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

ALEX AUGUSTO TIMM RATHKE

Studies on transfer pricing systems and profit shifting: impact of the international regulation on the shifting behaviour of Brazilian firms

ORIENTADOR: PROF. DR AMAURY JOSÉ REZENDE
COORIENTADOR: PROF. DR CHRISTOPH WATRIN

RIBEIRÃO PRETO
2019

Prof. Dr. Vahan Agopyan
Reitor da Universidade de São Paulo

Prof. Dr. André Lucirton Costa
Diretor da Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto

Prof. Dr. Fabiano Guasti Lima
Chefe do Departamento de Contabilidade

Prof. Dr. Amaury José Rezende
Coordenador do Programa de Pós-Graduação em Controladoria e Contabilidade

ALEX AUGUSTO TIMM RATHKE

Studies on transfer pricing systems and profit shifting: impact of the international regulation on the shifting behaviour of Brazilian firms

Tese apresentada ao Programa de Pós-Graduação em Controladoria e Contabilidade da Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto da Universidade de São Paulo, para a obtenção do Título de Doutor em Ciências. Versão Corrigida. A versão original está disponível na FEA-RP/USP.

ORIENTADOR: PROF. DR. AMAURY JOSÉ REZENDE
COORIENTADOR: PROF. DR. CHRISTOPH WATRIN

RIBEIRÃO PRETO
2019

Rathke, Alex Augusto Timm

Studies on transfer pricing systems and profit shifting: impact of the international regulation on the shifting behaviour of Brazilian firms

Ribeirão Preto, 2019.

111 p.

Tese de Doutorado apresentada à Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto – Universidade de São Paulo.

Área de Concentração: Controladoria e Contabilidade

Orientador: Rezende, Amaury José.

Coorientador: Watrin, Christoph.

1. *Profit shifting*. 2. *Transfer pricing*. 3. *Tax evasion*. 4. *Tax base erosion*.

FOLHA DE APROVAÇÃO

RATHKE, Alex Augusto Timm.
Studies on transfer pricing systems and profit shifting: impact of the international regulation on the shifting behaviour of Brazilian firms.

Tese apresentada ao Programa de Pós-Graduação em Controladoria e Contabilidade da Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto da Universidade de São Paulo como requisito para a obtenção do título de Doutor em Ciências.

Aprovado em:

Banca Examinadora

Prof. Dr.: Instituição:
Julgamento: Assinatura:

Prof. Dr.: Instituição:
Julgamento: Assinatura:

Prof. Dr.: Instituição:
Julgamento: Assinatura:

Prof. Dr.: Instituição:
Julgamento: Assinatura:

Prof. Dr.: Instituição:
Julgamento: Assinatura:

"(…) All things physical are information-theoretic in origin (…)."

Wheeler, J.A.
Information, Physics, Quantum: The search for links. (1989)

RESUMO

Rathke, A.A.T. (2019). Estudos sobre normas de preços de transferência e *profit shifting*: impacto da regulação internacional sobre o comportamento de alocação de resultados de empresas brasileiras. Tese (Doutorado) – Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto, Universidade de São Paulo.

O presente estudo busca investigar o efeito das normas de preços de transferência (TP) sobre a estratégia de minimização tributária das empresas conhecida como *profit shifting*. O estudo é composto por três partes. A primeira parte analisa as características das normas de TP nos países, para a criação de uma classificação de sistemas de TP baseada nas similaridades regulatórias de cada país. O método de *clustering* hierárquico é aplicado para a análise de 57 características quantitativas e qualitativas das normas de TP. Resultados indicam a existência de quatro grupos distintos de sistemas de TP, do qual o maior grupo é composto por países que possuem normas de TP que são consistentes com os *guidelines* internacionais propostos pela OECD. A segunda parte analisa a relação entre as características das normas de TP e a percepção de *enforcement* tributário nos países. A literatura tributária atual assume que normas tributárias mais detalhadas implicam em um maior *enforcement*, e o presente estudo busca analisar esse pressuposto. Resultados indicam que diferentes medidas de percepção de *enforcement* tributário estão associadas a diferentes características das normas de TP. A terceira parte investiga o *profit shifting* no Brasil e o efeito de diferentes sistemas de TP aplicáveis às partes relacionadas no exterior. O contexto brasileiro proporciona um caso oportuno para análise, pois combina uma extrema carga tributária, um sistema tributário de alta complexidade, e um conjunto de normas de TP único no mundo, de forma a representar um conjunto relevante de incentivos ao *profit shifting*. Conforme previsto, o estudo encontra fortes indícios de *profit shifting* nas empresas brasileiras. Além disso, os resultados sugerem que algumas normas de TP são mais efetivas em inibir o *profit shifting*, porém as empresas têm condições de explorar as vulnerabilidades das normas de TP em direção à estratégia de *profit shifting*.

Palavras-chave: *Profit shifting*, Preços de transferência (*transfer pricing*), Evasão tributária, Erosão tributária.

ABSTRACT

Rathke, A.A.T. (2019). *Studies on transfer pricing systems and profit shifting: impact of the international regulation on the shifting behaviour of Brazilian firms.* Tese (Doutorado) – Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto, Universidade de São Paulo.

This study investigates the effect of the transfer pricing (TP) rules on tax-induced profit shifting by firms. It is composed by three parts. The first part analyses the characteristics of TP rules across countries to create a classification of TP systems based on regulatory similarities. Hierarchical clustering method is applied for the analysis of 57 qualitative and quantitative TP characteristics. Results indicate the existence of four distinct TP systems, of which the largest group is composed of countries with TP rules that are consistent with the OECD TP guidelines. The second part analyses the relation between the characteristics of TP rules and the perception of tax enforcement across countries. Current tax research assumes that more extensive tax rules imply in higher tax enforcement, for this study focuses in testing this assumption. Results indicate that different measures for the tax enforcement perception are associated with different characteristics of TP rules. The third part investigates the profit shifting in Brazil and the effect of different TP systems applied to the foreign related parties. The Brazilian context provides a novel case for analysis, since it combines an extreme tax burden, a highly complex tax system, and a unique set of TP rules, thus to represent a relevant set of shifting incentives. As expected, this study finds strong evidences of profit shifting in Brazilian firms. Moreover, results suggest that some rules are more effective in curtailing the profit shifting, but firms are still able exploit vulnerabilities in TP systems towards the shifting strategy.

Keywords: Profit shifting, Transfer pricing, Tax evasion, Tax base erosion.

LIST OF TABLES

LIST OF FIGURES

SUMMARY

A GENERAL INTRODUCTION

The debate on international tax evasion has recently reached unprecedented level of public importance after the major economies worldwide have joined efforts to work on the Base Erosion and Profit Shifting (BEPS) action plan (OECD, 2013), proposed by the Organization for Economic Co-operation and Development (OECD). The OECD's BEPS initiative has the main objective to identify the tax-minimisation opportunities derived from globally integrated economies and from the interaction of countries' domestic tax systems, so to propose new measures to prevent double non-taxation, and to improve the current OECD standards (OECD, 2013). As a fast result, OECD reported in July, 2013 a major action plan with 15 topics to be addressed and the corresponding implementation deadlines (Dharmapala, 2014). Among the several measures proposed, one of the key matters refers to the improvement of the international transfer pricing (TP) guidelines. A new version of the TP guidelines was reported by the OECD in 2017, including the new BEPS proposals up to then.

Literature on corporate taxation accumulates remarkable evidences that multinational enterprises (MNE) adjust the TP on transactions with related parties, thus to transfer taxable profits from high-tax to low-tax countries. Governments consider these adjustments artificial maneuvers, where MNE have the single objective to segregate the taxable income from the economic activities that generate it (OECD, 2013). Several studies provide substantial evidences of profit shifting by means of direct TP manipulation (Davies, Martin, Parenti & Toubal, 2018; Cristea & Nguyen, 2016; Bernard, Jensen & Schott, 2006; Overesch, 2006; Bartelsman & Beetsma, 2003; Clausing, 2003; Swenson, 2001).

Furthermore, studies also investigate the impact of TP rules and tax enforcement on the profit shifting. While some studies find that specific anti-shifting measures are effective in preventing the shifting behaviour of firms (Marques & Pinho, 2016; Beuselinck, Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013), others show that MNE are able to exploit weaknesses and blind-spots in tax rules, thus to distort the TP (Davies, Martin, Parenti & Toubal, 2018; Beer & Loeprick, 2015). The predominant approach in current literature to propose some type of enforcement ranking of countries, based on the assumption that the existence of specific TP rules or that larger penalties for non-compliance implies higher tax enforcement. Main limitations on this approach refer to the presumption that the same TP rule produces equal effects in different countries, the interaction between different TP provisions

is usually not taken into account, and that the several TP enforcement measures across studies are not compatible when compared with each other. Overall, this approach assigns a set of artificial enforcement degrees to different TP provisions.

This scenario provides the main opportunity for the present study. Our major motivation is to investigate the effect of different TP rules on profit shifting, but we explicitly drop the "enforcement" assumption proposed in existing literature. Instead of assuming that some TP rules are more enforcing than others, we simply take them as "different" rules. Thence, we let the empirical investigation to reveal which are the TP rules that imply higher tax enforcement.

We also take this opportunity to investigate the tax-induced profit shifting in the novel Brazilian context. Although it is a well-established subject in tax literature, profit shifting research in Brazil is virtually non-existent. Brazil provides a favourable case for the analysis, since it combines an extremely high corporate taxation, one of the most complex tax systems in the world, and the most distinguished set of transfer pricing rules in the world (Jacob, 2018; Lohse, Riedel & Spengel, 2012).

The key research objective of this study is to investigate the effect of TP rules on profit shifting, taking the Brazilian case for analysis. In order to properly achieve the final goal, we develop our investigation in three separate stages, with specific objectives each. The first objective is to compare the TP rules across countries, thus to find significative differences that enable us to create group of countries that share similar rules. Remark that we do not assume *ex ante* any effect from the TP rules, for we do not intend to propose an enforcement ranking of countries. Rather, we focus in creating a non-ordered classification of TP systems, and to identify which are the main characteristics of each group.

The second objective is to test the association between TP rules and tax enforcement, as an attempt to validate the mainstream assumption in tax literature. This is not a straight task, since the level of tax enforcement by authorities is not an observable measure and is usually modelled indirectly. Hence, it is necessary to test a measure that reflects the tax enforcement of countries, but that is not directly based on the tax rules. The characteristics of TP rules in the first stage are applied in this second stage for analysis.

Finally, the third objective is to investigate the effect of TP rules on profit shifting. We focus on the Brazilian context since it provides a strong set of profit shifting incentives, thus the specific effect of TP rules is likely to be more clearly identified. The classification of different TP systems is obtained from the outcomes in the first stage.

The present study is developed in three stages, which are somewhat specific but integrated with each other. Based on that, this study is composed by three separate parts, with their own introductions, developments and conclusions each. These parts can be taken as individual papers, but also as a complete research towards the key research objective. This introductory Section aims to provide the brief overview on the motivation and the interconnection between all parts. Some points for discussion are presented at the closing Section of this manuscript.

1. CLASSIFICATION OF TRANSFER PRICING SYSTEMS ACROSS COUNTRIES

This Section analyses the characteristics of transfer pricing (TP) rules across countries to create a classification of TP systems based on regulatory similarities. We apply hierarchical clustering method for the analysis of 57 qualitative and quantitative TP characteristics. Our sample comprises of 44 countries for the period of 2010-2016. Our results indicate the existence of four distinct TP systems. The largest group is composed of countries with TP rules that are consistent with the OECD TP guidelines, while the other three groups include countries with domestic provisions that are substantially different from the baseline OECD standards. Overall, characteristics related to the priority of TP methods, to advanced pricing agreements and to the efficiency of competent authority procedures are the most distinctive differences between the groups. Our analysis contributes to the current literature as it provides a non-ordered classification of TP systems that is statistically significant and consistent for the complete period, and has the advantage of being more robust methodologically and not depending on assumptions about enforcement effects of specific tax provisions. Our results provide relevant information about the key differences of TP rules across countries and thus support the review of existing anti-shifting mechanisms as proposed by the OECD.

1.1 Introduction

Tax-induced profit shifting remains a critical subject under discussion among international policymakers. From an early body of evidences showing that multinational enterprises (MNE) perform intra-firm transactions to allocate taxable profits from high-tax to low-tax locations, major economies have historically implemented different types of regulatory and operational mechanisms in the attempt to monitor and to rule these activities.

One key profit shifting channel addressed by policymakers refers to transfer pricing (TP) abuse, when MNE have discretion in determining the prices applied on intra-firm transactions. Existing studies provide relevant evidences of profit shifting by means of direct TP manipulation (Davies, Martin, Parenti & Toubal, 2018; Cristea & Nguyen, 2016; Bernard, Jensen & Schott, 2006; Overesch, 2006; Bartelsman & Beetsma, 2003; Clausing, 2003;

Swenson, 2001). On this line, the baseline TP standard extensively accepted by countries is based on the guidelines prepared and published in 2010 by the Organization for Economic Co-operation and Development (OECD, 2017), which establishes the arm's length principle as the fundamental parameter for appropriate valuation of intra-firm transactions.

Despite the broad application of OECD TP guidelines as a baseline standard, countries maintain unilateral rules to prevent TP manipulation (Knoll & Riedel, 2014; Lohse, Riedel & Spengel, 2012). Countries typically implement the core of OECD guidelines into their domestic tax systems, and include specific provisions according with their regulatory background. Studies find that TP rules have a positive impact on preventing income shifting behaviour (Beuselinck, Deloof & Vanstraelen, 2015; Saunders-Scott, 2013), however some evidences show that MNE still manage loopholes and weaknesses in domestic TP regulations to distort intra-firm prices (Beer & Loeprick, 2015).

The recent OECD Base Erosion and Profit Shifting (BEPS) Action Plan (OECD, 2013) proposes a thorough review of current TP guidelines. The main objective is to adapt the current guidelines for contemporary unprecedent arrangements, thus to mitigate breaches that still allow TP abuse. OECD TP guidelines were reviewed in 2017 based on the Report on BEPS Actions 8-10 endorsed in 2015. These actions attain to review TP rules for high-risk transactions, in special for internal services, profit splits and intangibles. Also, the OECD advocates for the harmonisation of TP standards across countries, on the argument that regulatory overlaps and gaps result from the interaction of distinct domestic TP rules (Knoll & Riedel, 2014; OECD, 2013). Overall, the OECD ascertains that the TP Guidelines include supplemental material on specific aspects of TP and will be periodically reviewed on an ongoing basis (OECD, 2017). Therefore, it becomes necessary to identify the main elements responsible for the differences on TP systems across countries.

This Section analyses TP rules across countries in order to create a nominal classification of TP systems based on differences in regulatory characteristics. We focus on observable characteristics of TP rules in 44 countries for the period of 2010-2016, which are obtained from professional TP guidelines published by high-reputed tax advisory and audit firms. Classification of TP systems is based on hierarchical clustering method, for it compares all TP characteristics and merges countries into separate groups based on shared similarities.

Results indicate the existence of four significant TP systems for the period analysed. TP system #1 refers to the group of countries with least formalised TP rules, which are compatible with the core of the OECD TP principles. TP system #2 refers to TP rules that are based on OECD guidelines but includes specific domestic provisions that override OECD standards. TP system #3 refers to the group of countries that follows the traditional OECD TP Guidelines, with only few domestic adjustments. TP system #4 refers to a small group of countries with TP rules that are substantially distinct from the OECD standards. Relevant between-groups differences are primarily related with the priority of TP methods, availability of advanced pricing agreements (APA) and similar processes, and effectiveness of competent authority procedures. In less extent, additional relevant differences refer to the type and amount of tax penalties, type and extent of TP disclosures, and specific provisions for general internal services and related-party status. Classification of these four TP systems provide a relevant grouping structure that represents 33.8% of overall explained between-groups differences. Results are statistically significant and are consistent for the complete period of 2010-2016.

This study provides two major contributions for the profit shifting literature. First, our results provide a robust classification of TP systems that is based on a comprehensive set of regulatory characteristics. Existing studies focus in creating different enforcement rankings for groups of countries, on which larger tax penalties and more extensive documentation requirements are assumed to imply higher tax enforcement. Nonetheless, this assumption carries some relevant limitations, which are mostly related with the impact of similar TP rules on distinct countries, the interaction among different TP provisions and the assignment of an arbitrary enforcement measures to each provision. Our analysis focuses on creating an unordered classification of different TP systems, rather than proposing an ordered enforcement ranking based on presumed impact of particular TP requirements. This approach has the advantage to include a broad set of characteristics in the analysis, and it refrains from subjectively assigning an enforcement degree to specific TP provisions.

Second, our results provide knowledge about the key differences on TP rules across countries. Despite increasing efforts towards the consistency of domestic TP regulation, we observe that governments still maintain unilateral anti-shifting measures. Hence, our analysis is useful for the identification of inconsistencies across countries' TP rules, therefore contributing to a major review of TP guidelines as proposed by OECD. Our results may have

valuable application in solving regulatory mismatches, to eliminate gaps in TP rules, and to devise new anti-shifting mechanisms applicable to a broad set of countries.

The remaining of this Section is structured as follows: Section 1.2 presents a literature review on TP regulation and our research question, Section 1.3 describes the data set and research strategy, Section 1.4 presents the results for the classification of TP systems, and Section 1.5 concludes.

1.2 Literature on Transfer Pricing Regulation

Current literature on profit shifting focuses on the analysis of TP rules and on the impact of tax enforcement on the shifting behaviour of firms. In the following, we present relevant studies that develop specifically on the analysis of TP regulation.

The leading study of Lohse, Riedel and Spengel (2012) examine the transformation of different aspects of TP regulations on 44 countries for the period of 2001-2009. The analysis is based on a descriptive survey of different TP provisions in each country, including mainly the existence and applicability of TP rules, TP methods and priority of methods, documentation requirements and submission deadlines, penalties, status of limitations and APA provisions. As a result, the study proposes an ordered six-level measure of strictness of national TP regulations. The strictness measure is based on aspects related with the existence of TP regulation, documentation requirements and the disclosure extent of TP information. The study assumes that formal implementation of TP rules and documentation requirements into national tax law of each country and a larger extent of information disclosure represents higher strictness of TP regulation. The strictness level does not take into account the other TP aspects surveyed. Overall results indicate that the scope of TP regulation has been continuously extended through 2001-2009, and that TP rules in European countries are less strict than in non-European countries, based on their TP strictness measure.

