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Factors associated with welfare costs of economic fluctuations: some empirical evidence

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Abstract

Here we empirically study an association between the welfare cost of economic fluctuations and macroeconomic factors. First, we calculated the welfare cost for a set of 183 countries and find significant differences across countries. Then we examine the relationship of macroeconomic factors to cost using linear models. The results indicate that the increase in income uncertainty and savings variation are related to higher welfare costs, while countries that have fiscal rules that seek to stabilize the product have lower costs.

Key-words: Economic Fluctuations, Stabilization Policies, Welfare.

Resumo

Neste trabalho estudamos empiricamente a associação entre o custo de bem-estar das flutuações econômicas e fatores macroeconômicos. Primeiramente, calculamos o custo de bem-estar para um conjunto de 183 países e encontramos diferenças significativas nestes custos para diferentes países. Em seguida, examinamos a relação de fatores macroeconômicos com o custo usando modelos lineares. Os resultados indicam que o aumento da incerteza da renda e da variância da poupança estão relacionados a maiores custos de bem-estar, enquanto que países que possuem regras fiscais que buscam estabilizar o produto apresentam menores custos.

Palavras-chaves: Flutuações Econômicas, Políticas de Estabilização, Bem-Estar.

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1 Introduction

There is an important research field in macroeconomics that is dedicated to understanding the economic fluctuations and developing tools to minimize the impacts of these fluctuations. To understand how these fluctuations affect people's lives, normally, we consider models in which agents are risk-averse, such that they seek to smooth their lifetime consumption over time. In this way, a question that emerges from these models is how much these consumers would be willing to receive to be indifferent between current consumption and smooth consumption. Lucas (1987) shows that the welfare losses from the business cycles are small, specifically the author argues that the consumers would pay less than 0.1% of their annual consumption to eliminate the volatility.[1]

This paper inspired the emergence of rich literature that addresses the welfare cost of economic fluctuations. Most of the studies are focused on proposing new measures for the cost, changing the hypothesis of the model presented by Lucas (1987). For example, considering a representative agent environment several studies explore statistical properties of the consumption process. Obstfeld (1994) uses the random walk hypothesis to model the consumption process, Reis (2009) goes further using ARIMA(p,1,q), Guillén et al. (2014) takes into account the distinction between temporary and permanent shocks in household consumption, and Jorda et al. (2020) shows that there are large costs of goods be in the presence of economic disasters. Another important advance in the literature is to incorporate the presence of idiosyncratic risks in incomplete market economies and propose measures for the welfare cost of fluctuations.[2] On the other hand, few works are dedicated to measuring these costs for economies other than the US economy.[3] In this work, we aim to use a cost measure already proposed by the literature and estimate the welfare cost of economic fluctuations for different economies, this exercise allow us to assess the heterogeneity of costs and understand which factors are associated with the different estimated costs.

To do this, we first compute the cost of economic fluctuations for a total of 183 countries. In general, in studies that use statistical modeling for the consumption sequence of the economy, this cost is calculated as a convolution of parameters of consumer pref-

[1] The main hypothesis of Lucas (1987) are: representative agent, log-normal consumption process that grows around a deterministic trend and independent and identically distributed shocks.

[2] For example, see the works of Imrohoroğlu (1989), Krusell and Smith Jr (1999), Storesletten et al. (2001), De Santis (2007) and Barros et al. (2017).

[3] Important contributions in this sense are the works of Pallage and Robe (2003) in which the welfare cost of the cycles is computed for a set of low-income countries, Couto and Gomes (2017) which shows that there is great heterogeneity in the cost of economic fluctuations in Latin American countries and Kaba (2017) which relates the welfare cost of economic cycles in Sub-Saharan African countries participation in the common currency area of the French colonies in Africa.

erences – risk aversion, intertemporal discount factor, etc - and estimated parameters for the consumption process.[4] Here, we use the cost measure of fluctuations proposed by Reis (2009). This is an adequate measure for our purpose of studying possible factors that are related to the size of this cost, as it allows, in its modeling, to incorporate the persistence observed in the consumption processes, being of great importance to deal with the heterogeneity between different economies. Then, we empirically study possible factors that are associated with the estimated costs in the first stage of our work. We use linear models and regress costs against a wide range of variables that are related to different aspects of each country's economy, such as countries' vulnerability to economic cycles, fiscal and monetary rules, income group and social assistance policies.

Our results indicate that there is a big dispersion in welfare cost of business cycles, even if we consider identical preferences for consumers in different countries. For example, in our benchmark exercise, the welfare cost for the United States is about 2% of annual consumption, which is very close to the cost of South Africa (2.1%). However, there are countries where this cost is about 5 times higher, such as Zimbabwe, these results are very close to the results reported in the literature (Pallage and Robe, 2003). As expected, we find evidence that poorer countries on average have higher fluctuating welfare costs. However, we also find that several other factors are associated with costs. In particular, our results indicate that countries with stronger fiscal rules have lower welfare costs, as do countries with lower unemployment and inflation rates. On the other hand, there are factors such as Independence from the Central Bank and dependency ratio that proved to be unrelated to the costs of economic fluctuations.

These results are important, as they dialogue with the literature that argues that additional stabilization policies would not lead to large welfare gains as in Lucas (2003). In this work, we show that Lucas argument may hold only in a small group of high income countries as the other countries have significantly higher welfare costs, and we also show that countries which have fiscal rules aiming stabilize the product have lower welfare costs of business cycles even controlling by income group.

The text is organized as follows. The section 2 details the methods we use to compute the welfare cost of economic fluctuations and the methods we use to study macroeconomic and policy factors that are associated with costs. Then, section 3 describes the data we used in this study. The section 4 shows the results we found from our methodology. Finally, section 5 brings our final remarks. The appendix A shows a comparison between the methods of calculating the welfare cost of economic fluctuations proposed by Obstfeld (1994) and Reis (2009). We report in the appendix B the values computed for the cost in each of the economies studied and in the appendix C we describe an important part of

[4] For example, in Lucas (1987) the cost of economy cycles is approximately $1/2\gamma\sigma^2$, where γ represents the relative risk aversion of the representative consumer and σ^2 is the variance of the shocks that affect the agent's consumption.

the numerical method we use to compute the costs.

2 Welfare Cost of Business Cycles

In this section we show Reis (2009) framework, in which provides a very flexible methodology allowing us to compute the welfare cost for a wide range of countries, using a specific model for each of them chosen through their consumption per capita process. An additional feature of this method is its ease of calibrating countries' parameters in which can be difficult using others methodologies, as we will discuss further.

Lucas (1987) study the welfare cost of business cycles considering a risk-averse representative agent that lives infinite periods of time and its utility depends on a stochastic sequence of consumption $\{C_t\}_{t=0}^{\infty}$, that is,

$$U\Big(\{C_t\}_{t=0}^{\infty}\Big) = E_0\Bigg\{\sum_{t=0}^{\infty}\beta^t u(C_t)\Bigg\},$$

where $u(\cdot)$ is the representative agent's instantaneous utility, C_t is the consumption in the period t, $\beta \in (0,1)$ is the agent's intertemporal discount, and $E_t(\cdot)$ is the expectation operator conditional on the information available in t.

This agent, when faced with a situation of choice between a sequence of consumption with risk $\{C_t\}_{t=0}^{\infty}$ and a sequence of a counterfactual consumption, with the same average, but without risk, $\{\bar{C}_t\}_{t=0}^{\infty}$ naturally he chooses the latter, as he is risk-averse. In this framework, it is possible to find a scalar λ that provides the necessary compensation for the consumer to be indifferent between the sequence $\{(1+\lambda)C_t\}_{t=0}^{\infty}$ and the sequence $\{\bar{C}_t\}_{t=0}^{\infty}$. Thus, Lucas (1987) proposes that λ could be understood as the quantification of the preference for stability (or the *welfare cost*), calculated by the following equation:

$$E_0\Bigg\{\sum_{t=0}^{\infty}\beta^t u\Big[(1+\lambda)C_t\Big]\Bigg\} = \sum_{t=0}^{\infty}\beta^t u\Big(\bar{C}_t\Big). \tag{2.1}$$

To proceed with the calculation of λ it is necessary to assume a functional form for utility and for the stochastic process of consumption. In the present work, I assume as Lucas (1987) and Reis (2009), a CRRA utility function

$$u(C_t) = \begin{cases} \frac{C_t^{1-\gamma}}{1-\gamma}, & if \quad \gamma > 0 \quad e \quad \gamma \neq 1 \\ \ln(C_t), & se \quad \gamma = 1 \end{cases}.$$

