mathrm{Cov}_t(\gamma_c \Delta C^o_{t+1}, RX_{t+1})}{\mathbb{E}_t\left[\kappa^p_{t+1}(1-\gamma_c\Delta C^o_{t+1})\right]} + \frac{\left[1-\mathbb{E}_t(\gamma_c \Delta C^o_{t+1})\right]\mathrm{Cov}_t(-\kappa^p_{t+1}, RX_{t+1})}{\mathbb{E}_t\left[\kappa^p_{t+1}(1-\gamma_c\Delta C^o_{t+1})\right]} - TC_t. \quad (3.71)$$

$$\mathbb{E}_t(RX_{t+1}) = \left(\frac{\gamma_c \mathbb{E}_t(\kappa^p_{t+1})\,\mathrm{Var}_t(\Delta C^o_{t+1})}{\mathbb{E}_t\left[\kappa^p_{t+1}(1-\gamma_c\Delta C^o_{t+1})\right]}\right)\left(\frac{\mathrm{Cov}_t(\Delta C^o_{t+1}, RX_{t+1})}{\mathrm{Var}_t(\Delta C^o_{t+1})}\right)$$
$$+\left(\frac{\left[1-\gamma_c\mathbb{E}_t(\Delta C^o_{t+1})\right]\mathrm{Var}_t(\kappa^p_{t+1})}{\mathbb{E}_t\left[\kappa^p_{t+1}(1-\gamma_c\Delta C^o_{t+1})\right]}\right)\left(\frac{\mathrm{Cov}_t(-\kappa^p_{t+1}, RX_{t+1})}{\mathrm{Var}_t(\kappa^p_{t+1})}\right) - TC_t, \quad (3.72)$$

where $k^p_{t+1} = \frac{k_{t+1}}{k_t}$. The Beta representation is as follows:

$$\mathbb{E}_t\left(RX_{t+1}\right) = \lambda_c\beta_c + \lambda_\kappa\beta_\kappa - TC_t, \quad (3.73)$$

λ's represent the risk prices and β's are the risk quantities of our two risk factors (consumption growth and household preference), as expressed below:

$$\lambda_c = \left(\frac{\gamma_c \mathbb{E}_t(\kappa^p_{t+1})\,\mathrm{Var}_t(\Delta C^o_{t+1})}{\mathbb{E}_t\left[\kappa^p_{t+1}(1-\gamma_c\Delta C^o_{t+1})\right]}\right); \qquad \lambda_\kappa = \left(\frac{\left[1-\gamma_c\mathbb{E}_t(\Delta C^o_{t+1})\right]\mathrm{Var}_t(\kappa^p_{t+1})}{\mathbb{E}_t\left[\kappa^p_{t+1}(1-\gamma_c\Delta C^o_{t+1})\right]}\right);$$
$$\beta_c = \left(\frac{\mathrm{Cov}_t(\Delta C^o_{t+1}, RX_{t+1})}{\mathrm{Var}_t(\Delta C^o_{t+1})}\right); \qquad \beta_\kappa = \left(\frac{\mathrm{Cov}_t(-\kappa^p_{t+1}, RX_{t+1})}{\mathrm{Var}_t(\kappa^p_{t+1})}\right). \quad (3.74)$$

Equation (3.72) represents the fundamental asset pricing condition to foreign assets in our economy. The relation between the components of asset returns and aggregate consumption growth precisely measures their relevant risks. In particular, the model formally implies that the excess return on any asset or portfolio should be a compensation for risks associated with consumption growth and changes in household preferences.

3.9 Structural Shocks and CT Returns

IST, MEI, and MON Shocks Definition. In the model of Justiniano et al. (2011), the IST shock influences the conversion of final goods into investment goods and is related to the relative price of investment goods compared to consumption goods. Conversely, the MEI shock affects the production of installed capital from investment goods. The authors demonstrate that their multi-sector model, which includes intermediate-goods producers, final-goods producers, investment-goods producers, and capital producers, can be simplified into a model where the capital accumulation process is centralized in a single sector. They argue that this modelling strategy is necessary to distinguish the two disturbances that affect capital investment.

In our model, the IST shock directly influences investment, while the MEI shock operates by reducing investment adjustment costs. This differentiation between the two shocks is crucial as they capture distinct aspects of capital investment behavior. The MON shock affects the stock of money held by households. This choice is motivated by empirical evidence suggesting the relevance of money demand in explaining fluctuations in macroeconomic variables and asset prices. The implementation of quantitative easing programs by central banks in response to the Lehman bankruptcy further emphasizes the importance of investigating the role of money stock in the economy. Lastly, we combine the IST, MEI, and MON shocks to derive the time preference shock.

The works of Greenwood et al. (1992, 1997a) highlight the significance of the IST in driving capital investment and economic growth. They argue that advancements in technology have led to a decrease in the cost of equipment, which has stimulated increased investment in both the short and long run. These studies specifically emphasize that the IST shock, by making new capital less expensive, encourages the demand for new capital and plays a substantial role in explaining business cycle fluctuations in the US.

In line with the findings and methodology of Greenwood et al. (1992), Greenwood et al. (1997a), Justiniano et al. (2011), and Dogan (2019), we adopt the use of the relative price of investment as a proxy for the IST process in our model. By examining changes in the relative price of equipment, we can directly capture the effects of IST shocks on capital costs and the subsequent impact on investment decisions. This approach allows us to effectively analyze the role of IST in driving capital accumulation and its contribution to output growth and the overall dynamics of the economy.[9]

As highlighted by Justiniano et al. (2011), the financial system plays a crucial role in the process of physical capital production. They argue that the MEI shock can reflect structural disturbances in the ability of the financial system to facilitate capital investments. Specifically, when capital producers require financing for the purchase of investment goods, the production of physical capital is influenced by their access to financial resources and the efficiency with which the financial system channels credit. More efficient financial systems can reduce external costs associated with investment adjustment by increasing financing options for capital goods production and improving the speed at which capital becomes available. Furthermore, the findings of Basu and Kimball (2003) suggest that investment adjustment costs may proxy delays in investment planning or inflexibility in altering planned investment patterns. When investment planning and patterns rely on borrowing, more efficient financial systems can mitigate frictions arising from these sources. They facilitate smoother investment planning processes and enhance flexibility in adapting investment plans, ultimately reducing the costs and inefficiencies associated with investment adjustment.

While our model does not directly incorporate financial intermediation agents, it does recognize the role of the MEI shock in the transformation of real savings into physical capital. Negative shocks to the MEI can lead to a decrease in the quantity of effective physical capital installed relative to the amount of forgone consumption, thus increasing investment adjustment costs. This reflects a less efficient utilization of savings for productive purposes. In this sense, the MEI process can be interpreted as a proxy for the efficiency with which the financial sector channels household savings towards the production of physical capital.

In contrast to Justiniano et al. (2011), who use the spread between high-yield and AAA corporate bond returns as a measure of the MEI process, we adopt a broader measure in our asset pricing exercises. We employ the Index of Financial Development (IFD) developed by the IMF (Svirydzenka, 2016) as a proxy for the MEI process. The IFD incorporates not only the conventional measures of financial development, such as the ratio of private credit to GDP and the stock market capitalization to GDP, but also nine sub-indicators that capture various dimensions of financial institutions and markets, including their depth, access, and efficiency. Importantly, the IFD provides extensive coverage of 183 countries from 1980 onwards. The advantage of using the IFD is that it captures a comprehensive range of features of financial markets beyond just the corporate bond market. This is particularly relevant for our empirical analysis, as we consider countries with diverse financial structures. Some countries in our sample may have experienced significant improvements in their financial sector without relying heavily on a well-developed corporate bond market. Instead, these improvements could have been achieved through the development of the stock market or the banking system, among other factors.

In our model, MON shocks represent real money demand shocks and can generate business cycle fluctuations. As highlighted by Andrés et al. (2009), money demand can have both 'direct' and policy effects on the economy. The direct effect arises from the presence of portfolio adjustment costs, which directly impacts agents' utility. These adjustment costs make the money demand equation dynamic, introducing a forward-looking aspect to it. The interest-elastic and forward-looking nature of real balances allows them to function as leading indicators of future movements in the natural real interest rate (Nelson, 2002; Andrés et al., 2009). In this context, money demand contains important information besides that obtained from its responses to current income and nominal interest rate. It also varies in reaction to movements in expected future natural real rates, which are not captured by short-term nominal interest rates. These variations in money demand reflect expectations about future output and inflation. The policy effect pertains to the reaction of the monetary authority to changes in the nominal money growth

[9] The link between the relative price of investment and the IST may not hold in two specific cases: i) non-competitive multi-sector models with nominal rigidities and sectors with different markups (Justiniano et al., 2011); and ii) open economy models with different home bias in consumption and investment goods (Basu and Thoenissen, 2011). Both cases introduce a wedge between the relative price of investment and the IST. Note that our model abstracts from both features. Furthermore, in our asset pricing exercises, we make the assumption that any potential wedge between the relative price of investment and the IST is equal across countries, regardless of its magnitude. As a result, the results of our asset pricing estimation remain invariant to the presence of the wedge.

rate. When a money demand shock materializes, the monetary authority may neutralize the effect on the policy rate by adjusting money supply. Consequently, movements in real balances can be influenced by monetary policy actions aimed at stabilizing output and inflation.

There are several papers that consider money demand as a source of fluctuation in output and inflation in New-Keynesian models (see, e.g., Nelson (2002), Ireland (2004), Andrés et al. (2009), Arestis et al. (2010), Canova and Menz (2011), Castelnuovo (2012), Benchimol and Fourçans (2012), Benchimol and Fourçans (2017), and Benchimol and Qureshi (2020)). Chadha et al. (2014) find that money convey significant information to the central bank when there are shocks to credit supply. Andrés et al. (2009), and Castelnuovo (2012) demonstrate that incorporating money demand into both the utility function and the central bank's reaction function enhances the model's goodness of fit in comparison to the conventional New-Keynesian model. There are also many empirical studies that find significant effects of monetary aggregates on business cycle (see, e.g., Leeper and Roush (2003), Sims and Zha (2006), Hafer and Jones (2008), Favara and Giordani (2009), Šustek (2010), El-Shagi et al. (2015), and Benchimol and Fourçans (2017)).

In general, the literature that explores the role of money demand shocks in the economy assumes the existence of exogenous disturbances reflecting macroeconomic uncertainties and financial innovations, in addition to the endogenous determinants of real balances. Typically, increases in uncertainty are positively associated with money demand (precautionary reasons). Conversely, financial innovations are negatively associated with money demand (reduction of losses arising from the opportunity cost of holding money). We assume that the MON shock captures the combined effect of macroeconomic uncertainties and financial innovations.[10]

Macroeconomic uncertainty is a broad concept, it represents a set of forces that can contribute to changes in money demand. In addition, it may affect household's expectations about the evolution of the economy. The literature identifies various sources of macroeconomic uncertainty, including: i) volatility in monetary and fiscal policies; ii) occurrence of rare events, such as wars, natural disasters, and pandemic; iii) political disputes and banking crisis; and iv) volatility in financial markets. Financial innovations, on the other hand, are associated with technological and regulatory changes that encourage individuals to use electronic payment methods rather than cash for their transactions. These innovations, such as the widespread adoption of digital payments, online banking, and mobile wallets, can reduce the demand for physical cash and affect the overall dynamics of money demand. Overall, macroeconomic uncertainty and financial innovations are intertwined factors that can influence households' decisions regarding money demand, reflecting their expectations and response to changing economic conditions and technological advancements.

Short-term and Long-term Effects of IST, MEI, and MON Shocks. IST and MEI shocks have impacts on both the short-term business cycle fluctuations and long-term trend evolution of economic variables. When a positive innovation occurs in the IST or MEI process, it leads to an increase in the return on capital investment, thereby immediately stimulating new capital investments. These shocks contribute to explaining business cycle fluctuations by boosting investment demand and triggering short-term output growth. Consequently, the IST and MEI shocks play crucial roles in understanding the dynamics of the business cycle. Furthermore, the effects of these shocks extend to the long term. The process of capital accumulation, driven by the IST/MEI shock, results in an expanded capital stock, which in turn reduces the MPK (real interest rate). Simultaneously, the IST/MEI shock promotes the expansion of the supply of goods, leading to lower inflation rates. As a result, both shocks contribute to explaining the downward trend observed in the MPK and inflation rates, particularly among developing countries.

[10]Many empirical studies examine the relationship between money demand and macroeconomic uncertainty. For instance, Atta-Mensah (2004) analyzes the demand for money in Canada considering the period between 1960 and 2003. In their model, the demand shock process is proxied by an index of economic uncertainty. The author finds that an increase in economic uncertainty leads, in the short-run, to a rise in money balances. Cusbert et al. (2013) reveal a significant increase in money demand during the GFC in Australia. They argue that about 80% of the increase can be attributed to precautionary holdings. Bahmani-Oskooee and Nayeri (2018) analyze the impact of a broad measure of macroeconomic uncertainty on money demand in Australia between 1998 and 2016. Overall, they find that increased uncertainty induces the public to hold more cash to cover themselves against an uncertain future. In general, the results of these authors are in line with Bjørnland (2005), Miyagawa (2009), Bahmani-Oskooee et al. (2012), Bahmani-Oskooee et al. (2013), and Bahmani-Oskooee and Xi (2014).

The Fisher's (1930) equation predicts that this dynamic would lead to a reduction in nominal interest rates. Consequently, if countries with initially high nominal interest rates (indicating high MPK and inflation rates) experience higher IST and MEI growth rates compared to countries with initially low nominal interest rates (indicating low MPK and inflation rates), we would expect to observe a process of catching up in nominal interest rates. Chapter 2 provides some evidence supporting this hypothesis. Specifically, we show that: i) the IST growth rate of developing countries was significantly higher than that of developed countries between the mid-1990S and 2010, with some variations outside this period; ii) the MEI growth rate of developing countries surpassed that of developed countries from mid-2000s; iii) the IST spread between developing countries and the US decreased from 1980 and 2019, (also decreased between developing and developed countries); and iv) the MEI spread between developing countries and the US decreased during the 2000s and has remained relatively stable since then. These results align with the data presented in Table 2.6 of Chapter 2, which indicates that, in general, developing countries have exhibited higher growth rates of capital stock compared to developed countries from 1980 to 2019.

In Chapter 2, we also reveal the existence of a convergence process in the growth rate of aggregate real balances. The money stock growth rate in developing countries has converged to that of developed countries. The theoretical link between the stock of money and the nominal interest rate suggests that convergence in the growth rate of the money stock can accelerate the process of nominal interest rate convergence across countries. Differences in the growth rates of the IST, MEI, and MON processes across countries may contribute to explaining the long-term decline and convergence of nominal interest rates observed between 1980 and 2019.

Exchange rate variation also plays a role in explaining CT returns. Chapter 2 reveals that, in general: i) the growth of exchange rates has generally slowed down in developing countries in recent decades, while it fluctuates between -4% and +4% in developed countries; ii) the absolute value of exchange rate growth has declined in both developing and developed countries in recent decades; and iii) the standard deviation of the exchange rate growth and its absolute value decreased in developing countries between 1980 and 2019.

The reduction in the growth rate and standard deviation of exchange rates can also affect CT returns. The IST, MEI, and MON shocks can help explain the behavior of exchange rates through three possible channels. The first channel is associated with the magnitude of the shocks. As will be shown next, these shocks affect the nominal exchange rate and currency excess returns. Larger shocks tend to lead to greater variations in currency excess returns. In Chapter 2, we present evidence that supports these findings. Specifically, we show that the growth rates of the IST, MEI, and MON processes generally decreased between 1980 and 2019, particularly in developing countries. This suggests a moderation in the volatility of these shocks over time. Additionally, we find that the spread between developed/developing countries and the US in terms of the growth rates of the IST, MEI, and MON processes decreased during the same period. These findings suggest that the changing dynamics of the IST, MEI, and MON shocks contribute to the evolution of exchange rates and their influence on CT returns.

The second channel is linked to the change in the standard deviation of the IST, MEI, and MON values. If the distribution of these shock values is highly dispersed, the flows between countries influenced by these shocks are likely to exhibit greater volatility. It is reasonable to expect that more volatile capital flows would contribute to increased exchange rate variation. Thus, we can attribute the decline in the standard deviation of exchange rate growth of developing countries, to the decrease in the standard deviation of the IST and MON values as reported in Chapter 2. By observing the reduced dispersion in the IST and MON values, we can infer that capital flows associated with these shocks have become more stable. This has likely contributed to a decline in exchange rate volatility.

The third channel to explain the decrease in the standard deviation of exchange rate growth is related to the characteristics of the MEI and MON processes. In the short term, a positive MEI shock can lead to exchange rate volatility due to capital flows between countries. However, in the long term, positive MEI shocks that improve financial development can mitigate the effects of macroeconomic uncertainty and contribute to a reduction in exchange rate variance. The strengthening of the financial system, increased liquidity, and greater availability of credit enhance growth prospects and dampen the impact of uncertainty on the economy. During periods of uncertainty, economies with underdeveloped financial sectors are more prone to credit constraints for firms and households, resulting in higher costs of external financing. As a consequence, these economies experience higher levels of volatility in GDP, inflation, interest rates, and exchange rates compared to economies with more developed financial sectors. On the other hand, a decrease in money demand (captured by the MON shock) indicates lower macroeconomic uncertainty and reduced exchange rate volatility. This suggests a natural link between the MEI and MON processes and exchange rates, as the financial sector's stability and the level of macroeconomic uncertainty can impact the volatility.[11]

Time Preference and Household Expectations. Models of capital accumulation have been at the center of the theory of economic growth and business cycles. These models revolve around the dynamic decisions made by agents regarding their consumption and saving behavior, driven by the intertemporal trade-offs between present and future consumption. One crucial element within these models is the rate of time preference. Unlike the usual neoclassical approach, we do not assume that time preference is a fixed parameter, but rather that it adjusts according to average consumption growth, the IST, MEI, and MON shocks. By incorporating these adjustments, we capture the dynamic nature of time preference, which plays a pivotal role in shaping agents' decisions concerning consumption and saving over time.

The inclusion of time preference as a variable that adjusts over time in our model captures two important aspects of OPT agents' behavior in their intertemporal consumption decisions. The first reflects a consumption externality. The agent's consumption is affected by the consumption of others. The second, reflects changes in expectations. Agents' consumption is affected by changes in expectations about the evolution of the economy caused by macroeconomic shocks. Fluctuations in the macroeconomic environment can lead to adjustments in agents' expectations about future income and economic conditions, which, in turn, affect their intertemporal consumption choices.

Our choice of the time preference parameter is grounded in existing literature that models discount factors as time-varying variables. Numerous theoretical and empirical studies have raised concerns about the widespread use of fixed discount factors and have highlighted the importance of considering time-varying discounting patterns in economic analysis (see, e.g., Frederick et al. (2002)). Furthermore, the IST, MEI, and MON shocks play a central role in determining asset prices, because these shocks also affect demand for assets through changes in agents' time preference. Our model delivers an asset pricing equation with a risk factor associated with time preference shocks that is similar to the "Valuation risk" explored in the asset pricing literature.[12] By incorporating these elements into our model, we provide a framework that captures the dynamics of time preference and its implications for consumption behavior and asset pricing. This allows us to study how changes in intertemporal preferences, driven by consumption externalities and macroeconomic shocks, affect individuals' decisions, economic outcomes, and the pricing of financial assets.

As emphasised by Becker and Mulligan (1997), time preference plays a key role in theories of saving and investment, economic growth, interest rate determination, and asset pricing. The literature has

[11] The conjecture that the financial sector is crucial in mitigating the adverse effects of uncertainty on the real sector has been extensively investigated in the literature (Aghion et al., 2004; Raddatz, 2006; Carriere-Swallow and Cespedes, 2013; Dabla-Norris et al., 2013; Bloom et al., 2018; Karaman and Karaman-Yildirim, 2019). The model developed by Aghion et al. (2004) focuses on the role of financial constraints on firms and financial development in explaining macroeconomic stability and business cycle fluctuations. They demonstrate that countries at an intermediate level of financial development, rather than highly developed or underdeveloped ones, tend to exhibit the highest volatility. This suggests that countries in the process of expanding their financial development may experience increased short-term volatility. The underlying mechanism in their model combines two opposing forces. First, greater investment leads to increased production and profits, which enhances the credibility of firms and improves their access to lending. This, in turn, stimulates further investment. On the other hand, firms face borrowing constraints that limit their ability to secure sufficient funding for investment. In economies with very high levels of financial development, most firms are not constrained by funding sources, thus reducing the impact of borrowing constraints. Conversely, in economies with very low levels of financial development, firms face severe limitations on their borrowing capacity regardless of the availability of funding. The authors conclude that in both highly developed and underdeveloped financial systems, shocks to cash flow do not play a significant role in generating instability. However, they find that at intermediate levels of financial development, cash flow shocks can have an effect that leads to instability. Additionally, Aghion et al. (2004) argue that when economies open themselves to foreign capital, it can increase the availability of financing sources. However, this also introduces the potential for increased sensitivity to shocks, which in turn may contribute to greater macroeconomic volatility and business cycle fluctuations. Lastly, the authors note that their model reflects the experiences of many emerging countries in Asia, Latin America, and Europe.

[12] There are several papers that consider shocks to preferences or "taste shocks" in the asset pricing literature (Campbell, 1986; Stockman and Tesar, 1995; Pavlova and Rigobon, 2007; Maurer, 2012; Gabaix and Maggiori, 2015; Albuquerque et al., 2016; Chen and Yang, 2019; Gomez-Cram and Yaron, 2021). Albuquerque et al. (2016) call the risk associated with preference shocks as "Valuation risk".

explored several potential determinants of time preference, such as educational attainment, changes in life expectancy and mortality rates, consumption habits, considerations of one's present and future "self", uncertainty about future outcomes in uncertain environments, and changes in the stock of wealth (Becker and Mulligan, 1997; Frederick et al., 2002). Early contributions to the theory of time-varying preferences focused on the endogeneity of agents' discount rates. These studies assumed that time preference is an increasing function of the level of utility and, consequently, consumption flows (Uzawa, 1968; Epstein, 1987; Obstfeld, 1990), or an increasing function of wealth (Lucas Jr and Stokey, 1984). One implication of this assumption is that agents become impatient as they become richer. More recent papers propose that agents become more patient as they become richer and assume that the discount factor depends negatively on the flow of consumption or the stock of wealth (Becker and Mulligan, 1997; Das, 2003; Kam, 2005; Kam and Mohsin, 2006), and the stock of capital (Stern, 2006; Erol et al., 2011). On the other hand, Chen and Yang (2019) associates time-varying discount factor with agent's longevity[13], Creal and Wu (2020) assume that the rate of time preference is stochastic but it also depends on macroeconomic variables (aggregate consumption and inflation) and other authors consider a pure stochastic discount factor (Dutta and Michel, 1998; Eggertsson, 2011; Maurer, 2012; Nakata and Tanaka, 2020; Guerrieri et al., 2020; Gomez-Cram and Yaron, 2021; Kliem and Meyer-Gohde, 2022).[14]

In contrast to the studies that maintain the assumption of consistent preferences, another body of literature challenges this traditional view by suggesting that discount rates are not constant over time. These authors propose alternative discount functions that allow for decreasing discount rates (hyperbolic discounting), which contradicts the time consistency assumption (see, e.g., Mazur (1987), Loewenstein and Prelec (1992), Barro (1999), and Luttmer and Mariotti (2003)).

The time discount factor represents the degree to which the individual values future utility when making present decisions. OPT households consider savings necessary to increase future production and consumption. In addition to the traditional neoclassical motives that determine the subjective discount factor, we also incorporate a "long-term" and a "short-term" factor. These factors stem from households' expectation regarding the future prospects of the Home and Foreign economies. The "long-term" factor may be associated with the impact of longer life expectancy and lower death probabilities on households' plans for future consumption (Becker and Mulligan, 1997). In our model, individuals perceive future utility from consumption as uncertain. Consequently, they save in the present to mitigate consumption fluctuations in the future and secure resources for retirement.

The "short-term" factor can be associated with the "keeping up with the Joneses" behavior. As emphasized by Obstfeld (1990), when time preference depends on households' own consumption, it can be viewed as a special case of habit formation. An alternative model considered by Schmitt-Grohé and Uribe (2003) takes into account that time preference depends on average per capita consumption. In our model, we assume that time preference depends on average per capita consumption growth. In particular, it can be seen as a simple case of "keeping up with the Joneses", where a household's impatience to consume increases as the average per capita consumption growth rises. This feature is captured by the endogenous part of the discount factor. Thus, this endogenous part of time preference implies that the higher the average per capita consumption growth, the lower the household discount factor.

Our model connects local (Home and Foreign) and global IST, MEI, and MON shocks with good news about investment and consumption. Global shocks have the potential to influence all economies, capturing waves of world economic growth resulting from positive global investment shocks (IST and MEI), or economic slowdowns caused by increases in money demand (MON) due to greater global uncertainty. Since global shocks affect all countries simultaneously, they can impact household consumption in all economies. This can occur either because OPT households can seize higher investment opportunities

[13] Chen and Yang (2019) explore the effects of time preference shocks associated with changes in longevity on the cross-sectional asset pricing of US equity returns. They find that agents become impatient following a negative longevity shock. They construct a consumption-based three-factor model, including longevity risk, consumption growth rate, and the market portfolio, where longevity has a negative price of risk.

[14] Maurer (2012) develops an asset pricing model that highlights the significance of shocks to the agent's subjective time discount rate as a driving force in asset pricing. The author demonstrates that uncertainty in the time discount rate leads to a substantial risk premium. Furthermore, Maurer (2012) generates a time series of the time discount rate from the model and finds that it is highly positively correlated with the price-earnings ratio of US stocks. As emphasized by the author, this is important because the price-earnings ratio reveals valuable information about financial and macroeconomic variables. On the other hand, Gomez-Cram and Yaron (2021) find highly negative correlation between the time series of the time discount rate generated by their model and measures of the degree of financial stress in the US market.

or because they face higher levels of macroeconomic uncertainty. However, due to heterogeneity across countries in terms of shock absorption, global shocks can have different effects across countries.

Local disturbances have a direct effect on the domestic economy only. When the Home economy becomes more competitive than the Foreign economy, Home agents become optimistic about its future prospects. These agents recognize that future developments in the domestic economy depend on physical capital investment, which, in turn, determines the level of future consumption. To form their expectations about the future developments of both economies, domestic agents compare the local IST, MEI, and MON shocks that hit each economy. They take into account the different shocks and their impact on investment opportunities and macroeconomic uncertainty. These expectations play a crucial role in shaping the decisions of Home agents regarding consumption and saving, as well as their assessments of investment opportunities in the Home economy.[15]

When local shocks materialize, they reveal the present state of the economies. Agents use this information to form their expectations about the future evolution of the Home and Foreign economies. A fall in κ_t, triggered by a positive IST or MEI shock, means that Home agents become more confident, leading to positive expectations about the future (greater investment opportunity relative to the Foreign economy). A fall in κ_t, triggered by a positive MON shock, means a higher level of macroeconomic uncertainty, prompting Home agents to reduce current consumption to smooth future consumption. This creates an incentive to savings ("good news for investment" or "bad news for consumption"), where the "long-term factor" dominates the agents' decision. On the other hand, an increase in κ_t means that Home agents become less confident (indicating less investment opportunity relative to the Foreign economy) or may signal a lower level of macroeconomic uncertainty. This works to persuade Home agents to increase present consumption and reduce savings ("bad news for investment" or "good news for consumption"), with the "short-term factor" dominating the agents' decision.

Home Households' expectations about the prospects on future developments in both countries are driven by the effect of local shocks on κ_t. As positive local IST and MEI shocks indicate improvements within the production sector of the economy, which are interpreted as "good news for investment". Conversely, a positive local MON shock indicates the dominance of increases in macroeconomic uncertainty when compared to current financial innovations, leading to an increase in money demand. Households perceive this shock as "bad news for consumption", which increases savings. In contrast, negative news to local investment or decreases in macroeconomic uncertainty reinforces the *consumption externality* associated with "keeping up with the Joneses". Home households become more impatient about consuming right now. On the other hand, a positive global IST or MEI shock (or a negative global MON shock) are interpreted as "good news for investment" in both economies. As a result, both Home and Foreign households become more patient about consuming right now. Importantly, both local and global shocks drive currency excess returns in both countries.

Asset Pricing and Time Preference. Currency excess returns are linked to the IST, MEI, and MON processes through time preference shocks. Three important points can be made regarding the role of the time preference channel in transmitting shocks:

1. Our model predicts that currency excess returns depend on two key factors: i) the difference between local Home and Foreign IST, MEI, and MON shocks; and ii) the heterogeneous effect of the global IST, MEI, and MON shocks on each country.

2. Incorporating time preference shocks is crucial for understanding the behavior of CT returns. To illustrate this point, notice that "bad news for consumption" triggered by local shocks is associated with a low CT return and a low level of consumption. Low payoff occurs when the OPT agent values even more the additional dollar of return. Consequently, uncertainty in the agent's subjective time discount rate carries a market price of risk. An increase in patience is associated with a reduction in current consumption. As CT returns are decreasing in patience, the agent requires a positive compensation to engage in such an investment.

[15] Suppose there is a positive technology shock in both the Home and Foreign economies, and the magnitude of the shock in the Foreign economy is greater than in the Home economy. Despite the positive economic effect caused by the local shock on the return on capital investment in the Home economy, time preference decreases, and Home households become less patient, leading to a boost in Home consumption. It is important to note that these results depend solely on the magnitudes of the shocks, given that the Home and Foreign economies are symmetric.

3. Positive news about currency excess returns is associated with an increase in OPT households' consumption. Therefore, we expect OPT households to become less patient when facing a positive increase in Foreign bond returns because they have the opportunity to widen the gap between their level of consumption and that of the average individual. As a result, the time preference shock affects the consumer's saving decision and acts as an intertemporal asset demand shifter.[16]

Shock Processes Structure. Total factor productivity, government expenditure and the monetary policy innovation obey the following stationary stochastic process:

$$LogA_t = (1-\rho_A)log\overline{A} + \rho_A LogA_{t-1} + \epsilon_{A,t},$$

$$LogG_t = (1-\rho_G)log\overline{G} + \rho_G LogG_{t-1} + \epsilon_{G,t},$$

$$gc_t = \rho_{gc} gc_{t-1} + \epsilon_{gc,t}, \tag{3.75}$$

where $\overline{A}$ is the steady state total factor productivity value, $\rho_i \in (-1,1)$, $\epsilon_{i,t} \sim N(0,\sigma_i)$, where $i \in \{A,G,gc\}$; $\text{Cov}(\epsilon_{i,t},\epsilon_{j,t}) = 0$ and $\text{Cov}(\epsilon_{i,t},\epsilon^*_{j,t}) = 0$, where (i, j) $\in \{A,G,gc\}$ for all t ≥ 0, with the exception of the total factor productivity process, since we assume that the correlation between the Home and Foreign shock is equal to 1. We assume that there is no correlation within countries and between countries between: i) factor productivity, government spending and monetary policy processes; and ii) the IST, MEI, and MON processes.

We follow the literature and assume that currency excess returns are compensation to households for bearing country specific risk and a global risk (Lustig et al., 2011, 2014; Colacito et al., 2018; Verdelhan, 2018). The first is associated with changes in the IST, MEI, and MON processes caused by country-specific shocks. The second is associated with changes in the same processes caused by global shocks. We allow the Home and Foreign countries to have distinct exposures to global shocks. We assume that the IST, MEI, and MON follow the joint process:

$$\begin{bmatrix} log\psi_t \\ log\mu_t \\ log\iota_t \end{bmatrix} = \begin{bmatrix} 1-\rho_\psi & 0 & 0 \\ 0 & 1-\rho_\mu & 0 \\ 0 & 0 & 1-\rho_\iota \end{bmatrix} \begin{bmatrix} log\overline{\psi} \\ log\overline{\mu} \\ log\overline{\iota} \end{bmatrix} + \begin{bmatrix} \rho_\psi & 0 & 0 \\ 0 & \rho_\mu & 0 \\ 0 & 0 & \rho_\iota \end{bmatrix} + \begin{bmatrix} log\psi_{t-1} \\ log\mu_{t-1} \\ log\iota_{t-1} \end{bmatrix} + \begin{bmatrix} \Gamma^g_\psi & 0 & 0 \\ 0 & \Gamma^g_\mu & 0 \\ 0 & 0 & \Gamma^g_\iota \end{bmatrix} \begin{bmatrix} \epsilon^g_{\psi,t} \\ \epsilon^g_{\mu,t} \\ \epsilon^g_{\iota,t} \end{bmatrix} + \begin{bmatrix} \epsilon_{\psi,t} \\ \epsilon_{\mu,t} \\ \epsilon_{\iota,t} \end{bmatrix}$$

$$\text{with} \begin{bmatrix} \epsilon^g_{\psi,t} \\ \epsilon^g_{\mu,t} \\ \epsilon^g_{\iota,t} \end{bmatrix} \sim \text{i.i.d N} \left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma^g_\psi & 0 & 0 \\ 0 & \sigma^g_\mu & 0 \\ 0 & 0 & \sigma^g_\iota \end{bmatrix} \right) \quad \text{and} \quad \begin{bmatrix} \epsilon_{\psi,t} \\ \epsilon_{\mu,t} \\ \epsilon_{\iota,t} \end{bmatrix} \sim \text{i.i.d N} \left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\psi & 0 & 0 \\ 0 & \sigma_\mu & 0 \\ 0 & 0 & \sigma_\iota \end{bmatrix} \right),$$

where $\overline{\psi}$, $\overline{\mu}$ and $\bar{\iota}$ are the steady-state values of the respective stochastic processes; $\epsilon^g_{i,t}$ represent global shocks; $\rho_i \in (-1,1)$ where $i \in \{\psi,\mu,\iota\}$; and $\text{Cov}(\epsilon^g_{i,t},\epsilon_{j,t}) = 0$, where (i, j) $\in \{\psi,\mu,\iota\}$ for all t ≥ 0. We allow contemporaneous correlation between countries of innovations in the IST, MEI, and MON processes (e.g., the correlation between $\epsilon_{\psi,t}$ and $\epsilon^*_{\psi,t}$ may differ from zero). However, we assume that there is no cross-correlation between the processes (e.g., the correlation between $\epsilon_{\psi,t}$ and $\epsilon^*_{\mu,t}$ or $\epsilon_{\psi,t}$ and $\epsilon_{\mu,t}$ equals zero). $\Gamma^g_\psi, \Gamma^g_\mu$, and Γ^g_ι represent the country's weights attached to the global shocks. The greater the weight, the greater the impact of the global shocks on the country.

As emphasized by Colacito et al. (2018), the heterogeneous loadings associated with global shocks (Γ^g_ψ, Γ^g_μ and Γ^g_ι) can be seen as a reduced form way of capturing a mix of fundamental differences across countries such as size, commodity intensity, financial integration and trade openness. As in our model macroeconomic fluctuations are mainly driven by changes in households' time preference and in the IST,

[16] As emphasized by Albuquerque et al. (2016), time preference shocks can also be thought of as a way of reflecting the effect of fluctuations in market sentiment on asset price volatility, as discussed in Barberis et al. (1998) and Dumas et al. (2009).

MEI, and MON processes, countries' heterogeneous exposures to global shocks end up being important drivers of households' consumption-saving decisions and currency excess returns. This is because global shocks affect the evolution of IST, MEI, MON and household's time preference, which, in turn, helps determine consumer decisions and asset prices. We assume that innovations to time preference are combinations of the local and global IST, MEI, and MON shocks:

$$log\kappa_t = (1-\rho_\kappa)log\overline{\kappa} + \rho_\kappa log\kappa_{t-1} + \epsilon_{\kappa,t},$$

$$\epsilon_{\kappa,t} = \gamma\left[(\epsilon^*_{\psi,t} - \epsilon_{\psi,t}) + (\epsilon^*_{\mu,t} - \epsilon_{\mu,t}) + (\epsilon^*_{\iota,t} - \epsilon_{\iota,t}) - (\Gamma^g_\psi \epsilon^g_{\psi,t} + \Gamma^g_\mu \epsilon^g_{\mu,t} + \Gamma^g_\iota \epsilon^g_{\iota,t})\right], \tag{3.75}$$

where $\overline{\kappa}$ represents the steady-state value of the process and $\epsilon_{\kappa,t}$ is the time preference shock. Households posit that the lower the degree of home bias, captured by $(1-\gamma)$, the greater should be the impact of global shocks and differentials between local Foreign and Home shocks on households' time preference. This is because the home bias is directly associated with international trade, which is an important transmission channel in our model. As global shocks affect both countries, when they occur, we observe shifts in the same direction in OPT household consumption in both countries. However, the effect of global shocks on currency excess returns depends on countries' heterogeneous loadings. Thus, the covariance between currency excess returns and κ_t also depends on the values of the heterogeneous loadings attached to each country. As will be shown next, if the Foreign country has larger loadings than the Home country, from the perspective of an OPT Home household, the Foreign bond will provide a hedge against drops in consumption. Otherwise, such investments will be risky.

Heterogeneous loadings capture each country's exposure to global shocks. A country's exposure depends on how much the country is affected by global shocks and its absorption capacity. In general, developed countries use their available resources more productively and tend to have a higher level of absorption of the IST and MEI global shocks than developing ones. They have more diversified economies (they produce and export more products) and are more technologically advanced than developing economies. Developed countries tend to have synchronized business cycles and tighter trade and financial linkages. These linkages generate both demand and supply spillovers across countries (Kose et al., 2003b; Ahir et al., 2022). As emphasized by Sala-i Martin and Artadi (2004) developed countries tend to be more efficiency-driven or innovation-driven economies, in contrast with factor-driven developing countries.[17] Therefore, they are more prone to take advantage of global IST and MEI shocks.

We also assume that developed countries carry a higher level of absorption in the global MON shock than developing countries. First, because they are more globally interconnected than developing countries. Second, because in moments of greater global uncertainty, capital moves away from emerging countries and towards advanced economies (see, e.g., Obstfeld et al. (2009), Caldara and Iacoviello (2017), and Kang et al. (2020)). This is an additional source of money demand in advanced economies during periods of heightened global uncertainty. Note that, in general, developing countries experience more volatile business cycles than developed ones. Therefore, we should expect them to be more affected by the MON shocks. However, we consider that much of the increase in money demand in these countries is driven by local rather than global disturbances. This is justified, for instance, because developing countries are more subject to the occurrence of revolutions, wars, political instability and have less effective stabilizing macroeconomic policies (Koren and Tenreyro, 2007).

In our model, the local and global IST, MEI, and MON shocks affect not only the IST, MEI, and MON processes, but also households' time preference. They trigger business cycle fluctuations and asset price changes. Not only the magnitude of the shocks, but also countries' heterogeneous exposure to global shocks is critical to understanding changes in nominal exchange rates and interest rates that drive currency excess returns. Next, we analyze the macroeconomic implications of our model setup. We begin by deriving the deterministic steady state.

[17] Factor, efficiency and innovation-driven are growing degrees of complexity in economic activities. They are used by Sala-i Martin and Artadi (2004) to construct the Global Competitive Index. Note that, developed and developing countries can be at different stages of complexity. For example, a developing country can be in a transition from factor to innovation-driven stage.