In a subsequent study, Lohse and Riedel (2013) investigate the impact of TP regulations on profit shifting for a sample of 26 countries from 1999-2009. The baseline analysis segregates countries into three categories of TP rules, based on its existence and scope: category 1 includes countries with no TP regulation and very generic anti-shifting rules, category 2 includes countries with domestic TP rules and general documentation

requirements, and category 3 includes countries with domestic TP rules and strong documentation requirements formally implemented into domestic tax law. The study assumes that the three categories represent an increasing ordered-level measure of TP strictness. Results indicate that the implementation of TP rules and the increase in TP strictness is associated with a general reduction in profit shifting.

Marques and Pinho (2016) investigate the extent to which the implementation and tightening of TP regulation deter profit shifting in European countries. Analysis is applied to a sample of 33 countries for the period of 2001-2009. As a measure of TP strictness, the study proposes the creation of a TP strictness index based on factors related with TP regulations and law enforcement mechanisms. All factors are represented by indicator variables with value 1 for the presence of the factor and 0 otherwise. Factors on TP regulations includes four attributes: statutory rules on general TP principles, statutory rules on detailed application of TP provisions, statutory documentation requirements and non-regulated documentation requirements. For the factors on law enforcement, the study includes seven attributes: annual TP information in tax returns, country with special TP audit team, effective TP audits by authorities, specific TP audit procedures by authorities, penalties for failure in TP documentation, penalties for tax adjustments and interests applicable on tax adjustments. All factors are inputted into a weighted average sum to compute the TP strictness index, with weights following from a survey with tax specialists. The proposed index assumes that the existence of statutory TP rules and penalty rules imply in higher strictness level. Overall empirical results indicate that the stricter the TP regulation the lower the tax rate difference sensitivity on reported earnings.

Nicolay, Nusser and Pfeiffer (2017) investigate how MNE adjust their profit shifting mechanisms after changes in the strictness level of TP regulations and in thin capitalisation rules. Their sample comprises 32 countries for the period of 2004-2014. Baseline TP strictness is measured by means of a proxy for implementation and maturity of TP documentation requirements measured in years. The study assumes that the length of time in which documentation requirements have been applicable represents a valid ordered proxy for TP strictness. The study also compares the analysis with other measures of TP strictness, in special with TP categorisation proposed in Lohse and Riedel (2013). Results indicate that stricter TP documentation requirements reduces the profit shifting via TP manipulation. Tax planning via transfer prices is substituted by debt shifting.

Ignat and Feleaga (2017) analyse the strictness of TP rules for all European countries for the year 2015. The study proposes a TP strictness index based on 13 elements grouped in three categories, which are related mainly with TP documentation requirements, existence of penalties for failure in TP documentation, existence of TP disclosure, if the related-party status is based on a relationship threshold lower than 25%, if the status of limitations is greater than 5 years, and if APA are not available. All elements are represented by indicator variables with value 1 for the presence of the element and 0 otherwise. The TP strictness index is computed as a weighted average sum of all TP elements, where the weights refer to a percentage of importance of each category of elements attributed by the authors. The study assumes that the presence of TP elements represents higher strictness, and proposes an ordered five-level measure of strictness of TP regulations that is similar to one created in Lohse, Riedel and Spengel (2012). The study also designs an European map of how TP strictness index is distributed across countries. Overall results indicate that TP strictness index decreases from west to the east of the continent, and that countries may be segregated into two main areas: central-east Europe with less strict TP rules and south-west Europe with stricter TP rules.

Other studies analyse TP rules and general tax enforcement while investigating evidences of profit shifting. Beuselinck, Deloof and Vanstraelen (2015) examine cross-jurisdictional profit shifting and the impact of tax enforcement on a sample of 19 European countries for the period of 1998-2009. The study creates a general tax enforcement score which includes institutional characteristics representing tax audit risk, related-party disclosure requirements, existence of favourable regimes for MNE holding structures, thin capitalisation rules, double tax treaties and rules for tax losses carry-forward. The tax enforcement score assumes that the presence of a specific tax characteristic represents a higher tax enforcement. It does not include other specific characteristics of TP rules. Results indicate that countries shift more profits from high-tax locations to low-tax locations when local tax enforcement score is low.

Beer and Loeprick (2015) investigate the firm-level drivers of global profit shifting in a sample of 34 countries for the period of 2003-2011. Besides firm-level factors, the study includes the effect of TP documentation requirements on profit shifting estimate, by means of an indicator variable with value 1 for the presence of documentation requirements and zero otherwise. Results indicate that profit shifting among subsidiaries of MNE groups has

decreased after implementation of TP documentation requirements by countries, and this effect is persistent over time.

Beer and Loeprick (2017) also analyse profit shifting on 294 domestic and multinational parent companies and subsidiaries in 12 countries for the period of 2004-2012, all companies of oil and gas sector. Their analysis takes into account the maturity of domestic TP documentation requirements, assuming that TP rules implemented for longer periods represent stricter TP enforcement. The authors find that enforcement efforts proxied by means of TP documentation requirements are more successful to mitigate international profit shifting than mispricing of domestic transactions. Overall results show that non-OECD countries are more vulnerable to profit shifting in the oil and gas sector.

With respect to the literature that focus specifically on the analysis of different TP regulations or the one that estimate the impact of TP rules on profit shifting, we observe that almost all studies propose some type of enforcement ranking of countries based on a few characteristics of TP rules; some studies propose a numerical semi-continuous measure of enforcement (Nicolay, Nusser and Pfeiffer, 2015; Marques e Pinho, 2016; Beer and Loeprick, 2017), while others create an ordered discrete categorisation of set of countries (Lohse, Riedel and Spengel, 2012; Lohse and Riedel, 2013; Beer and Loeprick, 2015). The predominant approach is based on the assumption that the existence of a specific TP requirement or that larger penalties for non-compliance implies higher tax enforcement. Nonetheless, this assumption carries some relevant reserves.

First, it presumes that the same TP rule produces equal effects in different countries. Existing studies indicate that tax rules are implemented and enforced according to established tax characteristics of each country (Alm, 2018; Avi-Yonah, 2000), and empirical findings indicate that similar TP rules produce varying impacts on different countries (Beer and Loeprick, 2017).

Second, most studies focus on few rules regarding TP documentation requirements and penalties, and do not take into account the interaction of different TP provisions. One exception is the study of Marques e Pinho (2016), which includes factors related with countries' tax audits to analyse tax enforcement. On this account, countries implement diversified sets of anti-shifting mechanisms that are extremely relevant to control TP

manipulation and are not related with information requirements or penalisation, e.g. APA procedure are intensively applied and highly effective in some developed European countries (Becker, Davies & Jacobs, 2014).

Third, the various TP enforcement measures across studies are not completely compatible when compared with each other. More specific, it appears that the inclusion of different regulatory factors into the analysis results in changes on TP enforcement levels for the same country. With regard to studies that propose a TP enforcement index, some assume a linear relation between regulatory provisions (Nicolay, Nusser and Pfeiffer; 2015; Beer and Loeprick, 2017), while others define different weights for different TP factors (Marques e Pinho, 2016). Studies that propose a discrete ranking for group of countries face the problem that the segregation of different categories seems arbitrary or not based on a structured comparison method, e.g. Lohse, Riedel and Spengel (2012) define the existence of TP rules and documentation requirements as the main criteria for TP categorisation, while Ignat and Feleaga (2017) propose different weights on similar criteria set for their analysis. This approach provides a discrete order with artificial distances that do not necessarily reflect the progress of TP strictness levels from one category to the next one.

In contrast to prior literature, this study aims to analyse the characteristics of TP rules across countries by creating a nominal classification of TP systems based on shared characteristics. We seek to compare the differences across countries' TP rules based on a measure of similarity between observations, instead of proposing a unidimensional ordered rank of countries. This approach has the advantage of being able to include a broad set of quantitative and qualitative TP characteristics into the analysis, while it can drop the limiting assumption of assigning enforcement levels to each TP characteristic.

1.3 Data and Research Strategy

Our analysis focuses on similar sample of $N = 44$ countries studied in Lohse, Riedel and Spengel (2012) and Lohse and Riedel (2013), for the cumulative period of 2010-2016. Information about TP systems across countries are obtained from professional TP Guidelines published by the Big Four audit firms. These Guidelines provide updated information about countries TP rules and are widely applied on TP research, e.g. Beer and Loeprick (2015),

Beuselinck, Deloof and Vanstraelen (2015), Saunders-Scott (2013), Lohse, Riedel and Spengel (2012).

Characteristics of TP systems are numerous and vary across countries. For our analysis, we select 57 qualitative and quantitative TP characteristics that are observable and comparable. Most variables are found in two or more professional TP Guidelines, so we are able to cross-check them for information consistency. For qualitative characteristics, we set an indicator variable with value 1 for the presence of the characteristic and 0 otherwise. For quantitative characteristics, we use the numerical measure itself uniformly regularised over the variable range. Description of all TP variables and regularised mean values are presented in Appendix A.

For the baseline analysis, we apply agglomerative hierarchical clustering, which provides a proper method for comparison of factors when the number of groups is not previously determined (Legendre & Legendre, 2012; Gordon, 1987). Firstly, we compute differences on TP systems across countries by means of pairwise dissimilarities with respect to all $C = 57$ variables for the complete period $T = 7$. We define a dissimilarity measure d_{ij} between countries $i,j \in N = 44$ based on traditional Gower (1971) measure for mixed variables:

$$s_{ij} = \frac{\sum_{k=1}^{C} \sum_{t=1}^{T} \delta_{ijct} \pi_{ijct}}{\sum_{k=1}^{C} \sum_{t=1}^{T} \delta_{ijct}}$$

$$d_{ij} = \sup_{(i,j) \in N} (s_{ij}) - s_{ij}$$

Dissimilarity measure d_{ij} is a weighted mean of the contribution of variable $c \in C = 57$ for the differences between observations $i,j \in N = 44$ in year $t \in T = 7$. Indicator δ_{ijct} takes value 0 for missing variables, and value 1 otherwise. If variable c is binary, contribution π_{ijct} takes value 0 if it is equal for both observations, and value 1 otherwise. If variable c is continuous, contribution π_{ijct} is the absolute difference between observations $i,j \in N$ in year $t \in T$, regularised by total range of variable c.

For the measure d_{ij}, we assume all variables with the same weight, for all periods $t \in T$. Individual differences π_{ijct} are defined on the domain [0,1], from complete similarity to complete dissimilarity. In our analysis, indicator variables π_{ijct} for qualitative TP

characteristics are defined to become informative under complete similarity (value 0). Gower (1971) measure is consistent for this purpose.

Pairwise dissimilarities d_{ij} are then compared for the clustering process. Dissimilarity matrix $D_{2010\text{-}2016} = [d_{ij}]$ comprising all pairwise dissimilarities is presented in Appendix C. We apply conventional average linkage method, since it is appropriate for analysis of pairwise distances while controlling for the effect of groups sizes during each clustering stage (Legendre & Legendre, 2012; Gordon, 1987). Average linkage is based on distances between pairs of groups, thus measured as follows:

$$g_{PQ} = \frac{1}{n_P + n_Q} \sum_{p=1}^{P} \sum_{q=1}^{Q} g_{pq}$$

Groups distances g_{PQ} are measured with respect to n_P countries in group P and n_Q countries in group Q. Groups are combined through process of ordered pairwise similarities. Average linkage method is appropriate in our analysis since it combines groups with small variances in individual TP systems, while it prevents the consolidation of two groups based on the characteristics of a single country (Legendre & Legendre, 2012; Sokal & Michener, 1958).

Baseline analysis applies permutational analysis of between-groups variance – permutational ANOVA to test the significance of groups (Anderson, 2001; McArdle & Anderson, 2001). Permutational test is most appropriate for our analysis since our data comprises more variables than observations, and our sample's frequency distribution cannot be determined previously (Reiss, Stevens, Shehzad, Petkova & Milham, 2010; Gower & Krzanowski, 1999). We apply simple t-test on the incremental distances obtained from ordered group stages, thus to identify significant distances between groups. Analysis of significant distances is necessary to avoid model overfitting. We also focus on graphical inspection of the dendrogram, cophenetic correlogram and the "elbow graph" of ascending explained variances from hierarchical clustering.

1.4 Results

In this Section, we present the baseline analysis of groups of countries with different TP systems, the consistency of groups through time, and the main TP characteristics in each group.

1.4.1 Groups of TP Systems

Results from hierarchical clustering for overall sample are presented in Figure 1 and Table 1.1.

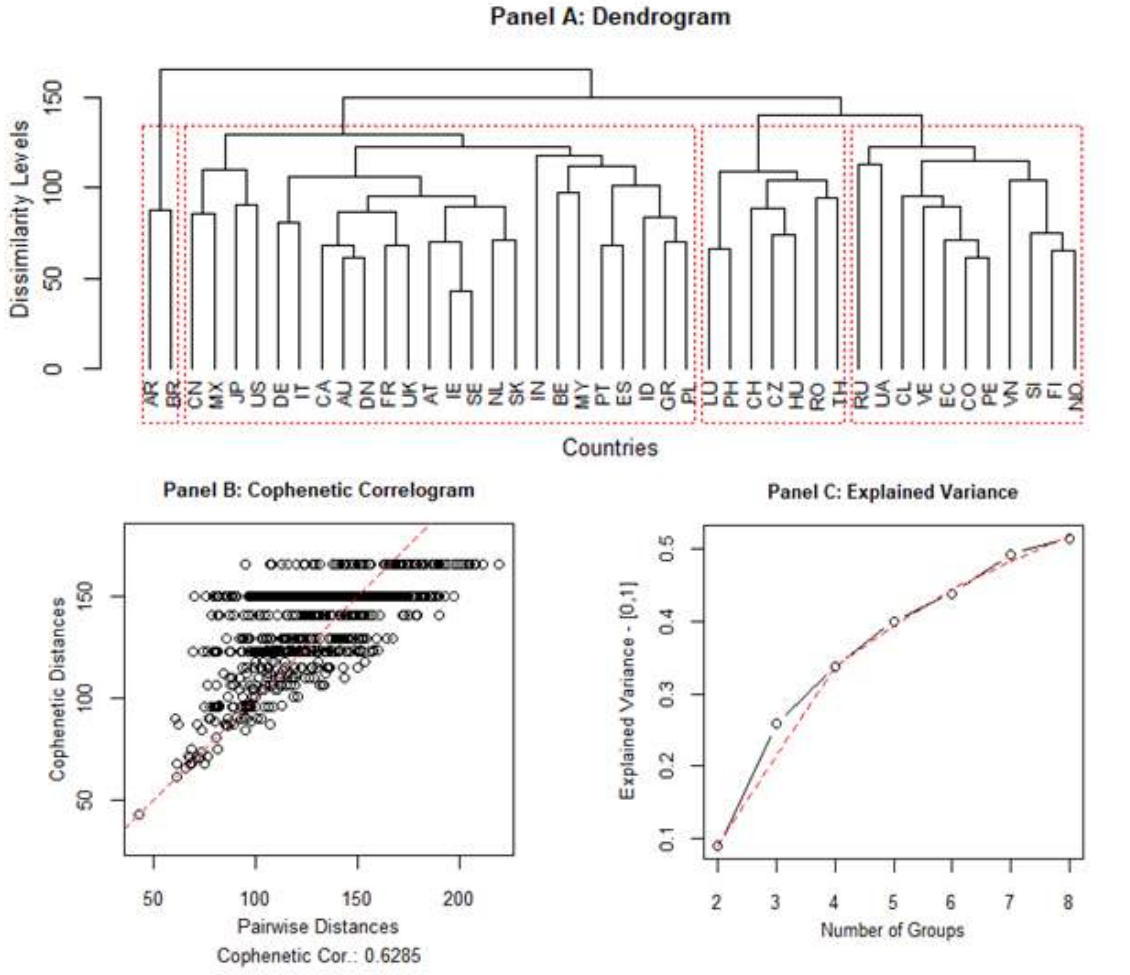


Figure 1: Hierarchical Clustering: Panel A presents the dendrogram of hierarchical clustering of countries and the dissimilarity levels. Red dashed frames indicate the segregation of countries into $k = 4$ groups. Panel B presents the cophenetic correlogram between pairwise distances and cophenetic distances. Cophenetic correlation follows conventional Pearson measure. Panel C presents the "elbow graph" of ascending explained variance for each number of groups, with regularised for the range [0,1].
Source: by author.

Dendrogram in Panel A of Figure 1 shows the pattern of groups at increasing dissimilarity levels. Groups are defined by cutting the dendrogram at significant heights. We can identify groups' components and the distance among them. Predominance of short lengths on mid-level branches shows that most countries merge homogeneously at the same narrow distance range. Stable groups are observed in longer branches, at higher levels on dendrogram.

Cophenetic correlogram in Panel B of Figure 1 compares countries' pairwise distances with the distance on which two groups with one country in each are merged into a single larger group, i.e. so called cophenetic distances. Larger distances between groups are plot as larger cophenetic distances on the *y*-axis. Parameter for the cophenetic correlation refers to the red diagonal dashed line. Concentration of observations in the middle of the plot indicate that countries are overall close to each other, so groups at mid-level range might be unstable with respect to changes in TP characteristics. We observe again that groups, which merge at higher dissimilarity levels, bear clearer bounds.

The elbow graph in Panel C in Figure 1 presents the amount of total explained variance for dissimilarity levels representing the segregation of countries into 2-8 groups. Total explained variance increases as the segregation of groups of countries become more detailed, however marginal changes in explained variance are decreasing. An elbow in the graph indicates the clustering stage from which an additional segregation provides little additional information. The Parameter for expected explained variance is shown by the smooth red dashed line. Panel C shows two bent points representing 3 and 4 clusters respectively, thus indicating that countries can be merged in 3 or 4 different groups. This outcome is consistent with analyses in Panels A and B of Figure 1.

Table 1.1: Permutation Analysis and Groups Distances

Number of Groups	Panel A. Permutation Analysis						Panel B. Groups Distances			
	Df	SS	MS	Pseudo-F st.		R-sqd	Permut.	Height	C.Dens.	Branch Increm.	
2	1	34326	34326	4.156	*	0.0901	946	165.81	0.0888	16.085	***
3	2	98461	49230	7.144	***	0.2584	>1000000	149.72	0.4567	9.095	***
4	3	128835	42945	6.812	***	0.3314	>1000000	140.63	0.0814	11.245	***
5	4	152639	38160	6.519	***	0.4006	>1000000	129.38	0.0846	6.133	*
6	5	167160	33432	5.941	***	0.4387	>1000000	123.25	0.0190	0.700	*
7	6	187859	31309	6.000	***	0.4931	>1000000	122.55	0.1015	5.022	*
8	7	196158	28022	5.457	***	0.5184	>1000000	117.53	0.0074	2.345	*

Panel A presents the permutation analysis of between-groups variance – permutational ANOVA, for highest levels representing 2-8 groups disclosed on dendrogram in Figure 1 (between-groups variance only). Analysis follows Anderson (2001) and McArdle and Anderson (2001). Permutations are calculated as the total number of possible permutations of $N = 44$ objects into k groups with n_k members in each group. Panel B presents t-test for distances disclosed on dendrogram and cophenetic correlogram in Figure 1. Height refers to the branch heights in dendrogram. C.Density refers to the cophenetic density of observations in each group stages of the cophenetic correlogram. Branch increment refers to the difference between the height of the present stage and the height of the previous stage.
*** Significant at <0.0001 level; * Significant at <0.001 level (one-tailed).
Source: by author.