For the stochastic consumption process, a way to model a counterfactual series for risk-free consumption $\bar{C}_t$ is to take the consumption expectation, where $\bar{C}_t = E[C_t] = C_0 e^{gt}$, where g is the average consumption growth rate. Assuming log-normality for consumption, Reis (2009) derive the following expression for the fluctuations' cost:

$$\ln(1+\lambda) = \begin{cases} 0.5(1-e^{-\rho})\sum_{t=0}^{\infty} e^{-\rho t} Var(c_t), & se \quad \gamma = 1 \\ [\gamma-1]^{-1}\ln(1-e^{-\rho})\sum_{t=0}^{\infty} e^{-\rho t} e^{0.5\gamma(\gamma-1)Var(c_t)}, & se \quad \gamma \neq 1 \end{cases}$$

where $c_t = \ln C_t$ and $\rho = -\ln\beta + (\gamma - 1)g$ is the effective discount rate. The author, when presenting evidence that the consumption process had persistence, only being stationary in its first difference, proposes an alternative functional form for consumption, which would follow an ARMA$(p, 1, q)$. As the series is stationary at the first difference, Wold's Theorem allows formulating a representation of a moving average, so a general statistical model for consumption can be written as

$$\Delta c_t = \textit{deterministic part} + A(L)u_t,$$

where $A(L) = \sum_{i=0}^{\infty} \alpha_i L^i$, with $\alpha_0 = 1$ and $\sum_{i=0}^{\infty} \alpha_i^2 < \infty$ and u_t have zero mean and variance σ_u^2. In this case, the welfare cost of the uncertainty of the cycle is calculated using MA(∞) representation of the consumption process, arriving at the final expression[1]

$$\ln(1 + \lambda_{reis}) = \begin{cases} \frac{1}{2}\sigma_u^2(1 - e^{-\rho})\Big(\sum_{t=1}^{\infty} e^{-\rho t} \sum_{j=0}^{t-1}\sum_{i=0}^{j} \alpha_i^2\Big), & if \quad \gamma = 1 \\ (\gamma - 1)^{-1} \ln\Big[(1 - e^{-\rho})\times \\ (1 + \sum_{t=1}^{\infty} e^{-\rho t} e^{0,5\sigma_u^2\gamma(\gamma-1)\sum_{j=0}^{t-1}\sum_{i=0}^{j}\alpha_i^2})\Big], & if \quad \gamma \neq 1. \end{cases} \tag{2.2}$$

Reis (2009) provides three reasons to calibrate the effective discount rate ρ: 1) using Ramsey (1928) we obtain the expression $\rho = r - g$, where r is the average return on savings, which allows us to retrieve the parameter ρ directly from the data, unlike β; 2) in Equation (2.2) the effective discount factor is ρ itself; 3) calibrating β can lead to incorrect inferences and counter-intuitive results, for example increasing the relative risk aversion coefficient γ increases costs directly but reduces them indirectly by increasing ρ.

Therefore, the author follows calibrating ρ and γ, and in doing so implicitly assumes that $\beta \geq 1$ for some combinations of parameters, as can be seen in Table 1 below. However, to ensure convergence of functional form on Equation (2.1) we must assume $\beta \in (0, 1)$, which is violated when using a grid for (ρ, γ). For this reason, we followed as Obstfeld (1994) calibrating β and γ, using the following grid of parameters $\gamma \in \{1, 3, 5\}$ and $\beta \in \{0.95, 0.96, 0.97\}$. The advantage of this option, in addition to maintain an internal consistency in the parameters, we follow what is usually adopted by the literature, and finally, we can capture idiosyncratic characteristics of countries in ρ through g.

[1] Note that if the process for the consumption difference is an ARMA(0,0) we have the particular case of Obstfeld (1994), where the author assumes a random walk for consumption and the cost has the following functional form:

$$1 + \lambda_{obstfeld} = \begin{cases} \exp\{0.5\gamma\sigma_\varepsilon^2\}\left[\frac{1-\Gamma\exp\{-0.5\gamma(1-\gamma)\sigma_\varepsilon^2\}}{1-\Gamma}\right]^{\frac{1}{1-\gamma}}, & if \quad \gamma > 0 \quad e \quad \gamma \neq 1 \\ \exp\left\{\frac{1}{1-\beta}\frac{\sigma_\varepsilon^2}{2}\right\}, \quad if \quad \gamma = 1 \end{cases}$$

A more detailed discussion of the relationship between the costs is in Appendix A.

Table 1 – Implicit β values

γ/ρ	0.03	0.02	0.01
1	0.97	0.98	0.99
3	**1.01**	**1.02**	**1.03**
5	**1.06**	**1.07**	**1.08**

Note: Here we assume g = 2.2%, the growth rate for US consumption in the definition $\rho = -\ln\beta + (\gamma - 1)g$.

2.1 Cross-Country Correlations

After estimating a collection of λ_i, in which $i \in \{\textit{Set of Countries}\}$, the final objective of this work is to find factors that explain it, for this, we estimate the following equation:

$$\ln\lambda_i = \gamma_0 + \boldsymbol{\gamma}_1\mathbf{X}_i + \epsilon_i, \tag{2.3}$$

where $\mathbf{X}_i$ is a matrix of covariates of dimension $N \times k$, N is the total number of countries in the sample and k is the number of covariates, and finally ϵ_i a random disturbance. The vector $\hat{\boldsymbol{\gamma}}_1$ provides a measure of the partial correlation across $\mathbf{X}_i$ variables and the log of cost.

2.2 Strategy

Reis (2009) assumes an ARIMA$(p, 1, q)$ for the data generating process of consumption, being more general than Obstfeld (1994), which assumes $p = q = 0$. Therefore, the first step is to choose the order (p, q), for this we assume that $0 \leq p \leq 3$, $0 \leq q \leq 4$ and for each country we estimate all 20 combinations of orders, choosing the one with the lowest Bayesian Information Criterion (BIC).[2] Once the orders for the consumption process have been chosen, we follow the algorithm described in Barros and de Pinho Neto (2016)[3] to invert an ARMA model and use its representation MA(∞). To recover the variance of the error term σ_u^2 we calculate

$$\hat{\sigma}_u^2 = \sum_{t=0}^{T} \frac{(\Delta c_{t+1} - \widehat{\Delta c_{t+1}})^2}{T - (p + q + 1)}, \tag{2.4}$$

where T is the length of the time series. So, for a given pair (γ, β) of parameters, $\hat{\alpha}_i$ estimation from MA(∞) and $\hat{\sigma}_u^2$, we only have to use (2.2) to obtain the cycle cost of Reis (2009).

[2] The use of the BIC criterion follows since it is asymptotically efficient, that is, the probability of the BIC selecting the correct model approaches unity in the measure than the sample size $N \to \infty$. This is not the case for AIC (Hastie et al., 2008, pg. 235).

[3] The algorithm is discussed in detail in the Appendix C.

Finally, to estimate (2.3), we can proceed in two ways, the first is the simplest, using ordinary least squares (OLS) and estimating the covariance matrix robust to heteroskedasticity and autocorrelation (HAC). This procedure is similar to the one adopted by Sarantis and Stewart (2003), which tries to explain the estimated proportion of *thumb-rule* consumers in different economies through variables such as credit, interest, unemployment, among others. However, there are issues associated with this method, the first one is related to dimensionality, since N is limited to the set of countries that exist, micronumerosity can increase the imprecision of the estimators (Goldberger, 1991, pg. 249). Another similar problem is multicollinearity, as we do not know which variables should be included in $\mathbf{X}$, including collinear variables would increase the estimator's imprecision and reducing the model is not a simple task and aggravated when the sample is not large (Ghysels and Marcellino, 2018, p. 19).

An alternative way of estimating (2.3) that solves the problem of dimensionality of the data is to estimate the model using some regularization method. The method introduces a penalty function that controls the complexity of the model, in particular, we will use the ℓ^2 norm as a penalty to find the ridge estimator,

$$\hat{\boldsymbol{\gamma}}^{ridge} = (\mathbf{X}^T\mathbf{X} + \psi\mathbf{I})^{-1}\mathbf{X}^T\mathbf{y},$$

where ψ is a complexity parameter, chosen through cross-validation, which controls the size of the model's shrinkage, and $\mathbf{I}$ is the identity matrix of dimension $k \times k$. Adding a positive diagonal matrix ($\psi\mathbf{I}$) on the matrix ($\mathbf{X}^T\mathbf{X}$) allows the existence of the inverse matrix even if the rank of the matrix ($\mathbf{X}^T\mathbf{X}$) is not complete, solving the dimensionality problem. Also, as we mentioned, there is a multicollinearity problem in the OLS, which is also solved in the ridge regression (Hastie et al., 2008, pg. 63). Of course, solving these two mentioned problems is not free, when we add a positive diagonal matrix we include a bias to the estimator, but still, is expect an increase in the estimator's precision.

However, as OLS is a widely disseminated estimator we will follow using OLS regressions as our benchmark exercises, and then, to overcome their caveats, we present a robustness exercise using ridge regressions.

3 Data

In short, this work proposes two exercises, the first one is to calculate the cost of well-being, as we mentioned, in this step we build a *grid* for some parameters; the second, to understand what factors are related to costs across countries. In this section, we present the data to carry out both exercises.

For the first exercise, we would ideally need a database that covers the consumption of non-durables per capita for a large number of countries. However, many countries do not provide disaggregated data for consumption, an alternative to using consumption data for non-durable goods is the use of *Penn World Table* 10.0 (Feenstra et al., 2015), which provides aggregated consumption data for 183 countries covering the period from 1950 to 2019, often, however, some countries doesn't have full data in the period (Vaidyanathan, 1993, also uses an unbalanced panel).[1] To construct per capita consumption variable, we use the variables of Real GDP (cgdpo), the share of consumption in GDP (cshc), and population (pop), all contained in the PWT. The main advantages of using this database are that the data comes from a single source, are adjusted for purchasing power parity, and are widely used in the consumer literature (Couto and Gomes, 2017, Houssa, 2013).

Once a collection of λ has been estimated in the first exercise, the second stage of this work consists of estimating (2.3). For this, it is necessary to make a careful choice of factors that potentially explain the cost of well-being associated with business cycles. Here, we can basically split into four groups of explanatory variables, described as follows: 1) Factors related to income and savings, Sarantis and Stewart (2003) finds evidence that access to the credit market – which allows consumption smoothing – varies according to unemployment and income; 2) The life cycle factors, since these are related to consumption and savings decisions, in addition, it is to be expected that these variables are related to the credit constraint (Sarantis and Stewart, 2003); 3) Factors related to the predictability of income and institutions; 4) Indices of commitment of fiscal and monetary policy to the stabilization of GDP and inflation, respectively.