3.10 Deterministic Steady State

Variables with no time index denote the steady-state level. We derive the steady state of the Home country. Similar expressions apply to the Foreign country. We assign the following values to the threshold bond real values $\overline{b}_h = \overline{b}_f = 0$ ($b_h^* = \overline{b}_f^* = 0$), for the inflation target $\overline{\pi} = \overline{\pi}_h = 1$ ($\overline{\pi}^* = \overline{\pi}_f^* = 1$) and for the constant parameters of the stochastic processes $\overline{\psi} = \overline{\mu} = \overline{\iota} = \overline{\kappa} = 1$. We also assume that $P = P_h = p_h = 1$, $\pi^w = 1$ ($\pi^{w,*} = 1$) and a zero-inflation steady state, $\pi = \pi_h = 1$ ($\pi^* = \pi_f^* = 1$). In the steady-state, the share of government spending of GDP equals $G = 0.2$ ($\overline{G} = 0.2$) and OPT households do not hold any bonds, $b_h^o = b_f^o = 0$. Since $\overline{A}$ only affects the scale of the economy, we normalize $GDP = 1$ and compute *ex-post* $\overline{A}$. We also normalize $u = 1$ and compute Ξ_1. We set $L = 1/3$ and compute χ_l *ex-post*. We set T^r to obtain $C^o = C^r = C$. Note also that, based on the assumptions imposed in the Unions problem, $L^o = L^r = L$. The stochastic processes in the steady state imply:

$$A = \overline{A}, \quad G = \overline{G}, \quad \psi = \overline{\psi}, \quad \mu = \overline{\mu}, \quad \iota = \overline{\iota}, \quad \text{and} \quad \kappa = \overline{\kappa}.$$

Equations (3.22), (3.20), (3.23) and (3.24) entail the following steady-state values:

$$r^k = \frac{1}{\beta} - 1 + \delta_0, \quad \vartheta = 1, \quad R = \frac{\pi}{\beta}, \quad \text{and} \quad R^* = \frac{\pi^*}{\beta}.$$

From the first-order condition for capacity utilization, Ξ_1 must be set to fix steady-state utilization equal to 1:

$$\Xi_1 = \frac{1}{\beta} - 1 - \delta_0.$$

Given the value for p_h, we obtain p_f from equation (3.9):

$$p_f = \left\{ \frac{1}{\gamma} \left[1 - (1-\gamma) p_h^{1-\eta} \right]^{\frac{1}{1-\eta}} \right\}.$$

We obtain the real exchange rate by combining the law of one price with equation (3.9):

$$1 = \left[\gamma^* (p_h^*)^{1-\eta} + (1-\gamma^*)(p_f^*)^{1-\eta} \right],$$

$$1 = \gamma^* \left(\frac{p_h}{Q} \right)^{1-\eta} + (1-\gamma^*) \left(\frac{p_f}{Q} \right)^{1-\eta},$$

$$Q = \left[\gamma^* p_h^{1-\eta} + (1-\gamma^*) p_f^{1-\eta} \right]^{\frac{1}{1-\eta}}.$$

By equation 3.43 we obtain:

$$mc = p_h \frac{\epsilon - 1}{\epsilon}.$$

Using the definition of GDP and rearranging equation 3.40:

$$Y_h = \frac{gdp}{p_h} \quad \text{and} \quad K = \frac{\alpha Y_h}{r^k} mc.$$

The steady-steady investment level can be obtained from the law of motion of capital stock:

$$I = \delta_0 K$$

Using equation (3.63) we obtain the trade balance:

$$TB = b_h - \frac{R b_h}{\pi} + Q b_f - Q \frac{R_* b_f}{\pi^*},$$

$$TB = b_h \left(1 - \frac{1}{\beta} \right) + Q b_f \left(1 - \frac{1}{\beta} \right).$$

Substituting equation (3.63) into equation (3.60), we obtain in steady state:

$$C = gdp - I - p_h G - TB.$$

From the first-order condition for consumption:

$$\lambda = C^{-\gamma_c}.$$

Using equation (3.19), we can retrieve real money demand:

$$m^o = (\chi_m)^{\frac{1}{\gamma_m}} \left(\lambda - \beta\frac{\lambda}{\pi}\right)^{-\frac{1}{\gamma_m}}.$$

Rearranging equations (3.41) and (3.51) we can recover the value for χ_l:

$$\chi_l = (1-\alpha)\frac{(\epsilon_w - 1)}{\epsilon_w}\frac{mc}{C^{\gamma_c}}\frac{Y_h}{L^{1+\gamma_l}}.$$

Using the first-order condition for labor demand (3.41) we retrieve the steady-state wage value:

$$W = (1-\alpha)mc\frac{Y_h}{L}.$$

We can recover the value for the calibration of $\overline{A}$ from the production function (3.39):

$$\overline{A} = \frac{Y_h}{K^\alpha L^{1-\alpha}}.$$

From the budget constraint of the ROT household we find T^r:

$$T^r = WL - C.$$

Combining equations (3.52) and (3.53), we derive T^o:

$$T_t^o = \frac{p_h G - \Phi T^r}{1-\Phi}.$$

Lastly, from the fiscal policy rule we obtain:

$$\overline{T^o} = T_t^o \quad \textit{and} \quad \overline{T^r} = T_t^r.$$

3.11 Inspecting the Mechanism

Model Parameters. Our aim is to investigate the role of IST, MEI, and MON shocks in explaining currency excess returns. Our parameterization closely follows the literature associated with DSGE modeling. Table (3.1) shows the parameter values used in the estimation of our baseline model. We consider a period of time to be a quarter. We follow Gali et al. (2007), and use standard parameter values for α, δ_0 and β. In steady state, the share of government spending in GDP is 0.20, the same value used by Gali et al. (2007). Ravn et al. (2007) report an average value of 20% for the share of government spending in GDP for the US, UK, Canada and Australia between 1975 and 2005. However, in contrast to Gali et al. (2007), the government always maintains a balanced budget in our model ($\phi_g = 1$).

The calibrated value used for the share of ROT consumers varies substantially in the literature. For example, Drautzburg and Uhlig (2015) use 0.25, Leeper et al. (2015) employ 0.30, Kriwoluzky (2012) use 0.40 and Colciago (2011), Gali et al. (2007), and Furlanetto et al. (2013) use 0.50 and Andrés et al. (2008) employ 0.65. We adopt a value of 0.50 in our baseline estimation. This is the lowest threshold for obtaining a positive aggregate consumption response to positive IST and MEI shocks. Frisch elasticity estimates range from around 0.70-0.75 in microeconomic studies (Chetty et al., 2011a,b) to around 1.9-4.0 in macroeconomic works (Prescott, 1986; King and Rebelo, 1999; Prescott, 2004; Smets and Wouters, 2007; Justiniano et al., 2011). We follow Furlanetto et al. (2013), and set an intermediate value, $\gamma_l = 1$. We follow Gali et al. (2007), and Furlanetto et al. (2013), and assign the value of ϵ consistent with a steady-state price markup of 20%. We set $\epsilon_w = 4$ implying a steady-state wage markup of 33%. This value is within the range of values for the labor market estimated by Griffin (1992), and is consistent with the calibrations employed by Huang et al. (2004), and Christiano et al. (2005). Furthermore, as emphasized by Furlanetto et al. (2013), this value implies a markup that is in line with DSGE studies.

It is a common strategy followed by the literature to calculate the values of the Rotemberg price and wage adjustment cost parameters Ξ_p and Ξ_w implied by the respective Calvo price ($\aleph_p$) and wage ($\aleph_w$) durations. Up to the first-order approximation, the models are identical in a zero-trend inflation setting (Nistico, 2007; Lombardo and Vestin, 2008). We use the same value adopted by Furlanetto (2011), Gali et al. (2007), and Galí (2011), and assume $\aleph_p = 0.75$ and $\aleph_w = 0.75$, which correspond to an average duration of price and wage of one year. This value is also consistent with the estimates of Justiniano et al. (2011). Given these values we can back out $\Xi_p = \frac{\aleph_p(\epsilon-1)}{(1-\aleph_p)(1-\beta\aleph_p)}$ and $\Xi_w = \frac{\aleph_w(\epsilon_w-1)(1+\gamma_{lw})}{(1-\aleph_w)(1-\beta\aleph_w)}$.

We set the values of ϕ_π, ϕ_{gdp}, ϕ_{mg} and ρ_r close to the parameter estimates reported by studies that include money growth rate in the Taylor rule (Andrés et al., 2009; Canova and Menz, 2011; Castelnuovo, 2012). These values are also consistent with estimates from other studies such as Smets and Wouters (2007), even when the money growth rate is not included in the Taylor rule. Regarding the other parameters associated with money, we use the values of γ_m (period utility function), $d1$ and $d2$ (portfolio adjustment cost of real assets) applied by Nelson (2002). As emphasized by Nelson (2002), in the case of no money holding portfolio adjustment cost, $\gamma_m = 5$ implies a steady-state value of the short-term interest rate elasticity of money demand of -0.2 and an income elasticity of 0.4. These values are in line with those estimated in the literature for the US (Ball, 2001; Knell and Stix, 2005).

The steady-state value of the investment cost parameter is set equal to the one used by Christiano et al. (2005). We interpret ν_1 as a parameter that controls the influence of the aggregate consumption growth rate on household intertemporal decisions (endogenous discount factor function). Therefore, we consider ν_1 similar to a measure of external habit formation and set its value close to the degree of habit formation used by Christiano et al. (2005), and Smets and Wouters (2007). Regarding ν_2 we follow Schmitt-Grohé and Uribe (2003), and set its value equal to -0.11. There is substantial uncertainty about γ_c which tends to be estimated with very large standard errors. Existing estimates of the relative risk aversion coefficient are very dispersed. For example, estimates from Mehra and Prescott (1985), and Kocherlakota et al. (1996) exceed 10, Szpiro (1986) estimate values between 2 and 10 and Smets and Wouters (2007) obtain a value around 1.38. Many studies implicitly adopt a relative risk aversion coefficient of 1 (Prescott, 1986; King and Rebelo, 1999; Christiano et al., 2005; Justiniano et al., 2011) or 2 (Benigno, 2009; Benchimol and Fourçans, 2012). We set the relative risk aversion coefficient to $\gamma_c = 2$.

As emphasized by Obstfeld and Rogoff (2000), the elasticity of substitution between Home and Foreign goods is a key parameter in open economy models. In general, the International Real Business Cycle literature assumes values in the range of 0.8-2.0. For instance, Corsetti et al. (2008) use 0.85, Benigno (2009) considers values between 0.8 and 6, Cooke (2010) employs 1.75 and Basu and Thoenissen (2011) set the value equal to 2. We chose an intermediate value of 1.25. We follow Corsetti et al. (2008), and assume a degree of consumption home bias of 0.28, which is close to value used by Cooke (2010), which is consistent with the range of values considered by Basu and Thoenissen (2011), as well as the value of 0.24 estimated by Justiniano and Preston (2010).

The adjustment cost parameter associated with bond holdings is generally calibrated to a small value in the literature (see, e.g., Schmitt-Grohé and Uribe (2003), Benigno (2009), and Ghironi et al. (2015)). We set it equal to 0.012, which is in line with the value used by Benigno (2009). We use χ_l to pin down the steady-state hours to L=1/3 of the available time. We set χ_m to obtain a steady-state money stock to GDP ratio of around 0.35, which is roughly the average of M1 and M2 to GDP for the US between 1980 and 2019. As discussed in the last subsection, Ξ_1 is defined to pin down the steady-state capital utilization at 1. The parameter Ξ_2 controls the capital utilization; when $\Xi_2 \to \infty$, $u_t = 1$. This parameter helps to control the effect of shocks on output, employment, consumption, and investment. We set $\Xi_2 = 5$, consistent with the value used by Junior (2016). The values chosen for the persistence parameters (ρ_A, ρ_G, ρ_v, and ρ_κ) and standard deviations (σ_A, σ_G, and σ_v) for the stochastic processes that govern total factor productivity, government spending, monetary policy innovation, and time preference are well within the range of values found in the literature (see, e.g., King and Rebelo (1999), Smets and Wouters (2007), Justiniano and Preston (2010), Justiniano et al. (2011), and Benchimol and Fourçans (2012)).

Table 3.1
Structural Model Parameter Values

The table shows the calibrated values of the parameters used in the simulation and in calculating the steady state value of the model variables.

Parameter	Description	Value
γ	Share of Foreign good in the Home basket	0.28
γ^*	Share of Home good in the Foreign basket	0.28
η	Elasticity of substitution between Home and Foreign goods	1.25
β	Exogenous part of discount factor	0.99
ν_1	Endogenous discount factor parameter 1	0.65
ν_2	Endogenous discount factor parameter 2	-0.11
d1	Parameter of adjustment cost of real asset portfolio 1	0.86
d2	Parameter of adjustment cost of real asset portfolio 2	0.43
δ_0	Depreciation rate	0.025
Ξ_b	Bond portfolio adjustment cost parameter	0.012
Ξ_I	Investment adjustment cost parameter	2.48
χ_l	Labor preference scale parameter	10.325
χ_m	Real asset preference scale parameter	0.00015
γ_c	Relative risk aversion coefficient	2
γ_l	Inverse of the Frisch elasticity coefficient	1
γ_m	Inverse of the elasticity between money holdings and the interest rate	5
ϵ	Elasticity of substitution between intermediate goods	6
α	Elasticity of production with respect to capital	0.33
ϵ_w	Elasticity of substitution between labor types	4
Ξ_p	Price adjustment cost parameter	58.25
Ξ_w	Wage adjustment cost parameter	174.70
Φ	Share of ROT households	0.50
ϕ_g	Tax reaction to government spending	1
ϕ_π	Monetary policy response to inflation	1.5
ϕ_{gdp}	Monetary policy response to output	0.125
ϕ_m	Monetary policy response to real money growth	0.35
ρ_r	Monetary policy inertia	0.80
ρ_ψ	IST persistence	0.70
ρ_μ	MEI persistence	0.60
ρ_ι	MON persistence	0.79
ρ_κ	Time preference persistence	0.50
ρ_A	Total factor productivity persistence	0.90
ρ_G	Public spending persistence	0.90
ρ_v	Monetary policy persistence	0.50
σ_A	Total factor productivity standard deviation	0.007
σ_G	Public spending standard deviation	0.0045
σ_v	Monetary policy standard deviation	0.0025
σ_ψ	IST standard deviation	0.018
σ_μ	MEI standard deviation	0.010
σ_ι	MON standard deviation	0.0175
Ξ_1	Capital utilization parameter 1	0.0351
$\Xi 2$	Capital utilization parameter 2	5

The persistence of the IST and MEI shocks (ρ_ψ and ρ_μ, respectively) are calibrated with values close to the estimates of Smets and Wouters (2007), and the value used by Furlanetto et al. (2013). The persistence of the MON shock (ρ_ι) was chosen equal to the Castelnuovo (2012) estimate. We calibrate the standard deviation of the MEI shock equal to 0.01. We set the standard deviation of the IST shock in line with the estimates of Smets and Wouters (2007), and the standard deviation of the MON shock to a value close to the estimates of (Castelnuovo, 2012).

Macroeconomic Dynamics. We now analyze the shock transmission mechanism. We depict the results of this part of the analysis through a set of Impulse Response Functions (IRFs), considering a temporary positive exogenous shock of one standard deviation in the IST, MEI, and MON processes of the Home country.[18]

Figures (3.1) and (3.2) show the result of the local IST shock. The figures reveal a certain degree of synchronization of macroeconomic fluctuations between countries. Variables such as GDP, Aggregate Consumption, ROT Consumption, Hours, Inflation, and Interest Rates co-move in both countries as a result of the local Home IST shock. This finding is consistent with previous studies on international comovement of macroeconomic variables, including Kose et al. (2003a), Ambler et al. (2004), and Justiniano and Preston (2010). In our model, trade in goods and bonds promotes the international transmission of shocks, which, in turn, is triggered by the IST shock and its effect on the time preference of OPT households. Consequently, the model generates a positive relationship between IST shocks and macroeconomic variables in the Home economy, such as GDP, Aggregate Consumption, Hours, Investment, and Capacity Utilization.

The transmission mechanism operates as follows. A positive local Home IST shock boosts the return on investment, attracting capital investment from Home OPT households and leading to a higher capital stock in the subsequent period. As a result, the capital replacement value declines, reducing the marginal utilization cost. This prompts a more intensive utilization of existing capital, resulting in increased labor usage, higher wages, and output expansion. The increase in hours worked and wages translates into an expansion of aggregate consumption and ROT household consumption. ROT households do not engage in intertemporal substitution; rather, they base their consumption decision on present income. Consequently, following a local IST shock, they expand their consumption, and if they represent a sufficiently high fraction of households, aggregate consumption also increases.[19]

The Foreign country is directly affected by two main sources of business cycle fluctuations. First, the demand for Foreign goods increases through exports to the Home country, resulting in a surplus in the Foreign country's trade balance. Second, the output of the Foreign country is positively affected by the expansion of the Foreign country's OPT household consumption.

As emphasized by Coeurdacier et al. (2010), IST shocks can help explain the countercyclical nature of the trade balance. This is precisely what we observe in our model. The increase in the rate of return on investment leads to higher production, triggering Home country imports, which negatively affects the Home trade balance and the net foreign asset (NFA) position. Note that in the first 10 quarters, the difference between the increase in Home and Foreign investment is high enough to generate a deterioration in Home net exports. In summary, the local IST shock induces an increase in Home imports and trade deficit. This is followed by purchases of Home bonds by Foreign OPT households that lead to a deterioration of the NFA. This result is consistent with the countercyclicality of the trade balance and the NFA found in the data by Coeurdacier et al. (2010) for a set of developed countries. The inflation rate increases in both countries, though to a lesser extent in the Home economy.

The results presented above are in line with those generated by closed-economy models (Greenwood et al., 1992; Fisher, 2006; Justiniano et al., 2011; Furlanetto et al., 2013) as well as open economy models (Basu and Thoenissen, 2011; Chen and Wemy, 2015). Banerjee and Basu (2019) is a notable exception. They estimate a small open economy model for India considering the period between 1971 and 2010. In their model, a positive IST shock causes a fall in relative price of investment goods, triggering new investment. However, the shock also causes a negative income effect due to the fall in income. This is because the IST shock also reduces the rental price of capital, leading intermediate-goods producers to reduce employment in response to a higher wage and rental price of capital. This, in turn, lower wages in the labor market. In general, the negative income effect outweighs the increase in investment, resulting in a countercyclical IST shock.

When a positive local Home IST shock occurs, the Home currency appreciates, and currency excess returns decrease on impact. In our model, the increased return on investment that drives business cycle expansions reduces Home OPT household consumption ("good news for investment"). Consequently, Home OPT household consumption is countercyclical, while Home ROT household consumption is procyclical. The behavior of Home aggregate consumption can be either procyclical or countercyclical,

[18]We used the Dynare platform to generate the IRFs. Appendix A.3 presents the source code.

[19]Note that, as the IST shock operates directly through capital accumulation and not through the production function, a positive IST shock always causes consumption to fall when prices and wages are flexible, even with a high fraction of ROT households. The addition of nominal rigidites implies a smaller drop in OPT household consumption. Which, together with the increase in ROT household consumption, leads to an increase in aggregate consumption (Furlanetto et al., 2013).

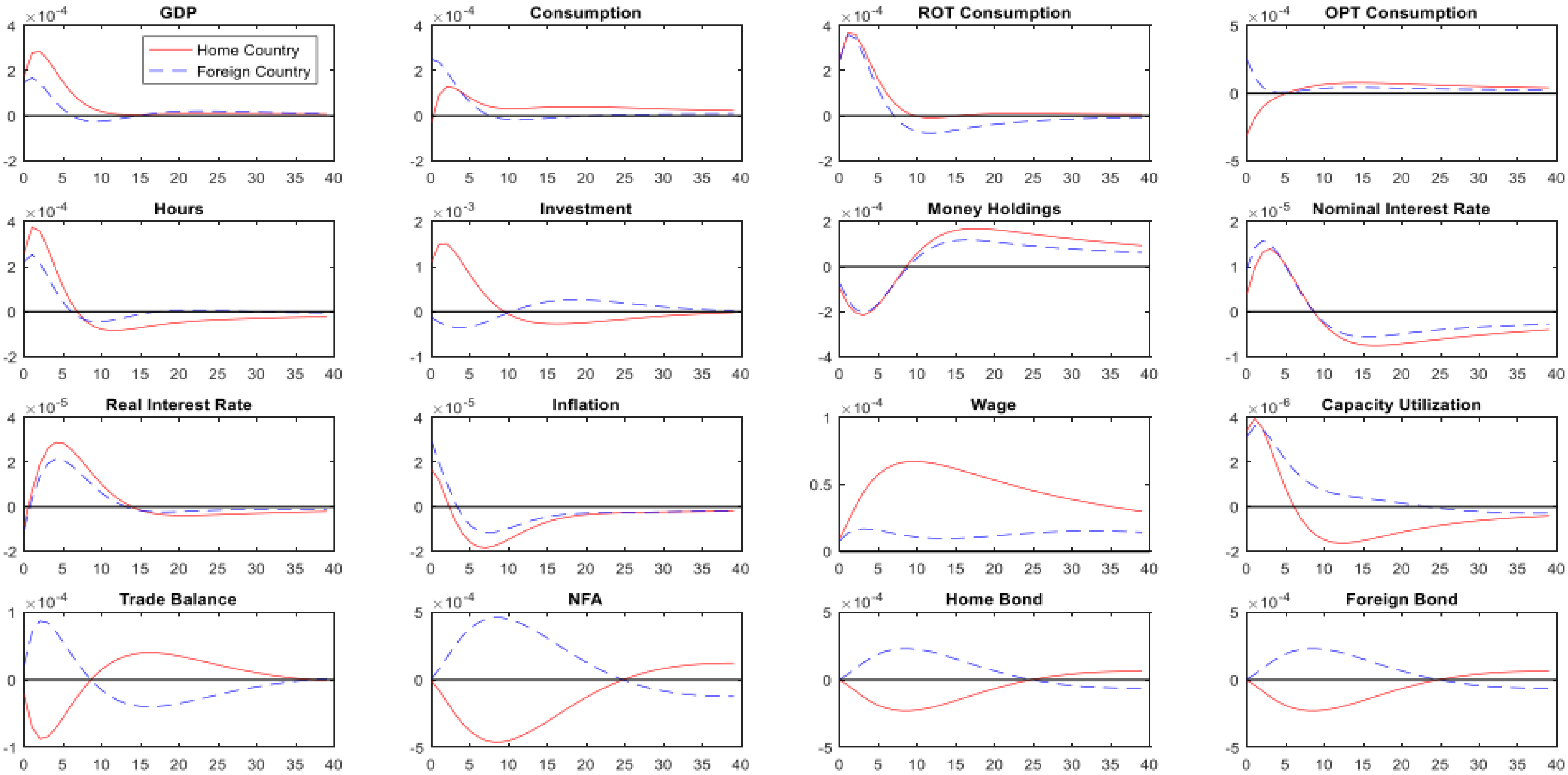


Figure 3.1: Responses to the Local IST Shock. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local IST process.

depending on the share of Home ROT households in the economy. Local Home IST shocks lead to a high Home OPT marginal utility of consumption and low currency excess returns, or equivalently, they carry a positive *risk premium*. CT investments are risky, and thus they must offer a positive premium to encourage investors to engage in this type of investment.

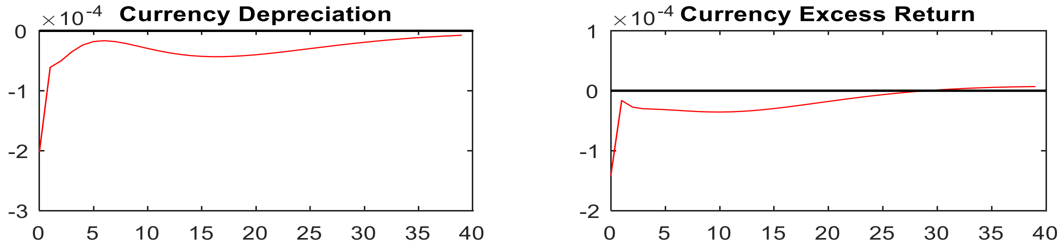


Figure 3.2: Currency Excess Return: Local IST Shock. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local IST process.

The co-movement between equity returns (return on capital investment) and OPT household consumption generated by the model may seem puzzling. The model predicts that investments on equity should act as a hedge against falls in consumption, which contradicts the standard prediction of asset pricing literature. However, we can reconcile our results with this literature by arguing that equity and foreign exchange investments have different time duration profiles. In general, foreign exchange investments tend to have a shorter duration and higher turnover compared to investing in domestic equity. As a result, we should expect different co-movements between each type of investment with consumption, even though both are risky.

In their study, Jagannathan and Wang (2007) estimate the CCAPM using year-over-year consumption growth and find that it explains the cross-section of stock returns as effectively as the three-factor model proposed by Fama and French (1993). The key argument made by Jagannathan and Wang (2007) is that using year-over-year consumption growth allows them to reconcile the CCAPM with the limited empirical evidence supporting the model when applied to stock returns. On the other hand, Parker and Julliard (2005) provide strong evidence against the standard CCAPM, when using contemporaneous consumption growth to explain the cross-section of stock returns. However, when adding cumulative consumption growth over several following quarters, they find strong evidence in favor of the CCAPM. Parker and Julliard (2005) find that adding the three-year cumulative consumption growth explains a large fraction of stock returns variation. These studies provide empirical evidence that suggests a medium to long-run association between stock returns and consumption growth.[20]

The literature on international portfolio diversification provides empirical support for the higher turnover in foreign equity and bond holdings relative to domestic holdings (Tesar and Werner, 1995; Warnock, 2002). Peiris (2010) argues that increased foreign participation in domestic bond markets, both government and corporate, may increase their turnover rate. By comparing countries with high foreign ownership of domestic bonds to those with low foreign ownership, the author concludes that increased foreign investor participation plays a role in increasing the turnover rate. As emphasized by Heath et al. (2007), tracking CT investments in data is challenging. This is because CT can involve transactions in both the bond and foreign exchange markets, or solely in the foreign exchange market. In addition, trades in the foreign exchange market can be settled in different markets (over-the-counter or futures exchange) and through various instruments (forwards, futures, swaps, and options contracts). Nonetheless, Heath et al. (2007) find a connection between high turnover in the foreign exchange market and the implementation of CT strategies. These studies provide empirical evidence supporting our conjecture about the different time duration profiles between foreign exchange and equity investments.

[20] An alternative interpretation of our findings is provided by Papanikolaou (2011), and Kogan and Papanikolaou (2014). Overall, they show that IST shocks generate differences in *risk premium* due to their heterogeneous impact on firms. The firm's risk premium would depend on the contribution of the technology shock to the firm's value. In the data Papanikolaou (2011) finds that firms in the investment sector and firms with high growth opportunities earn lower return, on average, than firms in the consumer sector and firms with low growth opportunities. Returns on the first group of firms are positively affected by IST shocks, providing insurance for households.

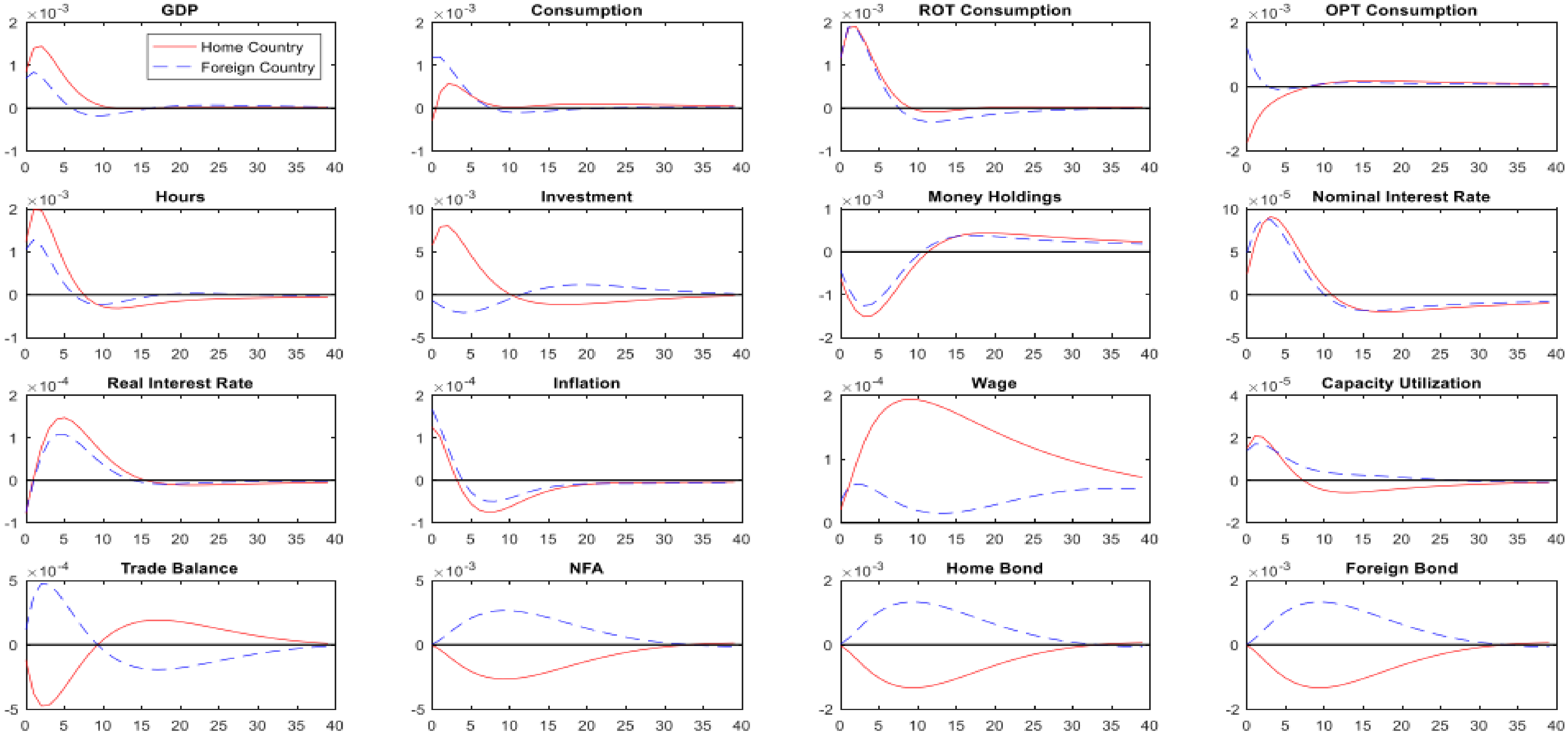


Figure 3.3: Responses to the Local MEI Shock. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local MEI process.

Figures (3.3) and (3.4) display the results of the local Home MEI shock. The figures show a similar dynamic to those obtained with the local IST shock, which is expected since both IST and MEI shocks directly impact capital investment, with these shocks being further amplified by hours worked and capital utilization. Consequently, both shocks lead to capital deepening in the economy. There are only a few differences related to the magnitude of the nominal interest rate, wage, and OPT consumption responses in the Home country. Overall, our findings align with previous studies such as Justiniano et al. (2011) and Hirose and Kurozumi (2012), although differences exist between our model setup and those employed by these authors. Note that, similar to the result of the IST shock, both Home consumption and currency excess returns fall on impact.

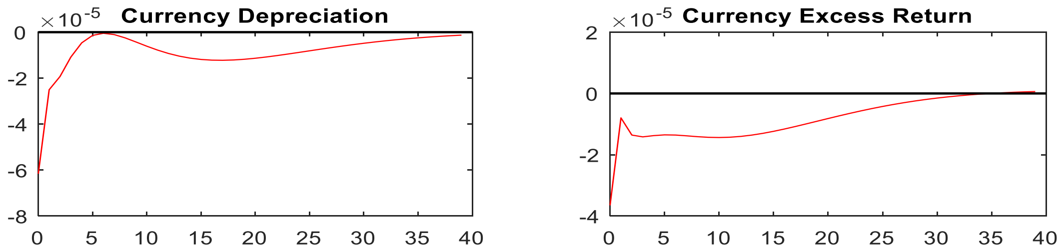


Figure 3.4: Currency Excess Return: Local MEI Shock. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local MEI process.

Figures (3.5) and (3.6) depict the results of the local Home MON shock. In our model, money demand shocks are linked to macroeconomic uncertainty and financial innovations. When uncertainty increases, individuals tend to hold more money balances to optimize their consumption over time, leading to shifts in real money balances and changes in the relative prices of financial and real assets. Consequently, aggregate demand and output are affected (Benchimol and Fourçans, 2012). In our model, a positive local MON shock in the Home country negatively impacts Home OPT household's consumption and positively affects Home investment. This means that an increase in macroeconomic uncertainty encourages OPT households to invest more in capital today to smooth consumption in the future.

Note that the increase in Home investment is not strong enough to offset the drop in aggregate Home consumption, resulting in a decline in Home output. The decrease in Home demand leads to an improvement in the Home trade balance imports. The combination of depressed consumption and rising investment and money holdings leads to a reduction in bond holdings (issued at Home and abroad) and a deterioration of the NFA position in the Home country. On the other hand, a combination of lower wages and fewer hours worked has a direct effect on reducing OPT and ROT household consumption in the Home country. Overall, our results are in line with Castelnuovo (2012), and Benchimol and Fourçans (2012), although they work with closed-economy models. They also find that output declines following a positive shock to money demand. An interesting common conclusion reached by Castelnuovo (2012), and Canova and Menz (2011) is that, regardless of the money demand shock, the omission of money in the model can bias the estimated responses of the variables in an economically relevant way. In the absence of money, the magnitude of the effects of technology, preference and monetary policy shocks on the economy can be damped.

A closer inspection of Figure (3.5) reveals that the co-movement between countries' macroeconomic variables is smaller than the co-movement produced by the local IST and MEI shocks. Notably, the dynamics observed for hours, investment, capacity utilization, and OPT consumption are significantly different between countries. In the Foreign country, the increase in OPT consumption counteracts the negative effects of the fall in investment, ROT consumption, and the deterioration of net exports on economic activity. As a result, output does not fall on impact. Lastly, Figure (3.6) shows that, on impact, Home currency appreciates and currency excess returns fall. Again, currency excess returns are low for OPT Home households exactly when they have high marginal utility of consumption.

Figure (3.7) shows the effects of the respective global IST, MEI, and MON shocks on consumption and currency excess returns. It is important to note that countries' exposures to the global IST, MEI,

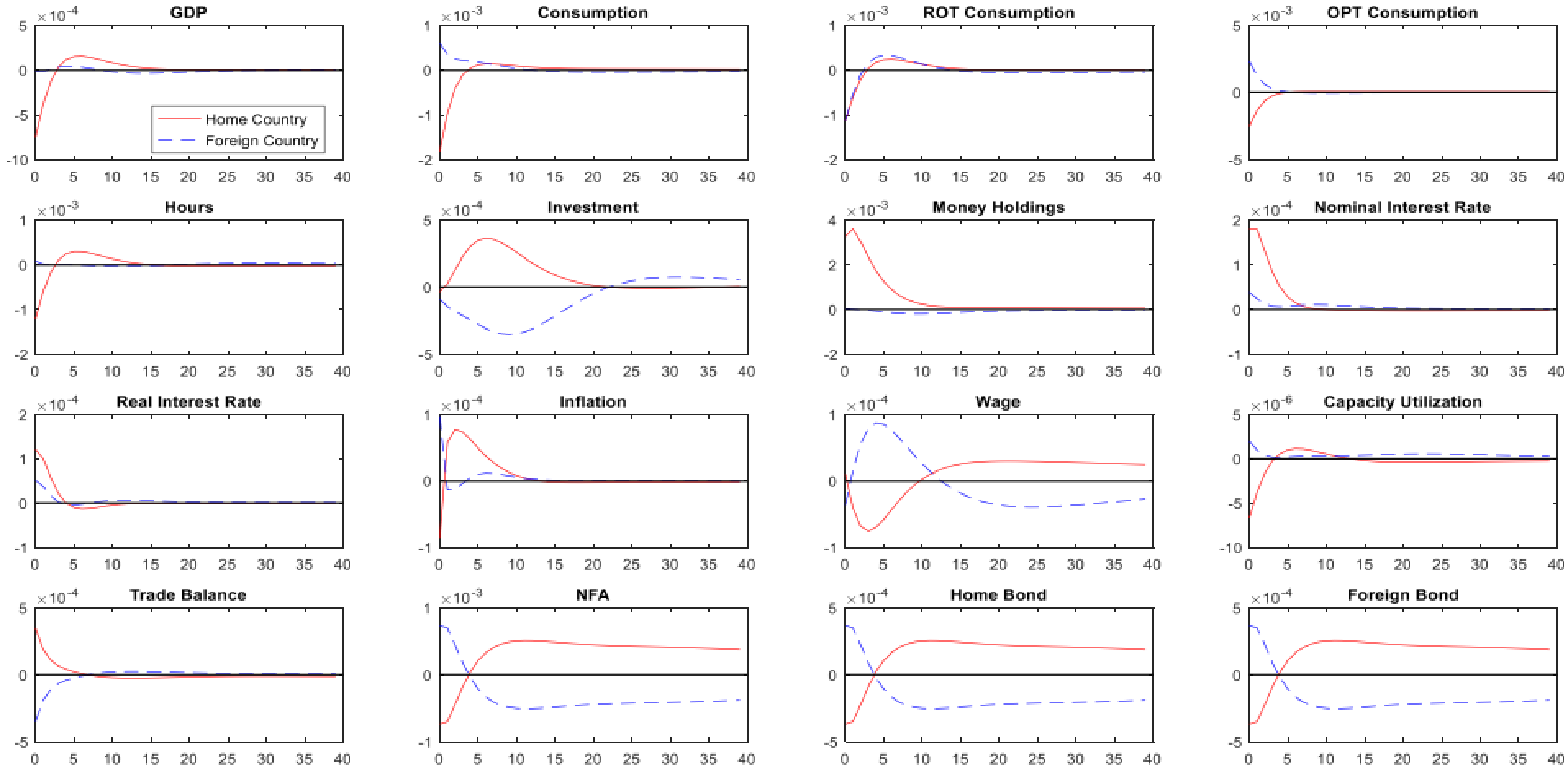


Figure 3.5: Responses to the Local MON Shock. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local MON process.

and MON shocks (the respective Home - Γ_{ψ}^{g},Γ_{μ}^{g}, and Γ_{ι}^{g} - and Foreign - $\Gamma_{\psi}^{*,g}$,$\Gamma_{\mu}^{*,g}$, and $\Gamma_{\iota}^{*,g}$ - loadings) are crucial in determining currency excess returns. These loadings govern the direction and magnitude

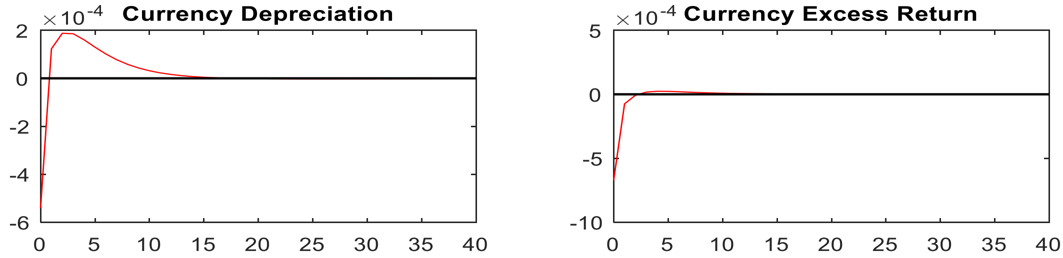


Figure 3.6: Currency Excess Return: Local MON Shock. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local MON process.

of changes in exchange rates and nominal interest rates when global shocks hit economies. We set the values of the Home loadings equal to 1 ($\Gamma_{\psi}^{g} = \Gamma_{\mu}^{g} = \Gamma_{\iota}^{g} = 1$) and the Foreign loadings equal to 1.5 ($\Gamma_{\psi}^{*,g} = \Gamma_{\mu}^{*,g} = \Gamma_{\iota}^{*,g} = 1.5$).

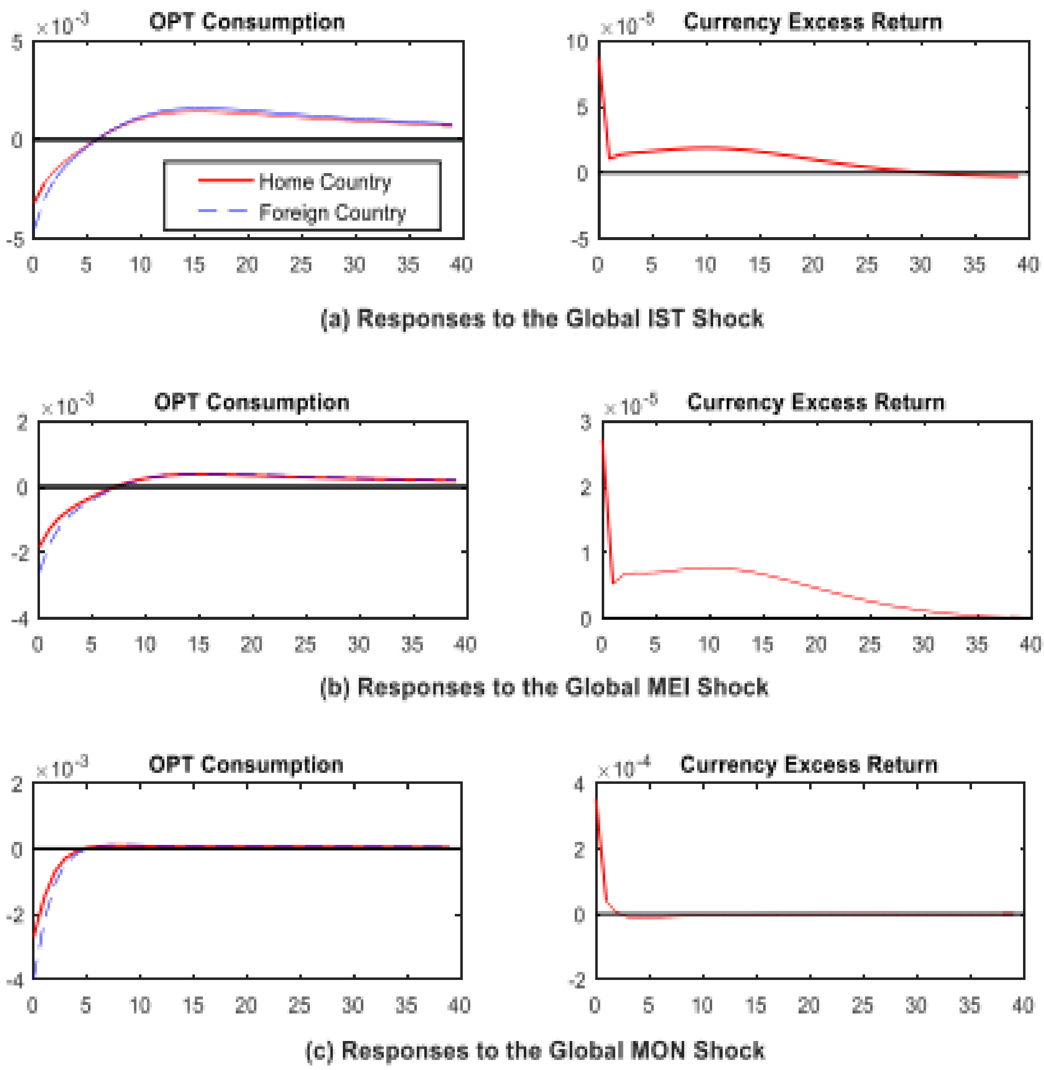


Figure 3.7: Responses to Global Shocks I. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global IST, MEI, and MON processes. The values of the Home loadings are equal to 1 ($\Gamma_{\psi}^{g} = \Gamma_{\mu}^{g} = \Gamma_{\iota}^{g} = 1$) and the Foreign loadings are equal to 1.5 ($\Gamma_{\psi}^{*,g} = \Gamma_{\mu}^{*,g} = \Gamma_{\iota}^{*,g} = 1.5$).