Results for permutational ANOVA are presented in Panel A of Table 1.1, for segregation of countries into 2-8 groups. It tests if the hierarchical clustering model provides statistically significant structures. Permutations are restricted to max = 1,000,000 due to computational limitations. Pseudo F-statistics indicate that the average linkage cluster method provides relevant groups of countries, for it is significant at <0.0001 level for all 3-8 groups. As expected, overall explained variance (R-square) increases as groups become more detailed, i.e. the number of groups increases, however marginal additional information is decreasing as the segregation of groups becomes more detailed.

Increasing explained variance may lead to model overfitting issues, thus relevant groups are most properly segregated if distances among them are significant. Panel B of Table 1.1 presents t-test on incremental between-groups distances. Results indicate that distances become significant at clustering stages where countries are merged into 2-4 different groups. Additional segregations at branches lower than the 140-dissimilarity level are less significant.

Therefore, baseline results indicate that we have 4 groups of different TP systems for the cumulative period of 2010-2016, which represents a R-squared statistic of 33.1% of overall explained variance. Groups' boundaries are relevant, with between-groups distances significant at <0.0001 level. It shows that countries classified in different groups present relevant differences in TP systems. Segregation of these 4 groups is disclosed in red dashed frames on dendrogram in Panel A of Figure 1.

1.4.2 Consistency of TP Systems Through 2010-2016

In the following we analyse whether the segregation of TP systems into 4 different groups is consistent through the complete period of 2010-2016. First, we compute pairwise distances d_{ijt} between observations $i,j \in N = 44$ for $T = 7$ cumulative periods beginning in 2010. We obtain 7 sets D_t, $t = \{ t \in T = 7 : D_t = D_{2010\text{-}l}$, $l = (2010,\ldots,2016) \}$ of pairwise dissimilarities, e.g. $D_7 = D_{2010\text{-}2016}$ is equal to the dissimilarity matrix for the complete period 2010-2016, as examined in Section 1.3.1. Sets D_t are then analysed via average linkage hierarchical clustering, thus to obtain 7 different cluster structures $h_t \in H$, one for each cumulative period. We divide all structures in H into $k = 4$ groups each and compare its components. Dissimilarity measure d_{ijt} and average linkage method applied in this Section follow the same methods described in Section 1.2. Cluster structures are divided into 4 groups via simple k-groups tree cut.

Comparison of groups across cluster structures in H is made by means of traditional B_k index from Fowkles and Mallows (1983). B_k index is a measure of similarity between two hierarchical clusterings, which is based on the comparison of the number of matching components in each of the k groups of both cluster structures. Values range from 0 to 1 where the latter indicates perfect agreement on groupings between trees (Meila, 2007; Fowkles & Mallows, 1983). Assume two cluster structures $f,h \in H$ with n objects each, both creating an equal number of k groups. Labelling clusters in f,h from 1 to k, define the matching matrix $M = [m_{f_k h_k}]$, $(f_k,h_k = 1,\ldots,k)$ where $m_{f_k h_k}$ is the number of common observations in the f_k -th group of f and h_k -th group of h. B_k index is then measured as follows:

$$B_k = \frac{\sum_{f_k=1}^{k} \sum_{h_k=1}^{k} m_{f_k h_k} - n}{\sqrt{(\sum_{f_k=1}^{k} (\sum_{h_k=1}^{k} m_{f_k h_k})^2 - n) \cdot (\sum_{h_k=1}^{k} (\sum_{f_k=1}^{k} m_{f_k h_k})^2 - n)}}$$

In words, it compares the number of matching components between the f_k -th group of f and h_k -th group of h with respect to the total number of components n. It represents the probability that a pair of components are in the same cluster k under both clustering structures $f,h \in H$ (Meila, 2007). In our case, we compute B_4 indexes for $k = 4$ groups, where different clustering structures refer to $T = 7$ different cumulative periods through 2010-2016. We apply permutation test over observations' labels to test statistical significance of indexes.

Permutation test is most appropriate for our analysis since groups' components across periods are correlated. Table 1.2 presents the B_4 indexes.

Table 1.2: B_4 Indexes

	B_4 indexes for cumulative periods of 2010-2016													
	2010-2016		2010-2015		2010-2014		2010-2013		2010-2012		2010-2011		2010	
2010-2016	1.0000	***	0.9588	***	0.8564	***	0.8056	***	0.8018	***	0.8596	***	0.5017	*
2010-2015			1.0000	***	0.8922	***	0.7806	***	0.7737	***	0.8248	***	0.4770	
2010-2014					1.0000	***	0.7286	***	0.7155	***	0.7756	***	0.4220	
2010-2013							1.0000	***	0.8861	***	0.8500	***	0.6081	
2010-2012									1.0000	***	0.8920	***	0.5089	
2010-2011											1.0000	***	0.4723	
2010													1.0000	***

This table presents the B_4 indexes regarding k = 4 groups of TP systems for cumulative periods within 2010-2016. Cluster structures follow hierarchical clustering procedures in Section 1.2. Groups across periods are determined by simple k-groups tree-cut method. Statistical significance of B_4 indexes is based on one-tailed permutation test over observations' labels. Permutations are restricted to max = 10.000 due to computational limitations.
*** Significant at <0.0001 level; * Significant at <0.001 level (one-tailed).
Source: by author.

Results show that the B_4 indexes are significant in magnitude and in probability distribution for all the cumulative periods, except for the period comprising 2010 only. It indicates that the segregation of all $N = 44$ countries into $k = 4$ groups of different TP systems is consistent through the complete period of 2011-2016, i.e. groups contain substantially the same components thorough 2011-2016. With respect to the year 2010, we notice that this is the year of the publication of the OECD TP Guidelines (OECD, 2010). Since its publication, OECD guidelines have become the baseline TP standard for most of countries (Knoll & Riedel, 2014; Lohse, Riedel & Spengel, 2012). Notwithstanding, results in Table 1.2 indicate that 2010's OECD TP Guidelines are followed by modifications in countries' TP rules in the next year, and most of these modifications carry within-groups stability through subsequent years. In special, it suggests that 2010 may be considered a "learning" period when governments are able to analyse the new TP standard and implement suitable modifications into their domestic TP rules.

In summary, overall results indicate the existence of 4 relevant groups of TP systems through the period of 2010-2016, including the learning period of 2010 when OECD TP Guidelines are published. Groups have significant between-groups distances and are consistent through the complete post-learning period of 2011-2016.

1.4.3 Characteristics of TP Systems

Based on results in Figure 1 and Tables 1.1 and 1.2, we create a classification of 4 different TP systems and identify which are the main TP characteristics in each group. For initial descriptives, we combine all $C = 57$ variables into 10 sets of TP topics and compute the mean value of TP variables composing each set, for each group. We obtain a measure of the average contribution of each TP topic in each TP system, including min-max range. Values are presented in Table 1.3, all values are regularised. Since TP variables comprise qualitative and quantitative characteristics, groups-by-topics means in Table 1.3 are interpreted as overall frequency information, i.e. represent the number or extent of provisions related with each TP topic that can be observed in each TP system through the period of 2010-2016. Recall that countries are merged into groups based on the presence or absence of a number of characteristics among its components.

Table 1.3: Descriptive Means - Groups-by-Topics

	Average contribution of TP topics in each TP system											
	TP System #1			TP System #2			TP System #3			TP System #4		
TP Topics	mean	min	max	mean	min	max	mean	min	max	mean	min	max
1. Implementation of TP system	0.497	0.192	1.000	0.752	0.306	1.000	0.681	0.316	1.000	0.725	0.398	1.000
2. Related-party status	0.493	0.000	0.898	0.709	0.195	1.000	0.718	0.351	0.994	0.671	0.000	1.000
3. TP methods and comparables	0.689	0.000	1.000	0.684	0.130	1.000	0.745	0.125	1.000	0.556	0.000	1.000
4. Priority of TP methods	0.168	0.000	0.306	0.312	0.091	0.494	0.330	0.060	0.577	0.375	0.000	1.000
5. Provisions on internal services and cost-sharing arrangements	0.577	0.000	1.000	0.477	0.091	0.910	0.610	0.292	0.976	0.786	0.000	1.000
6. Disclosure of TP information	0.334	0.000	0.959	0.654	0.338	0.935	0.594	0.375	0.911	0.559	0.000	1.000
7. Statute of limitations	0.478	0.383	0.571	0.428	0.364	0.512	0.392	0.250	0.537	0.275	0.000	0.550
8. TP penalisation	0.140	0.000	0.367	0.312	0.094	0.662	0.316	0.089	0.726	0.717	0.500	1.000
9. Advanced-pricing agreements - APA (or APA-like provisions)	0.523	0.082	0.796	0.420	0.143	0.662	0.724	0.435	0.952	0.000	0.000	0.000
10. Competent authority - CA procedure	0.408	0.143	1.000	0.290	0.013	1.000	0.616	0.155	0.994	0.167	0.000	1.000
Countries:	CZ, HU, LU, PH, RC CH, TH			CL, CO, EC, FI, NO, PE, RU, SI, UA, VE, VN			AU, AT, BE, CA, CN, DE, FR, DE, GR, IN, ID, IE, IT, JP, MY, MX, NL, PL, PT, SK, ES, SE, UK, US			AR, BR		

This table presents descriptive groups-by-topics means for TP characteristics. It comprises the mean value of all $C = 57$ variables divided into 10 sets of TP topics, for each TP system. All means are regularised for the range [0,1]. Means are based on qualitative and quantitative TP characteristics described in Appendix A, thus implying data-frequency interpretation.
Source: by author.

Table 1.3 shows how TP systems diverge with respect to different TP topics. TP system #1 has lower values on topics related with implementation of TP rules, related-party status, priority of methods, TP disclosures and penalisation. TP system #2 has lower values on topics related with internal services and competent authority procedures, while has higher value for TP disclosure. TP system #3 has higher values on topics related with TP methods and rules of price-comparables, APA and competent authority procedures. TP system #4 has lower values on topics related with APA and competent authority procedures, and higher values on internal services and TP penalisation.

In further detail, we present the classification of TP systems and describe the specific characteristics that are most relevant in each system. Appendix A presents all $C = 57$ individual TP variables and their mean values.

TP System #1:

Components: Czech Republic, Hungary, Luxembourg, Philippines, Romania, Switzerland, Thailand.

Main Characteristics: Group with least formalised TP rules in domestic tax law. Traditional transactional-based methods are preferred by authorities. Countries follow mostly the principles of OECD guidelines together with general domestic provisions on restricted deductibility of non-operational expenditures; exceptions apply for the Czech Republic and Hungary which have older TP rules. Hence, there are no requirements for yearly TP disclosures, with exception of Czech Republic that implemented a short TP return in 2014. Also, these countries set the largest average deadline for documentation disclosure upon request, in comparison to the other TP systems.

On the other hand, most of these countries have a special statute of limitations for intentional non-compliance, representing twice the time of ordinary limitations. TP penalisation is low, with fixed penalties for failure in providing TP documentation. There are no penalty reliefs, with exception of Thailand.

Most countries provide bilateral APA or APA-like alternative, with current average term of 4 years and no rollback. Other competent authority procedures are prescribed in domestic regulations, however they are not effective in solving tax disputes.

TP System #2:

Components: Chile, Colombia, Ecuador, Finland, Norway, Peru, Russia, Slovenia, Ukraine, Venezuela, Vietnam.

Main Characteristics: Group with most recent TP rules in average. All countries adopt the OECD guidelines, but implement relevant domestic TP provisions that are substantially different from the baseline standards. In overall, domestic TP rules override OECD standards under each countries' tax system. Related-party status in each country is determined by a specific threshold regarding shareholders' investments or other type of relevant influence, with exception of Venezuela that has no formalised threshold. Most countries have dedicated provisions regarding transactions with tax havens, on which TP rules apply.

While all TP methods in OECD guidelines are accepted up to 2016, most countries have historically defined the CUP method as priority for tax assessments. From 2013 on, all countries implement a yearly tax return including TP information, however a TP return is required only for companies under specific conditions in most countries. Also, most of these countries determine variable tax penalties for failure in providing TP documentation, which is based on the amount of tax shortfall.

APA and APA-like procedures are available up to 2016, except in Norway and Slovenia. Average APA term is 4 years, and most countries allow unilateral agreements only. APA rollback allowed only in Colombia and Ecuador. Competent authority procedures are defined in some countries, however its implementation is not effective.

TP System #3:

Components: Australia, Austria, Belgium, Canada, China, Denmark, France, Germany, Greece, India, Indonesia, Ireland, Italy, Japan, Malaysia, Mexico, Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden, United Kingdom, United States.

Main Characteristics: Largest group with more traditional and mature TP rules. OECD guidelines adopted mostly in full via implementation into domestic legal system or direct application, with few complementary domestic provisions. Most countries have provisions with explicit mention to permanent establishments and how TP rules apply to them. Also, these countries have more detailed provisions with respect to deductibility of management fees, head-office expenses, internal services and cost-sharing/cost-contribution agreements.

TP methods defined in OECD guidelines are adopted in full, and the best TP method must be defined by the best-for-transaction approach. Set-offs and bundled transactions under OECD standards are mostly accepted by authorities. Filing of yearly TP return is required, with an extensive TP disclosure in most of countries; exception of Austria, Germany, Ireland, Sweden and United Kingdom, which focus on TP documentation and do not implement a TP return on periodic basis.

Bilateral APA procedures are well defined, with average term of 5 years and possible rollback for most of countries. Other competent authority procedures are also well structured, being usually applicable after a tax assessment that results in a potential tax difference. In most countries, the competent authority procedure suspends tax payments until conclusion of the tax dispute. Overall, the competent authority procedure is highly effective in avoiding double taxation.

TP System #4:

Components: Argentina, Brazil.

Main Characteristics: Small group with TP rules that are substantially distinct in comparison with the OECD TP Guidelines. Criteria for related-party status is wide, and there are specific TP rules applicable for transactions in tax havens. Bundled transactions and set-offs among intra-firm transactions are not allowed for TP purposes. Withholding tax is applicable for mostly all services across countries.

Both countries implement specific TP methods that are different from the OECD standards, and specific rules for the priority of methods are established domestically. Brazilian

TP methods are not based on the arm's length principle. Yearly tax returns with extensive TP information are mandatory, and TP documentation must be disclosed within 15 days in average, upon request. Also, these countries apply the highest tax penalties in comparison with other TP systems, ranging between 1.5-10 times the amount of unpaid tax.

APA and competent authority procedures are not implemented in these countries.

1.5 Conclusion

This study analyses TP rules across countries and creates a classification of TP systems based on similar TP characteristics. For the sample analysed, results indicate the existence of four relevant TP systems with different features. In our classification, TP system #1 can be considered the group with a principles-based adoption of OECD TP guidelines, since it refers to the least formalised TP rules, on which the assessment of intra-firm transactions is based on the core of OECD principles and on general tax provisions for non-deductible expenses. TP system #2 is considered the group with partial adoption, for it follows the OECD TP guidelines, but includes relevant modifications according to the domestic tax policy of each country. TP system #3 is the larger group that follows the traditional OECD standards, so to be called full adoption group, and TP system #4 is the smallest group with well-established TP rules that are substantially different from the OECD guidelines. Most relevant between-groups differences refer to provisions for the priority of TP methods, availability of APA or APA-like rules and effectiveness of competent authority procedures and other mutual agreements.

OECD BEPS Actions 8-10 propose the review of TP guidelines, with the main objective to align TP outcomes with value creation. Characteristics of TP systems identified in this study contribute to enhance the understanding of different factors that influence TP rules in each country. Our results may indicate governments' preferences on different anti-shifting mechanisms and the potential regulatory inconsistencies resulting from interaction between these rules. Specific domestic TP provisions may suggest the existence of special shifting arrangements which are not yet effectively addressed by the international TP standards, or the inability of some countries in implementing the general guidelines.

The present analysis provides a novel non-ordered classification of TP systems which develops from an analytic comparison of relevant TP characteristics. Results are statistically significant and consistent for the complete period of analysis. Our findings contrast with the predominant approach in current literature, which focus in determining different enforcement rankings for groups of countries. This approach is defined by the subjective assignment of discrete enforcement levels to a few TP provisions, however implying a ponderous limitation. Existing studies indicate that the tax enforcement is not directly represented by the existence of a certain tax rule, but it refers to the way each country ensures that taxpayers comply with this rule. Hence, association between tax enforcement and TP rules appears to be an empirical question.

2. COMPARING THE TRANSFER PRICING RULES AND THE PERCEPTION OF TAX ENFORCEMENT ACROSS COUNTRIES

This Section analyses the relation between the characteristics of transfer pricing rules and the perception of tax enforcement across countries. The assumption that more extensive tax rules imply in higher tax enforcement is a predominant basis of the current research on profit shifting. We focus in testing this assumption. Our sample comprises 12 countries for the period of 2013-2016. Results indicate that different measures for the tax enforcement perception are associated with different characteristics of transfer pricing rules, and several of these relations are not monotone continuous through the enforcement range. Significative relations are found for transfer pricing rules for related party status, mutual agreement procedures and tax penalisation. Interestingly, no strong relation is found for the effect of rules on documentation requirements. Our findings suggest that the baseline assumption in tax research may not be fully valid. Instead, is indicates that the characteristics of transfer pricing rules and the level of tax enforcement may provide different but complementary information about the effect of anti-shifting mechanisms on firms' tax-avoidance behaviour.