For the first group, we use the fraction of unemployed in relation to the workforce (Unemployment), inflation (Inflation) and annual GDP growth (GDP Growth), savings rate (Savings GDP), share of social contributions in the government revenue (Social Contrib.) and share of the population living on less than \$1.9 a day (Poverty Pop.). For the second group, we included the dependency ratio (Age Dependency), fraction of elderly people (65 years and over) in the population (Age65+/Pop). For the third, we include an index of the strength of the laws of guarantees (Legal Rights) and an income inequality

[1] Reis (2009) mentions that using aggregate consumption can overestimate the cost calculation, since this is much more volatile than consumption of non-durable goods.

proxy (Gini) that varies between 0 and 1, where 0 represents complete equality and 1 complete inequality. of income. All these mentioned data is obtained from World Bank Open Data, using the longest series available for each country up to 2020. In the appendix B we detail the World Bank codes of each series.

For the last group of variables, we use two proxies proposed by Garriga (2016) that measures the independence of the Central Bank of 182 countries from 1970 to 2012, and varies from 0 to 1 (maximum independence). The first proxy (CBI Index_{wgt}) is a simple average of a set of 16 characteristics, the second (CBI Index_{unwgt}) respects a specific weight for each characteristic. In the field of fiscal stabilization, I use the Fiscal Rule Dataset, which gather information from fiscal rules from 1985-2015, in it we use two that indicate the presence of national or supranational fiscal rule in a given year (Stabilization $\text{Rule}_{nat.}$ and Stabilization $\text{Rule}_{supranat.}$, respectively).

For all covariates, we will use the mean and population variance as a way of aggregating the data, the procedure of calculating the mean of each variable in panel data is also used in other works (Sarantis and Stewart, 2003, Vaidyanathan, 1993, eg). After this procedure, we present the mean, standard deviation and coefficient of variation of each variable in Table 2 below.

Table 2 – Data Summary

Variable	**N**	**Mean**	**Std. Deviation**	**Variation Coef.**
$\mathbb{E}(\Delta\text{GDP})$	179	3.73	1.78	0.48
$\mathbb{E}$(Savings/GDP)	165	21.49	10.34	0.48
$\mathbb{E}$(Unemployment)	168	8.10	5.79	0.71
$\mathbb{E}$(Inflation)	173	26.57	71.32	2.68
$\mathbb{E}$(Poverty Pop.)	154	18.02	22.49	1.25
$\mathbb{E}$(Social Contrib)	143	11.88	13.76	1.16
$\mathbb{E}$(Age Dependency)	173	71.07	16.17	0.23
$\mathbb{E}$(Age65+/Pop)	173	6.57	4.14	0.63
$\mathbb{E}$(Legal Rights)	171	5.05	2.69	0.53
$\mathbb{E}$(Gini)	154	39.53	8.36	0.21
Var(ΔGDP)	179	39.91	72.85	1.83
Var(Savings/GDP)	165	59.41	161.38	2.72
Var(Unemployment)	168	6.07	9.31	1.53
Var(Inflation)	173	102878.15	854436.63	8.31
Var(Age Dependency)	173	162.79	156.79	0.96
Var(Age65+/Pop)	173	3.66	5.91	1.61
Var(Legal Rights)	171	1.27	3.41	2.69
Var(Social Contrib)	142	14.88	33.28	2.24
Var(Gini)	149	14.53	23.94	1.65
Stabilization $\text{Rule}_{nat.}$	181	0.04	0.13	3.25
Stabilization $\text{Rule}_{supranat.}$	181	0.05	0.13	2.60
CBI Index_{unwgt}	168	0.50	0.15	0.30
CBI Index_{wgt}	168	0.50	0.14	0.28

As ridge regression is sensitive to the unit of measurement of the variables, we normalize the data above, subtracting the mean and dividing the standard deviation for each variable, then we use the normalized data in all the results presented below.

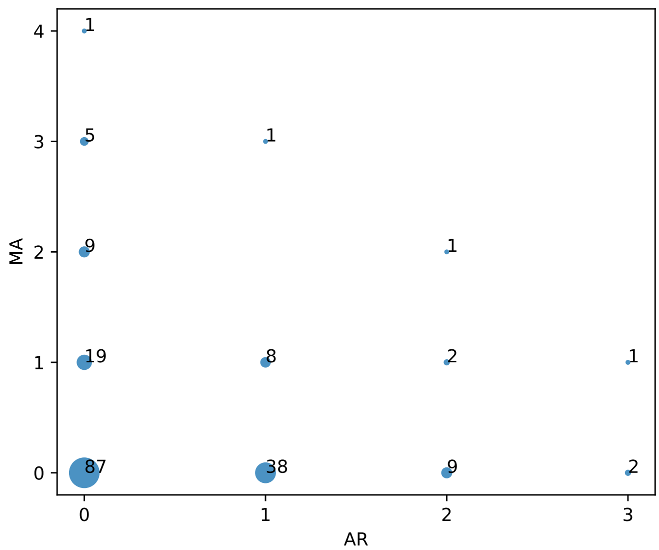
4 Results

In this section we present the estimated welfare costs using parameter grid. After, we report the results of the regression (2.3) using the aforementioned estimators – OLS and ridge regression.

4.1 Statistical Properties of Consumption

In order to understand the consumption process of each country, we assume that the first difference of the log-consumption follows an ARMA(p, q) process, then we choose the orders p, q from the Bayesian information criterion (BIC). The results these estimations are summarized in Figure 1 below.

Figure 1 – ARMA using BIC



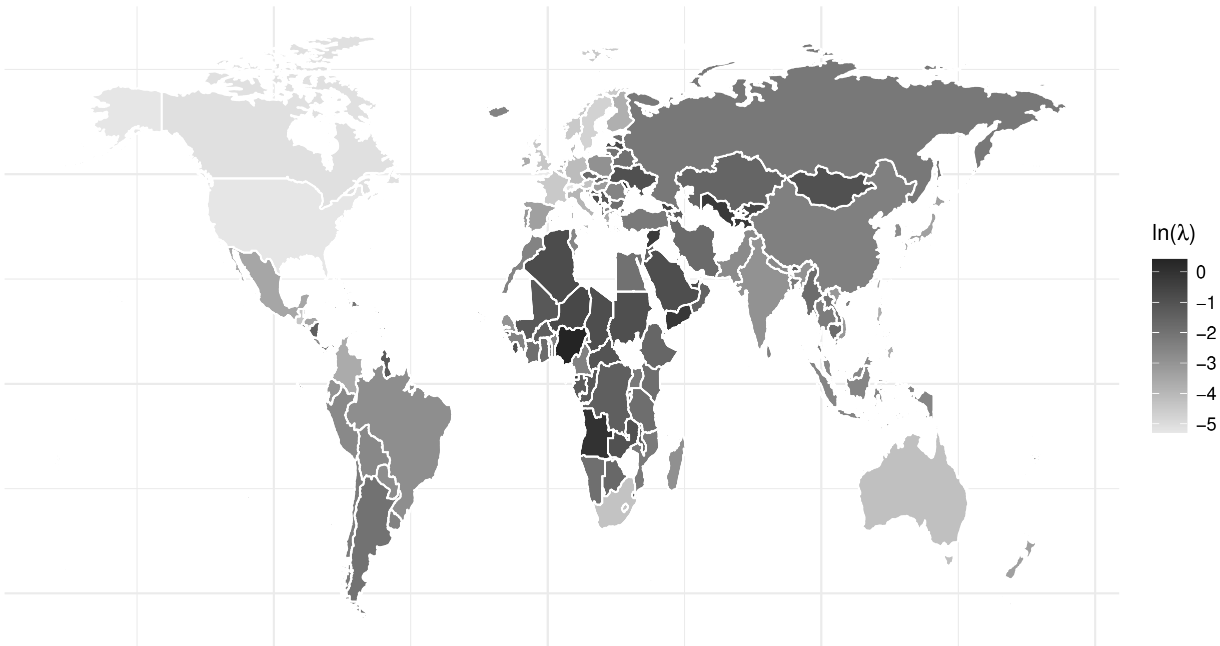
Note: The numbers next to each point refer to the number of countries in which it was identified that the difference in the log consumption follows the order p, q of the indicated ARMA.

As we can see, 87 countries (out of 183) follows an ARMA$(0, 0)$ as suggested by Hall (1978), for this group of countries adopt Obstfeld (1994) or Reis (2009) is similar in terms of welfare costs, however, for the other countries, not considering the persistence of the shock would lead to lower costs in Obstfeld (1994).

From these results, it is possible to follow the polynomial inversion algorithm described in the appendix C, adopt the parameters' grid for β and γ to calculate the welfare costs. In Table 7 we present an exhaustive list of estimated costs using different combinations of parameters and here on Figure 2 we summarize the results for $(\beta, \gamma) =$

(0.97, 3), as we can note, there is a clear pattern of lower costs for rich countries and higher costs for poor countries.

Figure 2 – Wealfare Costs



Note: We chose to present only $\lambda_{Reis} < e^{1.5}$ for the purpose of better data visualization.

4.2 Cross-country Correlations

To understand the factors that are correlated with the costs across countries, in this section we perform a series of regression exercises, initially using OLS. We start by using income dummies according to the criteria established by World Bank to make a general preliminary exercise.[1] The results are summarized in Table 3 and we present on Appendix B a full version.

As we can see below, the partial effect of the income group affects the cost significantly in all specifications. There is a large literature that negatively correlates economic development and income volatility, such as Koren and Tenreyro (2007), and also, as consumption volatility in emerging countries is about 40% higher than income volatility when compared to 1-1 volatility in developed markets (Aguiar and Gopinath, 2007). Once that the welfare costs is a function of consumption variance, this mentioned pattern may cause a high correlation between income and welfare costs documented in Table 3.