As can be seen from the figure, on impact, currency excess returns increase when Home OPT household consumption falls. Thus, Home investment in Foreign bonds from countries with higher loadings than the Home country provides a hedge for OPT Home households against falls in consumption. Figures (A.3), (A.4), and (A.5) in Appendix A.4 show that the responses of the other macroeconomic variables are very similar to those reported for the respective local IST, MEI, and MON shocks. The only important differences concerns the responses of investment, wage, and output (each country's money aggregate also responds differently to the global MON shock). As Home loadings are smaller than Foreign ones, Home investment and GDP increase less than Foreign ones when the global IST and MEI shocks hit both economies.

Figure (3.8) shows the effects of the respective global IST, MEI, and MON shocks on consumption and currency excess returns. We set the values of the Home loadings equal to 1 ($\Gamma^g_\psi = \Gamma^g_\mu = \Gamma^g_\iota = 1$) and the Foreign loadings equal to 0.5 ($\Gamma^{*,g}_\psi = \Gamma^{*,g}_\mu = \Gamma^{*,g}_\iota = 0.5$). The figure reveals that, on impact, currency excess return decreases when Home OPT household consumption falls. Thus, Home investment in Foreign bonds from countries with lower loadings than the Home country is risky. As revealed by figures (A.6), (A.7), and (A.8) in Appendix A.5, the responses of the other macroeconomic variables are very similar to those reported for the respective local IST, MEI, and MON shocks. The only important differences concern the responses of investment, wage, and output (each country's money aggregate also responds differently to the global MON shock). As Home loadings are greater than Foreign ones, Home investment

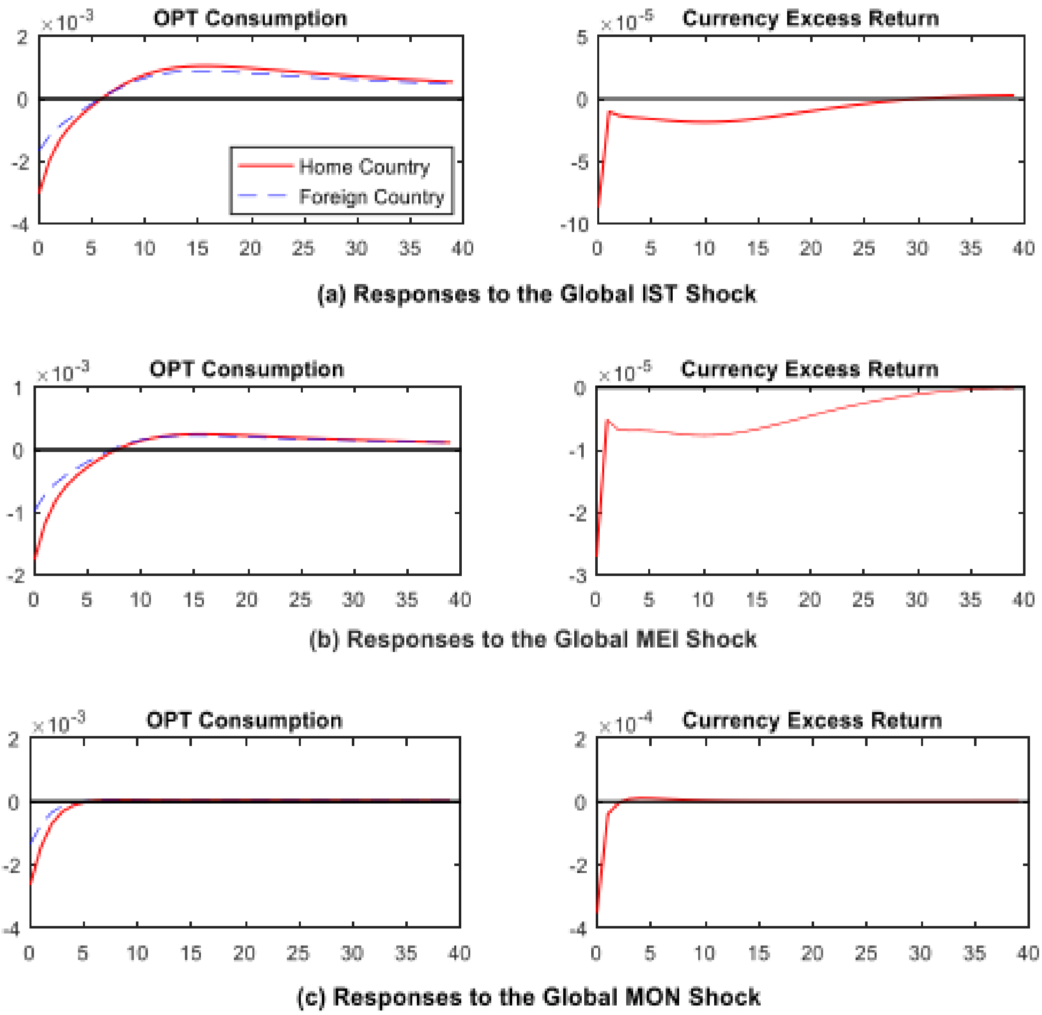


Figure 3.8: Responses to Global Shocks II. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the local IST process. The values of the Home loadings are equal to 1 ($\Gamma^g_\psi = \Gamma^g_\mu = \Gamma^g_\iota = 1$) and the Foreign loadings are equal to 0.5 ($\Gamma^{*,g}_\psi = \Gamma^{*,g}_\mu = \Gamma^{*,g}_\iota = 0.5$).

and GDP increase more than Foreign ones when the global IST and MEI shocks hit both economies.

The results of this section support our conjecture that the IST, MEI, and MON shocks can help explain the decline in CT returns in recent decades. These shocks can have both short-term and long-term effects on CT returns. In the short term, as revealed by our model's IRFs results, CT returns depend on the difference in the magnitudes of the local and global shocks in both countries. We have previously shown in Chapter 2 that, overall: i) most of the time the growth rate of the IST, MEI, and MON (M1 and M3) of developed/developing countries decreased during the period 1980-2019; and ii) the absolute values of the spread between developed/developing countries and the US relative to the growth rate of the IST, MEI, and MON (M1 and M3) decreased during the period 1980-2019. From a US investor's perspective, these results point to fewer profit opportunities for CT investments.

Overall, our results suggest a reduction in the magnitudes of the IST, MEI, and MON shocks and a convergence between developed and developing countries in the levels of these shocks. These shocks play a crucial role in explaining movements in nominal interest rates and exchange rates. Consequently, we would expect smaller fluctuations in these variables, which is consistent with lower profit opportunities for CT investments. This finding aligns with the downward trend of CT returns observed in the data. Our model's prediction is consistent with this observation, as CT returns are shown to be dependent on the magnitudes of these shocks. As the shocks decrease in magnitude and the gaps between countries narrow, the impact on CT returns becomes less pronounced, leading to reduced profit opportunities for CT investments over time.[21]

In the long term, the IST and MEI shocks lead to an increase in investment, which in turn increases the capital stock. This results in a decline in the MPK and, consequently, the real interest rate. Both shocks also contribute to an increase in the supply of goods, leading to a dampening effect on inflation. The combination of lower MPK and inflation results in a lower nominal interest rate in the long run. Furthermore, as discussed earlier, improvements in the country's financial development (positive MEI shock) may reduce exchange rate volatility. Additionally, reductions in the growth rate of the money stock triggered by decreases in macroeconomic uncertainty can also act to reduce exchange rate volatility.

We show in Chapter 2 that, overall, there has been a narrowing of the gap between developed and developing countries and the US in terms of inflation and nominal interest rates in recent decades. Furthermore, the level of inflation and nominal interest rates has declined in both developing and developed countries. Additionally, the level of the MPK in developing countries has also decreased during this period, with the gap between developing countries and the US in terms of the MPK narrowing between 1980 and 2019. In summary, the downward trend in CT returns is consistent with: i) the combination of falling nominal interest rates and growth rates of exchange rates across countries over the last decades; ii) the fluctuations of the IST, MEI, and MON processes across countries over the last decades; and iii) the long-term effect of the shock processes on macroeconomic variables. We now complement our analysis by assessing the explanatory power of risk factors derived from the IST, MEI, and MON processes in our asset pricing exercises.

3.12 Asset Pricing Analysis

Most of the finance literature investigating FX investments focuses on identifying new risk factors to explain currency excess returns (see, e.g.,Lustig et al. (2011), Menkhoff et al. (2012a), Corte et al. (2016), Berg and Mark (2018a), and Colacito et al. (2020)). Following the approach of these papers, we derived our proposed risk factors from empirical measures of the IST, MEI, and MON processes. Subsequently, we estimated our asset pricing model to test whether these risk factors are priced in a cross-section of currency portfolios. Lastly, we assessed how effectively these risk factors explain the additional returns of

[21] In our model, currency excess returns also depend on countries' exposure to global shocks. Generally, developed countries have greater exposure to global shocks than developing countries. However, our results so far indicate that changes in countries' exposure to global shocks in recent decades have helped to reduce the gap between developed and developing countries in terms of IST, MEI, and MON levels. There are several reasons to expect this reduction in the gap. First, the empirical evidence provided in Chapter 2 indicates an increase in the productivity of developing countries. Second, as highlighted in the literature, developing countries have benefited most from the massive wave of trade and financial openness observed over recent decades. This has led to tighter trade and financial linkages, making developing countries more globally interconnected. As highlighted in the last section, these two aspects are main determinants of country's exposure to global shocks.

individual currencies.

In our asset pricing exercises, we cover the period between 1980:M1 and 2019:M12. We follow most of the literature and work with monthly data. In our analysis, we consider a large panel of sixty countries and a sub-sample of twenty-two developed countries. The total set of countries accounts for more than 90% of world GDP in USD of 2018[22], and for approximately 90% of bilateral foreign currency turnover in April 2019 (Bank for Internatinal Settlements, 2019). The set of developed economies comprises Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. The other countries in the sample are: Bangladesh, Bolivia, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Ecuador, Egypt, Hong Kong, Hungary, India, Indonesia, Israel, Lithuania, Malaysia, Mexico, Morocco, Paraguay, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Sri Lanka, Thailand, Tunisia, Turkey, Ukraine and Uruguay. Some of these economies have pegged their exchange rates partially or fully to the USD at various points in time. These markets differ in the level of economic development, international financial integration, and market liquidity, hence, there are significant cross-sectional differences in the data. The sample period for each country varies and thus, the number of countries in our sample fluctuates across time due to data availability.[23]

We follow Lustig and Verdelhan (2007), and compute real monthly nominal currency excess returns as follows:

$$RX_{t+1}^{j} \equiv \left\{ \left[(1+i_{jt}) \left(\frac{S_{jt+1}}{S_{jt}} \right) - (1+i_t) \right] \left(\frac{P_t}{P_{t+1}} \right) \right\}, \tag{3.75}$$

where RX_{t+1}^{j} is the real *ex-post* currency excess return obtained by investors who borrow at the US nominal interest rate and purchase a bond issued by country j, considering that both trades are closed at t, with the same maturity; S_{jt} denotes the end of period exchange rate of country j in level, and; P_t is the US CPI. All exchange rates and yields are reported in US dollars and the moments of returns are annualized: we multiply the mean of the monthly data by 12 and the standard deviation by $\sqrt{12}$. Regarding interest rates, treasury bills were the most common rates chosen as a proxy of returns on short-term bonds. When these interest rates were not available, we worked with money market rates. In the absence of the latter, we selected Government Bonds and, lastly, if all the aforementioned options were unavailable, we used Deposit Rates. As discussed in section 2, we implemented two additional adjustments in our dataset: i) the exclusion of countries during periods when they experience states of very low international financial openness or sovereign default, and ii) the exclusion of European countries in their months of entry into the Eurozone, due to the change in the currency denomination.

Currency Portfolios. We construct our currency portfolios using two strategies. First, we use the values of the IST, MEI, and MON processes, which are proxied by the relative price of investment, the Index of Financial Development (IFD) developed by the IMF (Svirydzenka, 2016), and the growth rate of M1 and M3. Second, we use the values of each country's exposure to the global component of each shock process. If the IST, MEI, and MON values are priced as risk factors, the currencies sorted according to these two strategies are expected to yield a cross-section of portfolios with a reasonable spread in mean returns (Menkhoff et al., 2012a; Corte et al., 2016).[24]

To compute each country's exposure to the global component of the shock processes, we used two variables: i) the Global Competitive Index (Sala-i Martin and Artadi, 2004) reported by the World Economic Forum for every year since 2005; and ii) the commonality (proportion of the variance explained by the common factors) of each country extracted from the principal component analysis applied separately to the dataset of each of the processes (IST, MEI, and MON).We followed a two-step process to obtain the country's exposure to the global component of each process. In the first step, we applied principal component analysis to calculate each country's communality for each year from 2005 to 2018. For the

[22]Based on information published by the IMF.

[23]The availability of information is greater for the more recent periods and for developed countries when compared to the first years of the sample, especially for developing economies, resulting in an unbalanced panel (see details in Appendix A.1).

[24]We also sorted currencies according to the growth rate of the IST and MEI processes, however they generated a cross section of portfolios with a very low spread between portfolio returns.

IST and MEI, we used a rolling window of 26 annual observations, and for the MON (the growth rate of M1 and M3), we used 104 quarterly observations, starting in 1980. We selected the number of common factors (between two and five) to explain at least 50% of the data variance. In the second step, we multiplied each country's annual commonality value by its respective annual Global Competitive Index value. This strategy allowed us to calculate each country's exposure to the global component of each process for each year between 2005 and 2018.

At the end of each month t, we allocate all foreign currencies into six portfolios based on their IST, MEI, and MON (the growth rate of M1 and M3) values. The portfolios are rebalanced at the end of each year (IST and MEI) or quarter (MON). IST and MEI portfolios are ranked from high to low values: portfolio one contains the countries with the highest IST and MEI values, while portfolio six comprises the countries with the lowest IST and MEI values. MON portfolios are ranked from low to high values: portfolio one contains the countries with the lowest M1 (M3) growth rates, while portfolio six comprises the countries with the highest M1 (M3) growth rates. The same strategy is applied to generate portfolios ordered by nominal interest rates, and these portfolios are rebalanced monthly. This process results in six portfolios ranked from the lowest to the highest nominal interest rates. Portfolio returns are calculated as an equally weighted average of the currency excess returns within each portfolio. It is important to note that the number of countries in each portfolio varies over time due to data availability and adjustments made to the dataset, as discussed in the last chapter.

Similarly, at the end of each month t, we allocate all foreign currencies into six portfolios based on the country's exposure to the global component of the shock processes. Portfolios are reorganized at the end of each year. They are ranked from high to low values: portfolio one contains the countries with the highest exposures to each shock, while portfolio six comprises the countries with the lowest exposures to each shock. Since the Global Competitive Index is available only from 2005 onwards, we restrict our asset pricing exercises between 2006 and 2019. It is worth noting that the number of countries in each portfolio varies over time due to data availability and adjustments made to the dataset, as discussed in the last chapter.

We construct our risk factors following Lustig et al. (2011): the average of currency excess returns considering all countries (labeled as RX); and the difference in returns between portfolios six and one (labeled as HML). Thus, we denote HML^{ist}, HML^{mei}, HML^{mon1}, and HML^{mon3} for factors built from portfolios ranked by countries' IST value, MEI value, M1 growth rate, and M3 growth rate. HML^{ir} is the factor built from portfolios sorted by countries' nominal interest rates. We followed the same procedure regarding the country's exposure to the global component of the shock processes to construct the respective risk factors.

To assess whether sorting countries by nominal interest rates is equivalent to sorting them by the shock processes, we regressed each risk factor (HML^{ist}, HML^{mei}, HML^{mon1}, and HML^{mon3}) onto the HML^{ir} factor and a constant. We used the Newey and West (1987) heteroskedasticity-consistent standard errors to obtain the t-statistics. The slope coefficient estimates reached: 0.35, 0.31, 0.13 and 0.49, for the HML^{ist}, HML^{mei}, HML^{mon1} and HML^{mon3}, respectively. All coefficients are statistically different from zero at the 10% significance level and the adjusted R^2 values reached 0.16, 0.11, 0.01, and 0.14, respectively. We ran the same regressions for the risk factors generated by the country's exposure to the global component of the shock processes. All slope coefficients (0.37, 0.25, 0.41, and 0.63) are statistically different from zero at the 10% significance level and the adjusted R^2 values reached 0.18, 0.12, 0.21, and 0.33, respectively. Note that all slope coefficients are statistically different from unity. Therefore, sorting currencies by nominal interest rates is not the same as by the shock processes. The information from the IST, MEI, and MON processes matters for currency returns.

Figure (3.9) presents the values of portfolio returns and Sharpe ratios for each portfolio over the period from 1995:M01 to 2019:M12. We found similar results when considering the entire sample period, however, as will be discussed below, portfolio returns before 1995 may not provide a clear picture of currency excess returns due to the availability of data (especially for developing countries). The figure also includes the returns of two currency strategies: i) the RX, where a US investor goes long in all foreign currencies; and ii) the HML, where a US investor goes long in portfolio six and short in portfolio one. We follow the finance literature and assume that the returns from these two portfolios are the risk factors to be used in our asset pricing exercises. To calculate the Sharpe ratio for each portfolio, we divided its annualized excess return by its annualized standard deviation.

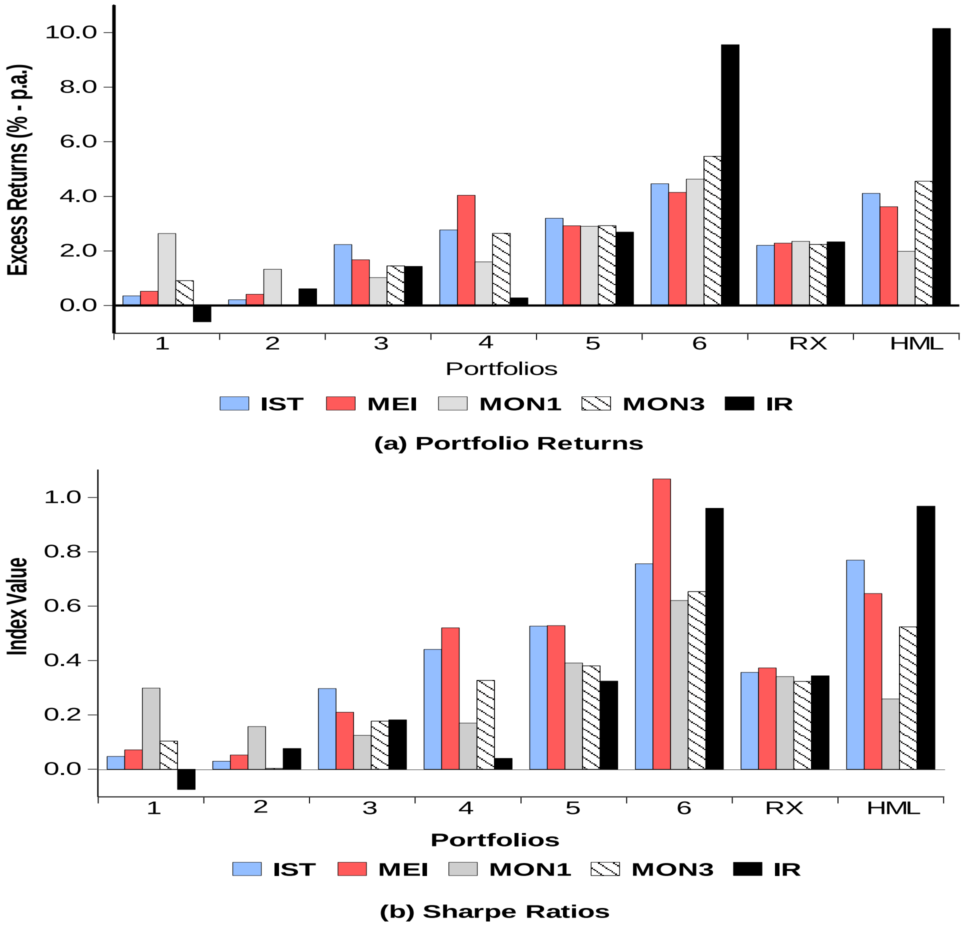


Figure 3.9: Currency Portfolio Returns: Total. The figure displays portfolio returns (Panel (a)) and Sharpe ratios (Panel (b)) for currency returns sorted by the IST, MEI, M1 growth rate (MON1), M3 growth rate (MON3) and the nominal interest rates (IR). All returns are annualized. The sample period is 1995:M01-2019:M12.

The main points to take away from Panel (a) of the figure are as follows. First, overall currency excess returns decline from the portfolio six to one. Second, the return on the RX portfolio is lower than the return on the HML portfolio (except in the case of the MON1 portfolio). Third, the return on the HML portfolio is higher when currencies are sorted by nominal interest rates (approximately 10.00%) than when sorted by the other risk factors (approximately between 1.99% and 4.55%).[25] Overall, Panel (b) of the figure reveals that the Sharpe ratio decreases from portfolio six to one. Note that, although portfolio six sorted by the MEI value, while not having the highest return among the portfolio six returns, generates the highest Sharpe ratio value. This finding highlights the importance of using information from the MEI process for constructing currency portfolios. The higher Sharpe ratio for the MEI-sorted portfolio suggests that currencies selected based on the MEI process offer a better risk-adjusted performance compared to other risk factors. This indicates that the MEI process captures valuable information that helps to identify currencies with attractive risk-return profiles, making it a relevant factor for currency portfolio construction.

Figure (3.10) presents portfolio returns and Sharpe ratios for currency returns sorted by the country's exposure to the global component of the shock processes - IST, MEI, and MON (M1 and M3 growth rates) - and the nominal interest rates. Overall, despite differences in magnitude, portfolio returns and Sharpe ratios exhibit a pattern similar to that identified in Figure (3.9). One interesting observation is that portfolio six, which is ordered by the IST value, does not have the highest return when compared to the other returns of portfolio six. However, it generates the highest Sharpe ratio value, indicating that using information from the IST process is valuable for constructing currency portfolios with better risk-adjusted performance. This further emphasizes the importance of considering the IST process as a

[25]Our results are in line with the findings of Menkhoff et al. (2012a) and Corte et al. (2016), which reported portfolio returns of 4.11% and 4.40% for their HML factors, respectively.

relevant factor for currency portfolio construction.

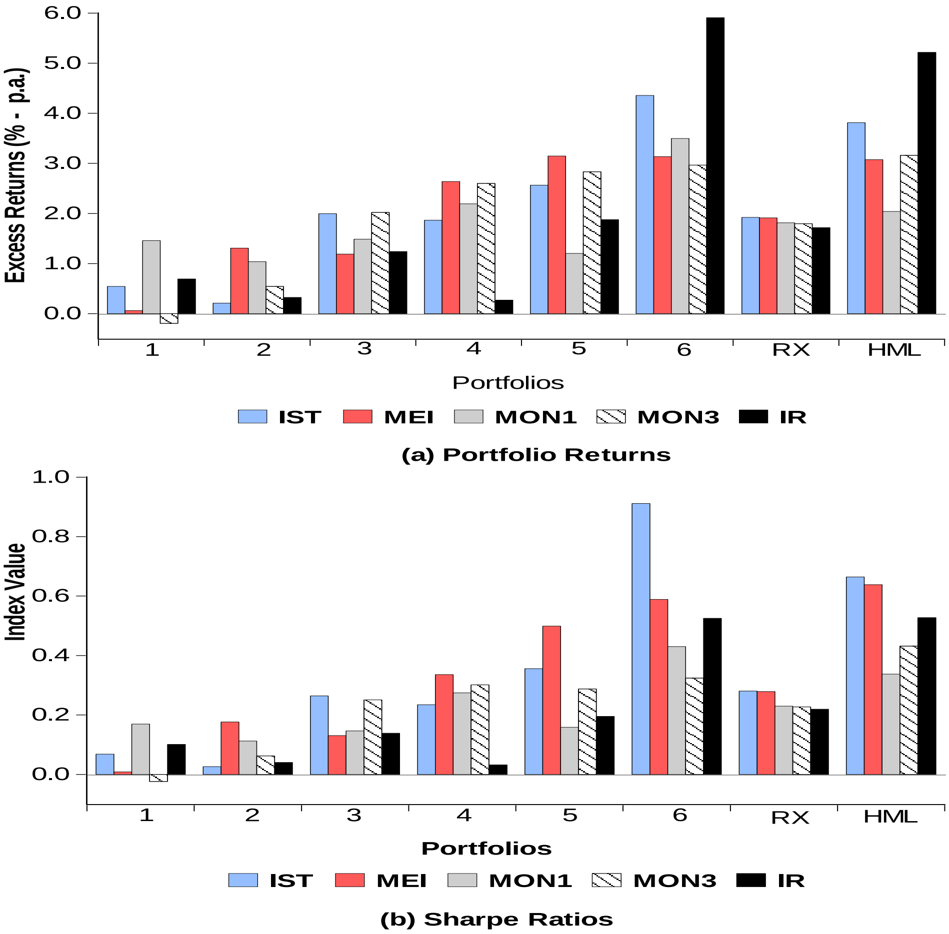


Figure 3.10: Currency Portfolio Returns: Global. The figure presents portfolio returns (Panel (a)) and Sharpe ratios (Panel (b)) for currency returns sorted by country's exposure to the global component of the shock processes - IST, MEI, and MON (M1 and M3 growth rates) - and the nominal interest rates (IR). The RX portfolio represents the average of returns considering all currencies. The HML portfolio represents the difference between the returns of portfolios six and one. All returns are annualized. The sample period is 2006:M01-2019:M12.

To put our results into perspective, we compare them with Lustig et al. (2011) and Colacito et al. (2020). Lustig et al. (2011) work with a set of 35 countries covering the period from 1983:M11 to 2009:M12. They construct currency portfolios based on nominal interest rates and find results similar to ours: i) currency excess returns and Sharpe ratios decline from portfolio six to one; and ii) the annual return of the RX portfolio (1.90%) is lower than the annual return of the HML portfolio (4.54%). Our results are also in line with those reported by Colacito et al. (2020). They consider 27 countries spanning the period from 1983:M10 to 2016:M01. Portfolios sorted by nominal interest rates reached excess returns and Sharpe ratios between -0.63% to 7.17% and -0.06 to 0.68, respectively.

It is important to note that Lustig et al. (2011) and Colacito et al. (2020) work with nominal currency excess returns net of transaction costs (bid/ask spread of spot and forward exchange rates). On the other hand, our analysis focuses on real currency excess returns and does not include transaction costs in constructing portfolio returns. The finance literature reports a reduction ranging from 0.95% (Colacito et al., 2020) to 1.50% (Lustig et al., 2011) in the average currency portfolio return caused by transaction costs. On the other hand, the average annual inflation rate in the US oscillates between 1.91% (for 2006:M01-2019:M12 interval) and 2.16% (for 1995:M08-2019:M12 interval). These results indicate that, despite methodological differences in the calculation of currency portfolio returns, our results remain comparable to those reported in the literature.[26]

[26] Note that transaction costs increase with the frequency of portfolio rebalancing. Unlike Lustig et al. (2011), and Colacito et al. (2020), we do not rebalance our portfolios on a monthly basis. Therefore, transaction costs are likely to be small.

Time-series Regressions. We now examine the time series properties of our portfolio returns. To obtain the sensibility of each portfolio's return to the risk factors, we performed the following OLS regression: $RX_t^{p,\iota} = \gamma_0 + \gamma_1 RX_t + \gamma_2^{\iota} HML_t^{\iota} + \tau_t$. $RX_t^{p,\iota}$ is the currency excess return for portfolio one to six; $p \in \{1,2,3,4,5,6\}$; $\iota \in \{IST, MEI, MON1, MON3, IR\}$, denotes the variable used to order currencies and compute the risk factors; and τ_t is a white noise error term. The sample period covers the interval from 1985:M8 to 2019:M12 for regressions involving the risk factors generated by the IST, MEI, and MON values and from 2006:M01 to 2019:M12 for regressions involving the country's exposure to the global component of these shock processes.

Table 3.2
Currency Portfolio Betas: Fundamental Risk Factors

The table reports the betas obtained from the OLS regressions of the time-series of currency excess returns of each portfolio "p" on two risk factors: $RX_t^{p,\iota} = \gamma_0 + \gamma_1 RX_t + \gamma_2^{\iota} HML_t^{\iota} + \tau_t$. $RX_t^{p,\iota}$ is the currency excess return for portfolio one to six; $p \in \{1,2,3,4,5,6\}$; $\iota \in \{IST, MEI, MON1, MON3, IR\}$, indicates the variable used to sort currencies and generate the risk factors; and τ_t is a white noise error term. R^2 is the adjusted R-squared of each model. Excess returns are annualized. Note that *a*, *b*, *c* and *d* denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute the t-statistics of the estimates. The sample period runs from 1985:M8 to 2019:M12 for regressions involving the risk factors generated by the IST, MEI, and MON values (Panel (a)) and from 2006:M01 to 2019:M12 for regressions involving country's exposure to the global component of the shock processes (Panel (b)).

Panel (a): 1995:M8-2019:M12

Portfolio	γ_0	γ_1	γ_2^{ist}	R^2	γ_0	γ_1	γ_2^{mei}	R^2
1	0.06	0.99^a	-0.45^a	0.96	0.42	0.82^a	-0.48^a	0.96
2	-1.79^a	1.08^a	-0.10^a	0.92	-1.23^a	1.08^a	-0.22^a	0.91
3	0.14	1.11^a	-0.08^b	0.89	-0.62	1.17^a	-0.09^d	0.89
4	0.49	0.95^a	0.07^c	0.85	0.17	1.24^a	0.21^a	0.79
5	1.03^d	0.86^a	0.01	0.78	0.84^c	0.86^a	0.06	0.84
6	0.06	0.99^a	0.55^a	0.94	0.42	0.82^a	0.52^a	0.86

	γ_0	γ_1	γ_2^{mon1}	R^2	γ_0	γ_1	γ_2^{mon3}	R^2	γ_0	γ_1	γ_2^{ir}	R^2
1	1.33^b	0.95^a	-0.57^a	0.90	1.01^d	0.98^a	-0.51^a	0.89	0.15	0.91^a	-0.33^a	0.93
2	-0.84	1.00^a	-0.03	0.68	-2.15^b	0.99^a	-0.04	0.72	-0.42	1.19^a	-0.22^a	0.93
3	-1.49^d	1.01^a	0.02	0.72	-0.74	1.07^a	-0.03	0.81	0.85^b	1.14^a	-0.15^a	0.93
4	-0.99	1.16^a	0.06	0.71	0.43	1.04^a	0.03	0.80	-0.25	0.94^a	-0.04^d	0.89
5	0.66	0.92^a	0.08^b	0.72	0.42	0.94^a	0.07^b	0.71	-0.48	0.90^a	0.09^a	0.80
6	1.33^b	0.95^a	0.43^a	0.86	1.01^d	0.98^a	0.49^a	0.87	0.15	0.91^a	0.66^a	0.95

Panel (b): 2006:M01-2019:M12

Portfolio	γ_0	γ_1	γ_2^{ist}	R^2	γ_0	γ_1	γ_2^{mei}	R^2
1	0.73^b	0.86^a	-0.48^a	0.97	0.44	0.90^a	-0.40^a	0.97
2	-1.35^b	1.07^a	-0.13^a	0.94	-0.10	0.99^a	-0.15^a	0.95
3	0.71	0.98^a	-0.16^a	0.94	-0.72	1.23^a	-0.14^a	0.96
4	-0.94	1.17^a	0.14^a	0.90	0.13	1.12^a	0.12^b	0.88
5	0.12^d	1.05^a	0.10^a	0.91	1.59^b	0.85^a	-0.21	0.86
6	0.73^b	0.86^a	0.52^a	0.93	-0.44	0.90^a	0.60^a	0.95

	γ_0	γ_1	γ_2^{mon1}	R^2	γ_0	γ_1	γ_2^{mon3}	R^2	γ_0	γ_1	γ_2^{ir}	R^2
1	0.68	0.96^a	-0.47^a	0.94	-0.60	0.94^a	-0.40^a	0.93	0.83^c	0.90^a	-0.37^a	0.94
2	-1.01	1.09^a	0.03	0.86	-0.73	1.03^a	-0.18^a	0.88	-1.18^b	1.15^a	-0.22^a	0.94
3	-0.94	1.21^a	0.11^b	0.88	0.63	0.94^a	-0.10^a	0.85	0.96^c	1.16^a	-0.19^a	0.94
4	0.53	0.93^a	-0.02	0.84	0.81	1.01^a	0.00	0.86	-0.68^d	0.95^a	0.00^d	0.94
5	0.04	0.85^a	-0.18^a	0.82	0.50	1.12^a	0.10^b	0.83	-0.76	0.92^a	0.16^a	0.87
6	0.68	0.96^a	0.52^a	0.94	-0.60	0.94^a	0.60^a	0.94	0.83^c	0.90^a	0.63^a	0.96

Furthermore, bid/ask spreads used in the literature tend to be overestimated (see, e.g., Lyons (2001), Menkhoff et al. (2012b), and Colacito et al. (2020)). Finally, Menkhoff et al. (2012b) report a decrease in bid/ask spreads in the foreign exchange market in recent decades.

Table (3.2) provides the beta estimates for portfolio returns sorted by the IST, MEI, and MON processes in Panel (a), and by the country's exposure to the global component of the three shock processes in Panel (b). These beta estimates allow us to retrieve portfolio returns by multiplying them by the risk factors (RX and HML portfolio returns). For illustration, we computed the following returns for portfolio one and six, respectively: i) 0.39%, 0.55%, 2.43% and 0.87%; and ii) 4.54%, 4.17%, 4.42% and 5.43% (for currencies ordered by the IST, MEI, M1 growth and M3 growth values, respectively). Note that these returns are in line with those presented in Panel (a) of Figure (3.9). Similar considerations apply when considering the results presented in Panel (b) of Table (3.2) and Figure (3.10).

Our findings are consistent with the results reported by Lustig et al. (2011). As can be seen in the table, in general, the sensitivities of portfolio returns to the risk factors (HML_t^{ist}, HML_t^{mei}, HML_t^{mon1}, HML_t^{mon3}, and HML_t^{ir}) decrease from portfolio six to one. For instance, there is a decrease in γ_2^{ist} from 0.55 (portfolio six) to -0.45 (portfolio one). Furthermore, as emphasized by Lustig et al. (2011), the sum of the absolute values of the coefficients associated with the HML factor of portfolio six and one should be close to one, which is indeed confirmed by the results in both Panels (a) and (b) of the table. For example, the sum of the absolute values of γ_2^{ist} of portfolio six (0.55) and one (0.45) equals 1.

The main result that emerges from this table is a clear increase in risk compensation from portfolio one to six. Portfolio one provides insurance to investors during moments of low performance of the HML portfolio. On the other hand, investors can benefit more from the good performance moments of the HML portfolio by investing in portfolio six.

Cross-sectional Regressions. To explore the cross-sectional properties of portfolios returns we follow the recent literature (see, e.g., Corte et al. (2016) and Colacito et al. (2020)). We construct twenty-four test assets based on portfolio formation strategies developed by the relevant literature in this area (Lustig et al., 2011; Menkhoff et al., 2012a,b; Asness et al., 2013). These portfolios are named in the literature as "momentum","value", and "volatility". They are used as test assets in our empirical analysis, alongside six portfolios sorted by nominal interest rates, six by the IST values, six by the MEI values, six by M1 growth rates, and six by M3 growth rates. Thus, our test asset set comprises a total of fifty-four currency portfolios.

Following the methodology of Menkhoff et al. (2012b), at the end of each month t, we form six portfolios based on currency excess returns for the previous k months. The countries with the lowest lagged returns are placed in portfolio one, while the countries with the highest lagged returns are placed in portfolio six. Portfolios are reorganized at the end of each month. We construct 6 "short-term momentum" (k=3) and 6 "long-term momentum" (k=12) portfolios. We used the first 3 and 12 months of data to calculate the returns for the "short-term momentum" and "long-term momentum" portfolios, respectively. Which shortened our sample period.

At the end of each period t, we construct 6 portfolios sorted by the value of the five-year lagged real exchange rate return, as in Asness et al. (2013). To build the "value" portfolios, we adjust the past five-year average spot exchange rate by the change in the Consumer Price Index (CPI) in the foreign economy relative to the US CPI to recover real exchange rate returns. Countries with the highest real exchange rate return are grouped in portfolio one and countries with the lowest real exchange rate return in portfolio six. Due to the methodology used to obtain the "value" portfolios, we have to restrict our empirical analysis to the period between 1985:M08 and 2019:M12.

We also employ a portfolio construction strategy based on countries' exposure to global exchange rate volatility, as in Menkhoff et al. (2012a). The measure for global FX volatility was computed as follows. First, we calculated the daily log return for each currency. Second, we computed the simple cross-sectional average of the absolute values of these daily log returns across all currencies. Thus, we ended up with one value for each day (daily measure of global exchange rate volatility). Third, we computed the time series simple average of the daily values obtained in the last step. We ended up with one value for each month (monthly measure of global exchange rate volatility). Lastly, we ran OLS regressions of monthly currency excess return on a constant and the first difference of the monthly measure of global exchange rate volatility for each country, considering a rolling window of thirty-six months. The estimate for the slope coefficient is the country's exposure to global exchange rate volatility. This approach allows us to obtain time-varying country's exposure to global exchange rate volatility. At the end of each period t, we group the countries with the highest exposures to global exchange rate volatility in portfolio one and the countries with the lowest exposures in portfolio six.[27]

Empirical analysis on cross-sectional asset pricing in currency markets are typically performed with a two-factor model (Lustig et al., 2011; Menkhoff et al., 2012a). However, recent papers have also considered a three-factor SDF (Corte et al., 2016; Colacito et al., 2020). The latter model is particularly important in our study because we propose three new risk factors. The three-factor model allows evaluating the degree of the additional pricing power brought by each risk factor. The first risk factor is the equally weighted average excess return of a portfolio in which the investor goes long in all currencies and short in the domestic currencies. This risk factor corresponds to the RX portfolio return. For the other risk factors, the literature has employed several options, such as the slope factor (Lustig et al., 2011), the global volatility factor (Menkhoff et al., 2012a), the global imbalance factor (Corte et al., 2016) or the output gap factor (Colacito et al., 2020). Following the literature, we work with a two-factor model with RX as the first factor and one of our proposed risk factors (HML^{ist}, HML^{mei}, HML^{mon1} and HML^{mon3}) as the second element. We also report results in which the second risk factor is the HML^{ir}. Furthermore, we also explore the results of a three-factor SDF, combining the RX with our proposed risk factors and the slope factor proposed by Lustig et al. (2011), the HML^{ir}.

Table (3.3) exhibits the results from the Fama and MacBeth (1973) two-pass procedure used to estimate the market price of risk associated with our proposed risk factors. We have to restrict our experiment to the period between 1985:M08 and 2019:M12, due to the methodology applied to construct the "value" portfolios. Furthermore, as detailed in Appendix A.1, there are countries that were excluded from our sample due to their degree of financial openness or episodes of sovereign default. These exclusions occur mainly before mid-1995. Therefore, we also report results for a period with a more complete dataset between 1995:M01 and 2019:M12.

We follow the literature (Lustig et al., 2011; Menkhoff et al., 2012a; Corte et al., 2016; Colacito et al., 2020), and do not include a constant in the second step of the Fama and MacBeth (1973) procedure. Our set of test assets consists of fifty-four portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by nominal interest rate, six by past three-month currency excess return (short-term momentum), six by past one-year currency excess return (long-term momentum), six by past five-year exchange rate return (value) and six by country's exposure to global exchange rate volatility. We conduct all of our asset pricing analysis considering this large set of fifty-four test portfolios, rather than just considering portfolios sorted by our shock processes (IST, MEI, and MON). This approach is motivated by the findings of Lewellen et al. (2010), which suggest that a strong factor structure in test assets can lead to misleading results in empirical studies. Additionally, Lewellen et al. (2010) propose adding risk factors as test assets to ensure that they price themselves. This is specially important in cases where the factors are tradable portfolios. Thus, we conducted our analysis by excluding and including the risk factors as test assets.