2.1 Introduction

Empirical research on corporate taxation has long focused on the investigation of profit shifting behaviour, as it becomes a key research matter over time. The increasing interest on this subject follows from the recent exposure of complex and aggressive tax schemes applied by multinational corporations, and from the public concerns about its effects over countries' tax revenues (Beer, De Mooji & Liu, 2018; Davies, Martin, Parenti & Toubal, 2018). Among several tax-avoidance strategies, it is known that multinational corporations perform intra-firm transactions in order to shift taxable profits from high-tax to low-tax jurisdictions, for the profit shifting is achieved by means of manipulation of internal transfer prices (TP). Empirical studies provide strong evidences supporting this practice (Davies, Martin, Parenti & Toubal, 2018; Cristea & Nguyen, 2016; Bernard, Jensen & Schott, 2006; Overesch, 2006; Bartelsman & Beetsma, 2003; Clausing, 2003; Swenson, 2001).

Current researches aim to analyse the profit shifting behaviour as a function of the cross-country tax differentials and the impact of countries' enforcement levels (Beer, De Mooji & Liu, 2018; Nicolay, Nusser & Pfeiffer, 2017; Marques & Pinho, 2016; Beuselink,

Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013). Relevant information about intra-firm transactions and tax rates are overall observable from public reports and from firms' financial statements, thus it is possible to obtain consistent measures for these factors. On the other hand, there is not a direct observable information about the tax enforcement level for a wide set of countries, and studies must rely on indirect information. The predominant approach is to use measures for the extent of TP documentation requirements and tax penalisation rules as proxies for tax enforcement (Beer, De Mooji & Liu, 2018; Ignat & Feleaga, 2017; Lohse & Riedel, 2013). In general, findings suggest a negative relation between these proxies and the profit shifting amounts, thus inferring that higher tax enforcement is effective in some degree.

This Section analyses the association between TP rules and the perception of tax enforcement level across countries. Our main objective is to test if the proxies predominantly applied by current profit shifting studies are appropriate to model the effect of the tax enforcement. Information about the perception of tax enforcement is obtained from the *OECD's Base Erosion and Profit Shifting (BEPS) initiative and the "Global Tax Reset"* annual surveys, which comprises information about 12 countries for the tax period of 2013-2016. Baseline analysis focuses on the creation of numerical TP indexes, imitating the prevailing approach in profit shifting literature. Further analyses are based on the comparison of the tax enforcement measures across groups of countries that share similar TP characteristics.

Results indicate that different variables for the perception of tax enforcement are associated with different TP characteristics, and several of these relations are not monotone through the complete range of the tax enforcement measure. We find that more specialised rules for related party status of companies, for advanced pricing agreements – APA, and for competent authority procedures are associated with the perception of higher tax enforcement across countries, for most of the enforcement measures. Moreover, we find that firms are more concerned with public interest in corporate taxation if they are subjected to more specialised penalisation rules and higher penalty rates. Interestingly, we find no significative relation between tax enforcement variables and differences in TP documentation requirements.

This study provides two major contributions for the current literature. First, it provides relevant findings about the traditional assumption in general tax research, namely that tax

rules reflect the enforcement of tax authorities. This assumption is commonly embraced since the tax enforcement is not an observable measure and must be modelled indirectly. Our analyses suggest that this assumption may not be fully valid. Results rather indicate that tax enforcement and TP rules are not associated with each other, thus implying in potential distinct effects over the profit shifting strategies by firms. In this case, using TP rules as proxies for tax enforcement may result in misleading conclusions.

Second, our analysis indicates that the effect of different TP rules is not fully captured by a numerical index, as the usual measure in profit shifting research (Beer & Loeprick, 2017; Ignat & Feleaga, 2017; Nicolay, Nusser & Pfeiffer, 2017; Marques & Pinho, 2016; Beuselink, Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013), since several TP rules refer to qualitative characteristics. Moreover, the assumption that a specific TP rule has a positive or negative effect within a numerical TP index is *ex ante* arbitrary. In this sense, we find that the application of a discrete approach for the analysis of different TP rules is more informative, regarding both the direction and the extent of the differences. This approach is straightforward applicable to the existing profit shifting research, therefore to provide new evidences of the effects of tax rules on the tax avoidance behaviour.

The remaining of this Section is structured as follows: Section 2.2 presents the literature on profit shifting and tax enforcement, Section 2.3 describes the data and research strategy, Section 2.4 presents the results, and Section 2.5 discusses some relevant points for conclusion.

2.2 Related Literature

Recent studies aim to analyse the impact of tax enforcement on the profit shifting behaviour of firms. Since the level of tax enforcement across countries is not directly observable, studies apply indirect measures to estimate this impact.

The paper of Lohse and Riedel (2013) is one of the first studies to create a special measure for the impact of TP rules on profit shifting. The study proposes an ordered 3-level categorisation of countries based on the existence of domestic TP rules and the extent of documentation requirements: category 1 includes countries with generic anti-shifting rules and no specific rules regarding TP documentation, category 2 includes countries with

domestic TP rules and general documentation requirements, and category 3 includes countries with domestic TP rules and strong documentation requirements. This 3-level categorisation assumes that the existence of TP rules and stronger documentation requirements imply in higher tax enforcement by countries. Sample comprises firm-level data from 26 countries for the period of 1999-2009. Results indicate that higher tax enforcement is associated with a reduction in profit shifting.

Beer and Loeprick (2015) investigate the determinants of cross-jurisdictional profit shifting across 34 countries for the period of 2003-2011. Among several firm-level variables, the study analyses the impact of TP documentation requirements by means of an indicator variable with value 1 for the presence of documentation requirements and 0 otherwise. Results suggest that intra-group profit shifting reduced after the implementation of documentation requirements by the home country.

Beuselink, Deloof and Vanstraelen (2015) also analyse the impact of tax enforcement on profit shifting, for a sample of 19 European countries for the period of 1998-2009. In this study, tax enforcement is measured by means of a numeric average score based on six dimensions of the tax environment: availability of double tax treaties, implementation of thin capitalisation rules, preferential treatment for holdings, prescription of tax losses carryforward, risk of tax audits, and disclosure requirements for related-party transactions. The study assumes that higher average scores correspond to higher tax enforcement. Results indicate that firms shift profits from high-tax to low-tax countries when the local tax enforcement is weak.

Marques and Pinho (2016) analyse the effect of TP enforcement on profit shifting in European countries. The study proposes a TP strictness index based on factors related with TP rules and law enforcement mechanisms. TP rules include four factors: statutory rules on TP principles, statutory rules on the application of TP rules, statutory documentation requirements, and non-regulated documentation requirements. Law enforcement mechanisms include seven factors: requirement of TP information on annual tax returns, special TP audit team in the country of residence, authorities effectively perform TP audits, penalties for absence of TP documentation, penalties for tax adjustments, and interests over tax adjustments. All factors are represented by an indicator variable with value 1 for the presence of the factor and 0 otherwise. TP strictness index is then computed as a weighted average of

all 11 factors, with different weights for each factor. The specific weights are obtained from a survey of tax specialists, which are asked to provide their individual assessment of the relevance of each factor. The resulting index assumes that the presence of these factors implies in higher tax enforcement. Sample comprises 33 countries for the period of 2001-2009. Overall results indicate that higher tax enforcement is associated with lower tax-gap sensitivity of reported earnings.

Nicolay, Nusser and Pfeiffer (2017) investigate if firms modify their profit shifting strategies after changes in the strictness of TP regulation and thin capitalisation rules. In this study, the main proxy for the level of tax enforcement is represented by the implementation and maturity of TP documentation requirements, under the assumption that older implementation implies higher tax enforcement. Their sample comprises 32 countries for the period of 2004-2014. Additional analyses include the effect of the TP categorisation as proposed by Lohse and Riedel (2013). Overall results suggest that higher tax enforcement is associated with a reduction in profit shifting. However, results also suggest that firms subjected to higher tax enforcement substitute transfer mispricing by debt shifting.

Beer and Loeprick (2017) also analyse the profit shifting behaviour on the oil and gas sector, for a sample of 12 countries for the period of 2004-2012. In this specific study, the existence of additional rent taxes for hydrocarbon producers motivates both the international and domestic profit shifting. The study analyses the impact of the maturity of TP documentation requirements, based on the assumption that TP rules implemented for longer periods imply in higher tax enforcement. Results indicate that the tax enforcement has a mitigation effect on international transfer-mispricing. However, higher tax enforcement is also associated with higher levels of domestic profit shifting.

In a separate study, Ignat and Feleaga (2017) propose a TP strictness index for countries, which is based on 13 elements of domestic TP rules. All elements refer to discrete factors that are associated mainly with the existence of TP documentation requirements, penalties for failures in TP documentation, evidences of TP disclosure, if the status of limitations is greater than 5 years, and if APA rules are available. The TP strictness index is then computed via weighted average of indicator variables related with these TP elements, thus to create a five-level categorisation of countries' TP strictness similar to the one proposed by Lohse and Riedel (2013). The TP strictness index is based on the assumption that the

presence of TP elements implies in higher strictness. The study suggests that the TP strictness decreases from the west to the east of Europe, and that countries may be divided into two regions, regarding low TP strictness in central-east Europe, and high TP strictness in south-west Europe.

In general, the assumption that the existence and the extent of TP rules imply in higher tax enforcement is clearly a predominant basis for the current profit shifting research. Most studies apply measures for the extent of documentation requirements and tax penalty rules for the creation of an enforcement index. In this line, we take it as an opportunity to test this assumption.

2.3 Data and Baseline Research Strategy

We build our sample based on the respondents of the *OECD's BEPS initiative and the "Global Tax Reset"* annual surveys, which are publicly available for the tax period of 2013-2016. These surveys are conducted by the audit firm Deloitte Touche Tohmatsu and are applied to tax managers and executives from several multinational companies, which are requested to provide their perceptions regarding relevant tax matters. According to the surveys' methodology, participants are requested to assess specific assertions by means of ordered 5-level discrete scale, varying from "strongly agree" to "strongly disagree". Surveys' results are available at the country level for $N = 12$ key countries and refer to the share of responses equal to "agree" or "strongly agree", with respect to total responses.

We use the surveys' responses to define numeric variables related to the perception of tax enforcement across countries. We select the following 6 assertions, thus to define the variables y_b, $B = 6 : b \in (1,\ldots,B)$, which, in our assessment, may provide information about the perception of tax enforcement:

y_1. "My organization has developed additional corporate policies and procedures in response to the increased scrutiny related to corporate taxation."

y_2. "I believe that tax structures implemented today are under greater scrutiny by tax administrations now than they would have been a year ago."

y_3. "In my country of residence, the tax authorities are becoming increasingly aggressive in tax examinations."

y_4. "My organization is concerned about the media, political and activist group interest in corporate taxation."

y_5. "Irrespective of legislative changes I believe that tax authorities will increase tax audit assessments globally as a result of the current BEPS debate."

y_6. "Greater scrutiny will be applied by tax authorities surrounding the level of substantive business operations conducted in low tax countries as a result of the BEPS initiatives in the future."

From the available responses, we obtain a sample panel of $N = 12$ countries, such that $i \in (1,\ldots,N)$, for the period of analysis of 2013-2016, $T = 4 : t \in (1,\ldots,T)$.

Information about TP rules across countries is collected from professional TP Guidelines prepared by the Big Four audit firms, which are widely applied in TP research, e.g. Ignat and Feleaga (2017), Nicolay, Nusser and Pfeiffer (2017), Marques and Pinho (2016), Lohse and Riedel (2013). We select 57 qualitative and quantitative TP characteristics that are directly observable, so to define our TP informative variables $v_k : k \in (1,\ldots,57)$. For qualitative characteristics, we set an indicator variable with value 1 for the presence of the characteristic and 0 otherwise. For quantitative characteristics, we use the numerical measure itself uniformly regularised over the variable range.

Informative variables v_k are then applied to define our main TP variables as follows. From all 57 TP characteristics k, we specify $C = 10$ different TP topics, which are based on the specific provisions of the TP systems. Following the research methods in current literature, we create a numerical TP index x_c for each TP topic, $x_c : c \in (1,\ldots,C)$, which is measured as a simple weighted sum of the TP informative variables included in each TP topic. The TP topic c is defined as a set of specific TP provisions k, therefore the TP index x_c is defined simply as

$$\forall k : \; x_c = \sum\nolimits_{k \in c} v_k.$$

Description of all TP characteristics and the $C = 10$ TP topics in Appendix E. Variables x_c thus imply the presence of a set of TP characteristics, $k \in c$. Remark that all TP characteristics k are mutually exclusive. Hence, we additionally define a full TP index x_{full} that includes all 57 TP characteristics and refers to the simple weighted sum of all variables v_k.

For the baseline analysis, we apply linear regression estimation, which is consistent with the predominant approach in profit shifting research (Beer, De Mooji & Liu, 2018). Current studies assume that some TP characteristics imply higher tax enforcement by tax authorities, e.g. higher tax penalties and more extensive documentation requirements may denote higher tax enforcement (Beer & Loeprick, 2017; Ignat & Feleaga, 2017; Nicolay, Nusser & Pfeiffer, 2017; Marques & Pinho, 2016; Beuselink, Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013). Therefore, assume the simple linear model

$$y_{bit} = \beta x_{cit} + \boldsymbol{\alpha} F + \varepsilon_{cit}$$

where y_{bit} is the tax enforcement variable with respect to the b-th assertion, $b \in (1,\ldots,B)$, for country i in year t, x_{cit} is the TP index with respect to the c-th TP topic, $c \in (1,\ldots,C)$, β is the main estimate parameter, F is a matrix of covariates to control for fixed individual and year effects, $\boldsymbol{\alpha}$ is the vector of within and between fixed effects estimates, and ε_{cit} is the residual term that is assumed to have normal distribution. Covariates to control fixed effects are necessary for our estimation since TP rules tend to be stable across time (Beer, De Mooji & Liu, 2018; Beer & Loeprick, 2017; Nicolay, Nusser & Pfeiffer, 2017; Lohse & Riedel, 2013).

Our interest is to investigate the main estimate parameter β. If it is significative, it means that there is a linear association between the TP index x_c and the tax enforcement variable y_b, thus the TP index x_c can be taken as an appropriate linear proxy to represent a continuous effect of the tax enforcement y_b on countries.

Besides the conventional analyses of statistical significance, we apply the traditional Chow test for structural breaks on the regression (Chow, 1960). The existence of structural breaks indicates that the relation between variables x_c and y_b is not linear or continuous (Greene, 2000), thus a different model specification is recommended. Moreover, we examine

the simple scatter plots of observed vs. fitted data, in order to observe if the data structure is consistent with our baseline research strategy.

2.4 Analysis

In this Section, we present the preliminary analyses regarding descriptive statistics and correlations, and the baseline regression results. Further in this same Section, we present complementary analyses based on the discretisation of the TP variables.

2.4.1 Descriptive Statistics and Correlation

Panel A in Table 2.1 presents the descriptive statistics for the tax enforcement variables y_b and the TP indexes x_c. Panel B in Table 2.1 presents the means for variables y_b and x_c separated by country.

Table 2.1: Descriptive Statistics

Panel A. Descriptive Statistics - by variable								
Variables	Description	mean	s.d.	min	max	*N*	*T*	v.r.
	Perception of tax enforcement:							
y_1	New tax policies	52.7771	13.3144	20.0000	83.0000	12	4	0-100
y_2	Increase in tax scrutiny	89.5500	7.7718	67.0000	100.0000	12	4	0-100
y_3	Aggressive tax audits	56.0833	23.7317	0.0000	100.0000	12	4	0-100
y_4	Media perception	74.1646	11.7326	38.0000	100.0000	12	4	0-100
y_5	BEPS: Audits increase	91.7500	7.3732	71.0000	100.0000	12	3[a]	0-100
y_6	BEPS: Increase in tax scrutiny	95.3611	4.5866	83.0000	100.0000	12	3[a]	0-100
	TP topics:							
x_1	Implementation of TP rules	2.5801	0.7786	0.9508	4.0000	12	4	0-4
x_2	Related-party status	3.4583	0.9818	2.0000	5.0000	12	4	0-5
x_3	TP methods and comparables	7.0000	1.0445	6.0000	9.0000	12	4	0-9
x_4	Priority of TP methods	1.6667	0.8349	0.0000	2.0000	12	4	0-4
x_5	Cost-sharing and internal services	3.7500	0.8660	3.0000	5.0000	12	4	0-7
x_6	TP documentation and disclosure	4.6532	1.4844	2.0000	6.6667	12	4	0-8
x_7	Statute of limitations	1.4333	0.6080	0.4500	2.4000	12	4	0-3
x_8	TP penalisation	1.9738	0.9736	0.1350	3.1800	12	4	0-6
x_9	APA rules	3.7622	1.3764	0.0000	4.7396	12	4	0-5
x_{10}	Competent authority procedures	3.2292	1.1153	1.0000	4.0000	12	4	0-6
x_{full}	All TP topics	33.0067	4.9991	22.1124	36.8518	12	4	0-57

Table 2.1 – Continued

Panel B. Means - by Country

	Countries													
Variables	AU	BE	CA	CN	DN	FR	DE	NL	NO	CH	UK	US	*T*	v.r.
y_1	48.96	40.75	58.78	67.33	46.23	48.20	55.83	64.50	52.58	51.33	58.83	39.98	4	0-100
y_2	91.75	97.25	92.20	84.50	84.15	88.18	92.50	90.58	81.50	89.50	91.18	92.33	4	0-100
y_3	69.33	46.50	81.43	70.08	80.20	58.15	70.58	20.68	48.08	38.23	42.00	47.78	4	0-100
y_4	79.83	80.75	75.10	79.65	78.90	78.83	64.33	73.33	53.33	71.48	76.83	77.65	4	0-100
y_5	94.33	96.33	96.67	93.67	91.67	87.33	86.33	84.00	91.33	95.00	90.67	93.67	3[a]	0-100
y_6	98.33	94.00	95.00	93.67	88.67	95.33	91.67	95.00	100.00	98.33	97.00	97.33	3[a]	0-100
x_1	2.70	2.20	2.36	3.14	2.36	2.65	3.68	2.27	2.33	0.95	2.33	4.00	4	0-4
x_2	3.00	3.00	3.75	4.00	3.75	5.00	4.00	3.00	2.00	3.00	5.00	2.00	4	0-5
x_3	8.00	6.00	7.00	7.00	7.00	6.00	8.00	6.00	6.00	6.00	8.00	9.00	4	0-9
x_4	2.00	2.00	2.00	1.00	2.00	1.00	2.00	0.00	0.00	0.00	1.00	1.00	4	0-4
x_5	4.00	3.00	3.00	5.00	3.00	3.00	4.00	5.00	3.00	4.00	3.00	5.00	4	0-7
x_6	5.06	5.00	6.67	4.76	6.33	5.58	3.67	4.89	5.94	2.00	2.33	3.61	4	0-8
x_7	1.20	1.65	1.05	1.50	0.80	0.45	1.90	0.75	1.70	1.50	2.40	2.30	4	0-3
x_8	2.20	2.20	2.04	2.00	3.05	3.18	3.04	1.10	0.14	0.44	2.18	2.14	4	0-6
x_9	4.32	4.03	4.57	4.58	3.00	3.57	2.57	4.57	0.00	4.74	4.57	4.57	4	0-5
x_{10}	4.00	4.00	3.50	3.00	4.00	3.25	4.00	4.00	1.00	1.00	4.00	3.00	4	0-6
x_{full}	36.48	33.13	35.93	35.97	35.29	33.68	36.85	31.58	22.11	23.63	34.81	36.62	4	0-57

Panel A presents the descriptive statistics for variables y_b and x_c, $B = 6 : b \in (1,\ldots,B)$, $C = 10 : c \in (1,\ldots,C)$, and for the full TP index x_{full}. Panel B presents the means for variables y_b and x_c separated by country. Variables y_b refer to the measure of the perception of tax enforcement across countries, based on the assertions described in Section 2.3, and refer to surveys' responses equal to "agree" or "strongly agree" at a country level. Variables x_c refer to the TP indexes, as described in Section 2.3. Column s.d. refers to the standard deviation; column v.r. refers the variable range, [inf-sup]. Description of all 57 TP characteristics *k* related with variables x_c is presented in Appendix E.