In the exercise of Table 4 we use the first three groups of factors taking the time series' average of each variable. As we can see, the average growth rate of GDP is not

[1] A similar exercise, but using geographic regions, is presented in the Table 8 available in the appendix B. We can see the same pattern of richer geographic regions having lower cost.

Table 3 – Cost by Income Groups

	Dependent variable: ln(λ)		
	(1)	(2)	(3)
Intercept	-3.303***	0.916***	0.358***
	(0.169)	(0.021)	(0.051)
Upper Middle Inc.	1.020***	0.170***	1.007
	(0.250)	(0.063)	(0.702)
Lower Middle Inc.	1.159***	0.162***	0.412***
	(0.247)	(0.063)	(0.140)
Low Inc.	1.540***	0.145**	0.490***
	(0.242)	(0.064)	(0.143)
N	181	181	181
R^2	0.18	0.06	0.02

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) reports $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. The omitted dummy refers to the group of *high income*. Standard errors are corrected by the HC0 covariance matrix.

significant this result is in line with our hypothesis of fixing the average growth of consumption g to pay attention only to how the variance of consumption in (2.2) affects the cost. The average savings rate has a negative and significant coefficient in model (1), after all, agents with a higher level of assets may have less variability in future consumption (Carroll et al., 1992). Unemployment also act to increase the cost, with a coefficient significant at 1%, this variables can be understood as a proxy of income uncertainty. Despite being significant, the variable $\mathbb{E}$(Poverty Pop) has the opposite sign of what was expected, in this case, an increase in the poorest population would reduce the welfare cost.

Average inflation is also significant and positively correlated with wealfare costs. Indeed, there is a large literature documenting higher welfare costs in case of high inflation scenario. Lucas (2000) surveys welfare cost of inflation and concludes that reducing inflation is equivalent to a real increase in income and Silva (2012) finds that reducing inflation lowers transaction costs, reducing the welfare costs. In the group of variables related to the life cycle/demographics, in specification (1) we found a negative and significant coefficient, indicating that a greater proportion of elderly people can reduce the cost, since high savings rates can be associated with older populations according to the life cycle model (Horioka and Watanabe, 1997). In addition, the dependency ratio, although positively associated with the cycle, is not significant. When we look at institutional factors, we notice that the proxy of credit recovery guarantees (Legal Rights) is not significant.

The significant negative correlation between inequality – measured here by Gini coefficient – and welfare cost is documented in Krusell et al. (2009). Exploring wealfare costs under heterogeneity, the author finds that eliminating the cycle causes an increase of interest rates – due to decrease of precautionary savings as the economy becomes less

Table 4 – Factors Mean

	Dependent variable: ln(λ)		
	(1)	(2)	(3)
Intercept	-2.776***	0.955***	0.466***
	(0.087)	(0.017)	(0.038)
$\mathbb{E}$(ΔGDP)	0.057	0.028	0.009
	(0.129)	(0.026)	(0.057)
$\mathbb{E}$(Savings/GDP)	-0.262*	-0.036	-0.083
	(0.152)	(0.039)	(0.086)
$\mathbb{E}$(Unemployment)	0.288***	0.033**	0.082**
	(0.100)	(0.014)	(0.034)
$\mathbb{E}$(Inflation)	0.210**	0.035*	0.080*
	(0.107)	(0.020)	(0.045)
$\mathbb{E}$(Poverty Pop)	-0.060	-0.078**	-0.114
	(0.154)	(0.039)	(0.081)
$\mathbb{E}$(Social Contrib.)	0.106	0.014	0.047
	(0.146)	(0.022)	(0.054)
$\mathbb{E}$(Age Dependency)	0.175	0.120	0.245*
	(0.272)	(0.076)	(0.148)
$\mathbb{E}$(Age65+/Pop)	-0.813***	-0.039	-0.149*
	(0.207)	(0.037)	(0.085)
$\mathbb{E}$(Legal Rights)	-0.023	-0.001	0.004
	(0.104)	(0.015)	(0.037)
$\mathbb{E}$(Gini)	-0.516***	-0.084***	-0.202***
	(0.125)	(0.027)	(0.057)
N	123	123	123
R^2	0.41	0.21	0.25

Nota: *p<0.1; **p<0.05; ***p<0.01. Os modelos (1), (2) e (3) reportam $\ln \lambda_{Reis}$ como variável dependente para as seguintes combinações de parâmetros (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectivamente. Os erros padrão estão corrigidos pela matriz de covariância HC0.

risky – making the rich richer, as they hold more assets. The poorest consumers also have a improvement in wealfare, as they do not must hold savings and may consume more. On the other hand, the middle class have a null effect in utility terms, and since they face lower wages they experience a wealfare loss from eliminating the cycle.

For the exercise presented at Table 5, we see that increasing variance in income growth, savings and inflation increase the cost of well-being, these results can be seen as an increase in the uncertainty of future income and, therefore, of consumption, raising the cost to stabilize the consumption path. The coefficient associated with the variable Var(ΔGDP) is significant in all specifications, while that of savings and inflation are only significant in specifiation (1). The variable Var(Social Contrib) is positive, but not significant, IMF (2015, Cap. 2) suggests that social spending is an important source of GDP stabilization. As can be seen, Var(Gini), which is a measure of uncertainty about income distribution, is positive and significant only in model (1).

The results of the last group of factors are presented in Table 6 below. The existence

Table 5 – Factors Variance

	Dependent variable: ln(λ)		
	(1)	(2)	(3)
Intercept	-2.554***	0.991***	0.543***
	(0.109)	(0.028)	(0.058)
Var(ΔGDP)	0.920***	0.210***	0.423***
	(0.171)	(0.064)	(0.113)
Var(Savings/GDP)	1.010**	0.110	0.322
	(0.411)	(0.110)	(0.221)
Var(Unemployment)	0.031	-0.019	-0.031
	(0.104)	(0.017)	(0.038)
Var(Inflation)	0.083***	-0.004	0.012
	(0.023)	(0.004)	(0.009)
Var(Social Contrib.)	-0.019	-0.004	-0.013
	(0.061)	(0.007)	(0.017)
Var(Age Dependency)	-0.016	-0.021	-0.070**
	(0.087)	(0.013)	(0.030)
Var(Age65+/Pop)	-0.106	-0.009	-0.036
	(0.069)	(0.011)	(0.027)
Var(Legal Rights)	0.004	-0.003	0.006
	(0.096)	(0.017)	(0.045)
Var(Gini)	0.473***	0.014	0.078
	(0.167)	(0.023)	(0.058)
N	121	121	121
R^2	0.39	0.39	0.38

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) report $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

of a fiscal rule to stabilize the product (both national and supranational) is negatively associated with the cost, after all, consumption is highly correlated with the product. IMF (2015, Chap. 2) argues that fiscal policy seems to contribute more to the stability of output in advanced economies than in emerging markets and developing economies, which may be biasing the coefficient. In the case of inflation, the coefficient is not significant in models (1) and (3) and in specification (2), the signs of the coefficients, depending on the measure used, are not unidirectional. This result is in line with Ball and Sheridan (2004), which finds that central bankers that pursues inflation targets does not affect output volatility.

As mentioned in the section 3, the means and variances of the covariates presented above are obtained from an unbalanced panel and, therefore, it is subject to the criticism of using different periods for the dependent and independent variables for different countries, which could mislead the interpretation of the estimated coefficients. For this reason, we present in the Tables 11, 12 and 13 the same exercises presented above but bounding the sample years from 1995 to 2015, both for the covariates and for the dependent variable. As presented, the estimated coefficients signs and their magnitudes are similar to the original

Table 6 – Stabilization policies

	Dependent variable: $\ln(\lambda)$		
	(1)	(2)	(3)
Intercept	-2.507***	1.028***	0.823***
	(0.092)	(0.026)	(0.208)
Stabilization Rule$_{nat.}$	-0.329***	-0.038***	-0.140**
	(0.081)	(0.010)	(0.059)
Stabilization Rule$_{supranat.}$	-0.452***	-0.055***	-0.211***
	(0.089)	(0.013)	(0.071)
CBI Index$_{unwgt}$	-0.047	-0.135**	-0.798
	(0.310)	(0.069)	(0.613)
CBI Index$_{wgt}$	0.322	0.148**	0.757
	(0.312)	(0.060)	(0.506)
N	168	168	168
R^2	0.25	0.07	0.02