As pointed by Cochrane (2005), if the market price of risk is statistically significant, then it is priced in the cross section of asset returns. Hence, we focus on the sign and statistical significance of the market price of risk associated with our proposed risk factors: λ^{ist}_{HML}, λ^{mei}_{HML}, λ^{mon1}_{HML}, and λ^{mon3}_{HML}. A positive value for the estimated price of risk is associated with higher *risk premia* for portfolio returns with a higher positive correlation with the risk factor and lower risk premia for those with a lower positive correlation with it (or for those negatively correlated with it). The table indicates that our three factors are priced in the cross-section of currency portfolios. Overall, the prices of risk associated with the IST,

[27] We collected daily data on exchange rates from Thomson Reuters. Due to data availability, only the following countries were used to compute the global FX volatility index: Australia (1980:M01-2019:M12), Bangladesh (1994:M09-2019:M12), Bolivia (1994:M09-2019:M12), Brazil (1994:M07-2019:M12), Canada (1980:M01-2019:M12), Chile (1990:M12-2019:M12), Colombia (1989:M11-2019:M12), Croatia (1994:M09-2019:M12), Czech Republic (1991:M01-2019:M12), Denmark (1980:M01-2019:M12), Hong Kong (1980:M01-2019:M12), Hungary (1993:M07-2019:M12), Iceland (1992:M03-2019:M12), India (1980:M01-2019:M12), Indonesia (1988:M01-2019:M12), Israel (1980:M01-2019:M12), Japan (1980:M01-2019:M12), Lithuania (1995:M05-2019:M12), Malaysia (1980:M01-2019:M12), Mexico (1989:M11-2019:M12), New Zealand (1980:M01-2019:M12), Norway (1980:M01-2019:M12), Paraguay (1990:M12-2019:M12), Peru (1991:M02-2019:M12), Philippines (1992:M06-2019:M12), Poland (1993:M07-2019:M12), Romania (1994:M09-2019:M12), Russia (19940:M07-2019:M12), Singapore (1981:M01-2019:M12), South Africa (1980:M01-2019:M12), South Korea (1981:M04-2019:M12), Sweden (1980:M01-2019:M12), Switzerland (1980:M01-2019:M12), Thailand (1981:M01-2019:M12), the United Kingdom (1980:M01-2019:M12), Tunisia (1990:M10-2019:M12), Turkey (1989:M11-2019:M12), Ukraine (1994:M09-2019:M12), and Uruguay (1992:M02-2019:M12). The euro was included in the calculation from 1999:M01 onwards. However, we computed country's exposure to global exchange rate volatility for all countries in our dataset.

MEI, and MON risk factors are positive and statistically significant. This implies that currencies from countries with low IST/MEI values and high M1/M3 growth rates earn higher excess returns on average.

Table 3.3
Asset Pricing Tests: All Countries

The table presents the results for currency portfolios sorted based on time $t-1$ information. The test assets include fifty-four portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by nominal interest rate, six by past three-month currency excess return (short-term momentum), six by past one-year currency excess return (long-term momentum), six by past five-year exchange rate return (value) and six by country exposure to global FX volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1}, HML^{mon3} and HML^{ir}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics.

Excluding Price Factors as Test Assets							**Including Price Factors as Test Assets**						
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	λ_{HML}^{ir}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	λ_{HML}^{ir}	R^2
Panel (a): 1985:M8-2019:M12													
3.29^a	4.62^a					0.10	3.30^a	3.84^a					0.08
3.50^a		5.73^a				0.25	3.47^a		4.44^a				0.24
3.32^a			4.71^a			-0.20	3.32^a			3.06^b			-0.20
3.28^a				5.45^a		-0.12	3.29^a				4.18^b		-0.14
3.19^a					8.70^a	0.34	3.18^a					9.30^a	0.46
3.15^a	-0.42				9.84^a	0.35	3.15^a	0.75				9.85^a	0.46
3.29^a		2.50^c			8.48^a	0.36	3.29^a		2.90^b			9.19^a	0.47
3.19^a			0.36		8.68^a	0.33	3.18^a			1.15		9.24^a	0.45
3.17^a				0.36	8.55^a	0.36	3.18^a				1.85	9.85^a	0.47
3.48^a	2.89^b	4.70^a				0.24	3.48^a	2.66^b	4.08^a				0.24
3.29^a	4.51^a		1.42			0.08	3.31^a	3.71^a		1.74			0.08
3.29^a	4.70^a			1.81		0.08	3.30^a	3.65^a			2.65		0.07
3.50^a		5.22^a	0.81			0.24	3.50^a		4.47^a	1.48			0.24
3.51^a		5.25^a		2.27		0.24	3.49^a		4.43^a		2.74^c		0.24
Panel (b): 1995:M01-2019:M12													
1.89^d	6.02^a					0.48	1.91^d	5.49^a					0.47
2.12^c		5.26^a				0.50	2.12^c		4.83^a				0.50
1.97^d			5.64^b			-0.04	1.98^d			3.55^b			-0.08
1.92^d				8.01^a		0.15	1.94^d				6.20^a		0.15
1.83^d					8.16^a	0.52	1.82^d					8.49^a	0.62
1.84^d	3.83^b				7.61^a	0.52	1.83^d	3.83^a				8.20^a	0.62
1.96^d		3.59^b			8.25^a	0.56	1.96^d		3.66^b			8.53^a	0.65
1.83^d			1.71		7.94^a	0.52	1.83^d			1.82		8.34^a	0.62
1.83^d				3.55^c	8.18^a	0.51	1.82^d				4.13^b	8.51^a	0.62
2.02^d	4.88^a	3.85^b				0.55	2.03^d	4.64^a	3.78^b				0.56
1.89^d	5.90^a		2.18			0.47	1.91^d	5.39^a		2.11			0.47
1.88^d	5.66^a			3.82^c		0.47	1.89^d	5.12^a			4.34^b		0.49
2.11^c		5.17^a	1.99			0.50	2.12^c		4.74^a	2.05			0.51
2.09^c		4.86^a		4.98^b		0.51	2.09^c		4.50^a		4.79^b		0.52

Panels (a) and (b) of the table reveal that λ_{HML}^{ist} has positive and statistically significant coefficients ranging from 2.66% to 6.02%. The adjusted R^2 values vary between 0.08 and 0.62. The λ_{HML}^{mei} has positive and statistically significant coefficients ranging from 2.50% to 5.73%. The adjusted R^2 values vary between 0.08 and 0.62. The λ_{HML}^{mon1} has positive and statistically significant coefficients ranging from 3.06% to 5.64%. The adjusted R^2 values vary between -0.20 and -0.08. Additionally, the M3 growth rate, used as a proxy for the MON process, yields positive and statistically significant coefficients ranging from 2.74% to 8.01%, with adjusted R^2 values between -0.12 and 0.62. Note that the estimates for the period

1995:M01 to 2019:M12 show higher adjusted R^2 values, indicating a better fit for the model during this more recent period.

Table (3.4) presents the results obtained when using the country's exposure to the global component of each shock process (IST, MEI, and MON) to construct the currency portfolios. Therefore, the test assets include fifty-four portfolios: six sorted by countries' exposure to the global component of the IST values, six by countries' exposure to the global component of MEI values, six by countries' exposure to the global component of M1 growth rate, six by countries' exposure to the global component of M3 growth rate, six by nominal interest rate, six by past three-month currency excess return (short-term momentum), six by past one-year currency excess return (long-term momentum), six by past five-year exchange rate return (value) and six by country exposure to global exchange rate volatility. Due to the inclusion of a short window of data before the start of the GFC (from 2006 to 2008), we estimated our model considering two sample periods: from 2006:M01 to 2019:M12 and from 2009:M01 to 2019:M12. This is a way to analyze the sensibility of our results to the GFC outbreak.

The table reveals that our three factors are priced in a large cross-section of currency portfolios. The positive and significant prices of risk associated with the country's exposure to the global component of the IST, MEI, and MON factors suggest that currencies from countries with low exposure to these global components tend to earn higher excess returns on average. The λ_{HML}^{ist} has positive and statistically significant coefficients ranging from 2.63% to 3.98%, with adjusted R^2 values between 0.43 and 0.71. The λ_{HML}^{mei} has positive and statistically significant coefficients ranging from 2.29% to 3.99%, with adjusted R^2 values between 0.46 and 0.64. The λ_{HML}^{mon1} has positive and statistically significant coefficients ranging from 3.42% to 4.61%, with adjusted R^2 values between 0.14 and 0.28. Additionally, the M3 growth rate, used as a proxy for the MON process, yields positive and statistically significant coefficients ranging from 3.13% to 5.70%, with adjusted R^2 values between 0.26 and 0.51. Note that the inclusion of a short window of data before the GFC outbreak reduces the overall statistical significance of the estimated coefficients and the adjusted R^2 values.

We conducted additional regression exercises focusing on a subset of developed countries. With a smaller number of countries, we included 41 portfolios as test assets in our estimation: five sorted by the IST values, five by the MEI values, three by M1 growth rates, three by M3 growth rates, five by nominal interest rate, five by past three-month currency excess return (short-term momentum), five by past one-year currency excess return (long-term momentum), five by past five-year exchange rate return (value) and five by country exposure to global exchange rate volatility. As most information on developed countries is available from the beginning of our sample period, our asset pricing estimation covers the entire period. The results, as shown in Table (A.2) in Appendix A.5, demonstrate that despite the magnitudes being lower compared to Table (3.3), we still find positive and statistically significant risk price estimates. Table (A.3) in Appendix A.5 displays the results obtained when employing the country's exposure to the global component of each shock process (IST, MEI, and MON) to construct the currency portfolios. Overall, the findings are consistent with those presented in Table (3.4).

To put our results into perspective, we compare them with Corte et al. (2016). Their study shares similarities with ours in terms of country and time coverage. Corte et al. (2016) work with a sample of 55 countries over the period from 1983:M10 to 2014:M06. They also report separate results for a subset of developed countries. In their study, Corte et al. (2016) find a positive and significant estimate for the price of risk associated with their proposed risk factor, known as the "global imbalance risk factor". The adjusted R^2 ranges from 0.49 to 0.65. Notably, the estimates for the price of risk for the set of developed countries (ranging between 3% and 6% p.a.) were lower than those obtained for the set of all countries (ranging between 4% and 8% p.a.), which is consistent with our results.

The key insight from our results is that countries with low IST and MEI levels have greater growth opportunities and higher demand for new capital goods. Positive IST and MEI shocks have a more significant positive impact on these countries as their firms invest to capitalize on growth prospects. However, they are also more susceptible to macroeconomic uncertainty, typically associated with domestic turmoil (higher rates of money growth). They have lower levels of economic and financial development. Consequently, investors perceive higher risk in holding bonds issued by these countries, leading to a higher *risk premium* demanded by investors to compensate for uncertainty and potential volatility in these markets. The cross-sectional differences in IST, MEI, and MON values lead to variations in *risk premium* among countries. The combination of growth opportunities and macroeconomic uncertainty shapes the risk-return profiles of different currency portfolios, affecting their excess returns and Sharpe ratios.

On the other hand, US investors place higher value on currencies that benefit the most from IST, MEI, and MON global shocks. Currencies from countries with high exposure to these global shocks tend to appreciate, driven by the shocks. In contrast, currencies from countries with low exposure tend to depreciate. As a result, US investors are willing to accept a lower *risk premium* to hold bonds issued by countries with high exposure to the global shocks.

Table 3.4
Asset Pricing Tests: All Countries - Global

The table presents the results for currency portfolios sorted based on time $t-1$ information. The test assets include fifty-four portfolios: six sorted by countries' exposure to the global component of the IST values, six by countries' exposure to the global component of MEI values, six by countries' exposure to the global component of M1 growth rate, six by countries' exposure to the global component of M3 growth rate, six by nominal interest rate, six by past three-month currency excess return (short-term momentum), six by past one-year currency excess return (long-term momentum), six by past five-year exchange rate return (value) and six by country exposure to global FX volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1}, HML^{mon3} and HML^{ir}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics.

Excluding Price Factors as Test Assets							**Including Price Factors as Test Assets**						
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	λ_{HML}^{ir}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	λ_{HML}^{ir}	R^2
Panel (a): 2006:M01-2019:M12													
1.68	3.06^c					0.43	1.67	3.23^b					0.45
1.71		3.39^b				0.47	1.71		3.32^b				0.48
1.60			4.17^c			0.19	1.62			3.42^c			0.14
1.59				5.29^b		0.28	1.61				4.46^b		0.26
1.60					5.04^b	0.36	1.60					5.17^a	0.44
1.68	3.16^c				4.43^b	0.42	1.67	3.42^b				4.79^b	0.50
1.69		3.18^b			4.19^b	0.47	1.68		3.12^b			4.62^b	0.52
1.61			1.30		5.25^a	0.35	1.60			1.67		5.29^a	0.43
1.59				3.52^c	5.12^b	0.35	1.59				3.31^c	5.09^a	0.44
1.70	2.63^d	3.28^b				0.46	1.69	2.92^c	3.23^b				0.48
1.69	3.20^b		1.31			0.43	1.68	3.39^b		1.62			0.44
1.67	2.96^c			3.13^d		0.42	1.66	3.22^b			3.09^d		0.45
1.73		3.68^a	1.38			0.46	1.72		3.45^a	1.72			0.47
1.73		3.64^b		3.82^c		0.46	1.72		3.46^a		3.54^c		0.47
Panel (b): 2009:M01-2019:M12													
1.10	3.73^b					0.62	1.11	3.69^b					0.64
1.13		3.82^b				0.52	1.12		3.99^b				0.53
1.00			4.61^c			0.28	1.04			3.52^c			0.22
0.98				5.70^b		0.39	1.01				4.56^c		0.35
1.01					5.78^b	0.62	1.00					5.98^a	0.69
1.05	2.99^c				5.42^b	0.63	1.05	3.20^c				5.75^b	0.71
1.03		2.29^d			5.52^b	0.62	1.03		2.53^c			5.82^a	0.69
1.02			1.15		6.08^a	0.62	1.01			1.39		6.18^a	0.70
1.03				2.95	6.41^a	0.63	1.03				2.85	6.42^a	0.71
1.10	3.98^b	2.51^d				0.62	1.10	3.89^a	2.65^c				0.64
1.11	3.76^b		1.75			0.61	1.10	3.71^b		1.74			0.63
1.11	3.80^b			3.29		0.61	1.12	3.76^b			3.05		0.64
1.12		3.71^b	2.16			0.51	1.13		3.55^b	1.99			0.52
1.11		3.66^b		4.66^c		0.51	1.14		3.44^b		3.87^c		0.51

Taken together, these results provide evidence on the relevance of our three proposed risk factors in pricing currency excess returns. They imply that factor models incorporating risk factors derived from the IST, MEI, and MON processes can price the cross-section of currency excess returns. A two-factor model that includes a risk factor associated with the IST, MEI or the MON processes performs well in our asset pricing exercises. Furthermore, part of the results reveal that our proposed risk factors are priced regardless of whether the HML^{ir} is added to the model. This suggest that our proposed risk factors convey additional information that is important for pricing currency excess returns.

Country-level Analysis. We adopt the methodology employed by Verdelhan (2018) to test the prediction of our proposed risk factors when applied to individual currencies. The author works with a sample of developed and developing countries, covering the period between 1983:M11 and 2010:M12. Verdelhan (2018) constructs two risk factors and runs OLS regressions of individual exchange rate returns on the these risk factors.

Table (3.5) reports the country-level results of the OLS regression of the time-series of currency excess returns for each country "j" on our risk factors: $RX_t^j = \phi_0 + \phi_1 RX_t + \phi_2^{\iota} HML_t^{\iota} + e_t$. ι stands for the IST, MEI, MON1 and MON3; e_t is a white noise error term. The table also documents the results of a second OLS regression: i) $RX_t^j = \psi_0 + \psi_1 HML_t^{\iota} + e_t$. Table (3.6) presents the results for our risk factors built based on the country's exposure to the global component of the IST, MEI, and MON processes.

Overall, we find that both factors appear highly statistically significant - approximately 75% (Table (3.5)) and 64% (Table (3.6)) of the estimated coefficients associated with the IST, MEI, and MON risk factors are statistically significant at the 15% level. The adjusted R^2 values range from 0.05 to 0.69 (Table (3.5)) and from 0 to 0.78 (Table (3.6)). These results suggest that our proposed risk factors are relevant in explaining currency excess return at the country-level. Verdelhan (2018) finds similar results: adjusted R^2 values ranging from 0.20 to 0.90 (developed countries) and from 0.10 to 0.75 (developing economies) for the model with the two factors. Most importantly, both tables make clear the distinction between funding and target countries for CT investments. For instance, funding countries like Switzerland tend to have lower estimated coefficients for the risk factors associated with the IST process, while target countries like Brazil and Turkey have higher estimated coefficients. This pattern holds for other risk factors as well. These findings reinforce our previous results and support the conclusion that our proposed risk factors are priced in foreign exchange markets.

3.13 Concluding Remarks

Motivated by our findings in Chapter 2, we develop an open economy DSGE model in which currency excess returns are explained by investment-specific technology, marginal efficiency of investment and money demand shocks. In our model, there are two types of households. Those with access to financial markets (Optmizing) and those without access to it (Rule-of-thumb). The shocks directly influence households' consumption and saving decisions. An additional effect on the behavior of Optimizing households occurs through changes in intertemporal time preference. These changes in time preference are influenced by the IST, MEI, and MON shocks. The interaction between these three fundamental shocks and time preference changes is the driving force behind the dynamics of economic variables in our model. Specifically, the model generates macroeconomic movements that impact currency excess returns through changes in nominal interest rates and exchange rates. By connecting the fundamental sources of risk originating from these shocks with currency excess returns, our model sheds light on the relationship between business cycle fluctuations and currency returns. These findings represent new contributions to the field of international finance literature.

We also present empirical evidence suggesting that the investment-specific technology, the marginal efficiency of investment and the growth rate of money help to explain currency excess returns. Specifically, we constructed portfolio-based factors for each of these shock processes. Our findings indicate that these factors are priced in the cross-section of currency excess returns, and the prices of risk associated with them are positive and statistically significant. Additionally, we find evidence supporting the importance of our proposed risk factors in explaining country-level excess returns. Overall, the results suggest the promising use of factors based on these three shock processes by the financial industry.

Table 3.5
Country-level Betas

The table reports the results of the OLS regression of the time-series of currency excess returns for each country "j" on our proposed risk factors: $RX_t^j = \phi_0 + \phi_1 RX_t + \phi_2^{\iota} HML_t^{\iota} + e_t$. ι stands for the IST, MEI, MON1 and MON3; e_t is a white noise error term. The table also presents the results of a second OLS regression: i) $RX_t^j = \psi_0 + \psi_1 HML_t^{\iota} + e_t$. R^2 is the adjusted R-squared of each model. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. The sample period is 1985:M01-2019:M12.

Panel (a)	ϕ_0	ϕ_1	ϕ_2^{ist}	R^2	ψ_0	ψ_1^{ist}	R^2	ϕ_0	ϕ_1	ϕ_2^{mei}	R^2	ψ_0	ψ_1^{mei}	R^2
Australia	-1.25	1.13^{a}	0.33^{a}	0.34	4.32^{b}	-0.34^{a}	0.03	-0.30	1.02^{a}	0.03	0.32	5.94^{a}	-0.72^{a}	0.17
Brazil	2.94	1.44^{a}	0.59^{a}	0.19	9.01^{b}	-0.04	0.00	2.69	1.67^{a}	0.61^{b}	0.18	10.97^{a}	-0.67^{a}	0.04
Canada	-1.41	0.65^{a}	0.18^{b}	0.25	1.78^{d}	-0.21^{a}	0.02	-1.20	0.62^{a}	0.06	0.24	2.63^{b}	-0.39^{a}	0.11
Mexico	-0.53	0.79^{a}	0.55^{a}	0.12	3.03^{d}	0.15^{d}	0.00	-2.39	1.14^{a}	0.77^{a}	0.13	3.97^{c}	-0.09	0.00
Switzerland	-1.64	1.24^{a}	-0.36^{a}	0.69	4.49^{a}	-1.11^{a}	0.32	0.84	0.93^{a}	-0.67^{a}	0.73	6.53^{a}	-1.35^{a}	0.60
Turkey	5.44^{b}	1.34^{a}	0.73^{a}	0.23	12.07^{a}	-0.06	0.00	4.74^{c}	1.44^{a}	0.55^{a}	0.20	13.56^{a}	-0.50^{a}	0.04
United Kingdom	-0.95	0.93^{a}	-0.28^{b}	0.53	3.66^{b}	-0.83^{a}	0.24	0.22	0.78^{a}	-0.39^{a}	0.54	5.01^{a}	-0.97^{a}	0.41
Panel (b)	ϕ_0	ϕ_1	ϕ_2^{mon1}	R^2	ψ_0	ψ_1^{mon1}	R^2	ϕ_0	ϕ_1	ϕ_2^{mon3}	R^2	ψ_0	ψ_1^{mon3}	R^2
Australia	-0.39	1.08^{a}	0.15^{b}	0.43	3.70^{c}	-0.06	0.00	-0.54	1.05^{a}	0.18^{a}	0.42	3.53^{c}	0.02	0.00
Brazil	5.29^{c}	1.39^{a}	-0.22	0.28	9.21^{b}	-0.36	0.02	4.67^{d}	1.33^{a}	0.21	0.25	8.18^{b}	0.19	0.00
Canada	-0.98	0.63^{a}	0.08^{c}	0.32	1.41	-0.04	0.00	-1.25	0.62^{a}	0.15^{a}	0.33	1.17	0.05	0.01
Mexico	1.42	0.76^{a}	0.20^{b}	0.15	3.46^{d}	0.07	0.00	-0.25	0.72^{a}	0.52^{a}	0.25	1.58	0.46^{b}	0.10
Switzerland	-1.28	1.13^{a}	-0.27^{a}	0.59	3.02^{c}	-0.49^{a}	0.11	-0.85	1.15^{a}	-0.31^{a}	0.66	3.61^{b}	-0.49^{a}	0.16
Turkey	6.95^{a}	1.19^{a}	0.49^{a}	0.29	11.46^{a}	0.25^{c}	0.01	5.96^{b}	1.18^{a}	0.65^{a}	0.36	10.54^{a}	0.46^{b}	0.07
United Kingdom	-1.12	0.92^{a}	-0.08^{c}	0.46	2.36	-0.27^{a}	0.04	-0.89	0.92^{a}	-0.13^{b}	0.49	2.67^{d}	-0.26^{a}	0.06

Table 3.6
Country-level Betas - Global

The table reports the results of the OLS regression of the time-series of currency excess returns for each country "j" on our proposed risk factors: $RX_t^j = \phi_0 + \phi_1 RX_t + \phi_2^{\iota} HML_t^{\iota} + e_t$. ι stands for country's exposure to the global component of the IST, MEI, MON1 and MON3; e_t is a white noise error term. The table also presents the results of a second OLS regression: i) $RX_t^j = \psi_0 + \psi_1 HML_t^{\iota} + e_t$. R^2 is the adjusted R-squared of each model. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. The sample period is 2006:M01-2019:M12.

Panel (a)	ϕ_0	ϕ_1	ϕ_2^{ist}	R^2	ψ_0	ψ_1^{ist}	R^2	ϕ_0	ϕ_1	ϕ_2^{mei}	R^2	ψ_0	ψ_1^{mei}	R^2
Australia	-1.67	1.69^{a}	0.29^{b}	0.73	6.46^{b}	-0.98^{a}	0.20	-1.07	1.62^{a}	0.22	0.72	5.97^{c}	-1.06^{a}	0.17
Brazil	0.47	1.83^{a}	0.77^{a}	0.41	9.29^{b}	-0.61^{b}	0.04	1.46	1.70^{a}	0.72^{a}	0.39	8.87^{b}	-0.62^{b}	0.03
Canada	-2.42	1.01^{a}	0.09	0.46	2.44	-0.66^{a}	0.15	-1.34	0.90^{a}	-0.16	0.46	2.56	-0.86^{a}	0.18
Mexico	-5.00^{b}	1.46^{a}	0.81^{a}	0.49	2.02	-0.28	0.02	-3.94^{c}	1.32^{a}	0.76^{a}	0.46	1.80	-0.29	0.01
Switzerland	3.16^{d}	0.71^{a}	-0.70^{a}	0.65	6.62^{a}	-1.24^{a}	0.50	0.54	1.01^{a}	-0.20	0.56	4.95^{b}	-1.00^{a}	0.22
Turkey	-2.15	2.06^{a}	1.55^{a}	0.48	7.77^{c}	-0.01	0.00	0.51	1.73^{a}	1.26^{a}	0.39	8.05^{c}	-0.10	0.00
United Kingdom	-1.13	0.64^{a}	-0.37^{b}	0.44	1.95^{b}	-0.87^{a}	0.30	-0.99	0.64^{a}	-0.50^{a}	0.46	1.79	-1.01^{a}	0.30
Panel (b)	ϕ_0	ϕ_1	ϕ_2^{mon1}	R^2	ψ_0	ψ_1^{mon1}	R^2	ϕ_0	ϕ_1	ϕ_2^{mon3}	R^2	ψ_0	ψ_1^{mon3}	R^2
Australia	0.06	1.40^{a}	0.04	0.78	3.00	-0.15	0.00	-0.02	1.39^{a}	0.07	0.78	2.10	0.18	0.01
Brazil	4.22^{d}	1.37^{a}	0.12	0.45	7.11^{d}	-0.07	0.00	2.41	1.32^{a}	0.68^{a}	0.55	4.45	0.79^{a}	0.13
Canada	-2.24^{c}	0.91^{a}	0.23^{b}	0.55	-0.32	0.11	0.00	-1.62	0.89^{a}	-0.02	0.52	-0.25	0.05	0.01
Mexico	-1.30	0.98^{a}	0.22^{d}	0.45	0.75	0.08	0.00	-2.05	0.94^{a}	0.41^{a}	0.52	-0.61	0.49^{a}	0.09
Switzerland	1.27	0.87^{a}	-0.48^{a}	0.59	3.10	-0.60^{a}	0.13	-1.16	0.92^{a}	-0.30^{a}	0.55	2.59	-0.23^{c}	0.02
Turkey	2.96	1.29^{a}	1.18^{a}	0.57	5.68^{d}	0.99^{a}	0.14	2.63	1.12^{a}	0.96^{a}	0.56	4.37	1.06^{a}	0.24
United Kingdom	-2.34	0.71^{a}	-0.13	0.41	-0.84	-0.23	0.02	-1.99	0.73^{a}	-0.20^{a}	0.43	-0.85	-0.15^{d}	0.01

A limitation of the current research is its lack of consideration of household heterogeneity in depth. In our model, there are only two distinct households (Optmizing and Rule-of-thumb), and this simplicity may not fully capture the complexity of real-world households. Heterogeneity could arise from various sources, such as household risk aversion, wealth levels, and individual tastes, leading to different types of agents with distinct behaviors and preferences.

In future developments of this literature, it would be valuable to incorporate a more detailed model that accounts for household heterogeneity, as it can significantly impact currency portfolio decisions. By understanding how different types of agents make their investment choices, we can better rationalize the existence of carry traders in countries with low interest rates, despite the tendency of these economies to have aggregate positions biased towards domestic assets, such as government bonds. Moreover, exploring the role of household heterogeneity in currency portfolio formation could yield valuable insights for the financial industry. Identifying and understanding the important risk factors that drive household's portfolio decisions can inform investment strategies and risk management practices. By incorporating such heterogeneity, future research can provide a more comprehensive understanding of currency markets and improve the practical applications for investors and financial institutions.

Chapter 4

Fundamental Sources of Risk and Equity Market

We now explore the connection between the fundamental sources of risk and foreign equity markets. We begin by briefly summarizing the main findings from the relevant literature. Next, we investigate the behavior of equity returns in a large set of countries in recent decades. We then examine the explanatory power of our proposed risk factors in a cross-section of stock market index returns from this set of countries. Lastly, we discuss the main results and present some final remarks.

4.1 Foreign Equity Market

An important topic explored in the finance literature concerns the identification of risk factors capable of explaining the excess returns of different types of assets (e.g., stocks, bonds, etc.). Burnside (2011a) investigates whether traditional CAPM risk factors, the three factors of Fama and French (1992), and the extended CAPM with industrial production and US stock market volatility can explain currency excess returns. The author demonstrates that none of these models has sufficient explanatory power. Furthermore, jointly estimated models containing currency and equity portfolios are also rejected, confirming that the conventional risk factors that have success in explaining stock returns fail to explain currency returns. Burnside (2011a) concludes that there is no unifying risk-based explanation for excess returns in the stock and FX markets. Based on the estimation of a multicurrency term structure model, Sarno et al. (2012) reach a similar conclusion. In their empirical analysis, they find that the model that price bonds with high accuracy does not work well with currency returns. Conversely, the model that best prices currency returns fails to price bond returns. The lack of a unifying risk-based explanation remains to date. Our objective is to examine whether our proposed risk factors reflect common sources of systematic risk in equity and currency markets.

Our analysis is also related to the literature that explores the empirical connection between stock market indices and exchange rates (Bahmani-Oskooee and Sohrabian, 1992; Kim, 2003; Ibrahim and Aziz, 2003; Aydemir and Demirhan, 2009). The main focus of these studies is to define the time interval (short-term connection or long-term equilibrium relation) and the sign (positive or negative correlation) of this relationship. Overall, the literature documents conflicting results. For example, Aydemir and Demirhan (2009) employ monthly data from 2001 to 2008 from various Turkish stock market indices. They find a bidirectional causality between all stock market indices and exchange rate. However, the sign of the correlations varies according to the stock market index analyzed. On the other hand, Ibrahim and Aziz (2003) use monthly data from 1977 to 1998 and find a negative correlation between stock prices and exchange rate in Malaysia. Domestic currency depreciation is associated with a drop in stock prices. Aydemir and Demirhan (2009) also reports that increases in stock prices are associated with appreciation of domestic currency. The author considers a set of six Asian countries (Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan) spanning the period from 1992 to 2009. In contrast to these studies, we look at the connection between stock markets and exchange rates from another perspective. We examine whether the excess returns derived from both markets can be explained by the same risk factors.

Finally, our empirical exercise also contributes to the literature that explores the Uncovered Equity

Parity (UEP) condition. Hau and Rey (2006) develop a model in which the rebalancing of stock portfolio triggers exchange rates fluctuations. In their model, domestic investors can buy foreign assets only with foreign currency. Since, domestic investors do not hold foreign currency, any increase in demand for foreign stocks translates into purchases of foreign currency. The main prediction of their model is that higher returns in the domestic stock market (in national currency) relative to foreign market translate into a depreciation of the national currency. This negative correlation is triggered by portfolio rebalancing. When the foreign stock market outperforms its domestic counterpart, domestic investors become more exposed to currency risk. Which, in turn, induces them to reduce their position in the foreign stock market to lower currency exposure. To operationalize this rebalancing, they sell the foreign currency leading to foreign currency depreciation. This is the UEP condition. Hau and Rey (2006) report empirical evidence in favor of the UEP condition for 17 OECD countries.

As emphasized by Curcuru et al. (2014), if the UEP holds, the behavior of equity investors would seem to contradict the behavior that drives CT, where a high interest-rate currency tend to appreciate and persist to appreciate. They investigate the behavior of US investors on forty-two stock markets spanning the period from 1990 to 2010. Curcuru et al. (2014) document that, in fact, US investors reallocate funds from foreign stock exchanges that recently performed well to other foreign stock exchanges that soon after perform well. In short, they do not repatriate to reduce their currency exposure. Similarly, Fuertes et al. (2019) find evidence in favor of deviations from the UEP condition. They work with stock market indices from eight Asian countries (India, South Korea, the Philippines, Taiwan, and Thailand) covering different time intervals for each country within the period from 1996 to 2013. They suggest that investors in these countries follow a return-seeking behavior rather than a portfolio rebalancing strategy. Which, in turn, leads to the failure of the UEP.

More recently, Camanho et al. (2022) find empirical support in favor of the UEP condition. They analyze quarterly fund-level data from the US, UK, Eurozone and Canada, covering the period between 1999 and 2015. In summary, the authors reveal that investors partially repatriate their equity wealth when foreign stock markets outperform the domestic counterpart. Furthermore, they show that an increase in global exchange rate volatility fuels such behavior. If our proposed risk factors are also priced in the international equity market, this would indicate that currency and equity market returns have common sources of variation. Thus, we should be able to shed some light on the nature of the correlation between these returns.

4.2 Stock Market Indices Return Trend

Motivated by the findings of the previous chapter, we investigate whether our proposed risk factors help to explain equity excess returns. Equity excess returns are computed according to equation (2.2), but the US investor always buys the foreign country stock index and not the foreign bond, regardless of the nominal interest rates in both countries. Therefore, equity excess returns from investing in foreign country stock indices are net of exchange rate depreciation. To complement our analysis, we also explore the behavior of simple equity returns computed from the same foreign country stock indices. It is worth mentioning that the payoff of the first investment is denominated in US dollars. Therefore, its return is sensitive to the correlation between the foreign currency and the foreign stock index. On the other hand, the simple equity return arises from a foreign-currency-denominated claim on the foreign stock market index. We chose to analyze both types of returns because, as documented by Hau and Rey (2006), foreign equity investment made by US institutional investors is at least partially hedged against FX exposure. The simple equity return would be the outcome of an investment fully hedged against currency exposure. As in chapter 3, we had to refine the raw data to take into account issues related to countries' financial openness, sovereign defaults and the entry of European countries into the Eurozone.

Data on stock market indices come from two data sources: Investing.com and Yahoo Finance. The set of foreign country stock market indices consists of the main stock index of each of the following fifty-two countries:

1. Investing.com - DSE30 (Bangladesh, 2013:M01-2019:M12), S&P/TSX (Canada, 1985:M01-2019:M12), S&P CLX IPSA (Chile, 1993:M09-2019:M12), COLCAP (Colombia, 1998:M01-2019M12), CROBEX (Croatia, 2001:M01-2019:M12), PX (Czech Republic, 2012:M01-2019:M12), OMX20 (Denmark, 2001:M02-2019:M12), Guayaquil Select (2011:M11-2019:M12), EGX30 (Egypt, 1998:M01-2019:M12),

OMX Helsinki 25 (Finland, 2001:M03-2019:M12), CAC40 (France, 1987:M07-2019:M12), Athenas General Composite (Greece, 2013:M10-2019:M12), Budapest SE (Hungary, 2011:M03-2019:M12), ICEX Main (Iceland, 2001:M01-2019:M12), Vilnius SE General (Lithuania, 2000:M01-2019:M12), S&P/BMV IPC (Mexico, 1987:M01-2019:M12), Moroccan All Shares (Morocco, 2002:M01-2019:M12), AEX (Netherlands, 1985:M01-2019:M12), NZX50 (New Zealand, 2001:M01-2019:M12), Oslo OBX (1999:M09-2019:M12), PSI (Portugal, 2010:M09-2019:M12), BET (Romania, 2010:M02-2019:M12), MOEX (Russia, 1997:M09-2019:M12), Tadawul All Shares (Saudi Arabia, 1998:M10-2019:M12), Belex 15 (Serbia, 2012:M12-2019:M12), SAX (Slovakia, 2011:M10-2019:M12), Blue-Chip SBITOP (Slovenia, 2006:M06-2019:M12), South Africa Top 40 (South Africa, 1995:M06-2019:M12), KOSPI (South Korea, 1985:M01-2019:M12), IBEX35 (Spain, 1991:M09-2019:M12), CSE All-Shares (Sri Lanka, 1993:M06-2019:M12), OMXS30 (Sweden, 1986:M09-2019:M12), SMI (Switzerland, 1988:M01-2019:M12), SET (Thailand, 1985:M01-2019:M12), Tunindex (Tunisia, 1998:M01-2019:M12), BIST100 (Turkey, 1995:M01-2019:M12), PFTS (Ukraine, 1997:M10-2018:M12); and

2. Yahoo Finance - S&P/ASX200 (Australia, 1992:M11-2019:M12), BEL20 (Belgium, 1991:M04-2019:M12), IBOVESPA (Brazil, 1994:M03-2019:M12), DAX (Germany, 1987:M12-2019:M12), Hang Seng (Hong Kong, 1987:M01-2019:M12), S&P BSE Sensex (India, 1997:M07-2019:M12), IDX Composite (Indonesia, 1990:M04-2019:M12), ISEQ ALL Shares (Ireland, 1997:M07-2019:M12), TA-125 (Israel, 1992:M10-2019:M12), Nikkei225 (Japan, 1985:M01-2019:M12), FTSE Bursa KLCI (Malaysia, 1993:M12-2019:M12), S&P/BVL Peru General TR (Peru, 1997:M03-2019:M12), STI (Singapore, 1988:M01-2019:M12), PSEi (the Philippines, 1987:M01-2019:M12), and the FSTE100 (the United Kingdom, 1985:M01-2019:M12).[1]

Following Asness et al. (2013), we also used foreign country stock indices obtained from Morgan Stanley Capital International (MSCI).[2] The set of country equity indices covers forty-one economies spanning the following periods: Australia (1985:M01-2019:M12), Austria (1985:M01-2019:M12), Belgium (1985:M01-2019:M12), Brazil (1998:M01-2019:M12), Canada (1985:M01-2019:M12), Chile (1995:M01-2019:M12), Colombia (1990:M01-2019:M12), Czech Republic (1995:M01-2019:M12), Denmark (1985:M01-2019:M12), Egypt (1995:M01-2019:M12), Finland (1985:M01-2019:M12), France (1985:M01-2019:M12), Germany (1985:M01-2019:M12), Greece (1985:M01-2019:M12), Hong Kong (1985:M01-2019:M12), Hungary (1995:M01-2019:M12), Italy (1985:M01-2019:M12), India (1993:M01-2019:M12), Indonesia (1993:M01-2019:M12), Ireland (1988:M01-2019:M12), Israel (1993:M01-2019:M12), Japan (1985:M01-2019:M12), Malaysia (1993:M01-2019:M12), Mexico (1993:M01-2019:M12), Netherlands (1985:M01-2019:M12), New Zealand (1985:M01-2019:M12), Norway (1985:M01-2019:M12), Peru (1998:M01-2019:M12), Portugal (1988:M01-2019:M12), Poland (1994:M01-2019:M12), Saudi Arabia (2005:M06-2019:M12), Singapore (1985:M01-2019:M12), South Africa (1993:M01-2019:M12), South Korea (1993:M01-2019:M12), Spain (1985:M01-2019:M12), Sweden (1985:M01-2019:M12), Switzerland (1985:M01-2019:M12), Thailand (1988:M01-2019:M12), the Philippines (1993:M01-2019:M12), the United Kingdom (1985:M01-2019:M12), and Turkey (1988:M01-2019:M12).

Figure (4.1) displays the evolution of the 10-year moving average of equity excess returns and equity returns by country groups (All, Developed, Developing, and G10). In all panels of this figure, the left axis represents values for the All and Developing country groups, while the right axis represent values for the Developed and G10 country groups. Two main results emerge from Panels (a) and (b) of the figure. First, most of the time, US investors realize greater equity excess returns when they invest in developing countries than in Developed and G10 countries. Second, average excess returns fluctuate without a clear trend. On the other hand, Panels (c) and (d) reveal the existence of a downward trend in average stock returns. As we can see in Panel (c), average returns fall from around 12% p.a. (1994) to about 8% p.a. (2019) in Developed and G10 countries. Similarly, average returns decline from around 30% p.a. (1994) to about to 8% p.a. (2019) in developing countries. The downward trend is even stronger when we consider

[1]Due to data availability, we considered the period from 1985:M01 onwards in our analysis. Note that some stock market indices are available on both Investing.com and Yahoo Finance. In these cases, we chose the source with the longest time coverage.

[2]MSCI is an investment research firm that provides stock indices and various analytical tools for asset investment. The MSCI country stock indices are market capitalization weighted indices that track the performance of large and mid-cap firms in each country.

the MSCI indices (see Panel (d)). This result indicates that CT investment is not a particular case of the downward trend in returns observed in recent decades.

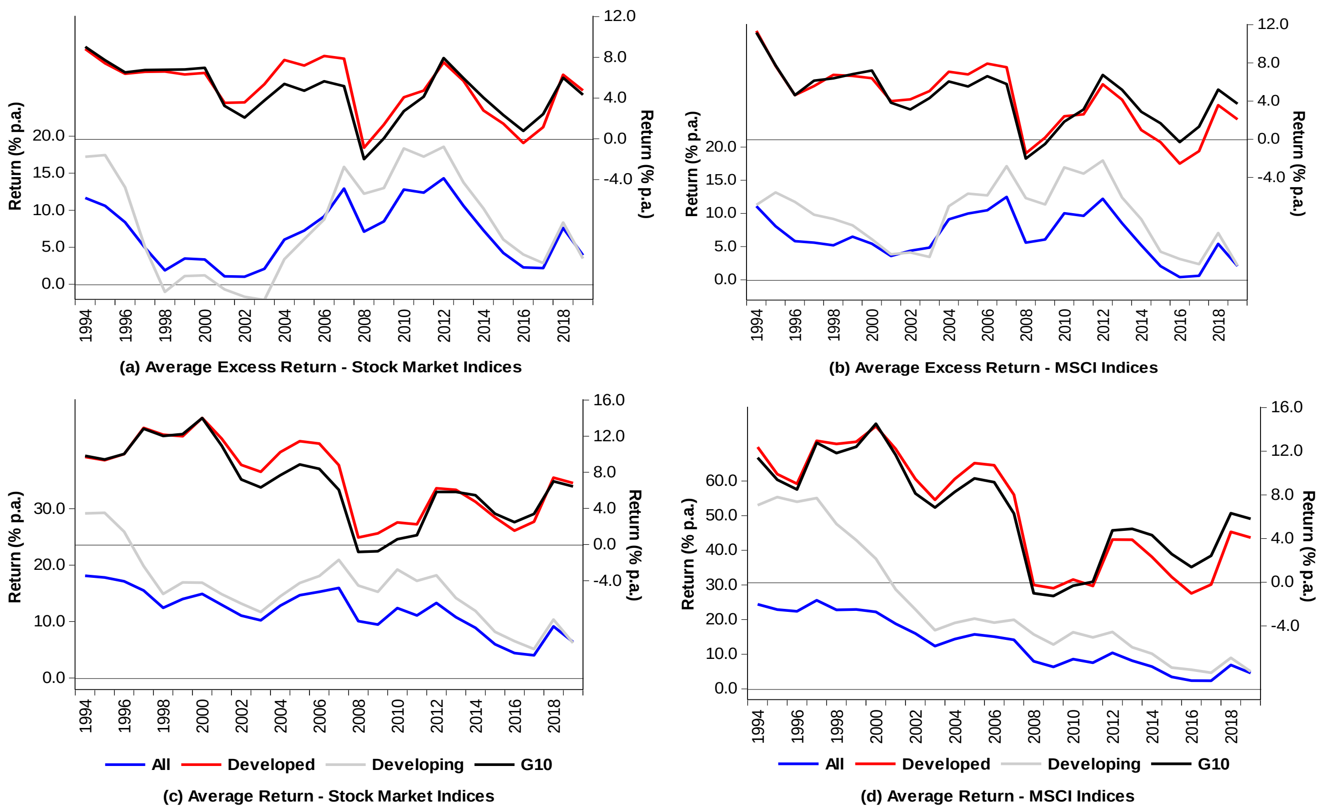


Figure 4.1: Behavior of Stock Market Indices. The figure shows the evolution over time of the 10-year moving average of the foreign stock indices excess returns (panels (a) and (b)) and of the foreign stock indices returns (panels (c) and (d)). To obtain the 10-year moving average values, we first computed the cross-sectional mean of the monthly data for each group of countries (All, Developed, Developing, and G10). We then used these values to calculate the the 10-year moving average. In all panels of this figure, the left axis represents values for the All and Developing groups, while the right axis represents values for the Developed and G10 groups. Monthly stock indices excess returns and stock indices returns are annualized (multiplied by twelve). The sample period is 1985-2019.