[a] Variables y_5 and y_6 are available for the period 2014-2016 only.

Source: by author.

Regarding the tax enforcement variables y_b, Panel A in Table 2.1 shows that firms' tax management have varying perceptions depending on different assertions, *b*. For example, variable y_2 has a high mean value of 89.55 and short standard deviation of 7.77, thus it shows that, on average, firms perceive an overall increase in scrutiny of tax structures by tax authorities. On the other hand, variable y_3 has a mean value of 56.08 and wider standard deviation of 23.73, thus indicating that not all firms perceive tax audits as increasingly aggressive. Moreover, variables y_5 and y_6 related with the impact of BEPS initiative have high mean values of 91.75 and 95.36 respectively, for it indicates that firms expect to face an increase in audit frequency and in scrutiny by tax authorities as a result of the current BEPS debate.

For the TP indexes x_c, Panel A in Table 2.1 shows some degree of heterogeneity across countries, with respect to some TP topics. For example, index x_3 referring to TP methods and

comparables has a mean value of 7.00 and varies between 6.00-9.00, despite having the widest variable range, [0.00-9.00]. It suggests that TP methods are substantially consistent across countries. On the other hand, index x_6 related with TP disclosures has a mean value of 4.65 and varies between 2.00-6.67 on a range of [0.00-8.00]. Hence, it suggests that TP documentation requirements might be heterogeneous across countries.

Panel B in Table 2.1 presents the mean values by country. For the tax enforcement variables y_b, we observe distinctive perceptions across countries. As an example, Netherlands and Switzerland have the lowest means for the variable y_3, with values 20.68 and 38.23 respectively, while Canada and Denmark have the highest means, with values 81.43 and 80.20 respectively. It indicates that firms have different perceptions regarding the aggressiveness of tax audits across countries.

For the mean TP indexes x_c by country, Panel B of Table 2.1 indicates how TP systems vary from one country to another. For example, Norway has a high index x_6 related with documentation requirements, with mean value of 5.94, while it has a low index x_8 related with tax penalisation, with mean value of 0.14. On the other hand, United Kingdom has a lower index x_6 related with documentation requirements, with mean value of 2.33, while it has a higher index x_8 related with tax penalisation, with mean value of 2.18. These differences may provide information about the preferences of different TP rules in each country.

Table 2.2 presents the pairwise correlations for variables y_b and x_c.

Table 2.2: Correlation Coefficients

Panel A. Perception of tax enforcement						
	y_1	y_2	y_3	y_4	y_5	
y_2	-0.01					
	0.07					
y_3	0.11	-0.19				
	0.75	*1.31*				
y_4	0.07	0.00	0.14			
	0.48	*0.00*	*0.96*			
y_5	-0.05	0.25	0.23	0.25		
	0.34	*1.75*	*1.60*	*1.75*		
y_6	-0.06	-0.13	-0.08	-0.01	0.36	
	0.35	*0.76*	*0.47*	*0.06*	*2.25*	*

Table 2.2 – Continued

Panel B. TP rules										
	x_1		x_2		x_3		x_4		x_5	
x_2	0.02									
	0.14									
x_3	0.66		0.06							
	5.96	**	*0.41*							
x_4	0.39		-0.28		0.28					
	2.87	**	*1.98*		*1.98*					
x_5	0.03		0.26		-0.11		-0.19			
	0.20		*1.83*		*0.75*		*1.31*			
x_6	0.17		0.13		0.46		0.13		0.13	
	1.17		*0.89*		*3.51*	**	*0.89*		*0.89*	

TP rules – Continued										
	x_1		x_2		x_3		x_4		x_5	
x_7	0.51		0.51		0.40		-0.17		0.09	
	4.02	**	*4.02*	**	*2.96*	**	*1.17*		*0.61*	
x_8	-0.07		0.18		0.25		0.39		-0.23	
	0.48		*1.24*		*1.75*		*2.87*	**	*1.60*	
x_9	0.39		0.38		0.37		-0.01		0.13	
	2.87	**	*2.79*	**	*2.70*	**	*0.07*		*0.89*	
x_{10}	0.35		0.25		0.42		-0.31		0.21	
	2.53	**	*1.75*		*3.14*	**	*2.21*		*1.46*	
x_{full}	0.57		0.52		0.62		0.18		0.39	
	4.71	**	*4.13*	**	*5.36*	**	*1.24*		*2.87*	**

TP rules – Continued										
	x_6		x_7		x_8		x_9		x_{10}	
x_7	-0.15									
	1.02									
x_8	0.02		0.21							
	0.14		*1.46*							
x_9	-0.10		0.73		0.37					
	0.68		*7.24*	**	*2.70*	**				
x_{10}	-0.03		0.76		0.13		0.68			
	0.20		*7.93*	**	*0.89*		*6.29*	**		
x_{full}	0.28		0.73		0.44		0.76		0.66	
	1.98		*7.24*	**	*3.32*	**	*7.93*	**	*5.96*	**

Panel A presents the Pearson correlation coefficients for pairwise correlation between the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$. Panel B presents the Pearson correlation coefficients for pairwise correlation between the TP indexes x_c, $C = 10 : c \in (1,\ldots,C)$, and the full TP index x_{full}. Variables y_b and x_c defined in Section 2.3 and Table 2.1. Correlation coefficients are computed for nested panels N-by-T of available data. Numbers in plain format refer to the nested Pearson correlation coefficients; numbers in italic refer to the t-statistics computed for the correlation coefficients, unsigned.

** Coefficient t-statistic is significant at a <0.01 level; * Coefficient t-statistic is significant at a <0.05 level.

Source: by author.

Panel A in Table 2.2 shows that the tax enforcement variables y_b are not correlated with each other, except for the variables y_5 and y_6, which refer to the perception of future effects from the BEPS initiative. It suggests that variables y_b provide different information on how countries enforce the application of tax rules and how firms perceive these enforcement measures.

Panel B in Table 2.2 presents the correlation coefficients for the TP indexes x_c. We observe that variables x_c are highly correlated with each other. In special, we observe that variables x_9 and x_{10}, referring to APA rules and CA procedures, are both correlated with each other and with variables x_1, x_2, x_3, x_7 and x_8. Variables x_1, x_2, x_3 and x_7 are also correlated with each other – they refer to the implementation of TP rules, related-party status, TP methods and statute of limitations, respectively. Besides, these variables are correlated with the full TP index x_{full}. All correlations are positive. Hence, it indicates that these TP indexes carry mutual information about the variation of TP systems across countries, despite all $C = 10$ TP topics being mutually exclusive by construction.

2.4.2 Baseline Regression Analysis

Table 2.3 presents the coefficient estimates for the baseline regression analysis.

Table 2.3: Regression Analysis – Coefficient Estimates

	Perception of tax enforcement: y_b											
TP index: x_c	y_1		y_2		y_3		y_4		y_5		y_6	
x_1	-7.22	‡ §	1.00		8.40		0.89		-0.83		-0.55	
	1.97	**	*1.39*		*3.28*	*	*1.95*		*1.71*		*0.72*	
x_2	4.37		-2.62		7.08		4.11		-0.05		-0.44	
	2.30		*1.55*		*3.53*		*1.93*	*	*1.11*		*0.80*	
x_3	-6.32	†	1.66		7.17		5.77	‡	0.75		-0.48	
	2.16	**	*1.23*		*3.23*	*	*1.45*	**	*0.97*		*0.56*	
x_4	1.17		2.34		-0.01		-2.08		-0.44		1.11	
	2.84		*1.98*		*4.57*		*3.36*		*2.07*		*1.50*	
x_5	-1.95		0.39		0.67		-3.32		1.44		0.57	
	1.83		*0.98*		*2.50*		*1.39*	*	*0.70*		*0.53*	
x_6	-5.99		-2.21		3.23		1.39		-0.23		-2.29	
	3.97		*2.24*		*6.30*		*3.98*		*2.44*		*1.61*	
x_7	-6.68	† §	0.78		10.74	†	5.88	‡	0.97		-0.78	
	1.94	**	*1.27*		*2.88*	**	*1.66*	**	*1.20*		*0.58*	
x_8	-1.12		0.96		-0.07		5.02	†	0.58		-0.01	
	1.74		*0.97*		*2.74*		*1.18*	**	*0.82*		*0.58*	
x_9	-5.32	‡	3.10		-5.23		6.29	†	-0.58		-0.83	
	2.06	*	*1.31*	*	*3.22*		*1.75*	**	*0.95*		*0.65*	
x_{10}	-12.05	†	3.21		12.12	‡	7.21	‡	2.23		-2.28	
	2.68	**	*1.80*		*4.30*	**	*2.31*	**	*1.41*		*0.79*	**
x_{full}	-1.57	†	0.42		1.55		1.43	†	0.26		-0.15	
	0.46	**	*0.27*		*0.76*	*	*0.32*	**	*0.23*		*0.13*	
N	12		12		12		12		12		12	
T	4		4		4		4		3[a]		3[a]	

This table presents the coefficient estimates for the linear regression between the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP indexes x_c, $C = 10 : c \in (1,\ldots,C)$, and the full TP index x_{full}. Variables y_b and x_c defined in Section 2.3 and Table 2.1. Regression model defined in Section 2.3. Numbers in plain format refer to the regression coefficients; numbers in italic refer to the coefficients' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency (White, 1980). Regression model includes fixed controls at the individual and year levels – within and between fixed effects estimates. Coefficients for within effects estimates (untabulated) are significative at a <0.05 level for virtually all linear relations with significant F-statistics. The Chow test (Chow, 1960) is applied for regression outputs with significant F-statistics. The Chow test is applied on different interquartile intervals through the whole domain of the TP indexes.

[a] Variables y_5 and y_6 are available for the period 2014-2016 only.

** Coefficient t-statistic is significant at a <0.01 level; * Coefficient t-statistic is significant at a <0.05 level.

† Regression F-statistic is significant at a <0.01 level; ‡ Regression F-statistic is significant at a <0.05 level.

§ Chow test F-statistic is significant at a <0.05 level.

Source: by author.

First, Table 2.3 shows that the regression analyses are significative for the tax enforcement variables y_1, y_3 and y_4 only, which refer to firms' perception of tax enforcement reflected respectively in the adoption of new tax policies, in the perceived increase in audit aggressiveness, and in the perception of increasing media interest about corporate tax matters.

Regarding the variable y_1 for firms' new tax policies, estimates are significative for variables x_1, x_3, x_7, x_9 and x_{10}, and for the full TP index x_{full}. The outcome is expected since these TP indexes are highly correlated with each other – see correlation analysis in Table 2.2.

We observe that the estimates are negative, thus suggestingx' that firms are less responsive in changing their tax policies as a result of increasing tax scrutiny if TP rules are more specialised. Nonetheless, we also observe the existence of structural breaks on the regressions for the variable y_1, specifically for variables x_1 and x_7. It indicates that the relation between variables y_1 and x_c is not linear or continuous.

For the variable y_3 referring to the aggressiveness of tax audits, Table 2.3 shows significative positive estimates for the TP indexes x_7 and x_{10}, regarding the statute of limitations and CA procedures. It indicates that firms perceive more aggressiveness in tax inspections in countries that establish a longer statute of limitations, and in countries where CA procedures are well established. It is interesting to see here that no significant results are found between the audit aggressiveness variable y_3 and the TP indexes x_6 and x_8 related respectively with TP documentation requirements and tax penalisation, i.e. these are the traditional proxies of tax enforcement that are widely applied in profit shifting research (Beer & Loeprick, 2017; Nicolay, Nusser & Pfeiffer, 2017; Marques & Pinho, 2016; Beer & Loeprick, 2015; Lohse & Riedel, 2013).

With respect to the variable y_4 related with the media interest in corporate taxation, we find significative estimates for the TP indexes x_3, x_7, x_8, x_9 and x_{10}, and for the full TP index x_{full}. Estimates are positive, thus suggesting that firms subjected to more specialised TP rules are concerned about the public opinion on corporate taxation.

In addition to the outputs in Table 2.3, we also inspect the scatter plots of observed vs. fitted data resulting from the regression estimates between variables y_b and x_c. Figure 2 shows the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the full TP index x_{full}. Appendices F-to-O show the scatter plots regarding the individual TP indexes $x_c : c \in (1,\ldots,C)$.

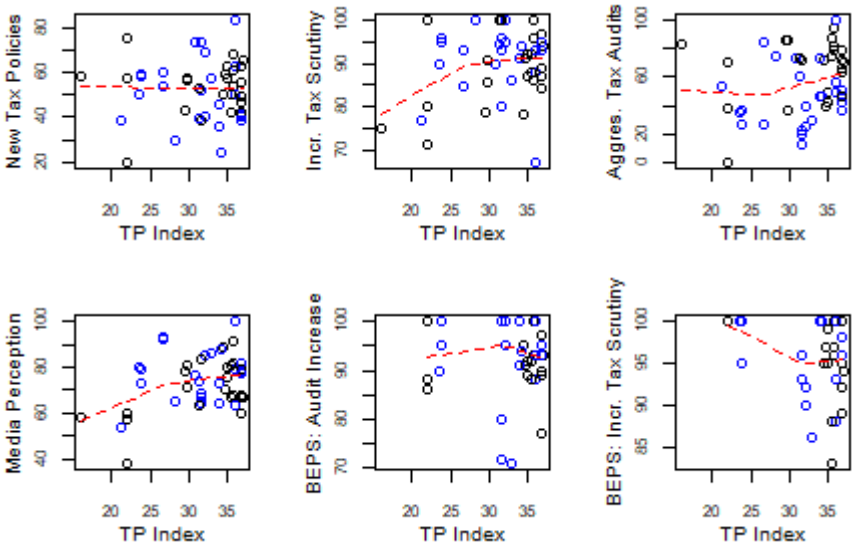


Figure 2: Tax enforcement variables y_b and TP index x_{full} – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the full TP index x_{full}. Variables y_b and x_{full} defined in Section 2.3 and Table 2.1.
Source: by author.

In Figure 2, observations are rather dispersed away from the fitted lines in all 6 plots. Although Table 2.3 presents significative estimates for the full TP index x_{full} regarding variables y_1 and y_4, the plots for both estimates display agglomerated observations in the last quarter of the TP-index range. The same pattern is observed in the other individual TP indexes, e.g. Appendix M.

Moreover, graphical inspection of Appendices F-to-O indicates that most of the data regarding the TP indexes is not homogeneously distributed through the variable range, but they follow a discrete structure, e.g. see Appendices G-to-I. This is due since most of the TP characteristics in our analysis are qualitative, for which the TP informative variable v_k is defined as an indicator variable for the presence of the characteristic k. In this case, TP indexes become categorical variables, for the relation between variables y_b and x_c is not continuous.

In overall, regression results indicate the existence of a relation between the perception of tax enforcement by firms and some of the TP characteristics measures by our TP indexes. Significant relation is found for variables y_1, y_3 and y_4, referring to the adoption of new tax policies by firms, perception of tax aggressiveness and media interest in corporate taxation, respectively. However, results in Table 2.3 also show a structural break on the linear estimates for variable y_1, thus suggesting that the relation between variables y_b and x_c is not linear. Moreover, inspection of the scatter plots in Appendices F-to-O indicate that most of the TP

variables are categorical, since they reflect qualitative TP characteristics. Therefore, it suggests that the effect of different TP characteristics is not appropriately measured by a numerical TP index, for it is better suited for a discrete approach.

2.4.3 Discrete Analysis of Groups of Countries

Instead of creating numerical TP indexes for each TP topic (Beer & Loeprick, 2017; Ignat & Feleaga, 2017; Nicolay, Nusser & Pfeiffer, 2017; Marques & Pinho, 2016; Beuselink, Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013), we compare the TP systems across countries in order to create groups of countries based on different TP characteristics. These groups do not follow a numerical ordered sequence but refer only to the outcome of merging countries based on similar TP rules. This approach changes the focus of analysis from the TP variables to the groups of countries.

We first compute the pairwise differences on TP rules between countries i,j, for $N = 12 : i,j \in (1,\ldots,N)$, for the TP informative variables v_k nested with respect to the $C = 10$ TP topics, for the complete period of 2013-2016, $T = 4 : t \in (1,\ldots,T)$. Pairwise differences are computed by means of the traditional Gower (1971) measure for mixed variables

$$s_{ijc} = \frac{\sum_{k \in c} \sum_{t=1}^{T} \delta_{ijkt} \pi_{ijkt}}{\sum_{k \in c} \sum_{t=1}^{T} \delta_{ijkt}}$$

$$d_{ijc} = \sup_{(i,j) \in N}(s_{ijc}) - s_{ijc}$$

Dissimilarity measure d_{ijc} is a weighted mean of the contribution of informative variable $v_k : k \in (1,\ldots,57)$ in TP topic c, for the differences between countries i,j in year t. Indicator δ_{ijkt} takes value 0 for missing variables, and value 1 otherwise. If the informative variable v_k is binary, contribution π_{ijkt} takes value 0 if it is equal for both observations, and value 1 otherwise. If the informative variable v_k is continuous, contribution π_{ijkt} is the absolute difference between observations i,j in year t, regularised by total range of the informative variable v_k. All informative variables v_k take the same weight within the dissimilarity d_{ijc}.

Pairwise dissimilarities d_{ijc} are then compared via hierarchical clustering method. We follow the average linkage approach, which is appropriate for analysis of pairwise distances while controlling for the effect of groups sizes during each clustering stage (Legendre &

Legendre, 2012; Gordon, 1987). Countries are merged to create from 2-to-6 groups by means of simple tree cut.