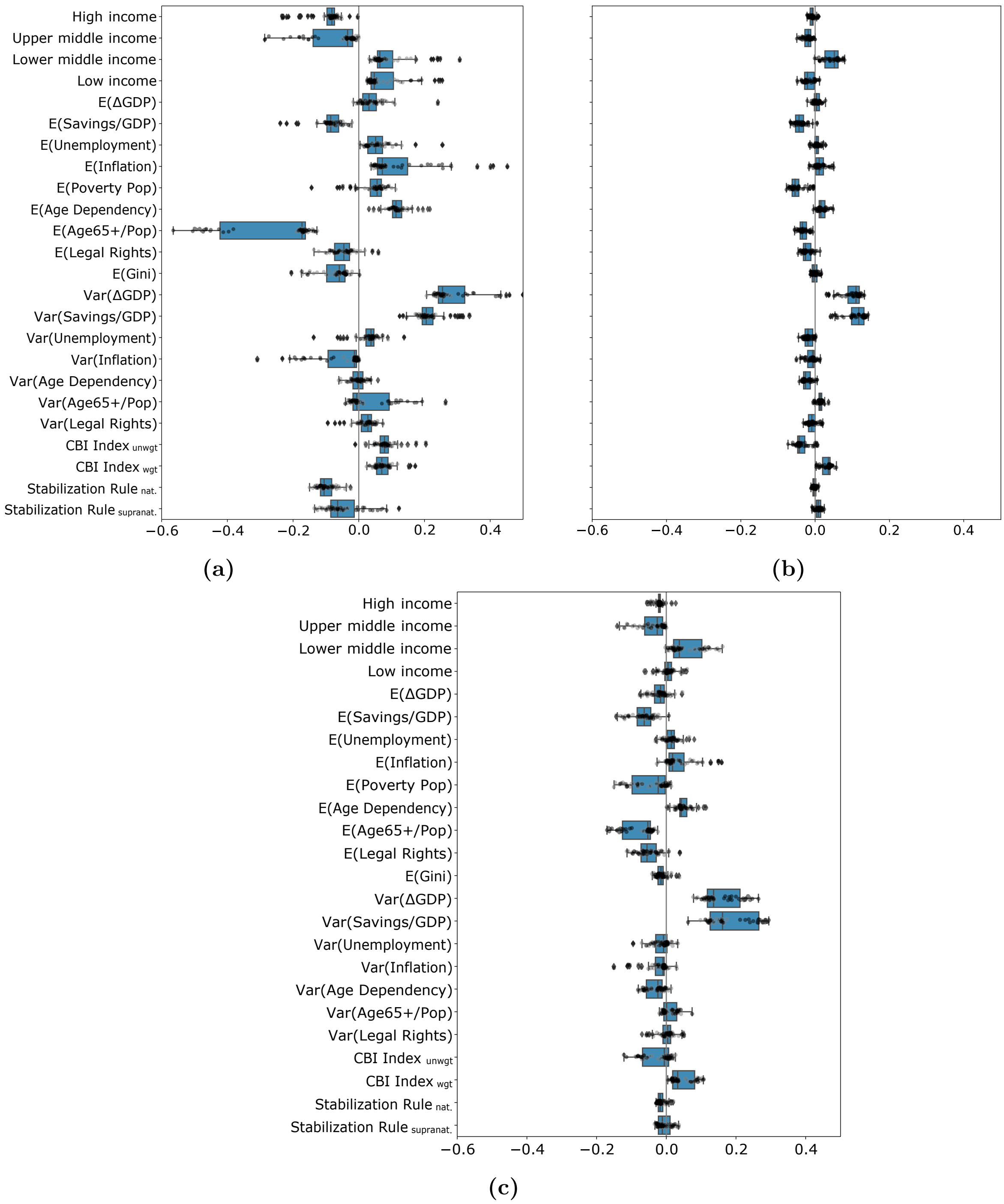
Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) report $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

exercises. We also in report Tables 14, 15 and 16 the above regressions tables controlling for the income groups, the same pattern is presented.

Due to the caveats mentioned in Section 2.2 related to the OLS estimator we do a robustness exercise using ridge regression. Here, we can include all variables at once, with no problem related to dimensionality and multicollinearity allowing us to have a better view of the sign, size and dispersion of coefficients. In Figure 3 we present the results of this exercise. As can be seen, the specification in Figure 3b is the one with the lowest dispersion of coefficients and almost all coefficients have the same sign and magnitude between the specifications. An exception is the variable Var(Unemployment), which has a negative coefficient in Figure 3a and a positive coefficient in the others. Two variables that stand out are Var(Savings/GDP) and Var(ΔGDP) that in all specifications, the coefficient is positive and greater than the others,[2] the same pattern found when using the OLS for estimation presented in Table 5.

[2] The comparison between coefficients can be done since the variables were standardized.

Figure 3 – Ridge Regression Coefficients



(a) **(b)** **(c)**

Note: Here the methodology of Reis (2009) is used to calculate the cost. Figures (a), (b) and (c) show $\ln \beta$ as the dependent variable for the following parameter combinations $(\gamma, \beta) = (1, 0.95); (3, 0.96); (5, 0.97)$ respectively. The reported coefficients were calculated using the 10-fold cross-validation procedure.

5 Conclusion

In this paper we use Reis (2009) to measure how much consumers would typically pay to eliminate the uncertainty associated with the trajectory of their consumption. Then, we discuss a caveat in the calibration procedure adopted by the author, proposing an alternative way to calibrate the parameters. A large literature already deals with the calculation of the welfare costs of cycles, but as far as we know, this is the first study that applies this measure simultaneously for a large group of countries and our results indicate a large heterogeneity in the cost of economic fluctuations between countries. After this exercise, we investigate through a simple exercise, factors that are associated with costs and could help us understand the differences across countries.

We summarize the results in a list of estimated cost that does not intended to be used as an exact measure of the true cost, however, as the present work covers a wide range of countries, we are able to understand the size of the welfare costs relatively to many countries.

As expected, we find that the uncertainty of future income measured here through the variance of income growth, average unemployment and inflation play a relevant role, as they are associated with higher costs. We also found that the average savings rate and the fraction of elderly people on population are negatively associated with cost, while the variance of the savings rate was positively associated. In addition, the average Gini index has a negative relationship with cost, which indicates decreasing the cost could increase inequality.

We also found evidence that government fiscal policy affects cost, in particular, the presence of a fiscal rule that has an explicitly focus on stabilizing the GDP decreases the cost by 4% to 30% on average – depending on the calibrated parameters. Monetary policy, however, did not present direct effects on cost, this result is according to the results found in the literature that relates monetary policy and income volatility.

These results indicates that poorest countries typically have higher costs, which is already documented in the literature (Couto and Gomes, 2017, Pallage and Robe, 2003), however, in the present work provides further evidence that these costs are in fact related to policies which aims stabilization. This may indicate that the gain from the implementation of these policies can help to reduce the volatility of consumption and, therefore, bring welfare gains to poor countries. Therefore, in summary the present work provides, in addition to the cost calculation, a direction in which it varies according to a series of factors. These directions are important guides in the discussion of economic policy, since it is possible to measure through a simple exercise which policy is more or less correlated with the welfare cost of business cycles in an economy.

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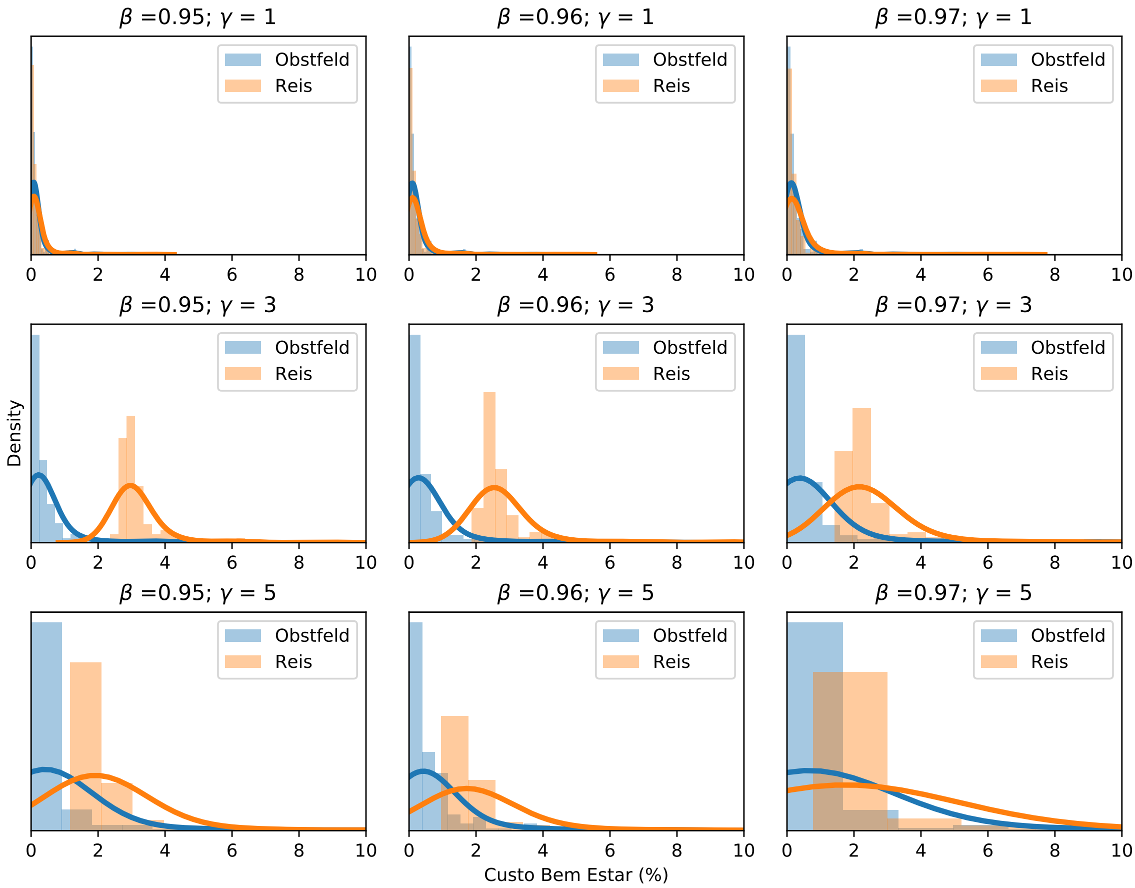
Appendix