Figure (4.2) shows the evolution overtime of the standard deviation of foreign stock market index returns. The main point to be drawn from Panels (c) and (d) of the figure is that, in general, the standard deviation of foreign stock market index returns has declined over the past few decades. Note that this downward trend is stronger in developing than in developed countries. For example, Panel (c) shows that the standard deviation of the index returns dropped from 90% to 50% in developing countries and from 45% to 38% in developed countries between 1994 and 2019. Panels (a) and (b) of the figure also reveal a similar pattern. Them main difference is the "hump" period (between mid-1995 and mid-2000) caused by exchange rate fluctuations in developing countries.

Table (4.1) is a representative summary of the mean and standard deviation of stock market index returns considering a five-year data window. Panel (c) and (d) of the table show that, overall, average stock returns for the 1985-1999 period are lower than for the 2000-2019 period for all group of countries. The decline in average stock returns is more pronounced among developing countries. For example, Panel (d) reports a drop in the average stock return in developing countries from 48.69% (1985-1989) to 4.83% (2015-2019). Similar considerations apply to the standard deviation of average stock returns.

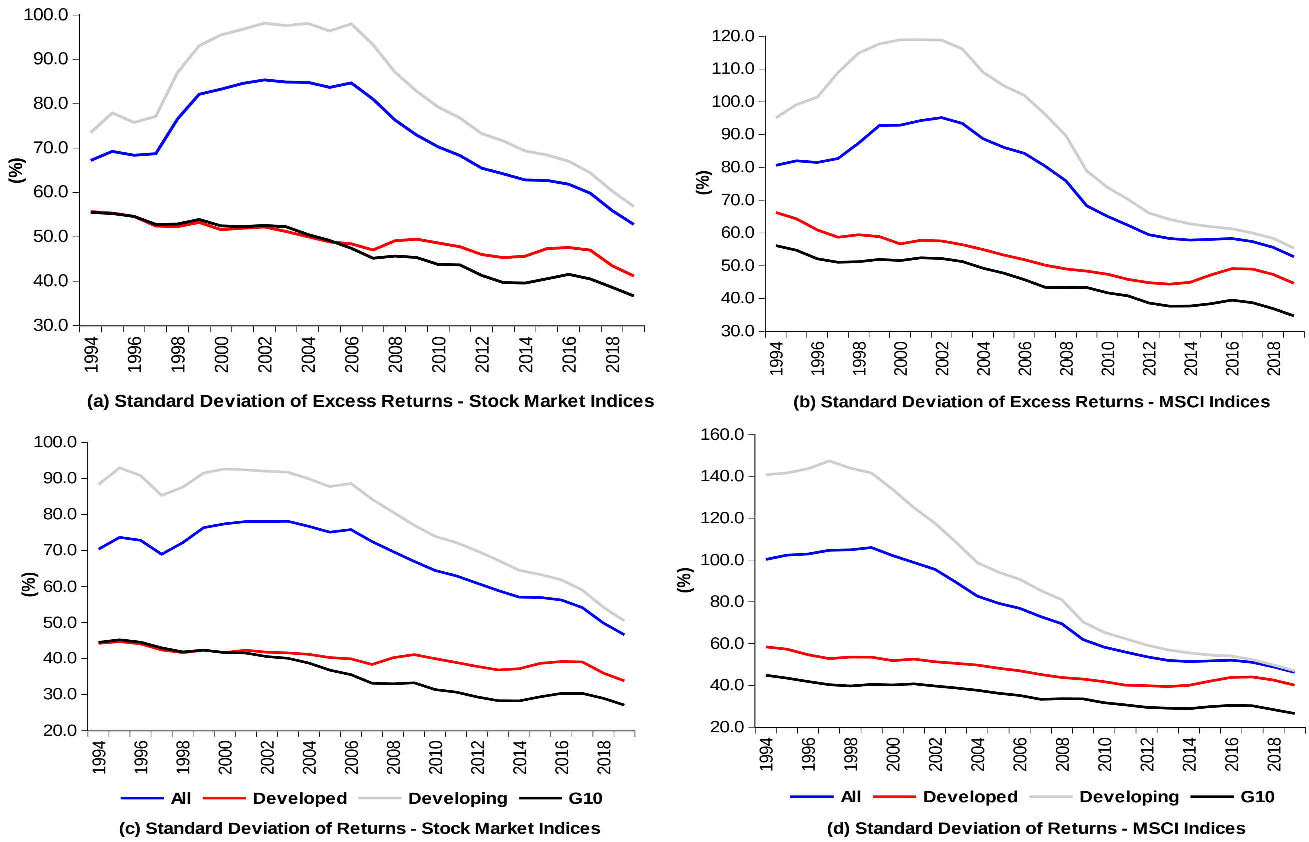


Figure 4.2: Standard Deviation of Stock Market Index Returns. The figure shows the evolution over time of the 10-year moving average of the standard deviation of the foreign stock indices excess returns (panels (a) and (b)) and of the foreign stock indices returns (panels (c) and (d)). To obtain the 10-year moving average values, we first computed the cross-sectional standard deviation of the monthly data for each group of countries (All, Developed, Developing, and G10). We then averaged these values considering data from a 10-year window. Monthly stock indices excess returns and stock indices returns are annualized (multiplied by twelve). The sample period is 1985-2019.

The situation regarding stock excess returns is less straightforward. Nonetheless, we can observe a decrease in equity excess returns in both Developed and G10 countries. Panels (a) and (b) of the table demonstrate that the average stock excess returns for the period 1985-1999 are lower than those recorded for the period 2000-2019 within these two groups of countries. For example, Panel (b) documents a drop in the average excess return from 22.75% (1985-1989) to 2.10% (2015-2019) in developed countries.

In summary, the results of this section point to conclusions similar to those drawn in Chapter 2 regarding CT returns. Overall, equity returns, as measured by the returns of the stock market indices and the MSCI indices, have declined over the last few decades. Note that equity returns depend on the operating performance of firms. Which, in turn, depends on the ability of firms to turn growth opportunities into profitable projects. In general, at least part of these projects involve investment in physical capital. In our model, investment is directly affected by the IST and MEI shocks. Furthermore, since firms investment depends on household saving decisions, which is influenced by MON shocks, it is reasonable to assume that they are also important for firm investment decisions. The bottom line is that while CT and stocks are different investment options, they can have the same fundamental sources of risk. Motivated by these considerations, we continue our analysis by investigating the explanatory power of the risk factors associated with the IST, MEI, and MON processes in the cross section of foreign stock indices returns.

Table 4.1
Descriptive Statistics - Stock Market Index Returns

The table shows the mean and standard deviation of equity excess returns and equity returns considering a five-year data window. The figures in each panel are five-year averages and standard deviations of the means of the cross-sectional values for each group of countries (All, Developed, Developing, and G10). All values in the table are presented in % p.a. The sample period is 1985-2019.

	All		**Developed**		**Developing**		**G10**	
Period	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**	**Mean**	**Sd.**
Panel (a): Excess Returns - Market								
1985-1989	21.34	49.18	17.32	52.16	29.65	64.87	17.32	52.16
1990-1994	2.02	48.58	0.10	48.76	5.30	65.69	0.55	47.64
1995-1999	8.31	62.88	12.55	42.57	2.67	88.27	13.06	42.15
2000-2004	8.30	52.67	2.92	53.13	11.83	55.17	-2.27	54.33
2005-2009	11.51	75.58	-0.14	72.97	18.92	78.27	2.34	67.42
2010-2014	4.73	53.40	5.71	57.28	4.28	52.56	5.74	50.94
2015-2019	3.17	37.55	3.77	39.91	2.73	38.27	2.91	37.81
Panel (b): Excess Returns - MSCI								
1985-1989	22.81	55.80	22.75	55.77	21.12	98.94	22.09	56.16
1990-1994	-0.91	54.62	-0.42	51.20	1.95	88.55	-0.17	48.09
1995-1999	13.90	65.99	13.68	46.85	14.48	97.22	13.80	42.74
2000-2004	4.34	59.98	0.48	58.53	7.69	67.65	-1.70	57.94
2005-2009	7.81	82.10	-0.14	75.13	14.99	90.24	0.71	69.68
2010-2014	2.63	60.47	2.06	65.35	3.27	59.97	5.03	56.84
2015-2019	1.52	44.49	2.10	44.32	1.01	49.18	2.39	40.23
Panel (c): Returns - Market								
1985-1989	26.35	57.45	15.74	53.40	40.70	73.53	15.74	53.40
1990-1994	10.09	54.09	3.63	51.70	18.18	65.30	3.89	50.47
1995-1999	17.92	61.21	20.36	50.00	15.68	75.53	20.5	51.47
2000-2004	7.73	45.98	0.11	51.25	13.29	47.02	-5.19	56.06
2005-2009	11.21	64.00	2.37	62.56	17.26	67.71	3.71	59.35
2010-2014	6.60	34.76	7.13	39.50	6.49	34.94	7.21	40.55
2015-2019	6.16	27.49	6.52	38.11	5.95	24.66	5.66	42.05
Panel (d): Returns - MSCI								
1985-1989	27.47	54.72	20.02	52.02	48.69	104.62	18.86	54.86
1990-1994	21.36	57.72	4.52	53.58	58.23	87.81	3.74	50.68
1995-1999	24.50	62.91	21.21	52.30	27.64	83.70	21.06	51.44
2000-2004	4.24	50.00	-2.30	53.97	10.46	54.16	-4.51	57.92
2005-2009	8.49	63.86	1.18	63.05	15.13	67.70	2.00	59.69
2010-2014	4.38	37.85	3.45	43.79	5.23	37.39	6.63	40.90
2015-2019	4.79	32.70	4.74	40.45	4.83	31.56	4.99	40.90

4.3 Asset Pricing Analysis

We now turn to analyze the performance of our proposed risk factors in pricing returns on foreign stock indices. In the empirical exercises, we work with monthly returns, covering the period between 1985:M01 and 2019:M12. We perform our analysis for our two datasets separately. Thus, we conduct two asset pricing exercises. The first for portfolio returns derived from foreign stock market indices and the second for portfolio returns derived from MSCI indices. This choice is motivated by differences in the sample of countries and coverage time between the two databases. We compute real equity excess returns as follows:

$$RX_{t+1}^{j} \equiv \left\{ \left[(1+e_{jt}) \left(\frac{S_{jt+1}}{S_{jt}} \right) - (1+i_t) \right] \left(\frac{P_t}{P_{t+1}} \right) \right\}, \tag{4.0}$$

where RX_{t+1}^{j} is the real *ex-post* equity excess return obtained by an investor who borrow at the US nominal interest rate and invest in a stock market index of country j, considering that both trades are closed at t; e_{jt} represents the end-of-period return of the stock market index; S_{jt} denotes the end-of-period exchange rate of country j in level; and P_t is the US CPI. The moments of returns are annualized: we multiply the mean of the monthly data by 12 and standard deviation by $\sqrt{12}$.

To assess how effective our risk factors are in explaining the stock market's behavior without factoring in exchange rate fluctuations, we also calculate straightforward equity excess returns as follows:

$$RX_{t+1}^{j} \equiv \left\{ [(1+e_{jt}) - (1+i_t)] \left(\frac{P_t}{P_{t+1}} \right) \right\}. \tag{4.0}$$

In the following, to facilitate comparison of results, we call the excess return obtained from equation (4.3) "excess returns" and the excess return obtained from equation (4.3) "returns", despite the fact that both represent excess returns from a US investor's perspective. As emphasized above, "excess returns" come from investments in assets that are sensitive to the correlation between the foreign currency and the foreign stock index. These are dollar-denominated claims on the foreign stock index. On the other hand, "returns" are foreign-currency-denominated assets in the foreign stock index. As in Chapter 3, we implemented two additional adjustments to our dataset: i) the exclusion of countries during periods when they experience states of very low international financial openness or sovereign default; and ii) the exclusion of European countries in their entry months into the Eurozone.

Foreign Stock Index Portfolios. We employed two strategies to construct our equity portfolios. First, we used the values of the IST, MEI, and MON processes, proxied by the relative price of investment, the Index of Financial Development (IFD) developed by the IMF (Svirydzenka, 2016), and the growth rate of M1 and M3. Second, we used the values of country's exposure to the global component of each shock process.

At the end of each month t, we allocate all countries into six portfolios based on their IST, MEI, and MON (the growth rate of M1 and M3) values. Portfolios are rebalanced at the end of each year (IST and MEI) or quarter (MON). IST and MEI portfolios are ranked from high to low values: portfolio one contains the countries with the highest IST and MEI values, while portfolio six comprises the countries with the lowest IST and MEI values. MON portfolios are ranked from low to high values: portfolio one contains the countries with the lowest M1 (M3) growth rates, while portfolio six comprises the countries with the highest M1 (M3) growth rates. Portfolio excess returns (returns) are calculated as an equally weighted average of the equity excess returns (equity returns) within each portfolio. The number of countries in each portfolio varies over time due to data availability.

Similarly, at the end of each month t, we allocate all countries into six portfolios based on the country's exposure to the global component of the shock processes. Portfolios are rebalanced at the end of each year. They are ranked from high to low values: portfolio one contains the countries with the highest exposures to each shock, while portfolio six comprises the countries with the lowest exposures to each shock. As the Global Competitive Index is available only from 2005 onwards, we restrict our asset pricing exercises between 2006 and 2019. The number of countries in each portfolio varies over time due to data availability.

We construct our risk factors following the same strategy adopted in Chapter 3: the average of equity excess returns (equity returns) considering all countries (RX); and the difference in excess returns (returns) between portfolios six and one (HML). Thus, we denote HML^{ist}, HML^{mei}, HML^{mon1}, and HML^{mon3} for risk factors constructed from portfolios ranked by countries' IST value, MEI value, M1 growth rate and M3 growth rate. We followed the same procedure regarding the country's exposure to the global components of the shock processes.

Cross-sectional Regressions. To analyze the cross-sectional properties of equity excess returns (equity returns), we followed the same strategy used in Chapter 3. We built twenty-four test assets ("momentum", "value" and "volatility") and used them as test assets in our empirical analysis, alongside six portfolios sorted by the IST values, six by the MEI values, six by M1 growth rates and six by M3 growth rates. Therefore, our test asset set comprises 48 equity portfolios.

At the end of each month t, we form six portfolios based on equity excess returns (equity returns) for the previous k months. We place the countries with the lowest lagged excess returns (returns) in portfolio one and the countries with the highest lagged excess returns (returns) in portfolio six. Portfolios are rebalanced at the end of each month. We construct six "short-term momentum" (k=3) and six "long-term momentum" (k=12) portfolios.[3]

At the end of each period t, we construct six portfolios sorted on the value of the five-year lagged foreign stock market index return. To build the "value" portfolios, we followed Asness et al. (2013), and computed the negative five-year return on the foreign stock market index, measured as the log of the average foreign stock market index from 4.5 to 5.5 years ago divided by its value today. Countries with the highest stock market returns are grouped in portfolio one and countries with the lowest stock market returns in portfolio six. Due to the methodology used to obtain the "value" portfolios, we have to restrict our empirical analysis between 1990:M08 and 2019:M12.

We also employ equity strategy based on countries' exposure to global stock market volatility. The measure of global stock market volatility is computed as follows. First, we calculated the daily log return for each foreign country stock market index. Second, we computed the simple cross-sectional average of the absolute values of these returns across all currencies. Thus, we ended up with one value for each day (daily measure of global stock market index volatility). Third, we computed the time series simple average of the daily values obtained in the last step. We ended up with one value for each month (monthly measure of global stock market volatility). Lastly, we ran individual OLS regressions of monthly foreign country stock market excess return (foreign country stock market return) on a constant and the first difference of the monthly measure of global stock market volatility, considering a rolling window of thirty-six months. The estimate of the slope coefficient is the country's exposure to global stock market volatility. With this strategy, we obtain time-varying country's exposure to global stock market volatility. At the end of each period t, we group the countries with the highest exposures to global stock market volatility in portfolio one and the countries with the lowest exposures in portfolio six.[4]

We work with a two and three-factor SDF. We ran our estimations with the RX factor combined with one or two factors (HML^{ist}, HML^{mei}, HML^{mon1} and HML^{mon3}). In what follows, the tables report the results from the Fama and MacBeth (1973) two-pass procedure used to estimate the market price of risk associated with our proposed risk factors. We report the results for two sample periods: from 1990:M08 to 2019:M12 and from 2000:M01 to 2019:M12. This choice is motivated by the presence of missing data for the period before 2000 (especially in the Investing.com and Yahoo Finance dataset) which can have a significant impact on our estimates. Therefore, we also present results for a period with a more complete dataset between 2000:M01 and 2019:M12.

We do not include a constant in the second step of the Fama and MacBeth (1973) procedure. The test assets include 48 portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess returns (equity returns), six by past one-year equity excess returns (excess returns), six by past five-year equity returns and six by countries' exposure to global stock market volatility. We focus on the sign and the statistical significance of the market price of risk associated with our proposed risk factors: λ^{ist}_{HML}, λ^{mei}_{HML}, λ^{mon1}_{HML}, and λ^{mon3}_{HML}.

Table (4.2) and (4.3) present the results of our asset pricing exercises for the "excess returns" and "returns", respectively. The tables indicates that our three factors are priced in the cross-section of equity portfolios. Overall, the prices of risk associated with the IST, MEI, and MON risk factors are positive and statistically significant. This implies that stock market indices from countries with low IST/MEI values and high M1/M3 growth rates earn higher excess returns on average.

Panels (a) and (b) in Table (4.2) show that λ^{ist}_{HML} has positive and statistically significant coefficients ranging from 2.72% to 10.64%. The adjusted R^2s reach values between 0.12 and 0.57. The λ^{mei}_{HML} has positive and statistically significant coefficients ranging from 8.79% to 9.48%. The adjusted R^2s reach values between 0.54 and 0.58. The λ^{mon1}_{HML} has positive and statistically significant coefficients ranging from 7.68% to 8.47%. The adjusted R^2s reach values between 0.26 and 0.33. On the other hand,

[3] We used the first three and twelve months of data to calculate the returns for the "short-term momentum" and "long-term momentum" portfolios, respectively.

[4] We constructed our measure of global stock market volatility by utilizing daily data from Investing.com and Yahoo Finance. Subsequently, we employed this measure to determine countries' sensitivities to global stock market volatility in our two datasets: the stock market indices from Investing.com and Yahoo Finance and the MSCI stock market indices. We opted for this approach because the daily data provided by MSCI spans a very brief timeframe, rendering it unfeasible to construct the volatility index from them.

Table 4.2
Asset Pricing Tests: Excess Returns (Market Indices)

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess returns, six by past one-year equity excess returns, six by past five-year equity returns and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from Investing.com and Yahoo Finance.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 1990:M8-2019:M12											
5.52^c	4.05				0.12	5.49^c	3.11				0.17
5.55^c		3.15			0.14	5.54^c		2.85			0.18
6.01^c			8.47^c		0.26	5.96^c			8.04^c		0.27
5.92^c				7.51^d	0.19	5.89^c				6.68^d	0.18
5.55^c	3.35^b	3.13			0.12	5.53^c	2.52	2.74			0.22
5.41	2.72^a		8.21^c		0.26	5.40^d	2.27		7.94^c		0.33
5.43^a	2.46			7.60^c	0.18	5.42^a	2.10			6.64^d	0.24
5.45^d		1.72	7.80^c		0.27	5.46^d		2.00	7.68^c		0.33
5.46^a		1.96		7.17^d	0.18	5.47^d		2.15		6.45^d	0.22
Panel (b): 2000:M01-2019:M12											
6.03^d	10.64^a				0.43	6.00^d	9.24^a				0.42
6.36^d		9.19^a			0.54	6.37^d		9.48^a			0.57
6.37			4.50		-0.02	6.35			3.19		0.02
6.40				8.21^c	0.07	6.39^d				7.73^c	0.08
6.32^d	8.01^b	8.79^a			0.54	6.35^d	7.81^a	9.27^a			0.57
6.07^d	11.03^a		1.32		0.43	6.02^d	9.38^a		1.86		0.45
6.06^d	10.87^a			4.97	0.43	5.99^d	9.27^a			6.25^d	0.41
6.35^d		9.13^a	2.48		0.54	6.36^d		9.45^a	2.26		0.58
6.31^d		8.97^a		5.91	0.54	6.32^d		9.36^a		6.68^c	0.57

the other variable used to proxy for the MON process, the M3 growth rate, has positive and statistically significant risk prices ranging from 6.45% to 8.21%. The adjusted R^2s reach values between 0.08 and 0.57. Note that the results for the period 2000:M01 to 2019:M12 reports a greater number of statistically significant estimates and higher adjusted R^2s. Overall, when statistically significant, the risk price estimates from this period are higher than those reported in Panel (a) of the table.

Two main results emerge from Panels (a) and (b) in Table (4.3). First, both the two and three-factor SDF models do well in explaining returns from foreign-currency-denominated stock indices. Overall, we observe statistically significant risk prices and a satisfactory cross-sectional fit in terms of adjusted R^2s. Second, as expected, most of the estimated *risk premia* are greater than those obtained for returns on dollar-denominated foreign stock indices. This reflects the effect of exchange rate variations on these latter investments.

Tables (4.4) and (4.5) present the respective results for the portfolios constructed from the MSCI indices. The results confirm the findings revealed by Tables (4.2) and (4.3). Note that there is a substantial increase in the number of statistically significant coefficients associated with our proposed risk factors and model fit in terms of adjusted R^2s. This may be a result of the more complete database of MSCI indices.

Table 4.3

Asset Pricing Tests: Returns (Market Indices)

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity returns, six by past one-year equity returns, six by past five-year equity returns and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from Investing.com and Yahoo Finance.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 1990:M8-2019:M12											
7.59^{a}	11.57^{a}				0.58	7.50^{a}	9.52^{a}				0.54
7.63^{a}		9.77^{a}			0.53	7.59^{a}		8.95^{a}			0.52
7.82^{a}			16.27^{a}		0.57	7.76^{a}			14.33^{a}		0.59
7.76^{a}				15.91^{a}	0.60	7.68^{a}				12.94^{a}	0.57
7.59^{a}	11.58^{a}	7.29^{b}			0.57	7.55^{a}	9.12^{a}	7.47^{b}			0.54
7.39^{a}	9.43^{a}		13.50^{a}		0.70	7.33^{a}	8.20^{a}		13.17^{a}		0.71
7.42^{a}	9.41^{a}			14.03^{a}	0.65	7.37^{a}	7.97^{a}			11.89^{a}	0.63
7.42^{a}		7.39^{b}	13.68^{a}		0.71	7.42^{a}		7.62^{b}	13.10^{a}		0.73
7.43^{a}		7.28^{b}		14.37^{a}	0.65	7.44^{a}		7.54^{b}		12.05^{a}	0.64
Panel (b): 2000:M01-2019:M12											
6.54^{b}	15.24^{a}				0.53	6.44^{b}	12.24^{a}				0.50
6.70^{b}		12.49^{a}			0.59	6.69^{b}		12.32^{a}			0.62
6.49^{c}			8.83^{b}		0.04	6.46^{c}			6.69^{c}		0.03
6.47^{c}				11.55^{a}	0.13	6.45^{c}				10.57^{a}	0.08
6.68^{b}	11.49^{a}	11.76^{a}			0.59	6.66^{b}	9.88^{a}	11.85^{a}			0.62
6.51^{b}	14.99^{a}		5.76^{d}		0.53	6.41^{b}	12.08^{a}		5.40^{d}		0.49
6.48^{b}	14.74^{a}			8.24^{b}	0.54	6.37^{b}	11.90^{a}			8.97^{a}	0.51
6.66^{b}		12.25^{a}	5.50		0.59	6.66^{b}		12.19^{a}	5.22^{d}		0.62
6.62^{b}		12.03^{a}		8.01^{b}	0.61	6.61^{b}		12.04^{a}		8.86^{b}	0.64

Tables (A.4) to (A.7) in Appendix A.6 reproduce the results when we applied the country's exposure to the global component of each shock process (IST, MEI, and MON) to build the portfolios. Therefore, the test assets include forty-eight portfolios: six sorted by countries' exposure to the global component of the IST values, six by countries' exposure to the global component of MEI values, six by countries' exposure to the global component of M1 growth rate, six by countries' exposure to the global component of M3 growth rate, six by past three-month equity excess returns (equity returns), six by past one-year equity excess returns (equity returns), six by past five-year equity returns and six by countries' exposure to global stock market volatility. Due to the inclusion of a short window of data before the start of the GFC (from 2006 to 2008), we estimated our model considering two sample periods: from 2006:M01 to 2019:M12 and from 2009:M01 to 2019:M12. This is a way to analyze the sensibility of our results to the GFC outbreak.

In general, Tables (A.4) to (A.7) provide weaker evidence on the explanatory power of the risk factors associated with countries' exposure to the global component of the shock processes. However, Panel (a) in Tables (A.5) and (A.7) present some favorable evidence regarding the explanatory power of the risk factors for foreign-currency-denominated stock market indices. Overall, Panel (a) of both tables report positive and statistically significant risk prices. This indicates that stock indices from countries with low exposure to these global components earn higher returns on average. For example, Panel (a) of Table (A.7) reveals that the λ_{HML}^{ist} has statistically significant coefficients ranging from 4.91% to 5.70% with an adjusted R^2 equals to 0.14. The λ_{HML}^{mei} has statistically significant coefficients ranging from 4.66% to 7.30%. The adjusted R^2s reach values between 0.21 and 0.29. The λ_{HML}^{mon1} has statistically significant coefficients ranging from 4.43% to 6.75%. The adjusted R^2s reach values between 0.24 and 0.29.

Table 4.4
Asset Pricing Tests: Excess Returns (MSCI Indices)

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess returns, six by past one-year equity excess returns, six by past five-year equity returns and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from MSCI.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 1990:M8-2019:M12											
5.01	6.73^c				0.52	5.01	6.44^c				0.52
5.03		6.81^c			0.49	5.09		6.19^d			0.48
5.54^d			6.71^c		0.49	5.55^d			6.82^c		0.50
5.46^d				6.71^c	0.47	5.42^d				5.75^d	0.45
5.01	6.99^c	5.67^d			0.51	5.00	6.43^c	5.42			0.51
5.00	6.08^c		4.85		0.52	4.99	5.84^c		5.98^c		0.52
5.01	7.02^c			4.29	0.51	5.01	6.51^c			4.42	0.51
5.09		6.25^c	5.36		0.49	5.08		5.73^d	6.31^c		0.50
5.10		6.64^c		4.79	0.48	5.09		5.99^d		4.64	0.48
Panel (b): 2000:M01-2019:M12											
4.28	9.81^a				0.56	4.28	9.16^a				0.59
4.43		8.98^b			0.55	4.42		8.00^b			0.54
4.68			10.54^b		0.51	4.66			9.33^a		0.53
4.53				6.79^c	0.28	4.52				4.67^d	0.26
4.32^d	8.77^b	7.69^b			0.57	4.31	8.53^a	7.19^b			0.60
4.32	8.77^b		7.96^b		0.57	4.25	8.28^b		8.09^b		0.69
4.27	10.10^a			1.64	0.55	4.28	9.26^a			2.44	0.58
4.39		7.64^b	8.03		0.64	4.38		7.20^b	8.22^b		0.66
4.43		8.96^b		2.89	0.54	4.42		7.97^b		2.88	0.54

Overall, our results suggest that the link between currency and equity returns is very strong. They indicate that the risk factors associated with the IST, MEI, and MON values are also relevant to explain equity excess returns (returns). The risk prices associated with our proposed risk factors are positive and statistically significant at conventional confidence levels. We also find a satisfactory cross-sectional fit in terms of R^2s. This indicates that currency and equity market returns have common sources of variation.

We showed in Chapter 3 that positive local shocks to the IST and MEI processes in the Foreign country boost investment and output in the Foreign country and increase currency excess returns of Home investors. The IST and MEI shocks encourage the implementation of new profitable projects that increase the value of firms. Thus, we should also expect an increase in stock prices in the Foreign country. In summary, the effects triggered by positive local IST and MEI shocks, together with our asset pricing results in FX and foreign equity markets, provide support in favor of UEP violations. From the Home investor's point of view, FX and foreign equity market returns would tend to be positively correlated.

The analysis of the local MON shock is not straightforward. We showed in Chapter 3 that positive local MON shocks in the Foreign country are followed by an increase in investment and a fall in output in the Foreign country. However, currency excess returns for Home investors increase. Positive MON shocks are associated with increased macroeconomic uncertainty. Therefore, it is less clear to infer the trajectory followed by the stock market after the materialization of this shock.

Table 4.5
Asset Pricing Tests: Returns (MSCI Indices)

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity returns, six by past one-year equity equity returns, six by past five-year equity returns and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from MSCI.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 1990:M8-2019:M12											
6.59^b	10.24^a				0.66	6.58^b	9.40^a				0.65
6.60^b		11.56^a			0.62	6.59^b		11.75^a			0.70
7.39^b			12.54^a		0.75	7.35^b			11.72^a		0.76
7.16^b				9.41^a	0.60	7.11^b				7.94^b	0.58
6.60^b	7.37^b	11.46^a			0.68	6.59^b	7.49^b	11.73^a			0.70
6.56^b	7.50^a		11.54^a		0.76	6.55^b	7.62^a		11.04^a		0.77
6.59^b	10.33^a			6.40^b	0.65	6.58^b	9.18^a			6.13^b	0.64
6.57^b		10.24^a	11.70^a		0.76	6.57^b		10.89^a	11.07^a		0.77
6.61^b		12.91^a		3.98	0.68	6.60^b		12.51^a		4.81^d	0.71
Panel (b): 2000:M01-2019:M12											
4.01	12.03^a				0.57	4.01	10.55^a				0.58
4.13		11.59^a			0.63	4.11		10.59^a			0.65
4.33			11.79^a		0.45	4.29			9.93^a		0.46
4.03				8.05^b	0.22	4.04				4.60^c	0.17
4.10	9.39^a	11.01^a			0.62	4.08	9.01^a	10.15^a			0.67
3.96	10.36^a		8.67^a		0.70	3.95	9.46^a		8.49^a		0.73
4.00	12.46^a			1.35	0.56	4.00	10.69^a			1.68	0.57
4.05		10.61^a	8.16^a		0.70	4.04		10.00^a	8.21^a		0.73
4.12		11.77^a		1.90	0.62	4.11		10.67^a		1.79	0.65

The analysis regarding the country's exposure to the global component of the IST, MEI, and MON processes yields less clear results. We find only weak evidence supporting the explanatory power of the risk factors associated with country's exposure to the global component of the shocks in the international stock market. A possible explanation for this outcome could be that global shocks can have different effects on currency excess returns, which may not necessarily occur with equity excess returns. For example, a global IST shock may lead to either positive or negative currency excess returns in the Home country. This depends on the degree of exposure of both Home and Foreign countries to the global IST shock. In contrast, investment and output increase in both countries, leading to higher equity excess returns. As a result, from the Home investor's perspective, global shocks can cause currency and equity excess returns to exhibit either positive or negative correlation.

4.4 Concluding Remarks

An important topic explored in the finance literature concerns the identification of risk factors with high explanatory power in different types of markets (e.g., stocks, bonds, etc.). Another important topic examined in the literature concerns the nature of the correlation between stock and currency returns. The lack of a unifying risk-based explanation for stock and currency returns and the lack of consensus on UEP deviations remain to so far.

This chapter addresses both issues. We show that currency and stock returns have common sources of variation. This, in turn, shed some light on the nature of the correlation between them. We show that the risk factors associated with the IST values, the MEI values and money growth rates are priced in a cross section of foreign equity excess returns (foreign equity returns). We also provide some empirical evidence that our proposed risk factors associated with the country's exposure to the global component of the IST, MEI, and MON help to explain stock excess returns (stock returns). However, this evidence turned out to be weak.

In short, we provide empirical support for the existence of a significant link between currency and stock returns, revealing common sources of risk between them.

Bibliography

Aghion, P., Bacchetta, P., and Banerjee, A. (2004). Financial development and the instability of open economies. *Journal of Monetary Economics*, 51(6):1077–1106.

Ahir, H., Bloom, N., and Furceri, D. (2022). The world uncertainty index. *NBER*, (29763).

Ahmad, R., Rhee, S. G., and Wong, Y. M. (2012). Foreign exchange market efficiency under recent crises: Asia-pacific focus. *Journal of International Money and Finance*, 31(6):1574–1592.

Akram, Q. F., Rime, D., and Sarno, L. (2008). Arbitrage in the foreign exchange market: Turning on the microscope. *Journal of International Economics*, 76(2):237–253.

Albulescu, C. T., Pépin, D., and Tiwari, A. K. (2016). A re-examination of real interest parity in ceecs using old and new second-generation panel unit root tests. *Bulletin of Economic Research*, 68(2):133–150.

Albuquerque, R., Eichenbaum, M., Luo, V. X., and Rebelo, S. (2016). Valuation risk and asset pricing. *The Journal of Finance*, 71(6):2861–2904.

Alfaro, L., Kalemli-Ozcan, S., and Volosovych, V. (2008). Why doesn't capital flow from rich to poor countries? An empirical investigation. *The Review of Economics and Statistics*, 90(2):347–368.

Ambler, S., Cardia, E., and Zimmermann, C. (2004). International business cycles: What are the facts? *Journal of monetary economics*, 51(2):257–276.

Andersen, L., Duffie, D., and Song, Y. (2019). Funding value adjustments. *The Journal of Finance*, 74(1):145–192.

Andrés, J., Doménech, R., and Fatás, A. (2008). The stabilizing role of government size. *Journal of Economic Dynamics and Control*, 32(2):571–593.

Andrés, J., López-Salido, J. D., and Nelson, E. (2009). Money and the natural rate of interest: Structural estimates for the united states and the euro area. *Journal of Economic Dynamics and Control*, 33(3):758–776.

Arestis, P., Chortareas, G., and Magkonis, G. (2014). Inflation targeting and inflation convergence: International evidence. *Journal of International Financial Markets, Institutions and Money*, 31(2):125–139.

Arestis, P., Chortareas, G., and Tsoukalas, J. (2010). Money and information in a new neoclassical synthesis framework. *Economic Journal*, 120(542):F101–F128.

Arslan, Y., Jasova, M., and Takáts, E. (2016). The inflation process. *BIS Papers*, (89c):23–40.

Ascari, G. and Rossi, L. (2012). Trend inflation and firms price-setting: Rotemberg versus calvo. *The Economic Journal*, 122(563):1115–1141.

Asness, C. S., Moskowitz, T. J., and Pedersen, L. H. (2013). Value and momentum everywhere. *The Journal of Finance*, 68(3):929–985.

Atanasov, V. and Nitschka, T. (2014). Currency excess returns and global downside market risk. *Journal of International Money and Finance*, 47:268–285.

Atta-Mensah, J. (2004). Money demand and economic uncertainty. Technical report, Bank of Canada.

Aydemir, O. and Demirhan, E. (2009). The relationship between stock prices and exchange rates: Evidence from turkey. *International research journal of finance and economics*, 23(2):207–215.

Aysun, U. and Lee, S. (2014). Can time-varying risk premiums explain the excess returns in the interest rate parity condition? *Emerging Markets Review*, 18:78–100.

Bacchetta, P., Benhima, K., and Renne, J.-P. (2022). Understanding swiss real interest rates in a financially globalized world. *Swiss Journal of Economics and Statistics*, 158(1):1–17.

Bacchetta, P. and Van Wincoop, E. (2010). Infrequent portfolio decisions: A solution to the forward discount puzzle. *American Economic Review*, 100(3):870–904.

Backus, D. K., Gavazzoni, F., Telmer, C., and Zin, S. E. (2013). Monetary policy and the uncovered interest rate parity puzzle. *Available at SSRN 1634825*.

Bahmani-Oskooee, M., Kutan, A. M., and Xi, D. (2013). The impact of economic and monetary uncertainty on the demand for money in emerging economies. *Applied Economics*, 45(23):3278–3287.

Bahmani-Oskooee, M. and Nayeri, M. M. (2018). Policy uncertainty and the demand for money in australia: An asymmetry analysis. *Australian Economic Papers*, 57(4):456–469.

Bahmani-Oskooee, M. and Sohrabian, A. (1992). Stock prices and the effective exchange rate of the dollar. *Applied economics*, 24(4):459–464.

Bahmani-Oskooee, M. and Xi, D. (2014). Economic uncertainty, monetary uncertainty, and the demand for money: Evidence from asian countries. *Australian Economic Papers*, 53(1-2):16–28.

Bahmani-Oskooee, M., Xi, D., and Wang, Y. (2012). Economic and monetary uncertainty and the demand for money in china. *Chinese Economy*, 45(6):26–37.

Ball, L. (2001). Another look at long-run money demand. *Journal of Monetary economics*, 47(1):31–44.

Balvers, R. J. and Huang, D. (2009). Money and the c-capm. *Journal of financial and quantitative analysis*, 44(2):337–368.

Banerjee, A. V. and Duflo, E. (2003). Inequality and growth: What can the data say? *Journal of economic growth*, 8(3):267–299.

Banerjee, S. and Basu, P. (2019). Technology shocks and business cycles in india. *Macroeconomic Dynamics*, 23(5):1721–1756.

Bank for Internatinal Settlements, B. (2019). Foreign exchange turnover in April 2019: Preliminary global results (Triennial Central Bank Survey 2019). *Bank for International Settlements, Monetary and Economic Department*.

Bansal, R. and Shaliastovich, I. (2013). A Long-Run Risks Explanation of Predictability Puzzles in Bond and Currency Markets. *The Review of Financial Studies*, 26(1):1–32.

Bansal, R. and Yaron, A. (2004). Risks for the long run: A potential resolution of asset pricing puzzles. *The journal of Finance*, 59(4):1481–1509.

Barberis, N., Shleifer, A., and Vishny, R. (1998). A model of investor sentiment. *Journal of financial economics*, 49(3):307–343.

Barkai, S. (2020). Declining labor and capital shares. *The Journal of Finance*, 75(5):2421–2463.

Barro, R. J. (1991). Economic growth in a cross section of countries. *The quarterly journal of economics*, 106(2):407–443.

Barro, R. J. (1999). Ramsey meets laibson in the neoclassical growth model. *The Quarterly Journal of Economics*, 114(4):1125–1152.

Basu, P. and Thoenissen, C. (2011). International business cycles and the relative price of investment goods. *Canadian Journal of Economics/Revue canadienne d'économique*, 44(2):580–606.

Basu, S. (2019). Are price-cost markups rising in the united states? a discussion of the evidence. *Journal of Economic Perspectives*, 33(3):3–22.

Basu, S. and Kimball, M. (2003). Investment planning costs and the effects of fiscal and monetary policy. *unpublished, University of Michigan.*

Baumol, W. J. (1986). Productitivity growth, convergence, and welfare: What the long-run data show. *American Economic Review*, 76(5):1072–1085.

Beck, T., Demirgüç-Kunt, A., and Levine, R. (2000). A new database on the structure and development of the financial sector. *The World Bank Economic Review*, 14(3):597–605.

Beck, T., Demirgüç-Kunt, A., and Levine, R. (2010). Financial institutions and markets across countries and over time: The updated financial development and structure database. *The World Bank Economic Review*, 24(1):77–92.

Becker, G. S. and Mulligan, C. B. (1997). The endogenous determination of time preference. *The Quarterly Journal of Economics*, 112(3):729–758.

Benchimol, J. and Fourçans, A. (2012). Money and risk in a dsge framework: A bayesian application to the eurozone. *Journal of Macroeconomics*, 34(1):95–111.

Benchimol, J. and Fourçans, A. (2017). Money and monetary policy in the eurozone: an empirical analysis during crises. *Macroeconomic Dynamics*, 21(3):677–707.

Benchimol, J. and Qureshi, I. (2020). Time-varying money demand and real balance effects. *Economic Modelling*, 87:197–211.

Benigno, P. (2009). Price stability with imperfect financial integration. *Journal of Money, credit and Banking*, 41:121–149.

Berg, K. A. and Mark, N. C. (2018a). Global macro risks in currency excess returns. *Journal of Empirical Finance*, 45:300–315.