For our analysis, we compare the tax enforcement measures y_b across groups of countries. We apply the traditional analysis of between-groups variance – ANOVA to test for global significative differences. ANOVA is a robust method even if normality and homoscedasticity assumptions are not met (Lix, Keselman & Keselman, 1996; Harwell, Rubinstein, Hayes & Olds, 1992; Glass, Peckman & Sanders, 1972). We apply the *post-hoc* Tukey test (Tukey, 1949) to identify pairwise differences if global differences are found. We apply the Games-Howell correction (Games & Howell, 1976) on the *post-hoc* Tukey test if pairwise differences have unequal variances.

We focus in identifying if the perception of tax enforcement is different across groups of countries. If this is the case, it means that the set of TP characteristics, $\forall k \in c$ that contribute for the merging of countries into separate groups can be considered as an appropriate proxy to model the effect of the perception of tax enforcement across groups of countries.

For the preliminary examination, it is interesting to compare the clustering structure created from the analysis of all the TP characteristics v_k with the structure based on the analysis of all the tax enforcement variables y_b. Dissimilarity measures for both variables v_k and y_b follow the Gower (1971) measure. If both clustering structures are correlated, it indicates that both the tax enforcement variables y_b and the TP informative variables v_k provide similar information regarding the data (Legendre & Legendre, 2012; Gordon, 1987). We apply the Mantel correlation test (Mantel, 1967) to investigate if pairwise distances with respect to variables y_b and v_k are correlated.

Figure 3 presents the scatter plot for the correlation between pairwise distances regarding variables y_b and v_k. Appendix P presents the dendrograms obtained from the hierarchical clustering for both variables y_b and v_k.

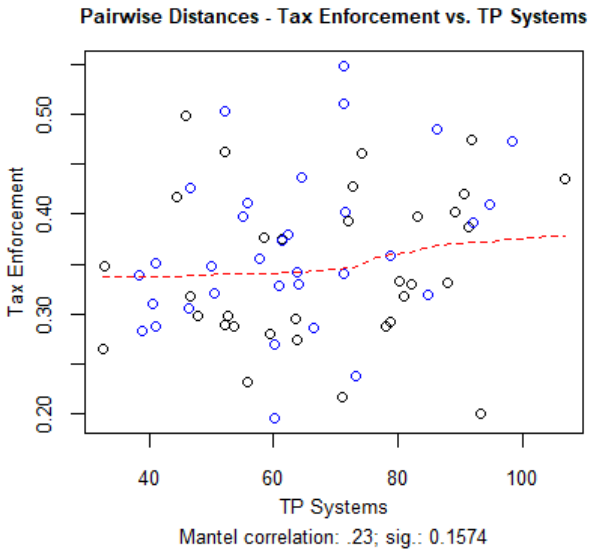


Figure 3: Pairwise Distances – Tax Enforcement vs. TP Systems. This figure presents the scatter plot for the correlation of pairwise distances regarding the tax enforcement variables y_b and the TP variables v_{fk} Red dashed line refers to the fitted correlation. Mantel correlation coefficient follows the method in Mantel (Mantel, 1967) considering max = 1,000,000 permutations within observations. Pairwise distances are computed based on the Gower (1971) measure, as described in Section 2.3.
Source: by author.

Figure 3 shows that the correlation data is sparse, and the slope of the fitted correlation in red dashed line on the plot is barely inclined. In addition, the Mantel correlation coefficient of 0.23 is not significative at a <0.05 level, with sig. = 0.1574. Hence, it indicates that the variables referring to the perception of tax enforcement by firms is not correlated with the TP characteristics across countries at a global level. This outcome is reinforced by the clustering outcomes presented in Appendix P.

The main analysis of the perception of tax enforcement across groups of countries is presented in Table 2.4, while the individual *post-hoc* tests are presented in Table 2.5. In order to obtain a detailed analysis, we focus in examining the results in Tables 2.4 and 2.5 jointly.

Table 2.4: Between-groups ANOVA – F-statistics

		Perception of tax enforcement: y_b					
TP topic c	n.g.	y_1	y_2	y_3	y_4	y_5	y_6
TP topic 1	2	0.05	0.00	2.55	0.23	0.63	1.39
	3	0.12	0.01	1.66	0.13	0.31	0.90
	4	0.41	0.60	1.69	0.90	0.20	0.58
	5	0.31	0.78	1.51	0.66	0.48	0.43
	6	1.47	1.22	1.31	0.82	0.47	0.34
TP topic 2	2	0.00	5.09 ‡	0.49	19.06 †	0.01	3.60
	3	1.43	4.01 ‡	6.36 †	9.40 †	0.19	4.09 ‡
	4	3.27 ‡	3.24 ‡	4.23 ‡	6.54 †	0.45	2.84
	5	2.54	2.39	5.92 †	5.00 †	0.50	3.22 ‡
	6	1.97	2.09	4.63 †	3.96 †	0.42	2.78 ‡
TP topic 3	2	1.30	1.31	0.16	0.70	0.40	0.25
	3	1.03	0.67	0.11	0.60	0.89	0.12
	4	0.75	0.47	3.45 ‡	1.19	0.64	0.29
	5	1.31	0.35	3.21 ‡	1.60	0.86	0.78
	6	2.04	0.55	4.55 †	1.83	0.70	0.85
TP topic 4	2	0.88	0.50	5.45 ‡	0.03	1.48	0.02
	3	2.45	0.57	2.83	0.21	0.89	0.29
	4	3.68 ‡	0.88	2.65	0.51	0.72	0.31
	5	3.49 ‡	0.99	1.95	0.38	0.95	0.24
	6	3.46 ‡	0.80	5.56 †	0.30	1.07	0.19
TP topic 5	2	0.59	0.36	0.96	1.26	0.25	0.05
	3	0.35	0.32	2.83	2.15	0.44	0.38
	4	0.40	0.26	2.48	1.41	0.81	0.75
	5	0.31	0.20	1.96	1.07	0.65	0.62
	6	0.49	0.25	2.04	0.88	1.02	0.48
TP topic 6	2	2.01	0.81	1.60	3.37	0.00	0.49
	3	1.25	0.59	1.68	1.66	2.73	1.67
	4	0.82	0.41	1.42	2.79	1.79	1.32
	5	0.77	0.71	1.99	2.08	1.32	0.98
	6	0.77	0.56	1.63	1.66	1.02	1.02
TP topic 7	2	0.03	0.70	2.97	11.89 †	0.26	5.61 ‡
	3	1.13	1.41	5.00 ‡	6.36 †	0.16	3.68 ‡
	4	1.05	1.68	6.68 †	4.20 ‡	0.26	2.65
	5	2.73 ‡	1.67	6.13 †	3.39 ‡	1.30	1.95
	6	2.14	1.61	4.89 †	2.71 ‡	1.78	2.45
TP topic 8	2	0.00	5.09 ‡	0.49	19.06 †	0.01	3.60
	3	0.11	2.70	0.99	14.18 †	0.90	2.77
	4	0.58	2.81	1.88	9.40 †	0.97	3.60 ‡
	5	0.44	2.24	1.90	6.89 †	0.85	4.04 †
	6	1.39	2.33	1.65	5.85 †	0.82	3.13 ‡
TP topic 9	2	1.71	5.59 ‡	0.44	4.52 ‡	0.55	2.30
	3	2.81	2.76	2.02	6.06 ‡	0.27	2.81
	4	5.15 †	2.81	2.07	4.30 †	0.85	1.96
	5	3.78 ‡	2.33	1.52	3.21 ‡	0.67	1.68
	6	2.91 ‡	1.82	1.62	2.57 ‡	0.63	1.35

Table 2.4 – Continued

TP Topic c	n.g.	Perception of tax enforcement: y_b											
		y_1		y_2		y_3		y_4		y_5		y_6	
TP topic 10	2	0.22		0.62		1.65		3.21		1.81		2.20	
	3	0.73		0.91		8.00	†	8.44	†	1.43		2.54	
	4	0.84		0.88		7.19	†	5.50	†	1.41		2.04	
	5	0.81		0.79		5.30	†	4.61	†	1.63		1.51	
	6	0.98		1.21		5.30	†	6.18	†	1.65		1.63	
All topics	2	0.03		2.70		2.97		11.89	†	0.26		5.61	‡
	3	0.03		1.66		1.45		6.07	†	0.45		2.91	
	4	0.02		1.89		1.07		6.72	†	0.41		1.96	
	5	0.07		1.44		1.10		7.48	†	0.63		1.81	
	6	1.92		1.62		1.26		5.87	†	0.49		1.66	
Obs.: N x T		48		48		48		48		36[a]		36[a]	

This table presents the F-statistics for the ANOVA regarding the comparison of the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$ across groups of countries. All the $N = 12$ countries are merged into groups based on the comparison of TP characteristics k via hierarchical clustering method. TP characteristics are nested into $C = 10$ TP topics, for $\forall k \in c : c \in (1,\ldots,C)$. Variables y_b and TP topics c defined in Section 2.3 and Table 2.1. Column n.g. shows the number of groups of countries, for 2-to-6. Aggregation of countries into separate groups is based on simple tree cut method.

[a] Variables y_5 and y_6 are available for the period 2014-2016 only.

† F-statistic is significant at a <0.01 level; ‡ F-statistic is significant at a <0.05 level.

Source: by author.

Table 2.5: *Post-hoc* analysis – Tukey test

Panel A. Tax enforcement variable y_1: New tax policies						
TP topic *c*	max n.g.	Levene test F-stat.		p.c.	difference	s.e.	
TP topic 2	4	0.9645		3-2	15.5000	5.0803	*
TP topic 4	6	1.9983		6-4	-27.3500	8.3819	*
TP topic 9	6	1.3998		4-2	26.5750	8.5596	*
				6-4	-27.3500	8.5596	*
Panel B. Tax enforcement variable y_2: Increase in tax scrutiny						
TP topic *c*	max n.g.	Levene test F-stat.		p.c.	difference	s.e.	
TP topic 2	4	1.1280		4-2	-13.2875	4.4522	*
TP topic 8	2	1.5934		2-1	-8.7818	3.8929	*
TP topic 9	2	7.1540	‡	2-1	-5.1158	3.2672[a]	
Panel C. Tax enforcement variable y_3: Aggressive tax audits						
TP topic *c*	max n.g.	Levene test F-stat.		p.c.	difference	s.e.	
TP topic 2	6	2.1694		3-1	32.8271	7.6988	**
TP topic 3	6	1.4669		2-1	-29.8688	7.1484	**
TP topic 4	6	2.9511	‡	2-1	-17.7583	6.7198[a]	*
				3-1	11.4750	4.9531[a]	*
				5-1	-49.2750	5.5159[a]	**
				6-1	-22.1750	6.8632[a]	**
				3-2	29.3333	5.0679[a]	**
				5-2	-31.5167	5.6192[a]	**
				5-3	-60.7500	3.3095[a]	**
				6-3	-33.6500	5.2565[a]	**
				5-4	-49.4000	11.4780[a]	**
				6-5	27.1000	5.7899[a]	**
TP topic 7	6	0.9240		5-1	-39.7917	11.5239	*
				5-3	-43.9250	12.2229	*
				5-4	-48.9667	11.5239	**
TP topic 10	6	2.3748		4-1	-48.6875	10.9861	**
				5-2	-6.4250	10.9861	*
				4-3	-49.9000	13.8964	*

Table 2.5 – Continued

Panel D. Tax enforcement variable y_4: Media perception						
TP topic *c*	max n.g.	Levene test F-stat.	p.c.	difference	s.e.	
TP topic 2	6	0.9115	5-1	-21.5500	5.9063	**
			5-2	-27.4250	7.2338	**
			5-3	-21.1688	5.7188	**
			5-4	-24.5000	6.2646	**
			6-5	24.3250	7.2338	*
TP topic 7	6	0.8426	6-1	-16.3667	4.9264	*
TP topic 8	6	0.5800	6-1	-26.9625	5.8358	**
			6-2	-22.3458	5.1467	**
			6-3	-25.5750	6.7386	**
			6-4	-25.5000	6.7386	**
TP topic 9	6	1.0027	5-1	-12.2400	4.5428	*
			5-2	-18.3500	6.6500	*
			5-4	-17.2500	6.6500	*
			6-5	15.2500	6.6500	*
TP topic 10	6	0.3473	5-1	-25.3188	5.2661	**
			5-2	-24.9125	5.2661	**
			5-4	-20.0000	6.6611	*
All topics	6	1.2499	4-1	-24.3250	5.0892	**
			4-2	-26.3250	6.7323	**
			6-4	24.3250	6.7323	**
Panel E. Tax enforcement variable y_6: BEPS: Increase in tax scrutiny						
TP topic *c*	max n.g.	Levene test F-stat.	p.c.	difference	s.e.	
TP topic 7	3	3.0246	3-2	5.5667	2.0632	*
TP topic 8	6	1.2203	6-3	11.3333	3.2788	*
All topics	2	4.8639 ‡	2-1	4.5667	1.1819[a]	**

This table presents the results for the *post-hoc* Tukey test (Tukey, 1949) of the differences in the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$ across groups of countries, for each of the c TP topic, $C = 10 : c \in (1,\ldots,C)$, and for all topics. *Post-hoc* test follows from the main ANOVA results presented in Table 2.3. Results are divided into Panels A-E for different tax enforcement variables y_b. Test for variable y_5 is omitted since ANOVA results in Table 2.3 are not significative for this variable. Variables y_b and TP topics c defined in Section 2.3 and Table 2.1. Column max n.g. refers to the maximum number of groups analysed in Table 2.3, assuming segregation of countries into 2-to-6 groups; column p.c. indicates the groups' pairwise comparison. Games-Howell correction is applied if the differences have unequal variances (Games & Howell, 1976), following from Levene test (Levene, 1960). This table includes significative results only, for brevity of disclosure.

[a] Difference t-statistic is adjusted via Games-Howell correction (Games & Howell, 1976).

** Difference t-statistic is significant at a <0.01 level; * Difference t-statistic is significant at a <0.05 level.

‡ Levene test F-statistic is significant at a <0.05 level.

Source: by author.

Firstly, we observe that Table 2.4 presents significative outcomes regarding all tax enforcement variables y_b, except for variable y_5 regarding the increase in tax audits as a result of the BEPS initiative.

For the variable y_1 referring to the adoption of new tax policies by firms, Table 2.4 shows significative differences for TP topics 4 and 9, related with provisions on the priority of TP methods and with APA rules respectively. Results are stable for the segregation of countries into 4-to-6 groups in both cases. Regarding TP topic 4, Panel A in Table 2.5 shows a significative result for the pairwise comparison 6-4 only. It suggests that these two groups of countries are located each at opposite extrema of the difference range, while other separate groups are located in-between them. Regarding TP topic 9, Panel A in Table 2.5 shows significative results for pairwise comparisons 4-2 and 6-4. Since the difference is positive for the common group n.4, it means that this specific group has a significatively higher measure for the variable y_1 than the other groups. Hence, it suggests that there is a separate group of countries with specific APA rules that implemented new tax policies in a greater extent than the other countries.

With respect to the variable y_2 regarding the perceived increase in scrutiny by tax authorities, Table 2.4 shows significative differences for TP topic 2, which refers to tax provisions on related party status. The result is consistent for the segregation of countries into 2-to-4 groups. Panel B in Table 2.5 shows that the difference is negative and significative for the pairwise comparison 4-2. In this case, results suggest that we obtain two distinct groups of countries that share similar rules for related party status, which diverge in their perception of increasing tax scrutiny. However, this difference vanishes across groups as the clustering structures become more detailed, i.e. as the number of groups increase.

For the variable y_3 related with the perception of more aggressive tax audits, Table 2.4 shows significative differences for TP topics 2, 3, 4, 7 and 10; these topics refer respectively to the provisions on related party status, TP methods and comparables, priority of TP methods, the statutes of limitations, and the competent authority procedures. Results are consistent for the segregation of countries up to 6 groups in all cases. For the TP topics 2 and 3, Panel C in Table 2.5 shows significative results for single pairwise comparisons in each case, i.e. comparisons 3-1 and 2-1 respectively. Regarding TP topics 7 and 10, we have significative results for multiple pairwise comparisons, i.e. for TP topic 7, significative comparisons are 5-1, 5-3 and 5-4, while for TP topic 10, significative comparisons are 4-1, 5-2 and 4-3. At last, for TP topic 4 analysed via Games-Howell correction (Games & Howell, 1976), most of the pairwise comparisons become significative. In summary, detailed analysis in Tables 2.4 and 2.5 indicates that the perception of tax audit aggressiveness by firms has a wide variance

across countries, and we obtain different grouping structures depending on which TP characteristics are taken into account. It suggests that the variable y_3 and the TP rules provide different information about countries, thus TP rules are not appropriate proxies to model the effect of the aggressiveness of tax audits.

Regarding the variable y_4 referring to the interest of media and public groups on corporate taxation, Table 2.4 provide significative results for TP topics 2, 7, 8, 9 and 10, and for all TP topics combined; the individual topics refer respectively to provisions on related party status, the statutes of limitations, TP penalisation, APA rules, and the competent authority procedures. Results are significative for the segregation of countries from 2-to-6 groups with respect to all TP topics. Panel D in Table 2.5 shows that the difference is negative for all significant pairwise comparisons, for all TP topics. Moreover, we observe that all pairwise comparisons share a single common group within each TP topic, e.g. for TP topic 2, the common group n.5, and for TP topic 8, the common group n.6. In this special case, it suggests that there is a particular group of countries for which the media perception y_4 is significatively different from the other countries.

For the variable y_6 referring to the greater scrutiny of firms' transactions with low tax countries following from the BEPS initiative, Table 2.4 presents significative results for TP topics 7 and 8, which refer to provisions on the statute of limitations and TP penalisation, respectively. Results in Table 2.4 are also significative for the analysis of all TP topics combined. From Panel E in Table 2.5, all three cases indicate relevant differences for the merging of countries in two separate groups. However, all differences vanish for further segregation of countries.

In overall, results in Tables 2.4 and 2.5 indicate that the tax enforcement variables y_b and the TP characteristics k provide distinct information about the tax attributes of each country. The outcomes from the comparison of the perception of tax enforcement across groups is directly affected by both the tax enforcement measure and the clustering criteria. In our analysis, comparison of the enforcement measures related with firms' new tax policies y_1 and the media interest on corporate taxation y_4 are stable for variations in the number of groups of countries. On the other hand, the tax enforcement level obtained from the perceived tax scrutiny y_2 is not significatively different across countries if the grouping structures become

more detailed. For the tax audit aggressiveness y_3, firms display varying perceptions that are not associated with a single TP characteristic.