APPENDIX A – Relationship of Obstfeld and Reis

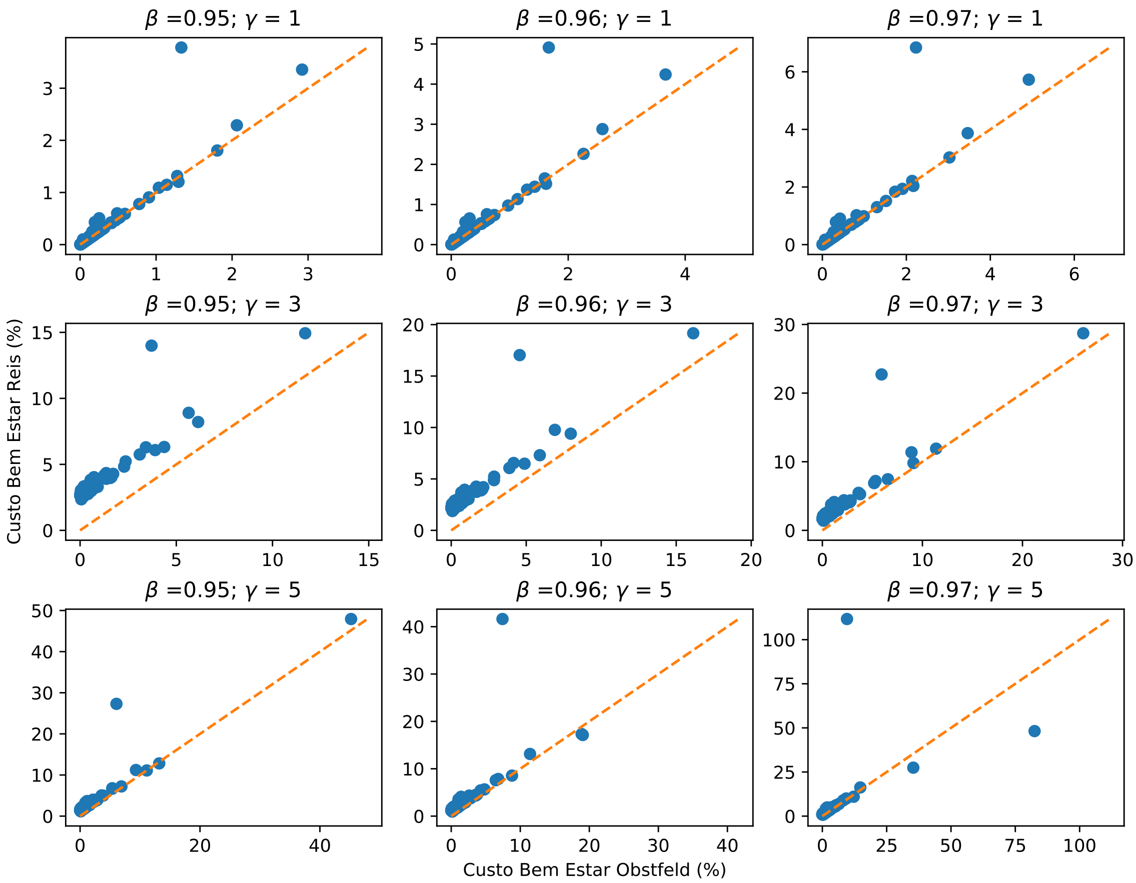
Below, we use the following parameters grid $\gamma \in \{1, 3, 5\}$ and $\beta \in \{0.95, 0.96, 0.97\}$ to compare Reis (2009) and Obstfeld (1994), removing costs above 200%. First, we can see in Figure 4 that as the discount factor β grows, the cost become more sensitive to the variance of the consumption process and Reis (2009), on average, provides higher estimates of cost when compared to Obstfeld (1994).

Figure 4 – Relationship between λ_{Reis} and $\lambda_{Obstfeld}$



In Figure 5, we plot how the methodologies are related in each country. Note that, as in Figure 4, for $\gamma = 1$ the costs in both methods and in the *grid* of the discount values are very similar (very close to the 45th line), but as we increase γ, the methods give slightly different results, but the relationship between the methods remains positive.

Figure 5 – Relationship between λ_{Reis} and $\lambda_{Obstfeld}$



Note: The orange line shows a 45º line.

APPENDIX B – Tables

Table 7 – Estimated Costs (%)

Country	Reis $(\beta, \gamma) = (0.95, 1)$	Reis $(\beta, \gamma) = (0.96, 3)$	Reis $(\beta, \gamma) = (0.97, 5)$
ABW	0.03	2.49	1.32
AGO	0.59	4.20	5.28
AIA	0.32	3.41	2.82
ALB	0.06	2.51	1.42
ARE	0.29	3.04	3.45
ARG	0.08	2.52	1.50
ARM	0.08	2.88	1.76
ATG	0.43	3.68	3.53
AUS	0.01	2.18	0.97
AUT	0.01	2.29	1.07
AZE	0.17	2.98	2.06
BDI	0.11	2.43	1.68
BEL	0.01	2.22	1.01
BEN	0.05	2.36	1.28
BFA	0.15	2.61	1.98
BGD	0.06	2.35	1.33
BGR	0.09	2.68	1.64
BHR	0.11	2.47	1.63
BHS	0.14	2.57	1.86
BIH	0.24	3.37	2.45
BLR	0.08	2.54	1.52
BLZ	0.10	2.45	1.57
BMU	0.01	2.22	1.00
BOL	0.04	2.40	1.27
BRA	0.04	2.46	1.31
BRB	0.10	2.40	1.61
BRN	0.19	2.64	2.40
BTN	0.16	2.91	2.00
BWA	0.11	2.91	1.84
CAF	0.20	2.76	2.40
CAN	0.00	2.17	0.94
CHE	0.00	2.14	0.91

CHL	0.06	2.38	1.33
CHN	0.05	2.55	1.43
CIV	0.09	2.49	1.54
CMR	0.05	2.33	1.26
COD	0.15	2.53	1.96
COG	0.18	2.69	2.16
COL	0.02	2.23	1.03
COM	0.08	2.39	1.41
CPV	0.07	2.61	1.53
CRI	0.03	2.30	1.16
CUW	0.02	1.88	0.77
CYM	0.02	2.18	1.02
CYP	0.08	2.67	1.59
CZE	0.10	2.52	1.60
DEU	0.01	2.35	1.13
DJI	0.53	3.98	5.77
DMA	0.10	2.69	1.68
DNK	0.01	2.19	0.98
DOM	0.08	2.56	1.50
DZA	0.25	3.03	2.66
ECU	0.03	2.28	1.14
EGY	0.09	2.76	1.67
ESP	0.02	2.35	1.16
EST	0.09	2.63	1.62
ETH	0.12	2.71	1.75
FIN	0.01	2.31	1.11
FJI	0.06	2.50	1.42
FRA	0.01	2.25	1.03
GAB	0.16	2.76	2.01
GBR	0.01	2.18	0.97
GEO	0.35	3.38	3.15
GHA	0.10	2.46	1.58
GIN	0.05	2.07	1.10
GMB	0.15	2.53	2.03
GNB	0.22	2.98	2.33
GNQ	0.52	4.05	3.87
GRC	0.02	2.35	1.15
GRD	0.08	2.70	1.62
GTM	0.01	2.20	0.98

GUY	0.18	2.85	2.09
HKG	0.02	2.47	1.27
HND	0.02	2.22	1.04
HRV	0.16	2.74	2.00
HTI	0.07	2.31	1.36
HUN	0.02	2.43	1.24
IDN	0.05	2.56	1.41
IND	0.03	2.37	1.21
IRL	0.02	2.25	1.06
IRN	0.10	2.48	1.61
IRQ	2.29	9.77	16.23
ISL	0.05	2.38	1.28
ISR	0.02	2.36	1.17
ITA	0.01	2.32	1.11
JAM	0.04	2.30	1.21
JOR	0.14	2.71	1.85
JPN	0.02	2.47	1.28
KAZ	0.12	2.64	1.74
KEN	0.09	2.44	1.51
KGZ	0.32	3.16	3.55
KHM	0.10	2.47	1.55
KNA	0.14	2.84	1.90
KOR	0.04	2.62	1.44
KWT	0.19	2.82	2.23
LAO	0.07	2.77	1.65
LBN	0.78	4.88	6.86
LBR	1.81	9.39	27.46
LCA	0.09	2.46	1.50
LKA	0.05	2.37	1.28
LSO	0.08	2.50	1.50
LTU	0.08	2.65	1.57
LUX	0.01	2.21	0.99
LVA	0.29	3.17	2.92
MAC	0.02	2.44	1.23
MAR	0.05	2.37	1.27
MDA	0.60	4.25	4.99
MDG	0.03	2.10	1.01
MDV	0.13	2.94	1.91
MEX	0.02	2.20	1.02

MKD	0.04	2.46	1.33
MLI	0.18	2.87	2.11
MLT	0.03	2.54	1.36
MMR	0.10	2.63	1.63
MNE	0.51	3.95	4.93
MNG	0.23	3.17	2.36
MOZ	0.06	2.31	1.31
MRT	3.78	17.03	111.70
MSR	1.09	6.06	10.00
MUS	0.10	2.55	1.61
MWI	0.14	2.58	1.88
MYS	0.04	2.50	1.36
NAM	0.09	2.44	1.50
NER	0.29	3.07	3.42
NGA	0.91	5.22	6.10
NIC	0.15	2.56	1.94
NLD	0.01	2.25	1.05
NOR	0.01	2.23	1.01
NPL	0.04	2.43	1.29
NZL	0.02	2.23	1.06
OMN	0.13	2.70	1.80
PAK	0.04	2.33	1.20
PAN	0.07	2.53	1.46
PER	0.04	2.36	1.24
PHL	0.01	2.34	1.14
POL	0.03	2.45	1.28
PRT	0.03	2.40	1.23
PRY	0.04	2.39	1.25
PSE	0.08	2.53	1.49
QAT	0.13	2.38	1.93
ROU	0.05	2.66	1.51
RUS	0.07	2.56	1.48
RWA	0.16	2.68	1.97
SAU	0.25	3.09	2.54
SDN	0.24	3.17	2.44
SEN	0.03	2.15	1.04
SGP	0.02	2.49	1.29
SLE	0.24	3.04	2.54
SLV	0.05	2.60	1.47