Berg, K. A. and Mark, N. C. (2018b). Measures of global uncertainty and carry-trade excess returns. *Journal of International Money and Finance*, 88:212–227.

Berg, K. A. and Mark, N. C. (2019). Where s the risk? the forward premium bias, the carry-trade premium, and risk-reversals in general equilibrium. *Journal of International Money and Finance*, 95:297–316.

Bernanke, B. S. (2005). The Global Saving Glut and the US Current Account Deficit. *Remarks at the Homer Jones Lecture, St. Louis, Missiouri. Federal Board of Governors.*

Bernanke, B. S. and Gürkaynak, R. S. (2001). Is growth exogenous? taking Mankiw, Romer, and Weilseriously. *NBER Macroeconomics Annual*, 16:11–57.

Bernanke, B. S., Laubach, T., Mishkin, F. S., and Posen, A. S. (2009). *Inflation targeting: lessons from the international experience.* Princeton University Press.

Bhatti, R. H. and Moosa, I. A. (2016). *International parity conditions: theory, econometric testing and empirical evidence.* Springer.

Bjørnland, H. C. (2005). A stable demand for money despite financial crisis: the case of venezuela. *Applied Economics*, 37(4):375–385.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., and Terry, S. J. (2018). Really uncertain business cycles. *Econometrica*, 86(3):1031–1065.

Boamah, M. I. (2018). Real interest parity: Evidence from trade partnerships. *Review of Financial Economics*, 36(3):199–205.

Bohrnstedt, G. W. and Goldberger, A. S. (1969). On the exact covariance of products of random variables. *Journal of the American Statistical Association*, 64(328):1439–1442.

Boileau, M. (2002). Trade in capital goods and investment-specific technical change. *Journal of Economic Dynamics and Control*, 26(6):963–984.

Boileau, M. and Normandin, M. (2008). Closing international real business cycle models with restricted financial markets. *Journal of International Money and Finance*, 27(5):733–756.

Borio, C. E., Disyatat, P., Juselius, M., and Rungcharoenkitkul, P. (2017). Why so low for so long? a long-term view of real interest rates. *BIS Working Paper*, (685).

Borio, C. E. and Filardo, A. J. (2007). Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation. *BIS Working Papers*, (227):1–48.

Braun, R. A. and Shioji, E. (2007). Investment specific technological changes in japan. *Seoul Journal of Economics*, 20.

Breeden, D. T. (1979). An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities. *Journal of Financial Economics*, 7:265–296.

Breeden, D. T., Gibbons, M. R., and Litzenberger, R. H. (1989). Empirical tests of the consumption-oriented CAPM. *The Journal of Finance*, 44(2):231–262.

Breeden, D. T. and Litzenberger, R. H. (1978). Prices of state-contingent claims implicit in option prices. *Journal of Business*, 51:621–651.

Brock, W. A. (1974). Money and growth: The case of long run perfect foresight. *International Economic Review*, 15(3):750–777.

Brož, V. and Kočenda, E. (2018). Dynamics and factors of inflation convergence in the european union. *Journal of International Money and Finance*, 86:93–111.

Brunnermeier, M. K., Nagel, S., and Pedersen, L. H. (2008). Carry trades and currency crashes. *NBER Macroeconomics Annual*, 23(1):313–348.

Burnside, C. (2011a). Carry trade and risk. *NBER Working Paper*, 17278.

Burnside, C. (2011b). The cross section of foreign currency risk premia and consumption growth risk: Comment. *American Economic Review*, 101(7):3456–3476.

Burnside, C., Eichenbaum, M., Kleshchelski, I., and Rebelo, S. (2010). Do peso problems explain the returns to the carry trade? *The Review of Financial Studies*, 24(3):853–891.

Busetti, F., Forni, L., Harvey, A., and Venditti, F. (2006). Inflation convergence and divergence within the European Monetary Union. *ECB Working Paper*, (574).

Caballero, R. J. and Farhi, E. (2014). On the role of safe asset shortages in secular stagnation. *Secular stagnation: Facts, causes and cures*, page 111.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2015). Global Imbalances and Currency Wars at the Zero Lower Bound. *NBER Working Paper*, 21670.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2016). Safe asset scarcity and aggregate demand. *American Economic Review*, 106(5):513–518.

Caldara, D. and Iacoviello, M. (2017). Measuring geopolitical risk. *mimeo*.

Calomiris, C. W. and Mamaysky, H. (2019). Monetary Policy and Exchange Rate Returns: Time-Varying Risk Regimes. *NBER Working Paper*, 25714.

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of monetary Economics*, 12(3):383–398.

Calvo, G. A., Leiderman, L., and Reinhart, C. M. (1996). Inflows of Capital to Developing Countries in the 1990s. *Journal of Economic Perspectives*, 10(2):123–139.

Camanho, N., Hau, H., and Rey, H. (2022). Global portfolio rebalancing and exchange rates. *The Review of Financial Studies*, 35(11):5228–5274.

Camarero, M., Carrion-i Silvestre, J. L., and Tamarit, C. (2010). Does real interest rate parity hold for oecd countries? new evidence using panel stationarity tests with cross-section dependence and structural breaks. *Scottish Journal of Political Economy*, 57(5):568–590.

Campbell, J. Y. (1986). Bond and stock returns in a simple exchange model. *The Quarterly Journal of Economics*, 101(4):785–803.

Campbell, J. Y. (1996). Consumption and the stock market: interpreting international experience. *NBER Working Paper*, 5610.

Canarella, G., Gil-Alana, L. A., Gupta, R., and Miller, S. M. (2022). Globalization, long memory, and real interest rate convergence: a historical perspective. *Empirical Economics*, pages 1–25.

Canova, F. and Menz, T. (2011). Does money matter in shaping domestic business cycles? an international investigation. *Journal of Money, Credit and Banking*, 43(4):577–607.

Carlson, J. A., Dahl, C., and Osler, C. L. (2008). Short-run exchange-rate dynamics: Theory and evidence. *CREATES Research Paper*, 1.

Carlstrom, C. T. and Fuerst, T. S. (1997). Agency costs, net worth, and business fluctuations: A computable general equilibrium analysis. *The American Economic Review*, pages 893–910.

Carriere-Swallow, Y. and Cespedes, L. F. (2013). The impact of uncertainty shocks in emerging economies. *Journal of International Economics*, 90:316–325.

Carvalho, C., Ferrero, A., and Nechio, F. (2016). Demographics and real interest rates: Inspecting the mechanism. *European Economic Review*, 88:208–226.

Caselli, F. and Feyrer, J. (2007). The marginal product of capital. *The Quarterly Journal of Economics*, 122(2):535–568.

Cass, D. (1965). Optimum growth in an aggregative model of capital accumulation. *The Review of economic studies*, 32(3):233–240.

Castelnuovo, E. (2012). Estimating the evolution of money's role in the us monetary business cycle (vol 44, pg 23, 2012). *Journal of Money Credit and Banking*, 44(4):751–755.

Cavallero, A. (2011). The convergence of inflation rates in the eu-12 area: A distribution dynamics approach. *Journal of Macroeconomics*, 33(2):341–357.

Chadha, J. S., Corrado, L., and Holly, S. (2014). A note on money and the conduct of monetary policy. *Macroeconomic Dynamics*, 18(8):1854–1883.

Champagne, J. and Sekkel, R. (2018). Changes in monetary regimes and the identification of monetary policy shocks: Narrative evidence from canada. *Journal of Monetary Economics*, 99:72–87.

Chan, K., Foresi, S., and Lang, L. H. (1996). Does money explain asset returns? theory and empirical analysis. *The Journal of Finance*, 51(1):345–361.

Chatterjee, S. and Naknoi, K. (2010). The marginal product of capital, capital flows, and convergence. *American Economic Review*, 100(2):73–77.

Chen, K. and Wemy, E. (2015). Investment-specific technological changes: The source of long-run tfp fluctuations. *European Economic Review*, 80:230–252.

Chen, Q., Filardo, A., He, D., and Zhu, F. (2016). Financial crisis, us unconventional monetary policy and international spillovers. *Journal of International Money and Finance*, 67:62–81.

Chen, Z. and Yang, B. (2019). In search of preference shock risks: Evidence from longevity risks and momentum profits. *Journal of Financial Economics*, 133(1):225–249.

Chetty, R., Friedman, J. N., Olsen, T., and Pistaferri, L. (2011a). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from danish tax records. *The quarterly journal of economics*, 126(2):749–804.

Chetty, R., Guren, A., Manoli, D., and Weber, A. (2011b). Are micro and macro labor supply elasticities consistent? a review of evidence on the intensive and extensive margins. *American Economic Review*, 101(3):471–475.

Chinn, M. D. and Ito, H. (2006). What matters for financial development? Capital controls, institutions, and interactions. *Journal of Development Economics*, 81(1):163–192.

Christiano, L. J., Eichenbaum, M., and Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of political Economy*, 113(1):1–45.

Ciccarelli, M. and Mojon, B. (2010). Global inflation. *The Review of Economics and Statistics*, 92(3):524–535.

Clarida, R., Galı, J., and Gertler, M. (2002). A simple framework for international monetary policy analysis. *Journal of monetary economics*, 49(5):879–904.

Cochrane, J. H. (2005). *Asset pricing: Revised edition*. Princeton University Press.

Cochrane, J. H. (2011). Presidential address: discount rates. *The Journal of Finance*, 66(4):1047–1108.

Cochrane, J. H. (2017). Macro-finance. *Review of Finance*, 21(3):945–985.

Coeurdacier, N., Kollmann, R., and Martin, P. (2010). International portfolios, capital accumulation and foreign assets dynamics. *Journal of International Economics*, 80(1):100–112.

Coeurdacier, N. and Rey, H. (2013). Home bias in open economy financial macroeconomics. *Journal of Economic Literature*, 51(1):63–115.

Colacito, R. and Croce, M. M. (2013). International asset pricing with recursive preferences. *The Journal of Finance*, 68(6):2651–2686.

Colacito, R., Croce, M. M., Gavazzoni, F., and Ready, R. (2018). Currency risk factors in a recursive multicountry economy. *The Journal of Finance*, 73(6):2719–2756.

Colacito, R., Riddiough, S. J., and Sarno, L. (2020). Business cycles and currency returns. *Journal of Financial Economics*, 137(3):659–678.

Colciago, A. (2011). Rule-of-thumb consumers meet sticky wages. *Journal of money, credit and banking*, 43(2-3):325–353.

Cooke, D. (2010). Consumption home bias and exchange rate behavior. *Journal of Macroeconomics*, 32(1):415–425.

Cooley, T. F. and Hansen, G. D. (1989). The inflation tax in a real business cycle model. *The American Economic Review*, pages 733–748.

Corsetti, G., Dedola, L., and Leduc, S. (2008). International risk sharing and the transmission of productivity shocks. *The Review of Economic Studies*, 75(2):443–473.

Corte, Pasquale, D., Riddiough, Steven, J., and Sarno, L. (2016). Currency Premia and Global Imbalances. *The Review of Financial Studies*, 29(8):2162–2193.

Creal, D. D. and Wu, J. C. (2020). Bond risk premia in consumption-based models. *Quantitative Economics*, 11(4):1461–1484.

Crowder, W. and Phengpis, C. (2014). A re-examination of international inflation convergence over the modern float. *Journal of International Financial Markets, Institutions and Money*, 17:285–295.

Cuestas, J. C., Gil-Alana, L. A., and Taylor, K. (2016). Inflation convergence in central and eastern europe vs. the eurozone: Non-linearities and long memory. *Scottish Journal of Political Economy*, 63(5):519–538.

Cumby, R. E., Obstfeld, M., et al. (1984). International interest rate and price level linkages under flexible exchange rates: a review of recent evidence. *Exchange rate theory and practice*, 121:51.

Cunado, J., Gil-Alana, L. A., and Pérez de Gracia, F. (2006). Additional empirical evidence on real convergence: A fractionally integrated approach. *Review of World Economics*, 142(1):67–91.

Curcuru, S. E., Thomas, C. P., Warnock, F. E., and Wongswan, J. (2014). Uncovered equity parity and rebalancing in international portfolios. *Journal of International Money and Finance*, 47:86–99.

Cusbert, T., Rohling, T., et al. (2013). Modelling currency demand in australia| rdp 2013-01: Currency demand during the global financial crisis: Evidence from australia. *Reserve Bank of Australia Research Discussion Papers*, (December).

Dabla-Norris, E., Srivisal, N., and Marston, D. (2013). Revisiting the link between finance and macroeconomic volatility. *IMF Working Paper*, (13/29).

Das, M. (2003). Optimal growth with decreasing marginal impatience. *Journal of Economic Dynamics and Control*, 27(10):1881–1898.

Daude, C. and Fratzcher, M. (2005). The pecking order of international financial integration. *European Central Bank Working Paper*, (590).

De Loecker, J., Eeckhout, J., and Unger, G. (2020). The rise of market power and the macroeconomic implications. *The Quarterly Journal of Economics*, 135(2):561–644.

Del Negro, M., Giannone, D., P., G. M., and Tambalotti, A. (2019). Global trends in interest rates. *Journal of International Economics*, 118:248–262.

Della Corte, P., Sarno, L., Schmeling, M., and Wagner, C. (2022). Exchange rates and sovereign risk. *Management Science*, 68(8):5591–5617.

Dissanayake, R., Watanabe, A., and Watanabe, M. (2019). Investment shocks and asset returns: International evidence. *University of Alberta School of Business Research Paper*, (2016-511).

Dogan, A. (2019). Investment specific technology shocks and emerging market business cycle dynamics. *Review of Economic Dynamics*, 34:202–220.

Dornbusch, R. (1976). Expectations and exchange rate dynamics. *Journal of political Economy*, 84(6):1161–1176.

dos Santos, M. B. C., Klotzle, M. C., and Pinto, A. C. F. (2016). Evidence of risk premiums in emerging market carry trade currencies. *Journal of International Financial Markets, Institutions and Money*, 44:103–115.

Drautzburg, T. and Uhlig, H. (2015). Fiscal stimulus and distortionary taxation. *Review of Economic Dynamics*, 18(4):894–920.

Dumas, B., Kurshev, A., and Uppal, R. (2009). Equilibrium portfolio strategies in the presence of sentiment risk and excess volatility. *The Journal of Finance*, 64(2):579–629.

Durlauf, S. N. and Johnson, P. A. (1995). Multiple regimes and cross-country growth behaviour. *Journal of applied econometrics*, 10(4):365–384.

Durlauf, S. N., Kourtellos, A., and Minkin, A. (2001). The local solow growth model. *European Economic Review*, 45(4-6):928–940.

Dutta, J. and Michel, P. (1998). The distribution of wealth with imperfect altruism. *journal of economic theory*, 82(2):379–404.

Edwards, S. (1990). Capital flows, foreign direct investment, and debt-equity swaps in developing countries. *NBER Working Paper*, 3497.

Edwards, S. (2015). Monetary policy independence under flexible exchange rates: an illusion? *The World Economy*, 38(5):773–787.

Eggertsson, G. B. (2011). What fiscal policy is effective at zero interest rates? *NBER Macroeconomics Annual*, 25(1):59–112.

Eggertsson, G. B., Mehrotra, N. R., and Robbins, J. A. (2019). A model of secular stagnation: Theory and quantitative evaluation. *American Economic Journal: Macroeconomics*, 11(1):1–48.

Eichengreen, B., Mussa, M., Dell'Ariccia, G., Detragiache, E., and Milesi-Ferretti, G. M. (1998). Capital account liberalization: theoretical and practical aspects.

Eickmeier, S. and Pijnenburg, K. (2013). The global dimension of inflation–evidence from factor-augmented phillips curves. *Oxford Bulletin of Economics and Statistics*, 75(1):103–122.

El-Shagi, M., Giesen, S., and Kelly, L. J. (2015). The quantity theory revisited: A new structural approach. *Macroeconomic Dynamics*, 19(1):58–78.

Engel, C. (1996). The forward discount anomaly and the risk premium: A survey of recent evidence. *Journal of empirical finance*, 3(2):123–192.

Engel, C. and Wu, S. P. Y. (2018). Liquidity and exchange rates: An empirical investigation. *NBER Working Paper*, 25397.

Engel, M. and Matsumoto, A. (2005). Portfolio choice in a monetary open economy DSGE model. *IMF Working Paper*, (165).

Epstein, L. G. (1987). A simple dynamic general equilibrium model. *Journal of Economic theory*, 41(1):68–95.

Epstein, L. G. and Zin, S. E. (1991). Substitution, risk aversion, and the temporal behavior of consumption and asset returns: An empirical analysis. *Journal of political Economy*, 99(2):263–286.

Erol, S., Le Van, C., and Saglam, C. (2011). Existence, optimality and dynamics of equilibria with endogenous time preference. *Journal of Mathematical Economics*, 47(2):170–179.

Eusepi, S. and Preston, B. (2009). Labor supply heterogeneity and macroeconomic co-movement. *National Bureau of Economic Research*, 15561.

Evans, L. T., Keef, S. P., and Okunev, J. (1994). Modelling real interest rates. *Journal of banking & finance*, 18(1):153–165.

Evans, M. D. D. and Lewis, K. K. (1995). Do long-term swings in the dollar affect estimates of the risk premia? *Review of Financial Studies*, 8(3):709–742.

Fama, E. F. (1984). Forward and spot exchange rates. *Journal of Monetary Economics*, 14(3):319–338.

Fama, E. F. and French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance*, 47(2):427–465.

Fama, E. F. and French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1):3–56.

Fama, E. F. and MacBeth, J. D. (1973). Risk, return, and equilibrium: empirical tests. *The Journal of Political Economy*, pages 607–636.

Farhi, E. and Gabaix, X. (2015). Rare disasters and exchange rates. *The Quarterly Journal of Economics*, 131(1):1–52.

Favara, G. and Giordani, P. (2009). Reconsidering the role of money for output, prices and interest rates. *Journal of Monetary Economics*, 56(3):419–430.

Favero, C. A., Gozluklu, A. E., and Yang, H. (2016). Demographics and the behavior of interest rates. *IMF Economic Review*, 64(4):732–776.

Feenstra, R. C. (1986). Functional equivalence between liquidity costs and the utility of money. *Journal of Monetary Economics*, 17(2):271–291.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review*, 105(10):3150–3182.

Feldstein, M. and Horioka, C. (1980). Domestic saving and international capital flows. *The Economic Journal*, 90(358):314–329.

Ferreira, A. and Matos, P. (2020). Precautionary risks for an open economy. *International Review of Economics & Finance*, 70:154–167.

Ferreira, A. L. (2011). On the differences between the marginal product of capital across countries. *The Manchester School*, 79(3):455–479.

Ferreira, A. L. and León-Ledesma, M. A. (2007). Does the real interest parity hypothesis hold? Evidence for developed and emerging markets. *Journal of International Money and Finance*, 26(3):364–382.

Ferreira, A. L. and Moore, M. J. (2015). Carry trade e risco cambial: um conto de dois fatores. *Revista Brasileira de Economia*, 69(4):429–449.

Fidora, M., Fratzscher, M., and Thimann, C. (2007). Home bias in global bond and equity markets: The role of real exchange rate volatility. *Journal of International Money and Finance*, 26:631–655.

Finn, M. G. (1999). An equilibrium theory of nominal and real exchange rate comovement. *Journal of Monetary Economics*, 44(3):453–475.

Fischbacher, U., Hoffmann, G., and Schudy, S. (2017). The Causal Effect of Stop-Loss and Take-Gain Orders on the Disposition Effect. *The Review of Financial Studies*, 30(6):2110–2129.

Fischer, M. M. and Stumpner, P. (2008). Income distribution dynamics and cross-region convergence in europe. *Journal of Geographical Systems*, 10(2):109–139.

Fisher, I. (1930). *The Theory of Interest*. Macmillan, New York.

Fisher, J. D. (2006). The dynamic effects of neutral and investment-specific technology shocks. *Journal of political Economy*, 114(3):413–451.

Flood, R. P. and Rose, A. K. (2002). Uncovered interest parity in crisis. *IMF staff papers*, 49(2):252–266.

Frankel, J. and Poonawala, J. (2010). The forward market in emerging currencies: less biased than in major currencies. *Journal of International Money and Finance*, 29:585–598.

Frankel, J. A. (1979). On the mark: A theory of floating exchange rates based on real interest differentials. *The American economic review*, 69(4):610–622.

Fratzscher, M., Menkhoff, L., Sarno, L., Schmeling, M., and Stoehr, T. (2018). Systematic Intervention and Currency Risk Premia. *Available at SSRN 3119907*.

Frederick, S., Loewenstein, G., and O'donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, 40(2):351–401.

French, Kenneth, R. and Poterba, J. M. (1991). Investor Diversification and International Equity Markets. *American Economic Review*, 81(2):222–226.

Frömmel, M. and Kruse, R. (2015). Interest rate convergence in the EMS prior to European Monetary Union. *Journal of Policy Modeling*, 37(6):990–1004.

Fuertes, A.-M., Phylaktis, K., and Yan, C. (2019). Uncovered equity âĂIJdisparityâĂİ in emerging markets. *Journal of International Money and Finance*, 98:102066.

Fujii, E. and Chinn, M. (2001). Fin de siècle real interest parity. *Journal of International Financial Markets, Institutions and Money*, 11(3-4):289–308.

Furlanetto, F. (2011). Fiscal stimulus and the role of wage rigidity. *Journal of Economic Dynamics and Control*, 35(4):512–527.

Furlanetto, F., Natvik, G. J., and Seneca, M. (2013). Investment shocks and macroeconomic co-movement. *Journal of Macroeconomics*, 37:208–216.

Gabaix, X. and Maggiori, M. (2015). International liquidity and exchange rate dynamics. *The Quarterly Journal of Economics*, 130(3):1369–1420.

Gagnon, J. E. and Unferth, M. D. (1995). Is there a world real interest rate? *Journal of international Money and Finance*, 14(6):845–855.

Galí, J. (2011). The return of the wage phillips curve. *Journal of the European Economic Association*, 9(3):436–461.

Gali, J., Lopez-Salido, J. D., and Valles, J. (2007). Understanding the effects of government spending on consumption. *Journal of the European Association*, 5(1):227–270.

Gali, J. and Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3):707–734.

Garlappi, L. and Song, Z. (2020). Investment shocks and asset prices: An investment-based approach. *Journal of Financial and Quantitative Analysis*, 55(8):2665–2699.

Gehrig, T. (1993). An Information Based Explanation of the Domestic Bias in International Equity Investment. *The Scandinavian Journal of Economics*, 95(1):97–109.

Ghironi, F., Lee, J., and Rebucci, A. (2015). The valuation channel of external adjustment. *Journal of International Money and Finance*, 57:86–114.

Giannellis, N. (2013). Asymmetric behavior of inflation differentials in the euro area: Evidence from a threshold unit root test. *Research in Economics*, 67(2):133–144.

Glick, R. (2020). R* and the global economy. *Journal of International Money and Finance*, 102:102105.

Goldberg, L. G., Lothian, J. R., and Okunev, J. (2003). Has international financial integration increased? *Open economies review*, 14(3):299–317.

Gollin, D. (2002). Getting income shares right. *Journal of Political Economy*, 110(2):458–474.

Gomez-Cram, R. and Yaron, A. (2021). How important are inflation expectations for the nominal yield curve? *The Review of Financial Studies*, 34(2):985–1045.

Gonçalves, C. E. S. and Salles, J. M. (2008). Inflation targeting in emerging economies: What do the data say? *Journal of Development Economics*, 85(1-2):312–318.

Gonçalves, F., Ferreira, G., Ferreira, A., and Scatimburgo, P. (2022). Currency returns and systematic risk. *The Manchester School*, 90(6):609–647.

Gordon, R. J. (2012). Is us economic growth over? Faltering innovation confronts the six headwinds. *NBER Working Paper*, 18315.

Gourinchas, P.-O. and Jeanne, O. (2006). The elusive gains from international financial integration. *The Review of Economic Studies*, 73(3):715–741.

Gourinchas, P.-O. and Rey, H. (2016). Real interest rates, imbalances and the curse of regional safe asset providers at the zero lower bound. *NBER Working Paper*, 22618.

Gourinchas, P.-O. and Rey, H. (2019). Global real rates: A secular approach. *BIS Working Paper*, (793).

Gray, C. (2013). Responding to a monetary superpower: Investigating the behavioral spillovers of us monetary policy. *Atlantic Economic Journal*, 41(2):173–184.

Greenwood, J., Hercowitz, Z., and Huffman, G. W. (1988). Investment, capacity utilization, and the real business cycle. *The American Economic Review*, pages 402–417.

Greenwood, J., Hercowitz, Z., and Krusell, P. (1992). Macroeconomic implications of investiment-specific technological change. *Discussion Paper 76, Institute for Emprical Macroeconomics Federal Reserve Bank of Minneapolis*.

Greenwood, J., Hercowitz, Z., and Krusell, P. (1997a). Long-run implications of investiment-specific technological change. *American Economic Review*, 87(3):342–362.

Greenwood, J., Hercowitz, Z., and Krusell, P. (1997b). Long-run implications of investment-specific technological change. *The American economic review*, pages 342–362.

Greenwood, J., Hercowitz, Z., and Krusell, P. (2000). The role of investment-specific technological change in the business cycle. *European Economic Review*, 44(1):91–115.

Griffin, P. (1992). The impact of affirmative action on labor demand: A test of some implications of the le chatelier principle. *The Review of Economics and Statistics*, pages 251–260.

Gu, L. and Huang, D. (2013). Consumption, money, intratemporal substitution, and cross-sectional asset returns. *Journal of Financial Research*, 36(1):115–146.

Guerrieri, L., Henderson, D., and Kim, J. (2020). Interpreting shocks to the relative price of investment with a two-sector model. *Journal of Applied Econometrics*, 35(1):82–98.

Guerriero, M. (2019). The Labor Share of Income around the World: Evidence from a Panel Dataset. *ADBI Working Paper*, (920).

Hafer, R. and Jones, G. (2008). Dynamic is curves with and without money: An international comparison. *Journal of International Money and Finance*, 27(4):609–616.

Hall, R. (2018). New evidence on market power, profit, concentration, and the role of mega-firms in the us economy. *NBER Working Paper*, (24574).

Hamilton, J. D., Harris, E. S., Hatzius, J., and West, K. D. (2016). The equilibrium real funds rate: Past, present, and future. *IMF Economic Review*, 64(4):660–707.

Hansen, L. P. and Hodrick, R. J. (1980). Forward exchange rates as optimal predictors of future spot rates: An econometric analysis. *Journal of Political Economy*, 88(5):829–853.

Hassan, T. A. (2013). Country size, currency unions, and international asset returns. *The Journal of Finance*, 68(6):2269–2308.

Hau, H. and Rey, H. (2006). Exchange rates, equity prices, and capital flows. *The Review of Financial Studies*, 19(1):273–317.

Heath, A., Galati, G., and McGuire, P. (2007). Evidence of carry trade activity. *BIS Quarterly Review, September*, pages 27–41.

Heathcote, J. and Perri, F. (2002). Financial Autarky and International Business Cycles. *Journal of Monetary Economics*, 49(3):601–627.

Henderson, D. J. (2010). A test for multimodality of regression derivatives with application to nonparametric growth regressions. *Journal of Applied Econometrics*, 25(3):458–480.

Herz, B. and Tong, H. (2008). Debt and Currency CrisesâĂŤComplements or Substitutes? *Review of International Economics*, 16(5):955–970.

Hirose, Y. and Kurozumi, T. (2012). Do investment-specific technological changes matter for business fluctuations? evidence from japan. *Pacific Economic Review*, 17(2):208–230.

Hoffmann, M. and Studer-Suter, R. (2017). Systematic consumption risk in currency returns. *Journal of International Money and Finance*, 74:187–208.

Hofmann, B. and Takáts, E. (2015). International monetary spillovers. *BIS Quarterly Review September*, (480):105–118.

Holmes, M. J. (2002). Does long-run real interest parity hold among eu countries? some new panel data evidence. *The Quarterly Review of Economics and Finance*, 42(4):733–746.

Holston, K., Laubach, T., and Williams, J. C. (2017). Measuring the natural rate of interest: International trends and determinants. *Journal of International Economics*, 108:S59–S75.

Hördahl, P., Sobrun, J., and Turner, P. (2016). Low long-term interest rates as a global phenomenon. *BIS Working Paper*, 574:1–20.

Huang, K. X. D., Liu, Z., and Phaneuf, L. (2004). Why does the cyclical behavior of real wages change over time? *American Economic Review*, 94(4):836–856.

Ibrahim, M. H. and Aziz, H. (2003). Macroeconomic variables and the malaysian equity market: A view through rolling subsamples. *Journal of economic studies*.

Ihrig, J., Kamin, S. B., Lindner, D., and Marquez, J. (2010). Some simple tests of the globalization and inflation hypothesis. *International Finance*, 13(3):343–375.

Ireland, P. N. (2004). MoneyâĂŹs role in the monetary business cycle. *Journal of Money, Credit, and Banking*, 36(6).

Ismailov, A. and Rossi, B. (2018). Uncertainty and deviations from uncovered interest rate parity. *Journal of International Money and Finance*, 88:242–259.

Jacob, P. and Peersman, G. (2013). Dissecting the dynamics of the us trade balance in an estimated equilibrium model. *Journal of International Economics*, 90(2):302–315.

Jagannathan, R. and Wang, Y. (2007). Lazy investors, discretionary consumption, and the cross-section of stock returns. *The Journal of Finance*, 62(4):1623–1661.

Jamali, I., Yamani, E., and Smallwood, A. D. (2023). An investment-based explanation of currency excess returns. *Journal of International Money and Finance*, page 102830.

Jiang, X., Han, L., and Yin, L. (2019). Can skewness predict currency excess returns? *The North American Journal of Economics and Finance*, 48:628–641.

Johnson, P. and Papageorgiou, C. (2020). What remains of cross-country convergence? *Journal of Economic Literature*, 58(1):129–75.

Junior, C. J. C. (2016). *Understanding DSGE models: theory and applications*. Vernon Press.

Juselius, M. and Takáts, E. (2015). Can demography affect inflation and monetary policy? *BIS Working Papers*, (485):1–44.

Justiniano, A. and Preston, B. (2010). Can structural small open-economy models account for the influence of foreign disturbances? *Journal of International Economics*, 81(1):61–74.

Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2010). Investment shocks and business cycles. *Journal of Monetary Economics*, 57(2):132–145.

Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2011). Investment shocks and the relative price of investment. *Review of Economic Dynamics*, 14:102–121.

Kam, E. (2005). A note on time preference and the tobin effect. *Economics letters*, 89(1):127–132.

Kam, E. and Mohsin, M. (2006). Monetary policy and endogenous time preference. *Journal of Economic Studies*, 33(1):52–67.

Kamber, G. and Wong, B. (2020). Global factors and trend inflation. *Journal of International Economics*, 122:103265.

Kang, W., Ratti, R. A., and Vespignani, J. (2020). Impact of global uncertainty on the global economy and large developed and developing economies. *Applied Economics*, 52(22):2392–2407.

Karabarbounis, L. and Neiman, B. (2014). The global decline of the labor share. *The Quarterly journal of economics*, 129(1):61–103.

Karaman, K. K. and Karaman-Yildirim, S. (2019). How does financial development alter the impact of uncertainty? *Journal of Banking and Finance*, 102:33–42.

Khan, H. and Tsoukalas, J. (2011). Investment shocks and the comovement problem. *Journal of Economic Dynamics and Control*, 35(1):115–130.

Khan, H. and Tsoukalas, J. (2012). The quantitative importance of news shocks in estimated dsge models. *Journal of Money, Credit and Banking*, 44(8):1535–1561.

Khan, M. S. and Senhadji, A. S. (2003). Financial Development and Economic Growth: A Review and New Evidence. *Journal of African Economies*, 12(suppl_2):ii89–ii110.

Kim, K.-h. (2003). Dollar exchange rate and stock price: evidence from multivariate cointegration and error correction model. *Review of Financial economics*, 12(3):301–313.

King, R. G. and Rebelo, S. T. (1999). Resuscitating real business cycles. *Handbook of macroeconomics*, 1:927–1007.

Kliem, M. and Meyer-Gohde, A. (2022). (un) expected monetary policy shocks and term premia. *Journal of Applied Econometrics*, 37(3):477–499.

Knell, M. and Stix, H. (2005). The income elasticity of money demand: A meta-analysis of empirical results. *Journal of Economic Surveys*, 19(3):513–533.

Kočenda, E., Kutan, A. M., and Yigit, T. M. (2006). Pilgrims to the eurozone: How far, how fast? *Economic systems*, 30(4):311–327.

Kocherlakota, N. R. et al. (1996). The equity premium: It's still a puzzle. *Journal of Economic Literature*, 34(1):42–71.

Kogan, L. and Papanikolaou, D. (2013). Firm characteristics and stock returns: The role of investment-specific shocks. *The Review of Financial Studies*, 26(11):2718–2759.

Kogan, L. and Papanikolaou, D. (2014). Growth opportunities, technology shocks, and asset prices. *The journal of finance*, 69(2):675–718.

Koopmans, T. C. (1963). On the concept of optimal economic growth. *Cowles Foundation Discussion Papers*, pages 1–38.

Koren, M. and Tenreyro, S. (2007). Volatility and development. *The Quarterly Journal of Economics*, 122(1):243–287.

Kose, M. A., Otrok, C., and Whiteman, C. H. (2003a). International business cycles: World, region, and country-specific factors. *american economic review*, 93(4):1216–1239.

Kose, M. A., Prasad, E. S., and Terrones, M. E. (2003b). How does globalization affect the synchronization of business cycles? *American Economic Review*, 93(2):57–62.

Kremens, L. and Martin, I. (2019). The Quanto Theory of Exchange Rates. *American Economic Review*, 109(3):810–843.

Kremer, M., Willis, J., and You, Y. (2022). Converging to convergence. *NBER Macroeconomics Annual*, 36(1):337–412.

Kriwoluzky, A. (2012). Pre-announcement and timing: The effects of a government expenditure shock. *European Economic Review*, 56(3):373–388.

Krueger, D. and Ludwig, A. (2007). On the consequences of demographic change for rates of returns to capital, and the distribution of wealth and welfare. *Journal of monetary Economics*, 54(1):49–87.

Landi, V. N. (2021). A two-country model. *Unpublished manuscript*.

Lane, P. R. and Ferretti, M. M. (2003). International Financial Integration. *IMF Working Paper*, (03/86).

Lane, Phillip, R. and Milesi-Ferretti, Gian, M. (2003). International financial integration. *IMF Staff Papers*, 50(1):82–113.

Lane, Phillip, R. and Milesi-Ferretti, Gian, M. (2007). A Global Perspective on External Positions. *NBER Working Paper: G7 Current Account Imbalances: Sustainability and Adjustment*, pages 67–102.

Leeper, E. M. and Roush, J. E. (2003). Putting" m" back in monetary policy. *Journal of Money, Credit and Banking*, pages 1217–1256.

Leeper, E. M., Traum, N., and Walker, T. B. (2015). Clearing up the fiscal multiplier morass: Prior and posterior analysis. *NBER Working Paper*, 21433.

Letendre, M.-A. and Luo, D. (2007). Investment-specific shocks and external balances in a small open economy model. *Canadian Journal of Economics/Revue canadienne d'économique*, 40(2):650–678.

Lewellen, J., Nagel, S., and Shanken, J. (2010). A skeptical appraisal of asset pricing tests. *Review of Financial Economics*, 96:175–194.

Lewis, Karen, K. (1999). Tyring to Explain Home Bias in Equities and Consumption. *Journal of Economic Literature*, 37(2):571–608.

Li, E. X., Li, H., Wang, S., and Yu, C. (2019). Macroeconomic risks and asset pricing: Evidence from a dynamic stochastic general equilibrium model. *Management Science*, 65(8):3585–3604.

Li, J. (2018). Explaining momentum and value simultaneously. *Management Science*, 64(9):4239–4260.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. volume 47, pages 13–37.

Liu, T.-Y. and Lee, C.-C. (2021). Global convergence of inflation rates. *The North American Journal of Economics and Finance*, 58:101501.

Liu, Z. and Stengos, T. (1999). Non-linearities in cross-country growth regressions: a semiparametric approach. *Journal of applied econometrics*, 14(5):527–538.

Liu, Z., Waggoner, D. F., and Zha, T. (2011). Sources of macroeconomic fluctuations: A regime-switching dsge approach. *Quantitative Economics*, 2(2):251–301.

Loewenstein, G. and Prelec, D. (1992). Anomalies in intertemporal choice: Evidence and an interpretation. *The Quarterly Journal of Economics*, 107(2):573–597.

Lombardo, G. and Vestin, D. (2008). Welfare implications of calvo vs. rotemberg-pricing assumptions. *Economics Letters*, 100(2):275–279.

Lopez, C. and Papell, D. H. (2012). Convergence of euro area inflation rates. *Journal of International Money and Finance*, 31(6):1440–1458.

Lucas, R. E. (1978). Asset prices in an exchange economy. *Econometrica*, pages 1429–1445.

Lucas, R. E. (1990). Why doesnâĂŹt capital flow from rich to poor countries? *American Economic Review*, 80(2):92–96.

Lucas Jr, R. E. and Stokey, N. L. (1984). Optimal growth with many consumers. *Journal of Economic Theory*, 32(1):139–171.

Lucas Jr, R. E. and Stokey, N. L. (1987). Money and interest in a cash-in-advance economy. *Econometrica: Journal of the Econometric Society*, pages 491–513.

Lunsford, K. G. and West, K. D. (2019). Some evidence on secular drivers of US safe real rates. *American Economic Journal: Macroeconomics*, 11(4):113–139.

Lustig, H., Roussanov, N., and Verdelhan, A. (2011). Common risk factors in currency markets. *The Review of Financial Studies*, 24(11):3731–3777.

Lustig, H., Roussanov, N., and Verdelhan, A. (2014). Countercyclical currency risk premia. *Journal of Financial Economics*, 111(3):527–553.

Lustig, H. and Verdelhan, A. (2007). The cross section of foreign currency risk premia and consumption growth risk. *American Economic Review*, 97(1):89–117.

Lustig, H. and Verdelhan, A. (2009). Comment on "Carry Trades and Currency Crashes". 23:361–384.

Lustig, H. and Verdelhan, A. (2011). The cross-section of foreign currency risk premia and consumption growth risk: Reply. *American Economic Review*, 101(7):3477–3500.

Luttmer, E. G. and Mariotti, T. (2003). Subjective discounting in an exchange economy. *Journal of Political Economy*, 111(5):959–989.

Lyons, R. K. (2001). The microstructure approach to exchange rates. *Cambridge, MA: MIT press.*

Mandelman, F. S., Rabanal, P., Rubio-Ramirez, J. F., and Vilan, D. (2011). Investment-specific technology shocks and international business cycles: An empirical assessment. *Review of Economic Dynamics*, 14(1):136–155.

Mankiw, N. G. and Shapiro, M. (1986). Risk and Return: Consumption Beta versus Market Beta. *The Review of Economics and Statistics*, 68(3):452–459.

Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1):77–91.

Maurer, T. A. (2012). Is consumption growth merely a sideshow in asset pricing? *Working Paper, London School of Economics.*

Mazur, J. E. (1987). An adjusting procedure for studying delayed reinforcement. *Quantitative analyses of behavior*, 5:55–73.

Mehra, R. and Prescott, E. C. (1985). The equity premium: A puzzle. *Journal of monetary Economics*, 15(2):145–161.

Mendoza, E. G. (1991). Real business cycles in a small open economy. *American Economic Review*, pages 797–818.

Menkhoff, L., Sarno, L., Schmeling, M., and Schrimpf, A. (2012a). Carry trades and global foreign exchange volatility. *The Journal of Finance*, 67(2):681–718.

Menkhoff, L., Sarno, L., Schmeling, M., and Schrimpf, A. (2012b). Currency momentum strategies. *Journal of Financial Economics*, 106:660–684.

Mikolajun, I. and Lodge, D. (2016). Advanced economy inflation: the role of global factors. *ECB Working Paper*, (1948):1–26.

Milani, F. (2010). Global slack and domestic inflation rates: A structural investigation for g-7 countries. *Journal of Macroeconomics*, 32(4):968–981.

Miranda-Agrippino, S. and Rey, H. (2021). The global financial cycle. *NBER Working Paper*, 29327.

Miranda-Agrippino, S., Rey, H., et al. (2015). World asset markets and the global financial cycle. *National Bureau of Economic Research*, 21722:1–68.

Miranda-Agrippino, S. and Ricco, G. (2021). The transmission of monetary policy shocks. *American Economic Journal: Macroeconomics*, 13(3):74–107.

Mishkin, F. and Hebbel-Schmidt, K. (2007). Does Inflation Targeting make a differece? *NBER Working Paper*, 12876.

Mishkin, F. S. (1984). Are real interest rates equal across countries? an empirical investigation of international parity conditions. *The Journal of Finance*, 39(5):1345–1357.

Miyagawa, S., M. Y. (2009). Financial crisis of finland, sweden, norway and japan. *Journal of the Faculty of Economics*, 19(1):45–77.

Miyamoto, W. and Nguyen, T. L. (2020). The expectational effects of news in business cycles: Evidence from forecast data. *Journal of Monetary Economics*, 116:184–200.

Moura, A. (2018). Investment shocks, sticky prices, and the endogenous relative price of investment. *Review of Economic Dynamics*, 27:48–63.