Recalling the regression results from Table 2.3, we observe that focusing on groups of countries as the main unit of analysis provides additional information about the relation between variables y_b and v_k, as we overcome the continuity and linearity assumptions. In addition to finding new significative relations between variables, the discrete approach adopted in this Section reveals further details about the extent to which countries differ. Nonetheless, overall results from both the regression analysis and ANOVA provide convincing evidences that the effect of tax enforcement across countries is not fully reflected by the domestic TP rules, and that both factors may bring complementary information for the empirical research on profit shifting.

2.5 Discussion and Conclusion

Results presented in Section 2.4 allow us to analyse if TP rules are appropriate proxies for the effect of tax enforcement across countries. We observe varying relations regarding different TP variables, and these relations are not consistent for all the tax enforcement measures analysed in this Section. We raise some points for discussion.

In first, we decide to test six enforcement variables y_b which refer to different ways the tax enforcement is perceived by firms, e.g. how firms react to audit scrutiny, y_1, or their concerns about the public interest on corporate taxation matters, y_4. In this line, weak correlation between the six enforcement variables is not surprising. Results in Tables 2.3-2.5 reflect this variation. There remains the difficult task to define which are the variables y_b that most properly represent the real tax enforcement across countries.

Second, our results clearly suggest that the extent of TP documentation requirements is not related with the level of tax enforcement, for it rejects a relevant assumption in profit shifting research (Beer & Loeprick, 2017; Ignat & Feleaga, 2017; Nicolay, Nusser & Pfeiffer, 2017; Marques & Pinho, 2016; Beuselink, Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013). It is not to say that TP documentation is not important, as the complete absence of supporting documents would certainly harm any attempt to impose anti-shifting regulations. It rather suggests that countries have varying necessities and preferences regarding TP rules,

so they opt for different mechanisms to reach similar enforcement levels. It also reinforces the hypothesis that TP rules produce different impacts in different countries. In this viewpoint, the tax enforcement is more properly understood as the set of general measures applied by governments to ensure that firms comply with the TP rules.

Third, results suggest that specialised rules related with APA and competent authority procedures may be related with higher levels of tax enforcement. We remark that these both rules invoke a mutual interaction between the taxpayers and the tax authority, and it naturally requires some flexibility degree from both parts to reach an agreement (Becker, Davies & Jakobs, 2017). In this case, the association may be twofold. From one side, these countries may actually bear a higher enforcement level, and the existence of mutual agreement rules reflects a distinctive characteristic of them. On the other side, this outcome may reflect a simple perception of firms, following from the interaction with tax authorities in order to apply these rules. A thorough analysis of this special case may provide further clarification of this impact.

In overall, our findings show that information regarding TP rules and tax enforcement are significantly distinct, hence using one as proxy for the other may result in misleading conclusions. Instead, we understand that both factors provide complementary information and can be combined in further empirical investigations, thus to improve our understanding of how each factor influences the profit shifting practice. Moreover, our findings show that firms reveal various perceptions of tax enforcement, each of which may affect the tax avoidance behaviour in different ways. This motivates further studies about firms' responses against different anti-avoidance measures, and encourages us to keep searching for new information sources about the tax enforcement across countries.

The present study is not free of limitations. Mainly, the specificity of our dataset may be a reserve, for it weights against a broad generalisation of the results. Nonetheless, we emphasise that this unique dataset provides original information about how firms perceive the enforcement of tax authorities. In our assessment, this direct feedback from firms has the advantage to provide quality information that more appropriately reflects the level of tax enforcement across countries. We take it as an opportunity to obtain new knowledge about the tax avoidance behaviour of firms, for this is a major contribution of our study.

3. PROFIT SHIFTING IN BRAZIL AND THE EFFECT OF COUNTRIES' TRANSFER PRICING SYSTEMS

This Section investigates the profit shifting in Brazil and the effect of different transfer pricing systems applied to the foreign related parties. The Brazilian context provides a novel case for analysis, since it combines an extreme tax burden, a highly complex tax system, and a unique set of transfer pricing rules, thus to represent a relevant set of shifting incentives. As expected, we find strong evidences of profit shifting in Brazilian firms. Moreover, results show that relevant differences between transfer pricing systems on the foreign country produce different effects on the shifting behaviour of Brazilian firms. It suggests that some rules are more effective in curtailing the profit shifting, but firms are still able exploit vulnerabilities in transfer pricing systems towards the shifting strategy.

3.1 Introduction

Profit shifting is a well-known tax-avoidance strategy where multinational enterprises (MNE) perform transactions with related parties located in other countries, thus to transfer taxable profits from high-tax to low-tax countries. One of the most traditional profit shifting channels refers to the manipulation of transfer prices, when MNE make tax-induced adjustments on intra-firm prices. A key advantage of the profit-shifting strategy is that taxable profits are not hidden or omitted, but they are merely allocated to a specific place with a low tax rate. Existing studies provide relevant evidences of profit shifting by means of direct transfer-pricing manipulation (Davies, Martin, Parenti & Toubal, 2018; Cristea & Nguyen, 2016; Bernard, Jensen & Schott, 2006; Overesch, 2006; Bartelsman & Beetsma, 2003; Clausing, 2003; Swenson, 2001).

Governments worldwide are long-time aware about the harming effects of profit shifting, and have historically implemented several mechanisms to curb this practice. In special, the Transfer Pricing Guidelines prepared by the Organization for Economic Co-operation and Development (OECD) is the baseline international standard implemented by most of countries. OECD guidelines determine that transfer prices must comply with the arm's length principle, for they must be comparable with the prices established under independent conditions (OECD, 2017). Countries commonly implement the core of the OECD guidelines into their domestic tax systems, and include specific unilateral measures in accordance with

their regulatory background (Knoll & Riedel, 2014; Lohse, Riedel & Spengel, 2012). In this line, studies find that specific anti-shifting measures are effective in preventing the shifting behaviour of firms (Marques & Pinho, 2016; Beuselinck, Deloof & Vanstraelen, 2015; Lohse & Riedel, 2013). However, some evidences show that MNE are able to exploit weaknesses and blind-spots in domestic tax rules, thus to distort transfer prices (Davies, Martin, Parenti & Toubal, 2018; Beer & Loeprick, 2015).

Profit shifting is one of the most fundamental research subjects in the international tax literature, especially on accounting and economics, and current researchers accumulate striking evidences on that account (Beer, de Mooji & Liu, 2018; Riedel, 2018; Heckemeyer & Overesch, 2017; Knoll & Riedel, 2014). Some initial studies analyse profit shifting on an aggregate level, focusing on the influence of cross-country tax differentials and the patterns of internal trades and firms' global profitability (Heckemeyer & Overesch, 2017; Dharmapala & Riedel, 2013; Taylor & Richardson, 2012; Desai, Foley, & Hines, 2006). Further studies obtain more direct evidences by means of direct inspection of intra-firm transactions. Results show that differences between the arm's length prices and intra-firm transfer prices vary systematically with tax differentials (Davies, Martin, Parenti & Toubal, 2018; Cristea & Nguyen, 2016; Bernard, Jensen & Schott, 2006; Overesch, 2006; Bartelsman & Beetsma, 2003; Clausing, 2003; Swenson, 2001). For a comprehensive review of the current profit shifting research, see Beer, de Mooji and Liu (2018), Riedel (2018) and Dharmapala (2014).

Despite being a well-established subject in tax literature, profit shifting research in Brazil is virtually non-existent. The only study dedicated to investigate profit shifting in Brazil is the one of Rathke (2014), which finds that Brazilian firms are able to transfer taxable profits away from Brazil, therefore resulting in a reduction of the total tax burden of the Brazilian consolidated group. Brazil provides a favourable context for the profit shifting research, since it combines an extremely high corporate taxation, one of the most complex tax systems in the world (Jacob, 2018), and the most distinguished set of transfer pricing rules in the world (Lohse & Riedel, 2013; Lohse, Riedel & Spengel, 2012).

This study investigates tax-induced profit shifting in Brazil, and analyses how differences on transfer pricing rules across countries influence the shifting behaviour. We follow the traditional models and identification strategies developed by the current profit shifting research and apply them to the novel Brazilian context. Data includes Brazilian listed

firms for the period 2010-2017 that publish information about intra-firm transactions in their annual financial statements. Results show that Brazilian firms have higher volume of transactions with foreign related parties in countries with lower tax rates. This result is strongly consistent with the profit shifting case, thus firms are able to transfer taxable profits away from Brazil by means of intra-firm transactions. Moreover, our results show that relevant differences in transfer pricing rules across countries produce different effects on the volume of intra-firm transactions. It suggests that some transfer pricing rules are more effective than others in curbing the profit shifting, and firms are still able to manipulate transfer prices under some tax rules.

Our analysis provides two main contributions. First, we obtain original evidences of profit shifting in Brazil. Existing studies are applied mostly to firms located in the United States and in the European countries, on which the OECD transfer pricing guidelines represent a robust regulation. We obtain relevant results from the novel Brazilian context, where the domestic transfer pricing rules are arbitrary and do not follow the traditional arm's length principle (Lohse, Riedel & Spengel, 2012). Brazil has one of the highest tax burdens in the world (Jacob, 2018), and our findings corroborate the intuitive perception that Brazilian firms shift taxable profits to low-tax countries. This motivates us to advance on the investigation of the shifting behaviour of Brazilian firms, thus to further develop the profit shifting research in Brazil.

Second, our analysis of the transfer pricing systems across countries is based on a comprehensive set of regulatory characteristics, thus to provide a classification of countries based on relevant differences. Results suggest that some transfer pricing systems are more effective in curtailing profit shifting than others, least for a portion of the taxable profits. This is a relevant finding, since it points to the key differences across countries' regulations, therefore to identify which are the most effective anti-shifting measures for each country. In this line, it contributes to the major review of the international transfer pricing standards as proposed by the OECD (OECD, 2017; 2013), thus to provide new knowledge about regulatory mismatches and blind-spots in current rules.

The remaining of this study is structured as follows: Section 3.2 presents the profit shifting incentive and hypotheses development, Section 3.3 describes the data and identification strategy, Section 3.4 presents the results, and Section 3.5 concludes.

3.2 A Simple Model on the Profit Shifting Incentive and Hypotheses Development

Our model is based on the "concealment costs" approach (Allingham & Sandmo, 1972; Yitzhaki, 1974; Kant, 1988) which is the most traditional in profit shifting literature (Beer, de Mooji & Liu, 2018; Davies, Martin, Parenti & Toubal, 2018). Consider two wholly owned divisions of a vertically integrated MNE located in different countries, $\{i,j\}$ each producing outputs x_i under costs $C_i(x_i)$, bringing revenues $R_i(s_i)$ from sales $s_i(x_i)$. Moreover, one of the divisions i sells a share of its outputs m to the other division $j \neq i$, charging a transfer price p established by the MNE's headquarter. Assume that the intra-firm output m depends on the market demand x_j for the final product of the purchaser division. The pre-tax profits of both divisions are

$$\pi_i = R_i(s_i) - C_i(s_i + m) + pm\ ;$$

$$\pi_j = R_j(s_j) - C_j(s_j - m) - pm\ , j \neq i\ .$$

For simplification, assume that the MNE is subjected to the source principle for the taxation of foreign profits, and no incremental costs are incurred on transfers of intra-firm outputs m. For an income tax rate $\tau_i \in [0,1]$ in each country, the baseline global net profits for both divisions is equal to $\Pi = (1 - \tau_i)\pi_i + (1 - \tau_j)\pi_j$. Profit shifting incentives arise if the tax rates between divisions are different, $\tau_i \neq \tau_j$, and global net profits Π increases if the MNE is able to manage intra-firm transactions pm thus taxable profits are transferred from the high-tax country to the low-tax country. In special, MNE has discretion in determining the transfer price p, therefore the maximising condition $\partial\Pi/\partial p = (\tau_j - \tau_i)m$ implies the following two cases:

$$\text{Low-transfer-price case – LTP: } \tau_j < \tau_i \rightarrow \frac{\partial \Pi}{\partial p} < 0\ ;$$

$$\text{High-transfer-price case – HTP: } \tau_j > \tau_i \rightarrow \frac{\partial \Pi}{\partial p} > 0\ .$$

For the LTP case, the MNE has incentives to charge a low transfer price p thus to keep taxable profits in Country j, which harms tax revenues in Country i. In the HTP case, the MNE maximises global profits Π by choosing a high transfer price p, so to shift taxable profits to Country i and harming Country j.

In this scenario, both countries implement domestic anti-shifting measures to prevent the intra-firm mispricing. The conventional regulatory approach requires that the transfer price p must comply with the price $\bar{p}$ determined under the arm's length condition (OECD, 2017). Any price deviations $\Delta p = p - \bar{p}$ are assessed by tax authorities in both countries, which may impose non-deductible penalties if they understand that the difference Δp represents enough evidence of profit shifting. Hence, assume that each country implement a set of domestic transfer pricing rules, such that $\forall i,j$, $D_i(\Delta p) : \mathbf{R} \to \{0,1\}$, $\Delta p = 0 \to D_i = 0$ is a characteristic map which triggers a tax penalty if the price deviation Δp is considered a sufficient evidence of profit shifting under these rules. In the case of penalisation, the harmed country requires the payment of the amount of evaded taxes $\tau_i \cdot \Delta pm$ plus a penalty rate $z_i > 0$ over this amount (Yitzhaki, 1974). Therefore, the tax penalty cost is represented by a function Z_i $(D_i(\Delta p), \tau_i \cdot \Delta pm \cdot (1 + z_i))$.

Assume that the arm's length price $\bar{p}$ is the same for all matters, such that both countries are not simultaneously harmed; it allows us to drop the divisions' indexes hereinafter for simplification. Therefore, the final maximisation object is equal to

$$\Pi_z = \Pi - Z\big(D(\Delta p), \tau \cdot \Delta pm \cdot (1 + z)\big) , \forall i, j .$$

For the tax differential $\Delta\tau = \tau_j - \tau_i$, the optimal transfer price p^* is obtained at the maximisation level where the marginal gains of profit shifting are equal to the marginal penalisation costs,

$$\frac{\partial \Pi_z}{\partial p} = \Delta\tau \cdot m - \frac{\partial Z}{\partial D} \cdot \frac{dD}{d(\Delta p)} \cdot \tau \cdot (1 + z) \cdot m = 0 ;$$

$$\Delta\tau = \frac{\partial Z}{\partial D} \cdot \frac{dD}{d(\Delta p)} \cdot \tau \cdot (1 + z) .$$

This is the fundamental equation of the optimal tax-induced transfer pricing. Notice that the marginal penalisation costs at the right hand side of the equality follow the sign of the profit shifting direction, $\Delta\tau$, since the sign of the price deviation Δp indicates which country is being harmed, i.e. LTP case implies $\Delta\tau < 0$, $\Delta p < 0 \to z = z_i$, $dD/d(\Delta p) < 0$, while the HTP case implies $\Delta\tau > 0$, $\Delta p > 0 \to z = z_j$, $dD/d(\Delta p) > 0$. In simple terms, it means that the profit

shifting always provides a global (non-negative) gain, regardless if it refers to LTP or HTP case, and this gain is increasing up to the optimal transfer price p^*. In its implicit form, $p^*(D^{-1},\Delta\tau,z)$, the inverse characteristic map $D^{-1} : \{0,1\} \rightarrow \mathbf{R}$ refers to the general effect of the transfer pricing rules of the harmed country; note that it is not theoretically necessary for each $D(\Delta p)$ or D^{-1} to be bijective mappings.

The MNE's main objective is to obtain maximum gains from choosing p^*. Net gains from profit shifting are computed by comparing the global net income under p^* with the global net income under the arm's length price $\bar{p}$. We obtain the explicit equation

$$\Pi_z(p^*) - \Pi_z(\bar{p}) \;=\; \Delta\tau \cdot (p^* - \bar{p})m - \alpha(D^{-1}) \cdot (\tau \cdot (p^* - \bar{p})m \cdot (1+z)) \geq 0$$

where $\alpha(D^{-1}) \in [0,1]$ is a cost parameter for the extent of the price deviation Δp that is considered appropriate under the transfer pricing rules. Of course, parameter $\alpha(D^{-1})$ is an exogenous measure that is not directly observable by the MNE and must be estimated. Generalisation of the cost parameter $\alpha(D^{-1}, \cdot)$ may include the MNE's different perceptions on the uncertainties related with tax rules and tax audits, and the MNE's intrinsic risk aversion.

The impact of domestic transfer pricing rules is reflected in the cost parameter $\alpha(D^{-1})$. The obvious variation $\partial\alpha(D^{-1})/\partial(D^{-1}) \leq 0$ implies that a more permissive tax rule allows for a wider price deviation Δp before triggering the tax penalty z. Stricter transfer pricing rules imply the opposite.

In this line, the MNE runs a second maximisation step with respect to the intra-firm output m. We have

$$\frac{\partial(\Pi_z(p^*) - \Pi_z(\bar{p}))}{\partial m} \;=\; \Delta\tau \cdot (p^* - \bar{p}) - \alpha(D^{-1}) \cdot \big(\tau \cdot (p^* - \bar{p}) \cdot (1+z)\big) \geq 0\,,$$

for it is clear that any increase in m implies in an increase of the net gains from profit shifting. Therefore, the optimal level of intra-firm output m^* depends only on the marginal rates of substitution between costs $\partial C_i/\partial m$, $\forall i,j$, and the MNE is able to intensify the net gains from profit shifting by varying production schedules and manipulating inventories turnover.

In overall, it is extremely convenient for the MNE to shift profits from high-tax to low-tax countries by means of transfer pricing adjustments. It is important to remark that the current international anti-shifting standards establish transfer pricing methods that are substantially flexible. Thus, it allows for a certain level of pricing abuse while still being considered appropriate by tax authorities (Beer, de Mooji & Liu, 2018; Davies, Martin, Parenti & Toubal, 2018). And after that, MNE is able to intensify the profit shifting by means of the intra-firm outputs m, since there are no regulatory requirements against any amount m if the transfer price p^* is considered appropriate. This effect is present for both LTP and HTP cases.

These outcomes yield our two main investigation hypotheses. The first and foremost is stated as follows:

H1: A larger tax differential between two countries is positively associated with the volume of intra-firm transactions between these two countries.

The relation in H1 is in the core of current profit shifting literature and has already been confirmed by numerous studies. The second hypothesis is stated as follows:

H2: Differences in transfer pricing rules across countries produce different effects on the volume of intra-firm transactions.