SRB	0.18	2.72	2.20
STP	0.25	3.00	2.63
SUR	1.20	6.48	10.99
SVK	0.11	2.53	1.65
SVN	0.02	2.25	1.08
SWE	0.01	2.18	0.96
SWZ	0.23	3.02	2.40
SXM	0.05	2.10	1.16
SYC	1.32	6.55	8.88
SYR	0.46	3.74	4.38
TCA	0.41	3.66	3.40
TCD	0.25	2.91	2.87
TGO	0.11	2.53	1.67
THA	0.06	2.58	1.47
TJK	0.50	3.89	5.44
TTO	0.18	2.83	2.12
TUN	0.04	2.50	1.36
TUR	0.06	2.46	1.40
TWN	0.02	2.58	1.37
TZA	0.09	2.54	1.57
UGA	0.07	2.36	1.35
UKR	0.23	2.98	2.44
URY	0.05	2.31	1.25
USA	0.00	2.18	0.96
UZB	0.43	3.69	4.20
VCT	0.16	2.80	1.98
VEN	1.15	7.30	48.18
VGB	0.19	2.83	2.21
VNM	0.03	2.56	1.37
YEM	0.50	3.96	3.81
ZAF	0.01	2.11	0.90
ZMB	0.23	2.85	2.66
ZWE	2.48	11.48	28.55

Table 8 – Region

	Dependent variable:		
	(1)	(2)	(3)
Intercept	-5.464***	0.784***	-0.035**
	(0.219)	(0.006)	(0.016)
Latin America & Caribbean	2.850***	0.183***	0.563***
	(0.282)	(0.043)	(0.116)
Europe & Central Asia	2.417***	0.176***	0.495***
	(0.303)	(0.025)	(0.071)
East Asia & Pacific	2.221***	0.144***	0.386***
	(0.292)	(0.018)	(0.051)
South Asia	2.667***	0.140***	0.393***
	(0.309)	(0.037)	(0.077)
Middle East & North Africa	3.649***	0.342***	0.934***
	(0.336)	(0.074)	(0.148)
Sub-Saharan Africa	3.632***	0.327***	0.918***
	(0.278)	(0.065)	(0.137)
N	180	180	180
R^2	0.25	0.08	0.11

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) report $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. The omitted dummy refers to the North America region. Standard errors are corrected by the HC0 covariance matrix.

Table 9 – Worldbank Codes

Variable	***World Bank Code***	**Group**
ΔGDP	NY.GDP.MKTP.KD.ZG	Income/Savings
Savings/GDP	NY.GNS.ICTR.ZS	Income/Savings
Unemployment	SL.UEM.TOTL.ZS	Income/Savings
Inflation	FP.CPI.TOTL.ZG	Income/Savings
Poverty Pop	SI.POV.DDAY	Income/Savings
Social Contrib	GC.REV.SOCL.ZS	Income/Savings
Age Dependency	SP.POP.DPND	Life Cycle
Age65+/Pop	SP.POP.65UP.TO.ZS	Life Cycle
Legal Rights	IC.LGL.CRED.XQ	Institutions
Gini	SI.POV.GINI	Institutions

Table 10 – Cost by Income Groups - Full set of parameters

	Dependent variable: $\ln(\lambda)$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	-3.303***	1.079***	0.578***	-3.077***	0.916***	0.468***	-2.787***	0.730***	0.358***
	(0.169)	(0.016)	(0.032)	(0.169)	(0.021)	(0.040)	(0.169)	(0.029)	(0.051)
Upper Middle Inc.	1.020***	0.131***	0.260***	1.020***	0.170***	0.411**	1.021***	0.229***	1.007
	(0.250)	(0.049)	(0.097)	(0.250)	(0.063)	(0.192)	(0.250)	(0.083)	(0.702)
Lower Middle Inc.	1.159***	0.122**	0.249***	1.161***	0.162***	0.313***	1.163***	0.225***	0.412***
	(0.247)	(0.050)	(0.090)	(0.247)	(0.063)	(0.109)	(0.247)	(0.081)	(0.140)
Low Inc.	1.540***	0.097*	0.258***	1.539***	0.145**	0.348***	1.538***	0.228***	0.490***
	(0.242)	(0.050)	(0.096)	(0.242)	(0.064)	(0.116)	(0.242)	(0.086)	(0.143)
N	181	181	181	181	181	181	181	181	181
R^2	0.18	0.05	0.06	0.18	0.06	0.05	0.18	0.06	0.02

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2), (3), (4), (5), (6), (7), (8) and (9) reports $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.95); (5, 0.95); (1, 0.96); (3, 0.96); (5, 0.96); (1, 0.97); (3, 0.97); (5, 0.97) respectively. The omitted dummy refers to the group of *high income*. Standard errors are corrected by the HC0 covariance matrix.

Table 11 – Factors Mean - Fixed Period

	Full Sample			*1985-2015*		
	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	-2.776***	0.955***	0.466***	-2.897***	0.959***	0.462***
	(0.087)	(0.017)	(0.038)	(0.096)	(0.020)	(0.045)
$\mathbb{E}(\Delta\text{GDP})$	0.057	0.028	0.009	0.109	0.036	0.024
	(0.129)	(0.026)	(0.057)	(0.138)	(0.027)	(0.062)
$\mathbb{E}$(Savings/GDP)	-0.262*	-0.036	-0.083	-0.277*	-0.037	-0.113
	(0.152)	(0.039)	(0.086)	(0.153)	(0.046)	(0.094)
$\mathbb{E}$(Unemployment)	0.288***	0.033**	0.082**	0.339***	0.028*	0.080**
	(0.100)	(0.014)	(0.034)	(0.102)	(0.015)	(0.037)
$\mathbb{E}$(Inflation)	0.210**	0.035*	0.080*	0.250**	0.041*	0.095**
	(0.107)	(0.020)	(0.045)	(0.117)	(0.022)	(0.047)
$\mathbb{E}$(Poverty Pop)	-0.060	-0.078**	-0.114	-0.175	-0.111**	-0.174
	(0.154)	(0.039)	(0.081)	(0.197)	(0.055)	(0.116)
$\mathbb{E}$(Social Contrib)	0.106	0.014	0.047	0.120	0.013	0.035
	(0.146)	(0.022)	(0.054)	(0.176)	(0.026)	(0.061)
$\mathbb{E}$(Age Dependency)	0.175	0.120	0.245*	0.337	0.110	0.211
	(0.272)	(0.076)	(0.148)	(0.270)	(0.071)	(0.142)
$\mathbb{E}$(Age65+/Population)	-0.813***	-0.039	-0.149*	-0.723***	-0.083**	-0.223**
	(0.207)	(0.037)	(0.085)	(0.205)	(0.037)	(0.088)
$\mathbb{E}$(Legal Rights)	-0.023	-0.001	0.004	-0.001	0.010	0.027
	(0.104)	(0.015)	(0.037)	(0.124)	(0.017)	(0.043)
$\mathbb{E}$(Gini)	-0.516***	-0.084***	-0.202***	-0.471***	-0.074***	-0.177***
	(0.125)	(0.027)	(0.057)	(0.131)	(0.023)	(0.054)
N	123	123	123	121	121	121
R^2	0.41	0.21	0.25	0.36	0.20	0.21

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) report $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

Table 12 – Factors Variance - Fixed Period

	Full Sample			*1985-2015*		
	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	-2.554***	0.991***	0.543***	-2.754***	0.974***	0.494***
	(0.109)	(0.028)	(0.058)	(0.120)	(0.019)	(0.047)
Var(ΔGDP)	0.920***	0.210***	0.423***	0.804***	0.165***	0.326***
	(0.171)	(0.064)	(0.113)	(0.125)	(0.037)	(0.064)
Var(Savings/GDP)	1.010**	0.110	0.322	1.021**	0.077	0.251
	(0.411)	(0.110)	(0.221)	(0.515)	(0.078)	(0.195)
Var(Unemployment)	0.031	-0.019	-0.031	0.179	0.006	0.035
	(0.104)	(0.017)	(0.038)	(0.119)	(0.013)	(0.038)
Var(Inflation)	0.083***	-0.004	0.012	0.105***	0.002	0.032***
	(0.023)	(0.004)	(0.009)	(0.036)	(0.003)	(0.007)
Var(Social Contrib)	-0.019	-0.004	-0.013	-0.028	-0.001	-0.011
	(0.061)	(0.007)	(0.017)	(0.065)	(0.007)	(0.018)
Var(Age Dependency)	-0.016	-0.021	-0.070**	0.060	0.006	0.003
	(0.087)	(0.013)	(0.030)	(0.081)	(0.011)	(0.026)
Var(Age65+/Pop)	-0.106	-0.009	-0.036	-0.086	-0.010	-0.030
	(0.069)	(0.011)	(0.027)	(0.068)	(0.009)	(0.023)
Var(Legal Rights)	0.004	-0.003	0.006	-0.052	-0.008	-0.028**
	(0.096)	(0.017)	(0.045)	(0.040)	(0.006)	(0.012)
Var(Gini)	0.473***	0.014	0.078	0.526***	0.052	0.145**
	(0.167)	(0.023)	(0.058)	(0.177)	(0.034)	(0.073)
N	121	121	121	113	113	113
R^2	0.39	0.39	0.38	0.40	0.50	0.42

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) report $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