Mumtaz, H. and Surico, P. (2012). Evolving international inflation dynamics: world and country-specific factors. *Journal of the European Economic Association*, 10(4):716–734.

Na, S., Schmitt-Grohé, S., Uribe, M., and Yue, V. (2018). The twin ds: Optimal default and devaluation. *American Economic Review*, 108(7):1773–1819.

Nakata, T. and Tanaka, H. (2020). Equilibrium yield curves and the interest rate lower bound. *CARF Working Paper*, (482):1–72.

Nelson, E. (2002). Direct effects of base money on aggregate demand: theory and evidence. *Journal of Monetary Economics*, 49(4):687–708.

Newey, W. K. and West, K. D. (1987). Hypothesis testing with efficient method of moments estimation. *International Economic Review*, 28(3):777–787.

Nistico, S. (2007). The welfare loss from unstable inflation. *Economics Letters*, 96(1):51–57.

Obstfeld, M. (1990). Intertemporal dependence, impatience, and dynamics. *Journal of Monetary Economics*, 26(1):45–75.

Obstfeld, M. and Ito, T. (2015). Trilemmas and trade-offs: living with financial globalisation. *BIS Working Paper*, (480):1–63.

Obstfeld, M. and Rogoff, K. (2000). New directions for stochastic open economy models. *Journal of international economics*, 50(1):117–153.

Obstfeld, M., Shambaugh, J. C., and Taylor, A. M. (2009). Financial instability, reserves, and central bank swap lines in the panic of 2008. *American economic review*, 99(2):480–486.

Osler, Carol, L. (2005). Stop-loss orders and price cascades in currency markets. *Journal of International Money and Finance*, 24:219–241.

Pain, N., Koske, I., and Sollie, M. (2006). Globalisation and inflation in the oecd economies. *OECD Working Papers*, (52):1–63.

Papanikolaou, D. (2011). Investment shocks and asset prices. *Journal of Political Economy*, 119(4):639–685.

Parker, J. A. and Julliard, C. (2005). Consumption risk and the cross section of expected returns. *Journal of Political Economy*, 113(1):185–222.

Patel, D., Sandefur, J., and Subramanian, A. (2021). The new era of unconditional convergence. *Journal of Development Economics*, 152:102687.

Pavlova, A. and Rigobon, R. (2007). Asset prices and exchange rates. *The Review of Financial Studies*, 20(4):1139–1180.

Peiris, M. S. J. (2010). *Foreign participation in emerging marketsâĂŹ local currency bond markets*. International Monetary Fund.

Pesenti, P. and van Wincoop, E. (2002). Can Nontradables Generate Substantial Home Bias? *Journal of Money, Credit and Banking*, 34(1):25–50.

Prescott, E. C. (1986). Theory ahead of business-cycle measurement. In *Carnegie-Rochester conference series on public policy*, volume 25, pages 11–44. Elsevier.

Prescott, E. C. (2004). Why do americans work so much more than europeans? *NBER Working Paper*, 10316.

Quah, D. (1993). Empirical cross-section dynamics in economic growth. *European Economic Revivew*, 37:426–434.

Rachel, L. and Smith, T. (2015). Secular drivers of the global real interest rate.

Rachel, L., Smith, T. D., et al. (2017). Are low real interest rates here to stay? *International Journal of Central Banking*, 13(3):1–42.

Raddatz, C. (2006). Liquidity needs and vulnerability to financial underdevelopment. *Journal of Financial Economics*, 80:677–722.

Raffo, A. (2010). Technology shocks: Novel implications for international business cycles. *FRB International Finance Discussion Paper*, (992).

Ramey, V. A. (2016). Macroeconomic shocks and their propagation. *Handbook of macroeconomics*, 2:71–162.

Ravn, M., Schmitt-Grohé, S., and Uribe, M. (2007). Explaining the effects of government spending shocks on consumption and the real exchange rate. *NBER Working Paper*, 13328.

Ready, R., Roussanov, N., and Ward, C. (2017). Commodity trade and the carry trade: A tale of two countries. *The Journal of Finance*, 72(6):2629–2684.

Rebelo, S. (1991). Long-run policy analysis and long-run growth. *Journal of political Economy*, 99(3):500–521.

Reinhart, C. M. (2002). Default, Currency Crises and Sovereign Credit Ratings. *The World Bank Economic Review*, 16(2):151–170.

Reinhart, C. M. (2010). This time is different chartbook: country histories on debt, default, and financial crises. *NBER Working Paper*, 15815.

Reinhart, C. M. and Rogoff, K. S. (2004). Serial default and the "paradox" of rich-to-poor capital flows. *American Economic Review*, 94(2):53–58.

Rey, H. (2015). Dilemma not trilemma: the global financial cycle and monetary policy independence. *NBER Working Paper*, 21162:1–42.

Richards, Daniel, W., Rutterford, J., Kodwani, D., and Fenton-O'Creevy, M. (2017). Stock market investors' use of stop losses and the disposition effect. *The European Journal of Finance*, 23(2):130–152.

Richter, A. W. and Throckmorton, N. A. (2016). Is rotemberg pricing justified by macro data? *Economics Letters*, 149:44–48.

Riedel, J. (2020). On real interest rate convergence among g7 countries. *Empirical Economics*, 59(2):599–626.

Roberts, J. M. (1995). New keynesian economics and the phillips curve. *Journal of money, credit and banking*, 27(4):975–984.

Rogers, J. H. (2007). Monetary union, price level convergence, and inflation: How close is Europe to the USA? *Journal of Monetary Economics*, 54(3):785–796.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of political economy*, 94(5):1002–1037.

Rotemberg, J. J. (1982). Monopolistic price adjustment and aggregate output. *The Review of Economic Studies*, 49(4):517–531.

Rotemberg, J. J. (1987). The new keynesian microfoundations. *NBER macroeconomics annual*, 2:69–104.

Roy, S., Kessler, M., and Subramanian, A. (2016). Glimpsing the end of economic history? unconditional convergence and the missing middle income trap. *Center for Global Development Working Paper*, (438).

Sachs, J. D., Warner, A., Åslund, A., and Fischer, S. (1995). Economic reform and the process of global integration. *Brookings papers on economic activity*, 1995(1):1–118.

Sala-i Martin, X. and Artadi, E. V. (2004). The global competitiveness index. *The global competitiveness report*, 2005:51–80.

Sala-i Martin, X. X. (1996). The classical approach to convergence analysis. *The economic journal*, pages 1019–1036.

Sarno, L., Schneider, P., and Wagner, C. (2012). Properties of foreign exchange risk premiums. *Journal of Financial Economics*, 105(2):279–310.

Saving, T. R. (1971). Transactions costs and the demand for money. *The American Economic Review*, 61(3):407–420.

Schmitt-Grohé, S. and Uribe, M. (2003). Closing small open economy models. *Journal of International Economics*, 61(1):163–185.

Schmitt-Grohé, S. and Uribe, M. (2007). Optimal simple and implementable monetary and fiscal rules. *Journal of monetary Economics*, 54(6):1702–1725.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance*, 19(3):425–442.

Sidrauski, M. (1967). Rational choice and patterns of growth in a monetary economy. *The American Economic Review*, 57(2):534–544.

Siklos, P. L. (2010). Meeting maastricht: Nominal convergence of the new member states toward emu. *Economic Modelling*, 27(2):507–515.

Sims, C. A. (1992). Interpreting the macroeconomic time series facts: The effects of monetary policy. *European economic review*, 36(5):975–1000.

Sims, C. A. (1998). Comment on glenn rudebusch's" do measures of monetary policy in a var make sense?". *International Economic Review*, 39(4):933–941.

Sims, C. A. and Zha, T. (2006). Were there regime switches in us monetary policy? *American Economic Review*, 96(1):54–81.

Singh, A., Brooks, R., Felman, J., Callen, T., and Thimann, C. (1998). *Australia: Benefiting from Economic Reforms*.

Singh, M. and Banerjee, A. (2006). *Testing real interest parity in emerging markets*. Number 6/249.

Smets, F. and Wouters, R. (2007). Shocks and frictions in us business cycles: A bayesian dsge approach. *American economic review*, 97(3):586–606.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, 70(1):65–94.

Sorensen, Brent, E., Wu, Y.-T., Yosha, O., and Zhu, Y. (2007). Home bias and international risk sharing: Twin puzzles separated at birth. *Journal of International Money and Finance*, 26:587–605.

Stern, M. L. (2006). Endogenous time preference and optimal growth. *Economic Theory*, 29(1):49–70.

Stockman, A. C. and Tesar, L. L. (1995). Tastes and technology in a two-country model of the business cycle: Explaining international comovements. *The American Economic Review*, pages 168–185.

Stulz, R. M. (2005). The limits of financial globalization. *The Journal of Finance*, 60(4):1595–1638.

Su, C.-W., Chang, H.-L., and Liu, Y. (2013). Real interest rate parity and two structural breaks: African countries evidence. *African Development Review*, 25(4):478–484.

Summers, L. H. (2014). Us economic prospects: Secular stagnation, hysteresis, and the zero lower bound. *Business economics*, 49(2):65–73.

Šustek, R. (2010). Monetary aggregates and the business cycle. *Journal of Monetary Economics*, 57(4):451–465.

Svirydzenka, K. (2016). Introducing a new broad-based index of financial development. *IMF Working Paper*, 16/5:1–42.

Szpiro, G. G. (1986). Measuring risk aversion: an alternative approach. *The review of economics and statistics*, pages 156–159.

Takáts, E. and Vela, A. (2014). International monetary policy transmission. *BIS papers*, (78b):25–44.

Tesar, Linda, L. and Werner, Ingrid, M. (1995). Home bias and high turnover. *Journal of International Money and Finance*, 14(4):467–492.

Turner, P. (2014). The global long-term interest rate, financial risks and policy choices in emes. *BIS Working Paper*, (441):1–19.

Uzawa, H. (1968). Time preference, the consumption function, and optimum asset holdings. *Value, capital and growth: papers in honor of Sir John Hicks. The University of Edinburgh Press, Edinburgh*, pages 485–504.

Verdelhan, A. (2018). The share of systematic variation in bilateral exchange rates. *Journal of Finance*, 73(1):375–418.

Walsh, C. E. (2009). Inflation targeting: what have we learned? *International Finance*, 12(2):195–233.

Walsh, C. E. (2017). Monetary theory and policy, edition. *Money*, 158:4–2.

Warnock, F. E. (2002). Home bias and high turnover reconsidered. *Journal of international Money and finance*, 21(6):795–805.

Yang, F. (2013). Investment shocks and the commodity basis spread. *Journal of Financial Economics*, 110(1):164–184.

Yogo, M. (2006). A consumption-based explanation of expected stock returns. *The Journal of Finance*, 61(2):539–580.

Appendix A

Appendix

A.1 Data Source and Sample Refinements

A.1.1 Data Source

Table A.1
Data Source

The table describe the dataset consisting of 12 variables. Our data come from the following sources: Organization for Economic Cooperation and Development (OECD), International Monetary Fund (IMF), FRED (Federal Reserve Bank of St. Louis), US Bureau of Labor Statistics (BLS), European Central Bank (ECB), Thompson Reuters (TR), Penn World Table 10 (PWT), US Bureau of Economic Analysis (BEA), Investing.com (INV), Yahaoo Finance (YAH) and Morgan Stanley Capital International (MSCI). Note that D denotes daily, M monthly, Q quarterly and A annual frequency.

Description	Frequency	Sources
Nominal interest rates	M	IMF, OECD and ECB
Consumer price index all items	M	IMF
Monetary aggregate M1	Q	IMF and OECD
Monetary aggregate M3	Q	IMF and OECD
USD spot exchange rate (end of period)	M	IMF
USD spot exchange rate (end of period)	D	TR
Price level of consumption	A	PWT
Price level of capital formation	A	PWT
Population by country	A	PWT
US consumption by household income	A	BEA
Stock market indices	D	INV
Stock market indices	D	YAH
Equity country indices	M	MSCI

A.1.2 Sample Refinements

Financial Openness. As highlighted by Lustig and Verdelhan (2007) engaging in CT investments involves cross-border capital flows and transactions in domestic and foreign currencies. Hence, these operations require a certain degree of financial openness to guarantee the fulfilment of purchases and sales of securities by non-residents. They also emphasized the restrictions imposed by the Euler equation on the joint distribution of exchange rates and interest rates makes sense only if foreign investors are not prevented from purchasing local securities. Chinn and Ito (2006) have built a capital account openness measurement index based on the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) published by the IMF. The index ranks countries with a binary range from 2 (full capital account openness) to -2 (lowest level of capital account openness). Intermediate values (1, 0 and -1) indicate economies with varying degrees of capital account liberalization. The last report released by the authors covers 182 countries from 1970 to 2017. We chose to eliminate countries in the years in which their classification reached -2. Under these circumstances the approval of both capital payments and receipts is rare or infrequently granted.[1]

Sovereign Default. Defaults may affect the returns on foreign currency investments, thereby, we chose to remove countries in periods of default from the sample. The data compiled by Reinhart (2010) was used to define the default intervals for each economy. The database covers different periods for each country, in an annual frequency, ranging from 1821 to 2009. As we work with month currency excess returns, we had to choose the start and end month of the sovereign default period within the annual data. In our dataset all periods of sovereign defaults are marked by stop losses.[2] Therefore, we could circumvent this issue by choosing the month of the occurrence of the first stop loss as the beginning of the default interval (within the year attested by the database). In addition, we assigned the month of December of the last default year as the end month of the non-payment period. We assumed the absence of default periods from 2009 onwards.[3] of default periods within our sample from 2009 onwards.

Entry of European Countries. The entry of European countries into the Eurozone has been accomplished through the substitution of the respective local currency by the euro. The change in currency denomination prevented us to compute the exchange rate change in the month of the adoption of the new currency. We, therefore, removed these observations.

Our panel includes sixty countries. We include each of the following countries for the dates noted in parentheses: Australia (1980:M01-2019:M12), Austria (1980:M01-1998:M12, 1999:M02-2019:M12), Bangladesh (1992:M01-2019:M12), Belgium (1980:M01-1998:M12, 1999:M01-2019:M12), Bolivia (1998:M01-2019:M12), Brazil (1998:M01-2019:M12), Canada (1980:M01-2019:M12), Chile (1995:M01-1995:M12, 1999:M01-2019:M12), Colombia (1990:M01-1992:M12, 1996:M01-2019:M12), Costa Rica (1982:M01-1984:M12, 1991:M01-2019:M12), Croatia (1993:M11-2019:M12), Czech Republic (1993:M02-2019:M12), Denmark (1982:M04-2019:M12), Ecuador (2007:M09-2019:M12), Egypt (1994:M01-2019:M12), Finland (1980:M01-1998M:12, 1999:M02-2019:M12), France (1980:M01-1998M:12, 1999:M02-2019:M12), Germany (1980:M01-1998M:12, 1999:M02-2019:M12), Greece (1980:M06-2000:M12, 2001:M02-2019:M12), Hong Kong (1980:M01-2019:M12), Hungary (1993:M01-2019:M12), Iceland (1986:M11-2019:M12), India (1980:M01-2019:M12), Indonesia (1983:M01-2019:M12), Ireland (1980:M01-1998:M12, 1999:M02-2019:M12), Israel (1992:M01-2019:M12), Italy (1982:M01-1998:M12, 1999:M02-2019:M12), Japan (1980:M01-2019:M12), Lithuania (1994:M07-2014:M12, 2015:M02-2019:M12), Luxembourg (1980:M01-1998:M12-1999:M02-2017:M05), Malaysia (1980:M01-2019:M12), Mexico (1980:M01-1982:M02, 1991:M01-2019:M12), Morocco (1986:M01-2019:M12), New Zealand (1980:M01:2019:M12), Norway (1980:M01-2019:M12), Paraguay (1989:M12-2017:M03), Peru (1998:M01-2019:M12), Poland (1994:M01-2019:M12), Portugal (1980:M01-1998:M12, 1999:M02-2019:M12), Romania (1993:M12-2019:M12), Russia (1995:M03-2019:M12), Saudi Arabia (1982:M01-1984:M12, 1993:M01-2019:M12), Serbia (2001:M12-2019:M12), Singapore (1980:M01-2019:M12), Slovakia (1995:M07-2008:M12, 2009:M02-2019:M12), Slovenia (1992:M11-2007:M02, 2007:M04-2019:M12), South Africa (1982:M01-1984:M12, 1993:M01-2019:M12), South Korea (1980:M01-1997:M11, 1999:M01-2019:M12), Spain (1980:M01-1998M:12, 1999:M02-2019:M12), Sri Lanka (1999:M03-2019:M12), Sweden (1980:M01-2019:M12), Switzerland (1980:M01-2019:M12), Thailand (1980:M01-2019:M12), the United Kingdom (1980:M01-2019:M12), the Netherlands (1980:M01-1998:M12, 1999:M02-2019:M12), the Philippines (1980:M01-1983:M10, 1993:M01-2019:M12), the United States (1980:M01-2019:M12), Tunisia (1987:M01-2019:M12), Turkey (1982:M01-2019:M12), Ukraine (1995:M01-

[1] All countries selected for this study are included in the Chinn and Ito (2006) dataset. For 2018, we considered that our entire sample countries were rated above -2.

[2] Imposing a limit on losses and gains is a common practice adopted by financial market professionals when designing portfolios with risky assets. The most common stop-loss and take-profit strategies are based on orders placed to buy or sell an asset once its price reaches a pre-specified level (see, e.g., Osler (2005), Richards et al. (2017), and Fischbacher et al. (2017), and the literature there in, for a discussion regarding the use of these practices among FX and stock market participants.). We adopted a stop-loss of 15% per month (180% per year) and a take-profit of 30% per month (360% per year) in order to mimic this common practice in the FX market. Thus, we assume that all trades settle automatically upon reaching a pre-specified profit or loss limit, imposing an upper limit on both the losses and gains on CT investments. If the limit is reached, the investor closes out all positions.

[3] Reinhart (2002) demonstrates that the probability of a significant exchange rate depreciation event is approximately 85% in periods marked by sovereign defaults. This outcome is ratified by Herz and Tong (2008), and Na et al. (2018) reinforcing the existence of a direct relationship between sovereign credit problems and episodes of sudden movements in exchange rates.

1996:M12, 1998:M01-2019:M12) and Uruguay (1980:M01:1982:M11, 1986:M01-2019:M12).

The time period for each country is determined by data availability, openness of the financial markets (according to the Chinn and Ito's (2006) index), occurrence of default states (according to the Reinhart's (2010) report) and the dates of entry into the Eurozone of European countries.

Openness of Financial Markets

We eliminated the following countries in the years (noted in parentheses) in which their classification reached -2, according to the Chinn and Ito's (2006) index: Bangladesh (1980-1991), Bolivia (1984-1985), Brazil (1980-1997), Chile (1982-1994, 1996-1998), Colombia (1980-1989, 1993-1995), Costa Rica (1985-1990), Egypt (1980-1993), Hungary (1986-1992), Iceland (1980-1982), Italy (1980-1981), Mexico (1985-1986), Morocco (1980-1985), Paraguay (1982, 1987-1988), Peru (1987-1990), Poland (1986-1993), Romania (1980-1991, 1993-1995), Russia (1999, 2001), South Africa (1980-1981, 1985-1992), Turkey (1980-1981) and Ukraine (1997, 2009-2017).

Default States

We excluded the following countries during the period (noted in parentheses) in which they were classified as in a default state, according to the Reinhart's (2010) report: Bolivia (1980-1997), Brazil (1983-1990), Chile (1983-1990), Costa Rica (1981, 1983-1990), Ecuador (1982-1995, 1999-2000, 2008), Egypt (1984), Indonesia (1998-2000, 2002), Korea (1997-1998), Mexico (1982-1990), Morocco (1983, 1986-1990), Paraguay (1986-1992, 2003-2004), Peru (1980, 1984-1997), Philippines (1983-1992), Poland (1981-1993), Romania (1981-1983, 1986), Russia (1991-2000), South Africa (1985-1987, 1989, 1993), Sri Lanka (1981-1983), Thailand (1997-1998), Tunisia (1980-1982), Turkey (1982, 2000-2001), and Uruguay (1983-1985, 1987, 1990-1991, 2003).

Dates of Entry into the Eurozone

We eliminated the following countries in their month of entry into the Eurozone (noted in parentheses): Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Portugal, Spain and the Netherlands, (1999:M01); Greece (2001:M01); Lithuania (2015:M01); Slovakia (2009:M01); and Slovenia (2007:M03).

A.2 CT Return and Fundamentals

A.2.1 CT Return Distribution

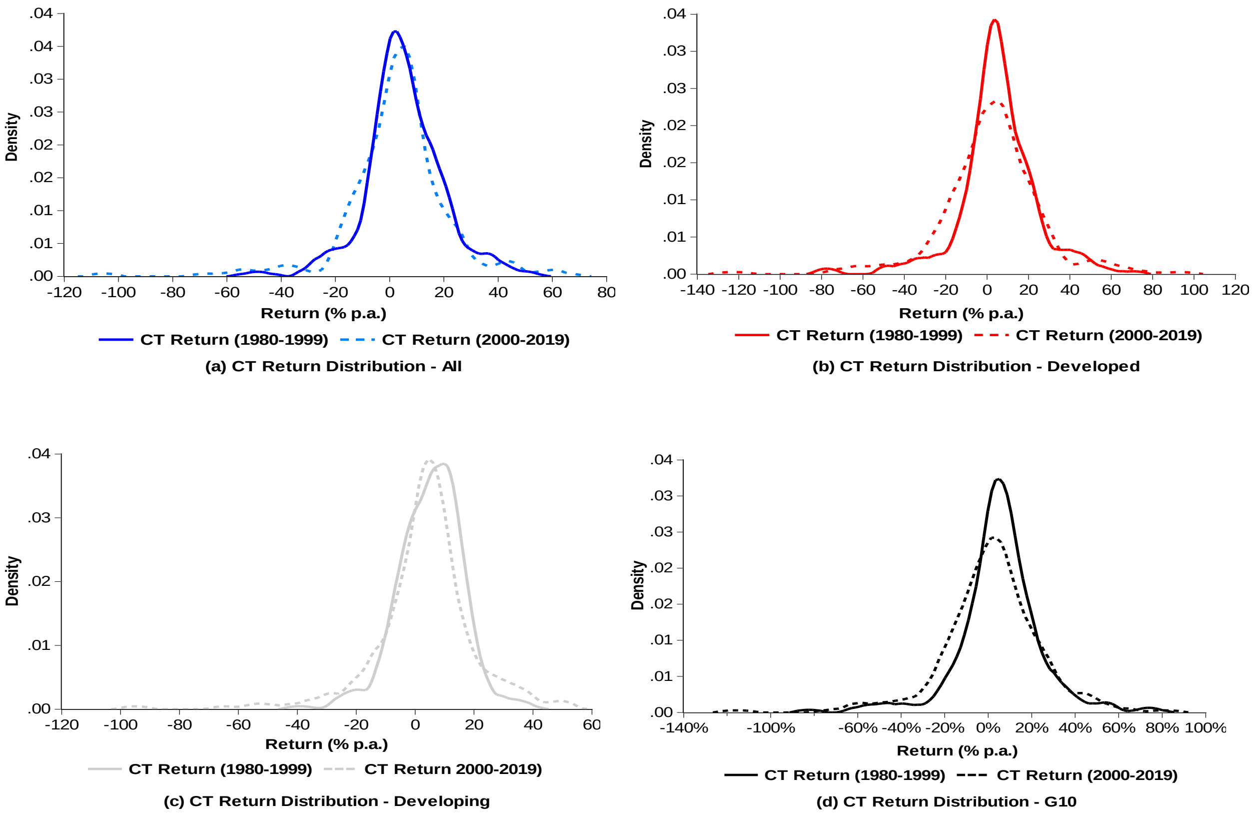


Figure A.1: Empirical Distribution of CT Returns. The figure displays the Kernel estimation of the probability density function of CT returns for each group of countries: All (Panel (a)), Developed (Panel b)), Developing (Panel (c)), and G10 (Panel (d)). We split the CT monthly returns data into two parts: from 1980 to 1999 and from 2000 to 2019. The sample period is 1980-2019.

A.2.2 Financial Development Index

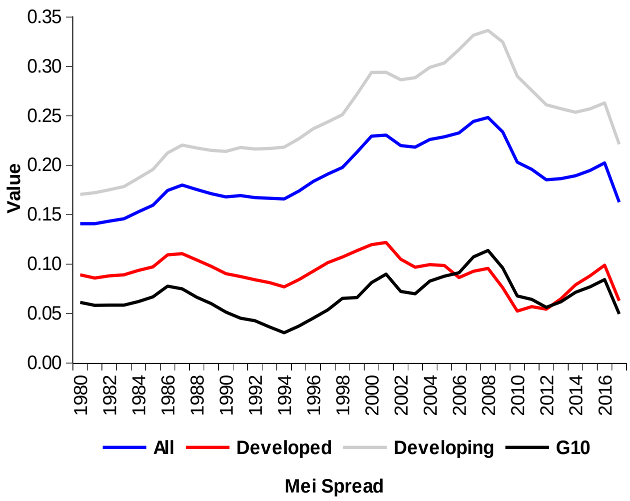


Figure A.2: MEI Process. The figure shows the behavior of the MEI spread. MEI spread is the difference between the value of the Financial Development Index of the US and the corresponding value for each group of countries. The data source for constructing the index is the World Bank Financial Development and Structure dataset. The sample period is 1980-2017.

A.3 Dynare Source Code

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%    Model Economy    %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Variables with "z" refer to the Foreign economy (starred variables in the thesis)

% Endogenous Variables

var
c       cz              % aggregate consumption
cr      crz             % ROT household consumption
co      coz             % OPT household consumption
h       hz              % hours
k       kz              % capital
q       qz              % Tobin q
i       iz              % investment
w       wz              % real wage
yH      yFz             % output
pH      pHz             % price of Home good
pF      pFz             % price of Foreign good
r       rz              % nominal interest rate
rr      rrz             % real interest rate
rmc     rmcz            % real marginal cost
lambdau lambdauz        % marginal utility of consumption
rk      rkz             % rental rate of capital
bH      bHz             % Home bond
bF      bFz             % Foreign bond
m       mz              % real money balance
pi      piz             % CPI inflation
piH     piFz            % intermediate producer inflation
tb      tbz             % trade balance
gdp     gdpz            % gross domestic product
g       gz              % government spending
a       az              % total factor productivity
tr      trz             % ROT households taxes
to      toz             % OPT households taxes
nfa     nfaz            % net financial asset position
uac     uacz            % union adjustment cost
piw     piwz            % real wage growth
Um      Umz             % average marginal utility
u       uz              % capacity utilization
delta   deltaz          % depreciation rate
kappa   kappaz          % time preference process
mei     meiz            % MEI process
ist     istz            % IST process
mon     monz            % MON process
gc      gcz             % Taylor equation shock
mg      mgz             % money's nominal growth rate
betaf   betafz          % endogenous discount factor
s                       % real exchange rate
De                      % nominal depreciation of Home currency
ct                      % ct return
tot                     % terms of trade

%  Log variables to have IRFs in percentage deviations from the steady state
clog
hlog
klog
ilog
slog
czlog
hzlog
kzlog
```

```
izlog
gdpzlog
Delog
pilog
pizlog
cr_log
co_log
crz_log
coz_log
mlog
mzlog
totlog
wlog
wzlog
ulog
uzlog
;

%  Exogenous Variables

varexo
va          vaz             % productivity shock
vg          vgz             % public spending shock
vgc         vgcz            % monetary policy shock
vist        vistz           % local IST shock
vmei        vmeiz           % local MEI shock
vmon        vmonz           % local MON shock
vk_vist                     % global IST shock
vk_vmei                     % global MEI shock
vk_vmon                     % global MON shock
;

% Parameters

parameters beta alpha delta0 gamma_c gamma_l eta gama gamaz chiL epsilon epsilonw piss pizss piwss piwzss gss gzss ass azss istss istzss meiss meizss
monss monzss kappass kappazss gcss gczss bFss bHzss pHss gdpzss rss rzss xi_I xi_P xi_W xi_B rhor phipi phiy phim toss trss tozss trzss phig rho_a rho_k
rho_g rho_ist rho_mei rho_mon rho_gc v1 v2 chiM gamma_m xi_1 xi_2 weight_rot d1 d2 gamma_ist gamma_istz gamma_mei gamma_meiz gamma_mon
gamma_monz;

beta=0.99;
alpha=0.33;
delta0=0.025;
gamma_c=2;
gamma_l=1;
eta=1.5;
gama=0.28;
gamaz=0.28;
chiL=10.3259;   % value obtained from steady state computation
epsilon=6;
epsilonw=4;
piss=1;
pizss=1;
piwss=1;
piwzss=1;
gss=0.20;
gzss=0.20;
ass=1.05839;    % value obtained from steady state computation
azss=1.05839;   % value obtained from steady state computation
istss=1;
istzss=1;
```

```
meiss=1;
meizss=1;
monss=1;
monzss=1;
kappass=1;
kappazss=1;
gcss=0;
gczss=0;
bFss=0;
bHzss=0;
pHss=1;
gdpzss=1;
rss=1.0101;       % value obtained from steady state computation
rzss=1.0101;      % value obtained from steady state computation
xi_I= 2.48;
xi_P=58.2524;  % adjustment cost coefficient to have the same Phillips Curve of Calvo framework
xi_W= 74.7;      % adjustment cost coefficient to have the same Phillips Curve of Calvo framework
xi_B=0.012;
rhor=0.8;
phipi=1.5;
phiy=0.125;
phim=0.35;
toss=0.4458;    % value obtained from steady state computation
trss=-0.0458;   % value obtained from steady state computation
tozss=0.4458;  % value obtained from steady state computation
trzss=-0.0458;  % value obtained from steady state computation
phig=1;
rho_a=0.90;
rho_k=0.50;
rho_g=0.90;
rho_ist=0.70;
rho_mei=0.60;
rho_mon=0.79;
rho_gc=0.50;
v1=0.65;
v2=-0.11;
chiM=0.00015;
gamma_m=5;
xi_1=0.0351;    % value obtained from steady state computation
xi_2=5;
weight_rot=0.5;
d1=0.86;
d2=0.43;
gamma_ist=1;
gamma_istz=1.5;
gamma_mei=1;
gamma_meiz=1.5;
gamma_mon=1;
gamma_monz=1.5;

%  Model

model;
% Households

lambdau=kappa*co^-gamma_c;
lambdauz=kappaz*coz^-gamma_c;

1=betaf*lambdau(+1)/lambdau*r/pi(+1);
1=betafz*lambdauz(+1)/lambdauz*rz/piz(+1);
```

```
1=betaf*lambdau(+1)/lambdau*rz/piz(+1)*s(+1)/s-xi_B*(bF-bFss);
1=betafz*lambdauz(+1)/lambdauz*r/pi(+1)*s/s(+1)-xi_B*(bHz-bHzss);

1=betaf*lambdau(+1)/lambdau*(rk(+1)*u(+1)+(1-delta)*q(+1))/q;
1=betafz*lambdauz(+1)/lambdauz*(rkz(+1)*uz(+1)+(1-deltaz)*qz(+1))/qz;

q*(xi_1+xi_2*(u - 1))=rk;
q*(xi_1+xi_2*(uz - 1))=rkz;

Um=weight_rot*cr^-gamma_c+(1-weight_rot)*co^-gamma_c;
Umz=weight_rot*crz^-gamma_c+(1-weight_rot)*coz^-gamma_c;

uac=(xi_W/2)*((pi*piw-piss)^2)*w*h;
uacz=(xi_W/2)*((piz*piwz-pizss)^2)*wz*hz;

k=(1-delta)*k(-1)+(1-xi_I/2*(i/(mei*i(-1))-1)^2)*i*ist;
kz=(1-deltaz)*kz(-1)+(1-xi_I/2*(iz/(meiz*iz(-1))-1)^2)*iz*istz;

1=q*ist*(1-xi_I/2*(i/(mei*i(-1))-1)^2-xi_I*(i/(mei*i(-1))-1)*i/(mei*i(-1))) +xi_I*betaf*lambdau(+1)/lambdau*q(+1)*ist(+1)*(i(+1)/(mei(+1)*i)-1)*(i(+1)/(mei(+1)*i))^2;
1=qz*istz*(1-xi_I/2*(iz/(meiz*iz(-1))-1)^2-xi_I*(iz/(meiz*iz(-1))-1)*iz/(meiz*iz(-1)))+xi_I*betafz*lambdauz(+1)/lambdauz*qz(+1)*istz(+1)*(iz(+1)/(meiz(+1)*iz)-1)*(iz(+1)
/(meiz(+1)*iz))^2;

m = ((1/((mon^gamma_m)*kappa*chiM))^(-1/gamma_m))*(lambdau-betaf/pi(+1)*lambdau(+1)+(d1/2)*((d2*exp(d2*(m/m(-1)-1)))/m(-1) -
(d2*exp(-d2*(m/m(-1)-1)))/m(-1))+ betaf*(d1/2)*((d2*m(+1)*exp(-d2*(m(+1)/m-1)))/(m^2) - (d2*m(+1)*exp(d2*(m(+1)/m-1)))/(m^2)))^(-1/gamma_m);
mz = ((1/((monz^gamma_m)*kappaz*chiM))^(-1/gamma_m))*(lambdauz-betafz/piz(+1)*lambdauz(+1)+(d1/2)*((d2*exp(d2*(mz/mz(-1)-1)))/mz(-1) -
(d2*exp(-d2*(mz/mz(-1)-1)))/mz(-1))+ betafz*(d1/2)*((d2*mz(+1)*exp(-d2*(mz(+1)/mz-1)))/(mz^2) - (d2*mz(+1)*exp(d2*(mz(+1)/mz-1)))/(mz^2)))^(-1/gamma_m);

% Firms

yH=a*(u*k(-1))^alpha*h^(1-alpha);
yFz=az*(uz*kz(-1))^alpha*hz^(1-alpha);

(1-alpha)*rmc*yH=w*h;
(1-alpha)*rmcz*yFz=wz*hz;

alpha*rmc*yH=rk*u*k(-1);
alpha*rmcz*yFz=rkz*uz*kz(-1);


% Unions

piw*pi*(pi*piw-piss)=betaf*((Um(+1)/Um)*piw(+1)^2*(pi(+1)*piw(+1)-piss)*(h(+1)/h)*pi(+1))+epsilonw/xi_W*((h^gamma_l*chiL)/(Um*w)-(epsilonw-1)/epsilonw);
piwz*piz*(piz*piwz-pizss)=betafz*((Umz(+1)/Umz)*piwz(+1)^2*(piz(+1)*piwz(+1)-pizss)*(hz(+1)/hz)*piz(+1))+epsilonw/xi_W*((hz^gamma_l*chiL)/(Umz*wz)
-(epsilonw-1)/epsilonw);

(piH -piss)*piH =betaf*(lambdau(+1)/lambdau*pH(+1)*yH(+1)/(pH*yH)*piH(+1)*(piH(+1) -piss))+epsilon/xi_P*(rmc/pH-(epsilon-1)/epsilon);
(piFz-pizss)*piFz=betafz*(lambdauz(+1)/lambdauz*pFz(+1)*yFz(+1)/(pFz*yFz)*piFz(+1)*(piFz(+1)-pizss))+epsilon/xi_P*(rmcz/pFz-(epsilon-1)/epsilon);


% Government

tr-trss=phig*(pH*g-gss);
to-toss=phig*(pH*g-gss);
```

```
trz-trzss=phig*(pFz*gz-gzss);
toz-tozss=phig*(pFz*gz-gzss);

% Monetary Authority

r/ (rss)= (((pi /piss) ^(phipi)*(gdp)^(phiy)*(mg/monss)^(phim))^(1-rhor)*(r(-1)/rss) ^(rhor))*exp(gc);
rz/(rzss)=(((piz/pizss)^(phipi)*(gdpz/gdpzss)^(phiy)*(mgz/monzss)^(phim))^(1-rhor)*(rz(-1)/rzss)^(rhor))*exp(gcz);

% Market clearing

yH= (1-gama)*pH^(-eta)*(c+i)+g+gamaz*pHz^(-eta)*(cz+iz)+(xi_P/2*(piH -piss)^2)*yH+uac;
yFz=(1-gamaz)*pFz^(-eta)*(cz+iz)+gz+gama*pF^(-eta)*(c+i)+(xi_P/2*(piFz-pizss)^2)*yFz+uacz;

bH+bHz=0;
bF+bFz=0;

gdp=c+i+pH*g+tb+pH*yH*(xi_P/2*(piH-piss)^2)+uac;
c=(1-weight_rot)*co+weight_rot*cr;
cr=w*h-tr-uac;
cz=(1-weight_rot)*coz+weight_rot*crz;
crz=wz*h-trz-uacz;

% Prices

1=(1-gama)*pH^(1-eta)+gama*pF^(1-eta);
1=(1-gamaz)*pFz^(1-eta)+gamaz*pHz^(1-eta);

pH=s*pHz;
pF=s*pFz;

piH=pH/pH(-1)*pi;
piFz=pFz/pFz(-1)*piz;

s/s(-1)=De*piz/pi;
tot=pF/pH;

% Shocks

log(a)=(1-rho_a)*log(ass)+rho_a*log(a(-1))+va;
log(az)=(1-rho_a)*log(azss)+rho_a*log(az(-1))+vaz;

log(g)=(1-rho_g)*log(gss)+rho_g*log(g(-1))+vg;
log(gz)=(1-rho_g)*log(gzss)+rho_g*log(gz(-1))+vgz;

gc=rho_gc*gc(-1)+vgc;
gcz=rho_gc*gcz(-1)+vgcz;

log(ist)=(1-rho_ist)*log(istss)+rho_ist*log(ist(-1))+vist+gamma_ist*vk_vist;
log(istz)=(1-rho_ist)*log(istzss)+rho_ist*log(istz(-1))+vistz+gamma_istz*vk_vist;

log(mei)=(1-rho_mei)*log(meiss)+rho_mei*log(mei(-1))+vmei+gamma_mei*vk_vmei;
log(meiz)=(1-rho_mei)*log(meizss)+rho_mei*log(meiz(-1))+vmeiz+gamma_meiz*vk_vmei;

log(mon)=(1-rho_mon)*log(monss)+rho_mon*log(mon(-1))+vmon+gamma_mon*vk_vmon;
log(monz)=(1-rho_mon)*log(monzss)+rho_mon*log(monz(-1))+vmonz+gamma_monz*vk_vmon;

log(kappa)=(1-rho_k)*log(kappass)+rho_k*log(kappa(-1))+gama*(vistz-vist)+gama*(vmeiz-vmei)+gama*(vmonz-
vmon)+gama*gamma_ist*vk_vist+gama*gamma_mei*vk_vmei+gama*gamma_mon*vk_vmon;
```

```
log(kappaz)=(1-rho_k)*log(kappazss)+ rho_k*log(kappaz(-1)) + gamaz*(vist-vistz)+gamaz*(vmei-vmeiz)+gamaz*(vmon-vmonz)+gamaz*gamma_istz*vk_vist+gamaz*gamma_meiz*vk_vmei+gamaz*gamma_monz*vk_vmon;

% Auxiliary variables

delta=delta0+xi_1*(u-1)+xi_2*(u-1)^2;
deltaz=delta0+xi_1*(uz-1)+xi_2*(uz-1)^2;

mg=(m/m(-1))*pi;
mgz=(mz/mz(-1))*piz;

piw=w/w(-1);
piwz=wz/wz(-1);

betaf=beta*(1+v1*((co-co(-1))/co(-1)))^(-v2);
betafz=beta*(1+v1*((coz-coz(-1))/coz(-1)))^(-v2);

rr=r/pi(+1);
rrz=rz/piz(+1);

gdp=pH*yH;
gdpz=pFz*yFz;

tb=bH+s*bF+m-r(-1)/pi*bH(-1)-s*rz(-1)/piz*bF(-1)-m(-1)/pi+xi_B/2*s*(bF-bFss)^2-xi_B/2*(bHz-bHzss)^2-s*mz+s*mz(-1)/piz;
tbz=bFz+bHz/s+mz-rz(-1)/piz*bFz(-1)-(1/s)*(r(-1)/pi)*bHz(-1)-mz(-1)/piz+xi_B/(2*s)*(bHz-bHzss)^2-xi_B/2*(bF-bFss)^2-m/s+(m(-1)/s)/pi;

nfa=(bH+s*bF)/gdp;
nfaz=(bHz/s+bFz)/gdpz;
ct=rz-r+Delog;

% Log variables

clog=log(c);
hlog=log(h);
klog=log(k);
ilog=log(i);
slog=log(s);
czlog=log(cz);
hzlog=log(hz);
kzlog=log(kz);
izlog=log(iz);
gdpzlog=log(gdpz);
Delog = log(De);
cr_log=log(cr);
co_log=log(co);
crz_log=log(crz);
coz_log=log(coz);
mlog = log(m);
mzlog = log(mz);
totlog=log(tot);
wlog=log(w);
wzlog=log(wz);
pilog=log(pi);
pizlog=log(piz);
ulog=log(u);
uzlog=log(uz);
end;

% Steady State
```

```
steady_state_model;
u=1;
uz=1;
uac=0;
uacz=0;
betaf = beta;
betafz = beta;
kappa=kappass;
kappaz=kappazss;
mon=monss;
monz=monzss;
mg=1;
mgz=1;
gc=gcss;
gcz=gczss;
mei=meiss;
meiz=meizss;
ist=istss;
istz=istzss;
piw=piwss;
piwz=piwzss;
pH=pHss;
gdp=1;
gdpz=gdpzss;
g=gss;
gz=gzss;
h=1/3;
hz=1/3;
pi=piss;
piz=pizss;
piH=piss;
piFz=pizss;
rr=1/betaf;
rrz=1/betafz;
r=pi/betaf;
rz=piz/betafz;
q=1;
qz=1;
delta=delta0;
deltaz=delta0;
rk=1/betaf-(1-delta);
rkz=1/betafz-(1-deltaz);
pF=(1/gama*(1-(1-gama)*pH^(1-eta)))^(1/(1-eta));
s=(gamaz*pH^(1-eta)+(1-gamaz)*pF^(1-eta))^(1/(1-eta));
pHz=pH/s;
pFz=pF/s;
bF=bFss;
bHz=bHzss;
bH=-bHzss;
bFz=-bFss;
rmc=pH*(epsilon-1)/epsilon;
rmcz=pFz*(epsilon-1)/epsilon;
yH=gdp/pH;
yFz=gdpz/pFz;
k=alpha*yH*rmc/rk;
kz=alpha*yFz*rmcz/rkz;
i=delta*k;
iz=deltaz*kz;
tb=bH*(1-1/betaf)+bF*s*(1-1/betafz);
```

```
c=gdp-i-pH*g-tb;
cr=c;
co=c;
tr=trss;
to=toss;
lambdau=(co)^-gamma_c;
w=(1-alpha)*yH*rmc/h;
cz=1/((1-gamaz)*pFz^(-eta))*(yFz-gz-gama*pF^(-eta)*(c+i))-iz;
crz=cz;
coz=cz;
trz=trzss;
toz=tozss;
lambdauz=(coz)^-gamma_c;
wz=(1-alpha)*yFz*rmcz/hz;
m=((mon/(kappa*chiM))^(-1/gamma_m))*(lambdau-betaf/pi*lambdau)^(-1/gamma_m);
mz=((monz/(kappaz*chiM))^(-1/gamma_m))*(lambdauz-betafz/piz*lambdauz)^(-1/gamma_m);
Um=weight_rot*cr^(-gamma_c)+(1-weight_rot)*co^(-gamma_c);
Umz=weight_rot*crz^(-gamma_c)+(1-weight_rot)*coz^(-gamma_c);
a=ass;
az=azss;
tbz=1/s*bHz*(1-1/betaf)+bFz*(1-1/betafz);
tot=pF/pH;
nfa=(-bHz+s*bF);
nfaz=(bHz/s-bF)/gdpz;

% Log variables

De=pi/piz;
clog=log(c);
hlog=log(h);
klog=log(k);
ilog=log(i);
slog=log(s);
czlog=log(cz);
hzlog=log(hz);
kzlog=log(kz);
izlog=log(iz);
gdpzlog=log(gdpz);
Delog=log(De);
cr_log=log(cr);
co_log=log(co);
crz_log=log(crz);
coz_log=log(coz);
mlog=log(m);
mzlog=log(mz);
totlog=log(tot);
wlog=log(w);
wzlog=log(wz);
pilog=log(pi);
pizlog=log(piz);
ulog=log(u);
uzlog=log(uz);
end;

steady;
check;
```

```
% Shocks

shocks;
var vgc; stderr 0.0025;
var vgcz; stderr 0.0025;
var va; stderr 0.01;
var vaz; stderr 0.01;
var vg; stderr 0.0045;
var vgz; stderr 0.0045;
var vmei; stderr 0.01;
var vmeiz; stderr 0.01;
var vist; stderr 0.018;
var vistz; stderr 0.018;
var vmon; stderr 0.0175;
var vmonz; stderr 0.0175;
var vk_vmon; stderr 0.0175;
var vk_vmei; stderr 0.01;
var vk_vist; stderr 0.018;
corr va, vaz = 1.00;
end;

% IRFs
stoch_simul(irf=40)
gdp
gdpzlog
clog
czlog
cr_log
co_log
crz_log
coz_log
hlog
hzlog
ilog
izlog
mlog
mzlog
r
rr
rz
rrz
pilog
pizlog
wlog
wzlog
ulog
uzlog
totlog
tb
tbz
nfa
nfaz
Delog
ct
s
bH
bF
bHz
bFz
;
```

A.4 Impulse Response Functions

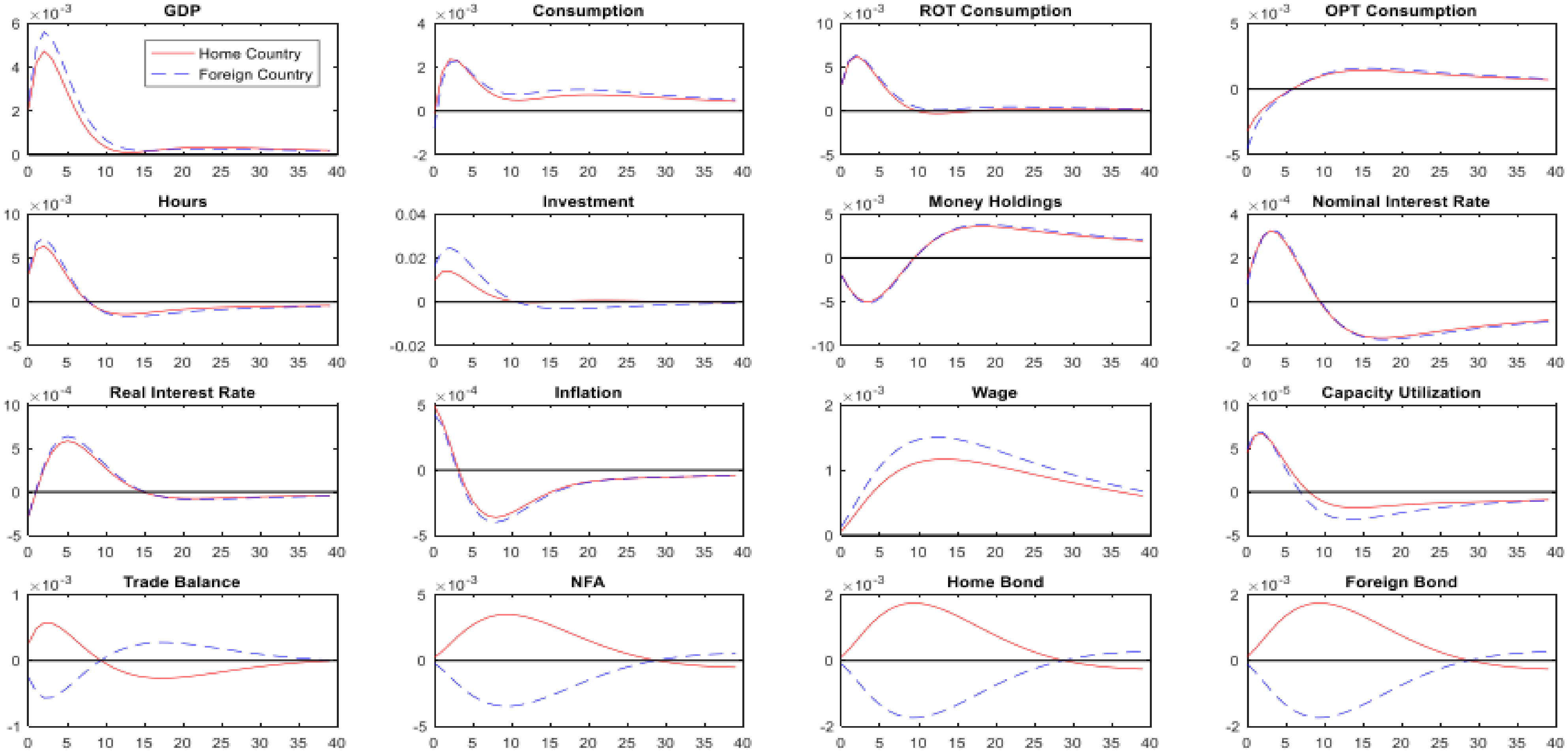


Figure A.3: Responses to the Global IST Shock I. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global IST process. The values of the Home loading equals 1 ($\Gamma_{\psi}^{g} = 1$) and the Foreign loading equals to 1.5 ($\Gamma_{\psi}^{*;g} == 1.5$).

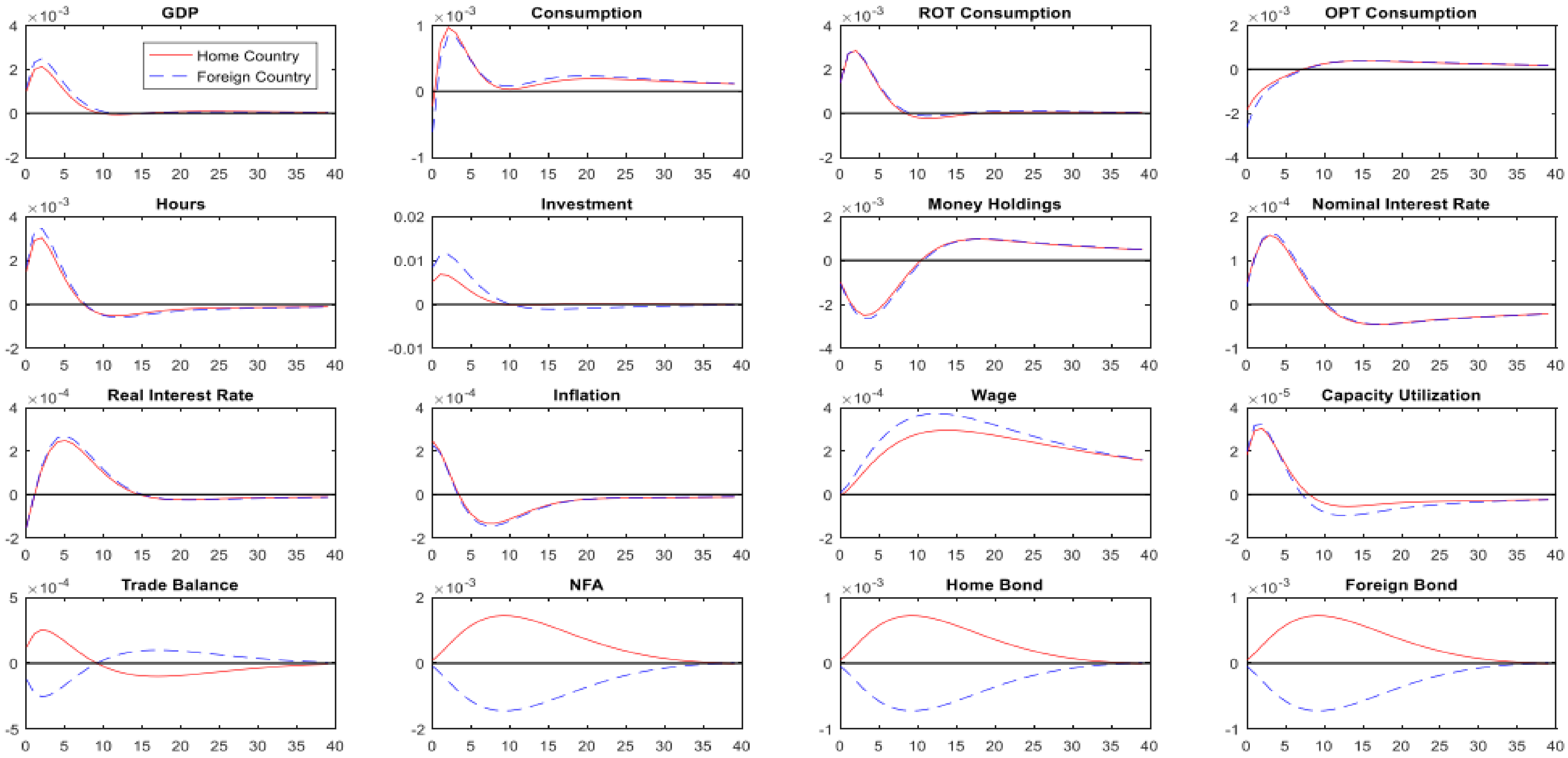


Figure A.4: Responses to the Global MEI Shock I. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global MEI process. The values of the Home loading equals 1 ($\Gamma^{g}_{\mu} = 1$) and the Foreign loading equals 1.5 ($\Gamma^{*;g}_{\mu} = 1.5$).

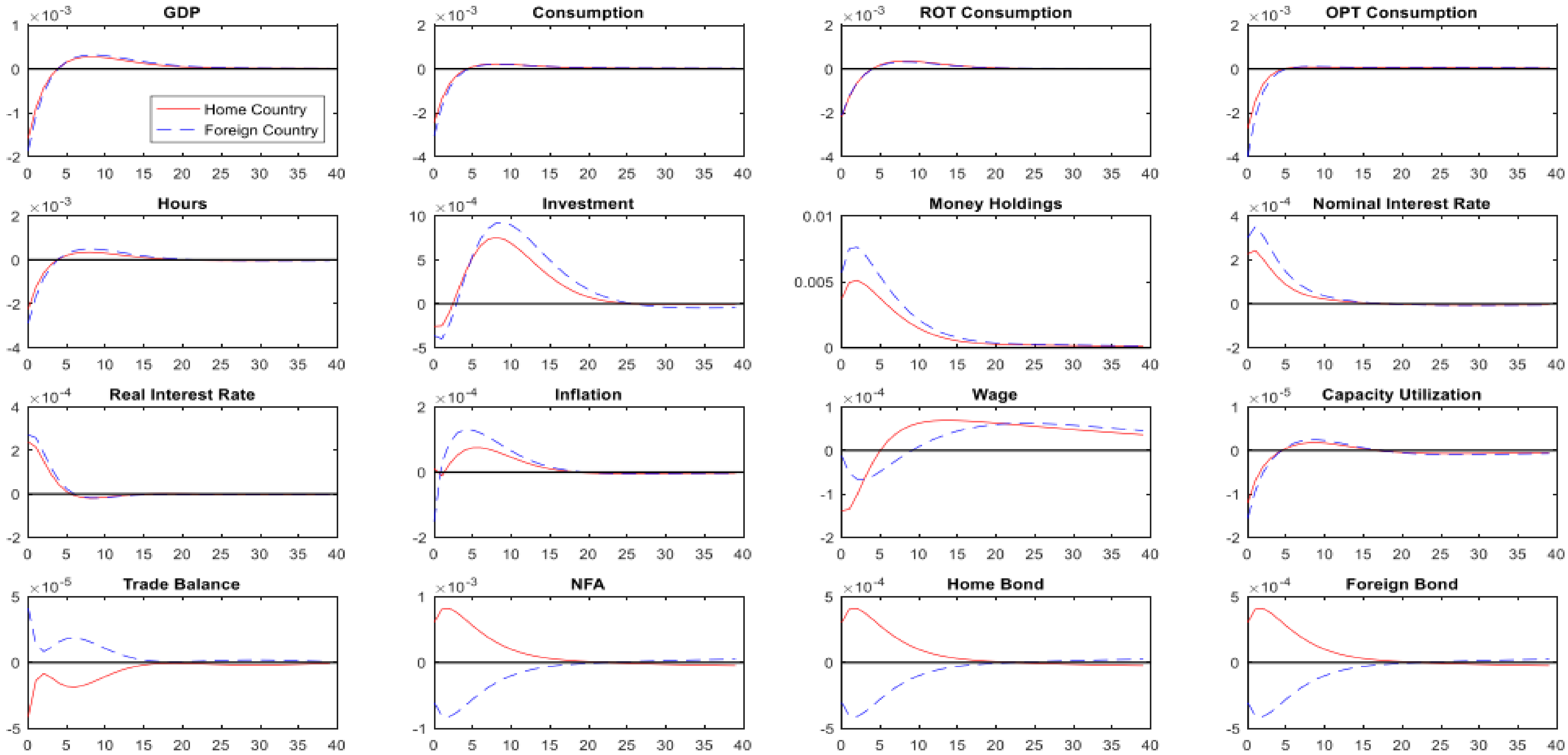


Figure A.5: Responses to the Global MON Shock I. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global MON process. The values of the Home loading equals 1 ($\Gamma_{\iota}^{g} = 1$) and the Foreign loading equals 1.5 ($\Gamma_{\iota}^{*,g} = 1.5$).

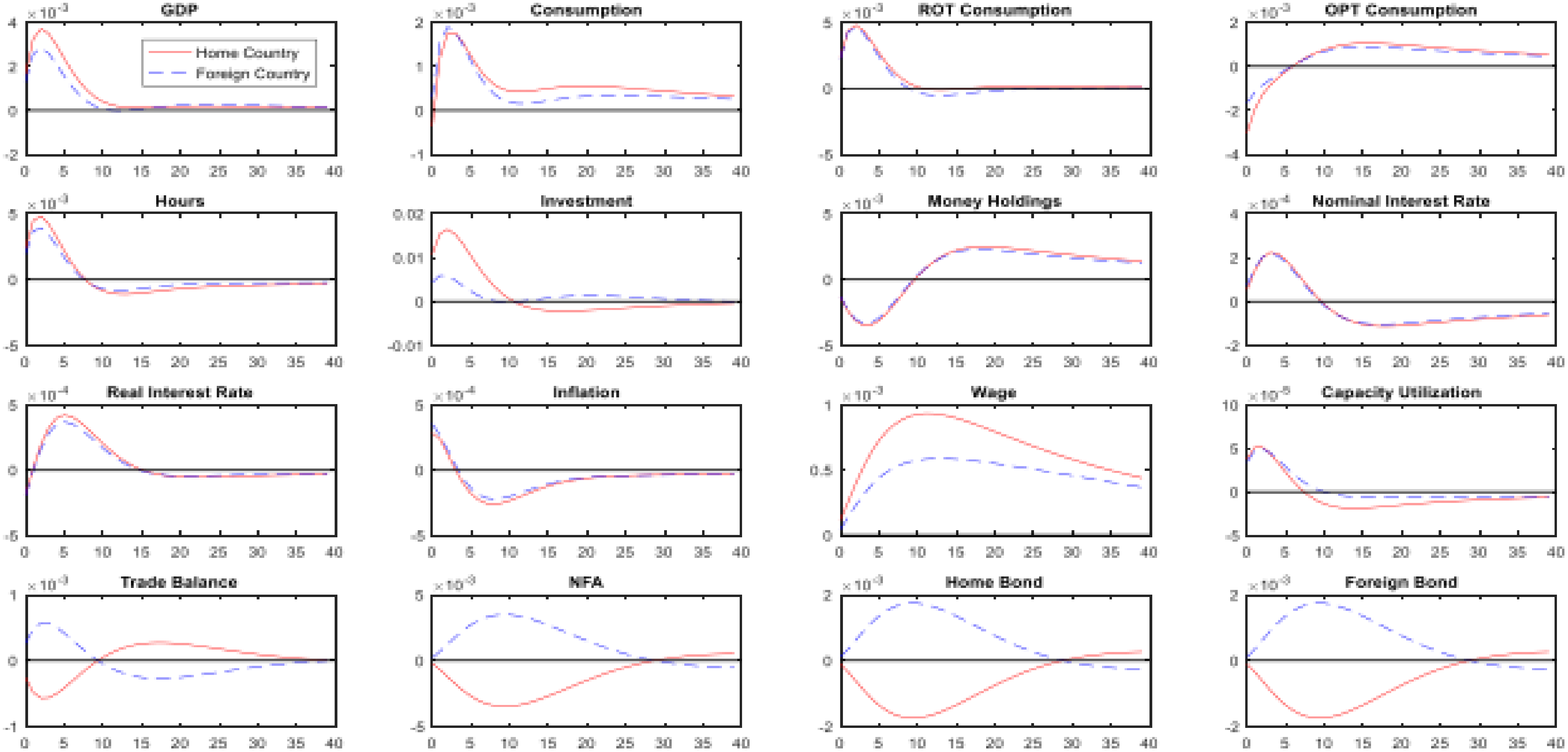


Figure A.6: Responses to the Global IST Shock II. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global IST process. The values of the Home loading equals 1 ($\Gamma_{\psi}^{g} = 1$) and the Foreign loading equals 0.5 ($\Gamma_{\psi}^{*,g} = 0.5$).

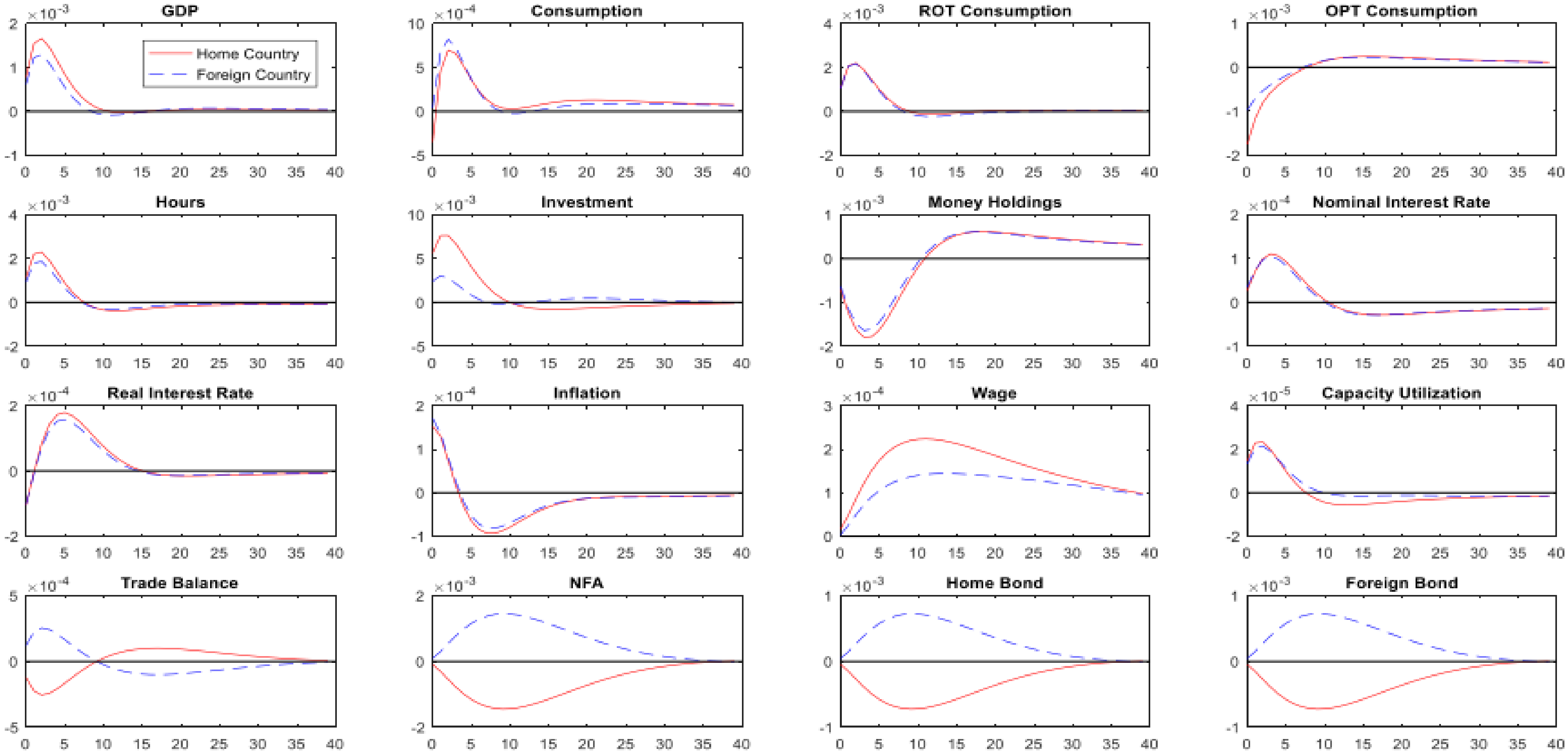


Figure A.7: Responses to the Global MEI Shock II. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global MEI process. The values of the Home loading equals 1 ($\Gamma_{\mu}^{g} = 1$) and the Foreign loading equals 0.5 ($\Gamma_{\mu}^{*;g} = 0.5$).

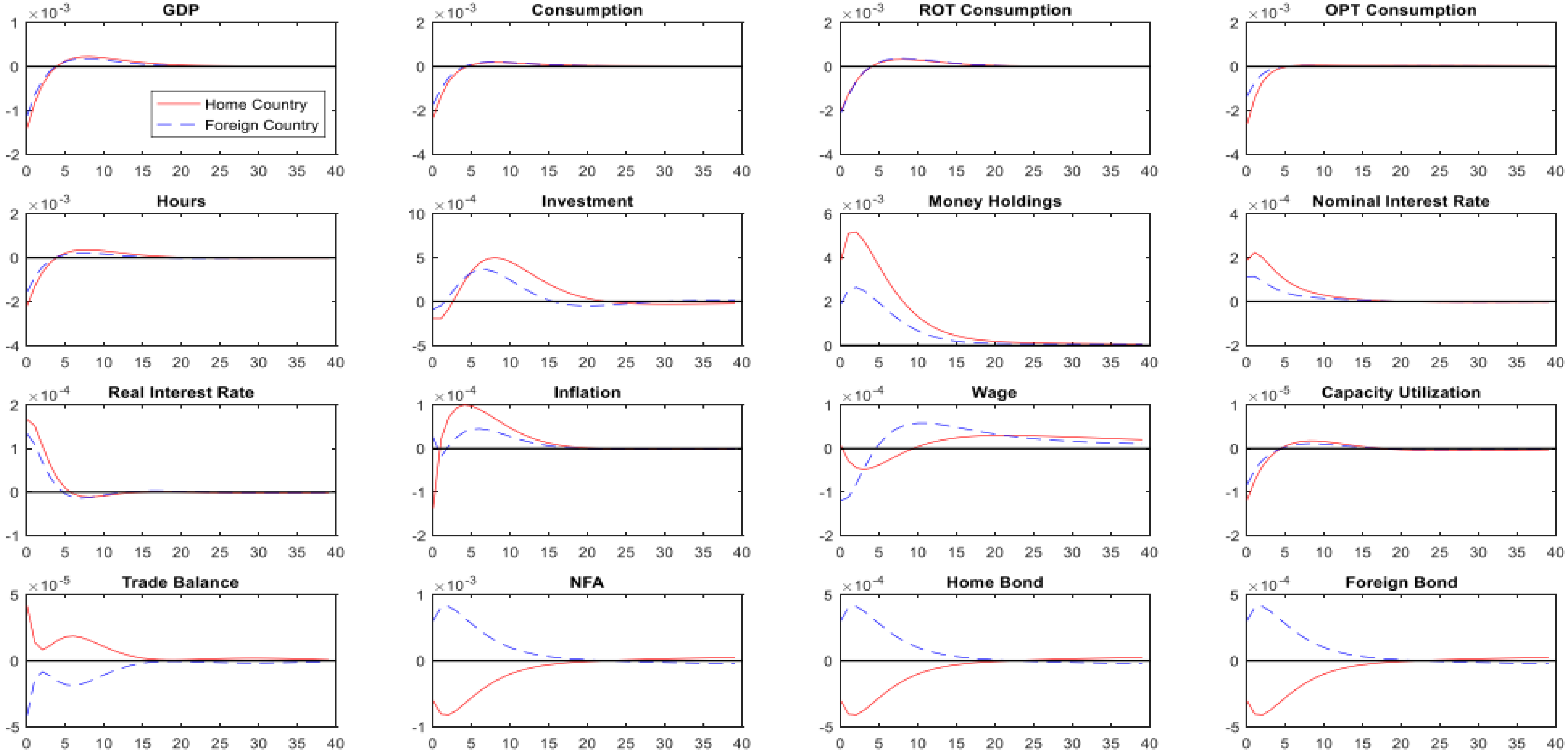


Figure A.8: Responses to the Global MON Shock II. The figure shows the Impulse Response Functions of a selected set of variables to an exogenous one standard deviation shock in the global MON process. The values of the Home loading equals 1 ($\Gamma_{\iota}^{g} = 1$) and the Foreign loading equals 0.5 ($\Gamma_{\iota}^{*,g} = 0.5$).

A.5 Asset Pricing Results - Currency Returns

Table A.2
Asset Pricing Tests: Developed Countries

The table presents the results for currency portfolios sorted based on time $t-1$ information. The test assets include forty-one portfolios: five sorted by the IST values, five by the MEI values, three by M1 growth rates, three by M3 growth rates, five by nominal interest rate, five by past three-month currency excess return (short-term momentum), five by past one-year currency excess return (long-term momentum), five by past five-year exchange rate return (value) and five by country exposure to global FX volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1}, HML^{mon3} and HML^{ir}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics.

Excluding Price Factors as Test Assets							**Including Price Factors as Test Assets**						
λ_{RX}	λ^{ist}_{HML}	λ^{mei}_{HML}	λ^{mon1}_{HML}	λ^{mon3}_{HML}	λ^{ir}_{HML}	R^2	λ_{RX}	λ^{ist}_{HML}	λ^{mei}_{HML}	λ^{mon1}_{HML}	λ^{mon3}_{HML}	λ^{ir}_{HML}	R^2
Panel (a): 1985:M8-2019:M12													
2.72^c	1.58^d					0.07	2.72^c	1.35^d					0.15
2.73^c		2.06^b				0.01	2.73^c		1.75^b				0.05
2.73^c			1.86^d			0.00	2.74^c			1.17			0.11
2.72^c				2.26^c		0.04	2.72^c				1.71^c		0.09
2.67^c					3.34^a	0.19	2.67^c					3.23^b	0.19
2.67^c	1.02				2.96^b	0.22	2.66^c	1.02				3.06^a	0.30
2.67^c		0.90			3.34^a	0.16	2.67^c		1.20^c			3.27^a	0.21
2.67^c			0.72		3.33^a	0.16	2.67^c			0.67		3.22^a	0.28
2.67^c				1.02	3.46^a	0.17	2.67^c				1.14	3.27^a	0.23
2.70^c	1.29	1.91^b				0.19	2.70^c	1.22	1.70^b				0.30
2.72^c	1.37		1.13			0.06	2.72^c	1.24		1.70^b			0.24
2.71^c	1.29			1.78^d		0.09	2.71^c	1.19^a			1.47^d		0.22
2.72^c		1.76^b	1.55			0.04	2.72^c		1.63^b	1.04			0.20
2.70^c		1.54^c		1.86^d		0.07	2.71^c		1.54^b		1.52^d		0.18

Table A.3
Asset Pricing Tests: Developed Countries - Global

The table presents the results for currency portfolios sorted based on time $t-1$ information. The test assets include forty-one portfolios: five sorted by country's exposure to the global component of the IST values, five by country's exposure to the global component of MEI values, three by country's exposure to the global component of M1 growth rate, three by country's exposure to the global component of M3 growth rate, five by nominal interest rate, five by past three-month currency excess return (short-term momentum), five by past one-year currency excess return (long-term momentum), five by past five-year exchange rate return (value) and five by country exposure to global FX volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1}, HML^{mon3} and HML^{ir}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics.

Excluding Price Factors as Test Assets							**Including Price Factors as Test Assets**						
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	λ_{HML}^{ir}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	λ_{HML}^{ir}	R^2
Panel (a): 2006:M01-2019:M12													
0.74	0.57					0.01	0.73	0.90					0.01
0.72		1.87				0.14	0.73		1.92^{d}				0.20
0.74			0.97			0.02	0.75			0.56			0.03
0.73				1.77		0.12	0.73				1.65		0.14
0.73					1.09	0.02	0.73					1.08	0.03
0.73	0.47				1.09	0.00	0.72	0.85				1.14	0.00
0.71		1.85			1.04	0.11	0.71		1.91^{c}			1.06	0.18
0.73			0.62		0.96	0.01	0.73			0.387		1.03	0.03
0.71				1.67	1.04	0.11	0.71				1.60	1.05	0.14
0.71	0.35	1.76				0.12	0.69	0.74	1.81^{d}				0.15
0.73	0.45		0.68			0.00	0.72	0.85		0.34			0.00
0.71	0.32			1.65		0.13	0.70	0.73			1.49		0.12
0.71		1.75	0.53			0.13	0.71		1.88^{c}	0.35			0.20
0.71		1.67		1.60		0.14	0.71		1.82^{d}		1.58		0.22
Panel (b): 2009:M01-2019:M12													
-0.11	3.17^{a}					0.39	-0.11	3.19^{a}					0.52
-0.11		2.57^{d}				0.16	-0.10		2.41^{c}				0.25
-0.07			1.74			0.16	-0.06			1.08			0.04
-0.13				2.25^{d}		0.15	-0.11				1.80^{c}		0.17
-0.14					3.13^{b}	0.20	-0.13					2.91^{b}	0.32
-0.15	3.14^{a}				3.08^{b}	0.45	-0.15	3.14^{a}				2.89^{b}	0.61
-0.15		2.22			2.78^{c}	0.23	-0.15		2.22^{d}			2.74^{b}	0.41
-0.16			2.06		3.34^{b}	0.30	-0.15			1.23		2.87^{b}	0.37
-0.15				1.99	2.79^{c}	0.21	-0.14				1.40	2.71^{c}	0.34
-0.17	3.05^{a}	2.30				0.57	-0.17	3.12^{a}	2.26^{d}				0.69
-0.12	3.08^{a}		1.54			0.46	-0.12	3.16^{a}		0.98			0.57
-0.19	3.02^{a}			1.82		0.59	-0.18	3.13^{a}			1.57		0.68
-0.11		2.40^{d}	1.32			0.17	-0.11		2.34^{c}	0.87			0.26
-0.12		2.25		2.03		0.17	-0.11		2.19^{d}		1.67		0.27

A.6 Asset Pricing Results - Equity Returns

Table A.4
Asset Pricing Tests: Excess Returns (Market Indices) - Global

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess return (equity return), six by past one-year equity excess return (equity return), six by past five-year equity return and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from Investing.com and Yahoo Finance.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 2006:M01-2019:M12											
4.76	2.00^a				0.05	4.73	0.61				0.17
4.81		3.28			0.13	4.83		4.00			0.12
5.10			4.59		0.08	5.09			3.49		0.09
5.13				3.87	0.05	5.11				2.86	0.08
4.81	-0.47	4.73^d			0.19	4.91	-0.99	4.97			0.32
4.66	1.45		4.44		0.06	4.65	0.16		3.22		0.21
4.69	1.66			3.39	0.04	4.68	0.37			2.60	0.20
4.80		3.24	3.16		0.11	4.85		4.01	2.76		0.12
4.81		3.27		2.60	0.11	4.85		4.01		2.17	0.14
Panel (b): 2009:M01-2019:M12											
8.09^c	1.83				0.08	8.07^c	1.43				0.30
8.08^c		2.08			0.12	8.10^c		2.72			0.21
8.82^c			3.27		0.00	8.82^c			3.11		0.14
8.79^c				2.10	-0.03	8.76^c				1.19	0.24
8.08^c	0.96	2.20			0.10	8.08^c	0.93	2.84			0.38
8.03^c	1.69		2.93		0.08	8.01^c	1.33		2.92		0.38
8.19^c	2.17			1.26	0.09	8.17^c	1.60			1.15	0.46
8.07^c		2.04	2.26		0.11	8.09^c		2.74	2.65		0.29
8.26^c		2.82		0.82	0.19	8.28^c		3.16		0.50	0.46

Table A.5
Asset Pricing Tests: Returns (Market Indices) - Global

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess return (equity return), six by past one-year equity excess return (equity return), six by past five-year equity return and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from Investing.com and Yahoo Finance.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 2006:M01-2019:M12											
5.41	4.88^{d}				0.16	5.38^{d}	3.41				0.18
5.46^{d}		5.42^{c}			0.23	5.47^{d}		5.85^{b}			0.23
5.30			8.01^{b}		0.23	5.34			6.49^{c}		0.21
5.49				3.51	0.03	5.49				2.39	0.06
5.47^{d}	2.84	5.82^{c}			0.22	5.46	2.11	6.09^{b}			0.27
5.31	3.56		7.52^{b}		0.23	5.30	2.55		6.10^{c}		0.25
5.42	4.86^{d}			0.53	0.14	5.38	3.38			2.16	0.20
5.38		4.61^{d}	6.79^{c}		0.24	5.42		5.39^{c}	5.71^{c}		0.23
5.47^{d}		5.39^{c}		-1.11	0.21	5.47^{d}		5.87^{b}		1.98	0.25
Panel (b): 2009:M01-2019:M12											
9.21^{a}	2.75				0.12	9.21^{a}	2.76				0.28
9.28^{a}		3.05			0.21	9.30^{a}		3.68			0.28
9.69^{a}			5.09		0.08	9.69^{a}			4.94		0.17
9.71^{a}				10.76	0.07	9.75^{a}				2.93	0.24
9.22^{a}	0.93	4.04			0.22	9.30^{a}	1.79	4.38^{d}			0.41
9.16^{a}	2.26		4.23		0.13	9.16^{a}	2.48		2.56		0.34
9.21^{a}	2.24			7.92	0.15	9.21^{a}	2.64			2.56	0.41
9.27^{a}		2.90	3.29		0.19	9.28^{a}		3.65	4.09		0.32
9.27^{a}		3.21		4.79	0.21	9.29^{a}		3.69		2.23	0.41

Table A.6
Asset Pricing Tests: Excess Returns (MSCI Indices) - Global

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess return (equity return), six by past one-year equity excess return (equity return), six by past five-year equity return and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Excess returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from MSCI.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2	λ_{RX}	λ_{HML}^{ist}	λ_{HML}^{mei}	λ_{HML}^{mon1}	λ_{HML}^{mon3}	R^2
Panel (a): 2006:M01-2019:M12											
3.09	4.22				0.19	3.11	2.43				0.18
3.11		4.80			0.26	3.11		4.42			0.26
3.27			5.47		0.28	3.22			3.85		0.24
3.19				3.02	0.12	3.18				2.49	0.13
3.13	3.21	5.16^d			0.25	3.15	1.62	4.38^d			0.25
3.05	2.52		5.47^d		0.26	3.08	1.31		3.74		0.25
3.10	4.91			1.25	0.19	3.11	2.49			1.59	0.17
3.06		3.44	4.66		0.28	3.09		3.80	3.18		0.27
3.13		5.22^d		1.19	0.25	3.12		4.58^d		1.54	0.25
Panel (b): 2009:M01-2019:M12											
6.13	1.50				-0.02	6.14	0.17				0.25
6.13		1.43			0.00	6.13		1.45			0.11
6.15			1.68		-0.02	6.14			1.31		0.16
6.09				1.38	-0.04	6.10				1.23	0.13
6.15	1.12	1.95			-0.05	6.17	-0.11	1.54			0.33
6.11	0.69		2.17		-0.02	6.12	-0.34		1.58		0.36
6.13	1.70			1.27	-0.07	6.14	0.05			1.14	0.33
6.10		0.80	1.75		-0.04	6.10		1.16	1.30		0.24
6.15		1.71		1.14	-0.06	6.14		1.60		1.09	0.22

Table A.7
Asset Pricing Tests: Returns (MSCI Indices) - Global

The Table presents the results for equity portfolios sorted based on time $t-1$ information. The test assets include forty-eight portfolios: six sorted by the IST values, six by the MEI values, six by M1 growth rates, six by M3 growth rates, six by past three-month equity excess return (equity return), six by past one-year equity excess return (equity return), six by past five-year equity return and six by countries' exposure to global stock market volatility. The set of pricing factors includes the RX, HML^{ist}, HML^{mei}, HML^{mon1} and the HML^{mon3}. We report the market price of risk λ and the cross-sectional adjusted R-squared (R^2) obtained from the second pass of the Fama and MacBeth (1973) regression approach. Returns are annualized. Note that a, b, c and d denote statistical significance at the 1%, 5%, 10%, and 15% levels, respectively. The Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors were used to compute t-statistics. Data are from MSCI.

Excluding Price Factors as Test Assets						**Including Price Factors as Test Assets**					
λ_{RX}	λ^{ist}_{HML}	λ^{mei}_{HML}	λ^{mon1}_{HML}	λ^{mon3}_{HML}	R^2	λ_{RX}	λ^{ist}_{HML}	λ^{mei}_{HML}	λ^{mon1}_{HML}	λ^{mon3}_{HML}	R^2
Panel (a): 2006:M01-2019:M12											
3.21	5.70^d				0.14	3.22	3.47				0.09
3.22		6.43^c			0.25	3.22		5.57^c			0.24
3.17			6.65^c		0.28	3.16			5.15^c		0.25
3.11				4.56	0.14	3.12				4.13	0.14
3.24	2.94	7.30^b			0.26	3.24	1.59	5.87^b			0.25
3.15	3.12		6.75^b		0.27	3.17	1.94		5.10^c		0.24
3.21	4.91^d			3.84	0.14	3.20	2.77			3.65	0.12
3.17		4.89^d	5.71^c		0.29	3.18		4.66^c	4.43^d		0.27
3.22		6.35^b		2.62	0.21	3.21		5.39^c		3.08	0.22
Panel (b): 2009:M01-2019:M12											
7.10^c	2.40				-0.17	7.09^c	1.00				0.11
7.10^c		1.77			-0.16	7.09^c		1.86			-0.01
6.73^c			2.26		-0.02	6.75^c			2.35		0.09
6.67^c				1.36	-0.09	6.69^c				2.11	-0.01
7.11^c	1.73	2.36			-0.18	7.11^c	0.51	2.11			0.19
7.06^c	0.42		3.41		0.02	7.06^c	-0.11		2.98		0.32
7.08^c	0.89			1.85	-0.10	7.07^c	0.17			2.35	0.22
7.05^c		0.04	2.97		-0.03	7.05^c		0.93	2.71		0.18
7.07^c		0.65		1.60	-0.13	7.07^c		1.28		2.29	0.07