Table 13 – Stabilization Policies - Fixed Period

	Full Sample			*1985-2015*		
	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	-2.507***	1.028***	0.823***	-2.612***	1.019***	0.920***
	(0.092)	(0.026)	(0.208)	(0.101)	(0.027)	(0.321)
Stabilization Rule$_{nat.}$	-0.329***	-0.038***	-0.140**	-0.297***	-0.033***	-0.159*
	(0.081)	(0.010)	(0.059)	(0.097)	(0.011)	(0.088)
Stabilization Rule$_{supranat.}$	-0.452***	-0.055***	-0.211***	-0.461***	-0.064***	-0.261***
	(0.089)	(0.013)	(0.071)	(0.097)	(0.014)	(0.099)
CBI Index$_{unwgt}$	-0.047	-0.135**	-0.798	-0.122	-0.130	-1.137
	(0.310)	(0.069)	(0.613)	(0.334)	(0.081)	(0.932)
CBI Index$_{wgt}$	0.322	0.148**	0.757	0.365	0.131*	0.983
	(0.312)	(0.060)	(0.506)	(0.339)	(0.069)	(0.737)
N	168	168	168	163	163	163
R^2	0.25	0.07	0.02	0.21	0.07	0.02

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) report $\ln \lambda_{Reis}$ as a dependent variable for the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

Table 14 – Factors Mean - Income Group

	Dependent variable: $\ln \lambda_{Reis}$					
	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	-2.776***	0.955***	0.466***	-3.396***	0.888***	0.291**
	(0.087)	(0.017)	(0.038)	(0.312)	(0.054)	(0.119)
Upper Middle Inc.				0.633*	0.103*	0.205
				(0.370)	(0.053)	(0.128)
Lower Middle Inc.				0.865**	0.095	0.248
				(0.437)	(0.078)	(0.173)
Low Inc.				1.207**	0.053	0.278
				(0.608)	(0.152)	(0.328)
$\mathbb{E}(\Delta\text{GDP})$	0.057	0.028	0.009	0.129	0.036	0.030
	(0.129)	(0.026)	(0.057)	(0.120)	(0.023)	(0.053)
$\mathbb{E}$(Savings/GDP)	-0.262*	-0.036	-0.083	-0.235	-0.041	-0.082
	(0.152)	(0.039)	(0.086)	(0.166)	(0.046)	(0.099)
$\mathbb{E}$(Unemployment)	0.288***	0.033**	0.082**	0.257***	0.025**	0.070**
	(0.100)	(0.014)	(0.034)	(0.098)	(0.013)	(0.032)
$\mathbb{E}$(Inflation)	0.210**	0.035*	0.080*	0.202**	0.032*	0.076*
	(0.107)	(0.020)	(0.045)	(0.101)	(0.018)	(0.043)
$\mathbb{E}$(Poverty Pop)	-0.060	-0.078**	-0.114	-0.181	-0.067**	-0.128*
	(0.154)	(0.039)	(0.081)	(0.150)	(0.027)	(0.070)
$\mathbb{E}$(Social Contrib)	0.106	0.014	0.047	0.063	0.012	0.037
	(0.146)	(0.022)	(0.054)	(0.142)	(0.020)	(0.050)
$\mathbb{E}$(Age Dependency)	0.175	0.120	0.245*	0.143	0.128	0.244
	(0.272)	(0.076)	(0.148)	(0.297)	(0.086)	(0.166)
$\mathbb{E}$(Age65+/Pop)	-0.813***	-0.039	-0.149*	-0.485*	0.008	-0.048
	(0.207)	(0.037)	(0.085)	(0.259)	(0.037)	(0.090)
$\mathbb{E}$(Legal Rights)	-0.023	-0.001	0.004	-0.002	-0.002	0.007
	(0.104)	(0.015)	(0.037)	(0.103)	(0.016)	(0.039)
$\mathbb{E}$(Gini)	-0.516***	-0.084***	-0.202***	-0.443***	-0.085**	-0.188***
	(0.125)	(0.027)	(0.057)	(0.139)	(0.034)	(0.069)
N	123	123	123	123	123	123
R^2	0.41	0.21	0.25	0.43	0.22	0.26

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) uses the following parameter combinations $(\gamma, \beta) = (1, 0.95); (3, 0.96); (5, 0.97)$ respectively. Standard errors are corrected by the HC0 covariance matrix.

Table 15 – Factors Variance - Income Group

	Dependent variable: $\ln \lambda_{Reis}$					
	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	-2.554***	0.991***	0.543***	-3.418***	0.951***	0.375***
	(0.109)	(0.028)	(0.058)	(0.229)	(0.037)	(0.081)
Upper Middle Inc.				0.577**	-0.005	0.032
				(0.268)	(0.030)	(0.080)
Lower Middle Inc.				1.303***	0.106**	0.334***
				(0.285)	(0.049)	(0.111)
Low Inc.				1.585***	0.025	0.289**
				(0.303)	(0.055)	(0.129)
Var(ΔGDP)	0.920***	0.210***	0.423***	0.841***	0.219***	0.431***
	(0.171)	(0.064)	(0.113)	(0.202)	(0.068)	(0.127)
Var(Savings/GDP)	1.010**	0.110	0.322	0.433	0.054	0.155
	(0.411)	(0.110)	(0.221)	(0.353)	(0.103)	(0.207)
Var(Unemployment)	0.031	-0.019	-0.031	0.143	-0.013	-0.001
	(0.104)	(0.017)	(0.038)	(0.102)	(0.018)	(0.038)
Var(Inflation)	0.083***	-0.004	0.012	0.019	-0.004	0.001
	(0.023)	(0.004)	(0.009)	(0.021)	(0.004)	(0.011)
Var(Age Dependency)	-0.016	-0.021	-0.070**	0.024	-0.020	-0.051
	(0.087)	(0.013)	(0.030)	(0.102)	(0.016)	(0.037)
Var(Age65+/Pop)	-0.106	-0.009	-0.036	0.047	-0.003	-0.005
	(0.069)	(0.011)	(0.027)	(0.067)	(0.012)	(0.024)
Var(Legal Rights)	0.004	-0.003	0.006	0.011	0.003	0.017
	(0.096)	(0.017)	(0.045)	(0.073)	(0.015)	(0.036)
Var(Social Contrib)	-0.019	-0.004	-0.013	0.033	0.001	0.003
	(0.061)	(0.007)	(0.017)	(0.056)	(0.007)	(0.015)
Var(Gini)	0.473***	0.014	0.078	0.056	-0.008	-0.019
	(0.167)	(0.023)	(0.058)	(0.148)	(0.026)	(0.063)
N	121	121	121	121	121	121
R^2	0.39	0.39	0.38	0.51	0.42	0.43

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) uses the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

Table 16 – Stabilization Policies - Income Group

	Dependent variable: $\ln \lambda_{Reis}$					
	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	-2.507***	1.028***	0.823***	-2.835***	0.963***	0.448***
	(0.092)	(0.026)	(0.208)	(0.223)	(0.034)	(0.101)
Upper Middle Inc.				0.278	0.102	0.901
				(0.319)	(0.072)	(0.820)
Lower Middle Inc.				0.493	0.096	0.257
				(0.317)	(0.076)	(0.181)
Low Inc.				0.865***	0.078	0.343*
				(0.309)	(0.071)	(0.187)
Stabilization $\text{Rule}_{nat.}$	-0.329***	-0.038***	-0.140**	-0.283***	-0.030***	-0.103***
	(0.081)	(0.010)	(0.059)	(0.075)	(0.008)	(0.040)
Stabilization $\text{Rule}_{supranat.}$	-0.452***	-0.055***	-0.211***	-0.333***	-0.031**	-0.059
	(0.089)	(0.013)	(0.071)	(0.115)	(0.016)	(0.069)
CBI Index_{unwgt}	-0.047	-0.135**	-0.798	-0.068	-0.138**	-0.799
	(0.310)	(0.069)	(0.613)	(0.303)	(0.068)	(0.600)
CBI Index_{wgt}	0.322	0.148**	0.757	0.330	0.144**	0.665
	(0.312)	(0.060)	(0.506)	(0.302)	(0.058)	(0.411)
N	168	168	168	168	168	168
R^2	0.25	0.07	0.02	0.29	0.08	0.03

Note: *p<0.1; **p<0.05; ***p<0.01. Models (1), (2) and (3) uses the following parameter combinations (γ, β) = (1, 0.95); (3, 0.96); (5, 0.97) respectively. Standard errors are corrected by the HC0 covariance matrix.

APPENDIX C – Algorithm

In this appendix, we will detail the numerical procedure described by Barros and de Pinho Neto (2016) to transform a stationary ARMA(p, q) model into a MA(∞). Suppose we have the following invertible ARMA(p, q) process for the first difference of the consumption log:

$$\Delta c_t = \phi_1 \Delta c_{t-1} + \ldots + \phi_p \Delta c_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \ldots + \theta_q \varepsilon_{t-q}$$

Then the coefficients a_j's for the $j \in (1, 2, \ldots)$ of the MA(∞) can be calculated recursively using the ϕ's and the θ's of the as follows:

$$\begin{aligned}
a_0 &= 1 \\
a_1 &= \theta_1 + \phi_1 1 \\
a_2 &= \theta_2 + \phi_2 1 + \phi_1 a_1 \\
a_3 &= \theta_3 + \phi_3 1 + \phi_2 a_1 + \phi_1 a_2 \\
&\vdots \\
a_j &= \theta_j + \phi_p a_{j-p} + \phi_p a_{j-p+1} + \ldots + \phi_1 a_{j-1},
\end{aligned}$$

where $a_h = 0$ if $h < 0$ and $\theta_h = 0$ if $h > q$.

Obviously, the polynomial A(L) cannot be computed in its infinite form, so we use the algorithm that computes the coefficients a_j's up to a certain order $T \in \mathbb{N}$. Barros and de Pinho Neto (2016) chooses the following values for $T : 10,000, 20,000$ and $50,000$, not finding sensitivity in the cost estimate up to the third decimal place, which makes us choose to choose $T = 10,000$ in the current year.