The prediction in H2 is not directional. Countries implement different transfer pricing rules according to the general characteristics of their domestic tax systems (Lohse, Riedel & Spengel, 2012; Knoll & Riedel, 2014). We understand that it is not possible to infer *ex ante* the results of the interaction between various tax provisions on the shifting behaviour of firms, for this effect is a matter of empirical investigation.

3.3 Data and Identification Strategy

We focus on the analysis of profit shifting in Brazilian listed firms by means of the volume of import and export transactions with related parties in other countries. Data for intra-firm transactions and firm-level covariates are obtained from firms' annual financial statements, for the period of 2010-2017. The volume of intra-firm imports and exports are obtained for individual firms for each year, segregated by country. The income tax rates across

countries are obtained from the CBT Tax Database of the Oxford University Centre for Business Taxation, for the period of 2010-2017. All data is regarded at the year-basis. Since Brazilian firms perform intra-firm transactions with related parties located in several countries, we focus on the transaction-by-country as a unit of analysis.

Analysis of the effect of domestic transfer pricing rules on profit shifting is not a straight task, since we need to observe the characteristics of these rules across countries, in order to identify whether they are significatively different from each other. For this purpose, we focus in creating groups of countries that share similar transfer pricing characteristics.

Information about transfer pricing rules across countries is collected from professional guidelines prepared by the Big Four audit firms, which are widely applied in profit shifting research, e.g. Ignat and Feleaga (2017), Nicolay, Nusser and Pfeiffer (2017), Marques and Pinho (2016), Lohse and Riedel (2013). We select 57 qualitative and quantitative characteristics that are directly observable. For qualitative characteristics, we set an indicator variable with value 1 for the presence of the characteristic and 0 otherwise. For quantitative characteristics, we use the numerical measure itself uniformly regularised over the variable range. Details on the transfer pricing characteristics are presented in Appendix A.

Transfer pricing characteristics are applied to create groups of countries via unweighted hierarchical clustering method. The pairwise differences across countries are computed by means of the traditional Gower (1971) measure for mixed variables. Unweighted hierarchical clustering is appropriate for our analysis since it provides a measure of pairwise distances between countries and controls for the effect of groups sizes during each agglomeration stage (Legendre & Legendre, 2012; Gordon, 1987). Significance of the groups' distances is analysed by means of permutational analysis of between-groups variance – permutational ANOVA (Anderson, 2001; McArdle & Anderson, 2001). We apply simple t-test on the incremental distances between group stages, thus to identify significant distances between groups.

For the identification strategy of hypotheses H1 and H2, we follow a similar idea developed by Hines and Rice (1994), which is the basis for the prominent approach in profit shifting literature (Beer, de Mooji & Liu, 2018). Hines and Rice (1994) derive a simple estimation for the non-shifted profits based on the traditional Cobb-Douglas production

function, where the firm's real output is a function of the main production factors. The standard Cobb-Douglas production function is equal to $Q = L^{\beta}K^{1-\beta}$, where Q is the firm's output, L and K are the production factors related with labor and capital respectively, and β is a regularised production parameter.

As described in Section 3.2, the profit shifting incentive arises if tax rates are different across countries, therefore the amount of intra-firm output is likely to be associated with the magnitude and the direction of the tax differential. Moreover, the existence of distinct transfer pricing rules may also affect the amount of intra-firm outputs, i.e. for Q as the intra-firm output, both the tax differential $\Delta\tau$ and the transfer pricing rules affect Q such that $Q(\Delta\tau,T) = f(\Delta\tau) \cdot TL^{\beta}K^{1-\beta}$, where $f(\Delta\tau)$ is a function for the impact of the profit shifting incentive, and T is a parameter for the transfer pricing rule. Based on this design, simple linearisation derives the following baseline regression model (Hines & Rice, 1994)

$$\log(Q) = \beta_0 + \gamma \log\big(f(\Delta\tau)\big) + \mu T + \boldsymbol{\beta}_l X + \varepsilon$$

where γ is the estimate parameter for the profit shifting incentive, μ is the estimate parameter for the effect of the transfer pricing rule, X is a matrix of l covariates representing the log of the production factors, and $\boldsymbol{\beta}_l$ is a vector for the parameters of the covariates. Indexes for firm, year and country are absent from the regression equation for simplification. Our analysis focuses on the volume of intra-firm output as the dependent variable, thus to conform with the core of the Cobb-Douglas approach. We apply the baseline regression model for the investigation of predictions H1 and H2. Prediction H1 implies the estimate parameter γ to be positive, while prediction H2 implies the estimate parameter μ to be statistically significative.

Table 3.1: Descriptive Statistics

Variables	Obs.	mean	s.d.	min.	max.
Firm-level Variables:					
Volume of Intra-firm Transactions	989	468.4	4030.7	0.0	57026.0
Labor Expenses	648	1180.23	2263.61	2.1	29732.1
PPE	989	4926.0	32768.3	0.0	629830.9
Inventories	987	1864.2	3118.3	3.6	29057.2
Capital Expenditures	984	1033.3	4198.3	3.0	71311.0
Revenues – Net	989	17479.0	36270.2	245.7	321638.0
Assets – Total	989	19163.5	52835.9	145.8	900135.1
Country-level Variables:					
Income Tax Rate – Foreign (%)	336	27.0	8.1	0.0	35.0
Tax Differential (%)	336	7.0	8.1	-1.0	34.0
GDP (US$ 000.000.000)	336	3903.2	5963.3	3.4	19390.6
GDP ratio (US$)	336	1.8	2.8	0.0	10.4
Distance from Brazil – regularised	42	0.4072	0.2411	0.0672	1.0000
N. Firms	68				
N. Foreign Countries	42				
N. Years	8				
N. Industries	7				

This table presents the descriptive statistics for the firm-level and country-level variables. All variables are obtained at a year-basis. All firm-level variables are presented in millions of Brazilian reals, R$ 000.000. Volume of intra-firm transactions refer to the sum of the amount of import and export transactions with related parties, for each sample firm, for each year. PPE refer to the net balances of plant, property and equipment. Inventories refer to the amount of net inventories. Revenues refer to the total revenues from sales minus sales deductions. Assets refer to total assets balance. All firm-level variables are obtained from the firms' annual financial statements. Country-level variables are presented according to the type of variable. Tax differential refers to the difference between the Brazilian marginal tax rate of 34% and the income tax rate on the country of the related party, for each year. GDP refers to the annual gross domestic product of the foreign country for each year. GDP ratio refers to the ratio between the GDP of the foreign country and the GDP in Brazil. Data for GDP by country is obtained from the OECD Statistics database. Distance from Brazil is regularised on the range [0,1]. Since firms perform intra-firm transactions with related parties in several countries, we obtain a repeated-firm database; we focus on the transaction-by-country as a unit of analysis. Additional details on the data are presented in Section 3.3. All 42 foreign countries analysed in this study are presented in Appendix Q.
Source: by author.

Table 3.1 presents the descriptive statistics for the firm-level and country-level data. We obtain a total of 989 transaction-by-country observations for the complete period of 2010-2017. Some variables are not available for all observations, e.g. labor expenses. Preliminary analysis of the descriptive numbers provides some insights about the data structure. We observe that the volume of intra-firm transactions has a wide variation range, with the max amount on about 14 times the standard deviation. This strongly suggests the existence of outliers in our sample. Moreover, Table 3.1 shows that the income tax rate across countries has a mean of 27%, and it varies within the range of [0.0%-35.0%]. It indicates that the

Brazilian marginal tax rate of 34% is among the highest tax rates of our sample, therefore it reinforces the prediction H1 for the Brazilian case.

3.4 Analysis

In this Section, we first present the summary results for the creation of groups of countries based on similarities of the domestic transfer pricing rules. Then, we present the baseline regression results for the hypotheses H1 and H2 and complementary analyses.

3.4.1 Groups of Countries Based on Similarities of Transfer Pricing Rules

Results for the creation of groups of countries that share similar transfer pricing rules are presented in Table 3.2, ref. Table 1.1.

Table 3.2: Transfer Pricing Systems – Permutational ANOVA

N.Groups	d.f.	SS	MS	Pseudo-F st.		R-sqd.	Dist.	Dist. Increm.	
2	1	34326	34326	4.1585	‡	0.0901	165.81	16.08508	**
3	2	98461	49230	7.1437	†	0.2584	149.72	9.09491	**
4	3	128835	42945	6.8120	†	0.3381	140.63	11.24457	**
5	4	152639	38160	6.5168	†	0.4006	129.38	6.13303	*
6	5	167160	33432	5.9407	†	0.4387	123.25	0.69951	*

This table presents the permutational analysis of the between-groups variance – permutational ANOVA, regarding the characteristics of transfer pricing rules across countries. Results are presented for the highest levels representing 2-6 groups of countries. Permutational ANOVA follows Anderson (2001) and McArdle and Anderson (2001). Permutations are calculated as the total number of possible permutations of 42 countries into 2-6 groups, limited to max = 1,000,000 permutations. N. Groups refer to the number of groups of countries at each grouping stage. Dist. refers to the hierarchical distances each grouping stage. Dist. Increm. refers to the difference between the hierarchical distance on the present cluster stage and the distance of the previous stage. Details on the transfer pricing characteristics are presented in Appendix A.
† Pseudo-F statistic significative at <0.0001 level; ‡ Pseudo-F statistic significative at <0.001 level.
** t-statistic significative at <0.0001 level; * t-statistic significative at <0.001 level (one-tailed).
Source: by author.

Table 3.2 shows that the countries are can be merged into 3-6 groups, for the pseudo-F statistic is significative at <0.0001 level. Moreover, the overall explained variance computed by the R-squared increases as the grouping of countries become more detailed, although the marginal incremental information at each subsequent group stage is decreasing. These

outcomes indicate that the hierarchical clustering method is appropriate to compare the characteristics of transfer pricing rules across countries.

We also observe that the incremental between-groups distances are significative for the first 2-4 grouping stages, with t-statistic significative at <0.0001 level. Therefore, results in Table 3.2 indicate that countries can be merged into four separate groups with significative differences in transfer pricing rules, which represent a R-squared of 33.8% of global explained variance. The components of each group are described in Appendix Q. We refer to them as the four distinct transfer pricing systems hereinafter.

3.4.2 Testing the Hypothesis H1

We compute the estimate coefficients for the baseline model derived in Section 3.3, omitting the parameter for the transfer pricing system *T*. Traditional production factors refer to labor expenses, fixed assets and inventories. All firm-level variables are regularised with respect to total net revenues or total assets, to allow for comparability; details in Table 3.3 further. Hence, estimates are computed with respect to the monotone transformation log(1 + variable) for the regularised variables, so to account for the constraints of the log range.

Initial results for the prediction H1 are presented in Table 3.3.

Table 3.3: Hypothesis H1 – Regression Estimates

	Estimate Coefficients							
Variables	(1)		(2)		(3)		(4)	
Tax Differential - $\Delta\tau$	0.1726	**	0.1709	**	0.1934	**	0.2150	**
	0.0444		*0.0425*		*0.0509*		*0.0516*	
Labor Expenses	-0.0569	*	-0.0312		-0.0566	*	-0.0355	
	0.0255		*0.0275*		*0.0261*		*0.0284*	
PPE	0.0931	**	-0.0031		0.0917	**	-0.0052	
	0.0297		*0.0390*		*0.0302*		*0.0389*	
Inventories	-0.2214	**	-0.0422		-0.2242	**	-0.0394	
	0.0777		*0.0548*		*0.0775*		*0.0538*	
Industry-level Controls	N		Y		N		Y	
Country-level Controls	N		N		Y		Y	
Observations	648		648		648		648	
F-statistics	20.10	†	20.98	†	13.83	†	18.26	†
R-squared - adjusted	0.1056		0.2359		0.1063		0.2425	

This table presents the estimate coefficients for the baseline regression model. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Derivation of the baseline model is presented in Section 3.3. Details about all variables are presented in Section 3.3 and Table 3.2. Column (1) presents the estimate coefficients with no controls for industry or country effects. Column (2) includes industry-level fixed controls only. Column (3) includes country-level controls only. Column (4) includes industry-level and country-level effects. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.

† F-statistic significative at <0.01 level.

** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.

Source: by author.

H1 addresses the influence of the fundamental profit shifting incentive $\Delta\tau$ on the volume of intra-firm transactions. We observe that the estimate effect of the tax differential $\Delta\tau$ is significative in magnitude and direction for all cases presented in Table 3.3, thus supporting H1. The positive effect indicates that Brazilian firms have a larger volume of intra-firm transactions with related parties located in jurisdictions with lower income tax rates. This result is significative for variations in industry-level and country-level controls. Since we have a repeated-firm database, the common effects across each year are already captured by the firm-level covariates.

It is important to assess the robustness of the outcomes in Table 3.3. Firstly, we observe the existence of potential outliers on our sample, e.g. see the descriptive statistics in Table 3.1.

We apply the traditional Bonferroni adjustment on studentised residuals from the estimates in Table 3.3, which reveals the existence of ten outlier observations on our sample. The baseline estimates excluding the outliers are presented in Table 3.4.

Moreover, estimates in Tables 3.3 and 3.4 assume that $\log(f(\Delta\tau)) = \Delta\tau$ for simplification. We explore some simple changes in variables. In special, we analyse H1 assuming the monotone transformation $\log(1 + \Delta\tau)$ for the tax differential as well. Also, we compute the estimate coefficients by direct regression between regularised variables. All variations in the baseline estimates exclude outliers, while include industry-level and country-level controls. Results are presented in Tables 3.5 and 3.6 respectively.

Table 3.4: Hypothesis H1 – Regression Estimates, Dropping Outliers

	Estimate Coefficients							
Variables	(1)		(2)		(3)		(4)	
Tax Differential - $\Delta\tau$	0.1025	**	0.1008	**	0.1263	**	0.1351	**
	0.0346		*0.0356*		*0.0392*		*0.0441*	
Labor Expenses	-0.0270		-0.0059		-0.0271		-0.0078	
	0.0208		*0.0226*		*0.0210*		*0.0229*	
PPE	0.0554	**	-0.0050		0.0541	**	-0.0063	
	0.0188		*0.0262*		*0.0188*		*0.0261*	
Inventories	-0.0715		0.0255		-0.0737		0.0272	
	0.0560		*0.0465*		*0.0557*		*0.0458*	
Industry-level Controls	N		Y		N		Y	
Country-level Controls	N		N		Y		Y	
Observations	638		638		638		638	
F-statistics	9.60	†	9.56	†	7.41	†	8.86	†
R-squared - adjusted	0.0512		0.1185		0.0569		0.1290	

This table presents the estimate coefficients for the baseline regression model, excluding outlier observations from the sample. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. Details about all variables are presented in Section 3.3 and Table 3.2. Column (1) presents the estimate coefficients with no controls for industry or country effects. Column (2) includes industry-level fixed controls only. Column (3) includes country-level controls only. Column (4) includes industry-level and country-level effects. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.
† F-statistic significative at <0.01 level.
** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.
Source: by author.

Table 3.5: Hypothesis H1 – Regression Estimates, Variable Transformation log(1 + Δτ)

	Estimate Coefficients							
Variables	(1)		(2)		(3)		(4)	
Tax Differential - log(1 + Δτ)	0.1105	**	0.1078	**	0.1385	**	0.1481	**
	0.0375		*0.0388*		*0.0428*		*0.0482*	
Labor Expenses	-0.0273		-0.0061		-0.0274		-0.0081	
	0.0208		*0.0226*		*0.0210*		*0.0230*	
PPE	0.0556	**	-0.0046		0.0546	**	-0.0058	
	0.0189		*0.0263*		*0.0189*		*0.0261*	
Inventories	-0.0715		0.0260		-0.0739		0.0276	
	0.0561		*0.0464*		*0.0558*		*0.0457*	
Industry-level Controls	N		Y		N		Y	
Country-level Controls	N		N		Y		Y	
Observations	638		638		638		638	
F-statistics	9.39	†	9.46	†	7.28	†	8.78	†
R-squared - adjusted	0.0500		0.1172		0.0558		0.1279	

This table presents the estimate coefficients for the baseline regression model, excluding outlier observations from the sample. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. Details about all variables are presented in Section 3.3 and Table 3.2. Column (1) presents the estimate coefficients with no controls for industry or country effects. Column (2) includes industry-level fixed controls only. Column (3) includes country-level controls only. Column (4) includes industry-level and country-level effects. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent and independent variables, and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.
† F-statistic significative at <0.01 level.
** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.
Source: by author.

Table 3.6: Hypothesis H1 – Regression Estimates, Direct Linear Model

	Estimate Coefficients							
Variables	(1)		(2)		(3)		(4)	
Tax Differential - $\Delta\tau$	0.1177	**	0.1157	**	0.1423	**	0.1530	**
	0.4408		*0.0426*		*0.0461*		*0.0522*	
Labor Expenses	-0.0231		-0.0048		-0.0228		-0.0061	
	0.0180		*0.0193*		*0.0182*		*0.0197*	
PPE	0.0510	**	-0.0100		0.0497	**	-0.0117	
	0.0184		*0.0264*		*0.0185*		*0.0263*	
Inventories	-0.0698		0.0191		-0.0722		0.0202	
	0.0555		*0.0452*		*0.0551*		*0.0445*	
Industry-level Controls	N		Y		N		Y	
Country-level Controls	N		N		Y		Y	
Observations	638		638		638		638	
F-statistics	9.48	†	9.58	†	7.19	†	8.78	†
R-squared - adjusted	0.0505		0.1187		0.0549		0.1278	

This table presents the estimate coefficients for the baseline regression model, excluding outlier observations from the sample. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. Details about all variables are presented in Section 3.3 and Table 3.2. Column (1) presents the estimate coefficients with no controls for industry or country effects. Column (2) includes industry-level fixed controls only. Column (3) includes country-level controls only. Column (4) includes industry-level and country-level effects. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed by direct linear regression. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.
† F-statistic significative at <0.01 level.
** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.
Source: by author.

We observe that all results from Tables 3.4-3.6 also show a positive effect of the profit shifting incentive $\Delta\tau$ on the volume of intra-firm transactions, regardless of the specification applied. Results are significative in magnitude and direction for all variations, thus to provide robustness for the support of the theoretical hypothesis H1.

3.4.3 Testing the Hypothesis H2

The effect of the differences in transfer pricing systems across countries is addressed by the prediction H2. We follow the same approach as in Section 3.4.2. We compute the estimate coefficients for the baseline model derived in Section 3.3, including the parameter for the transfer pricing system *T*. Estimates are computed with respect to the monotone

transformation log(1 + variable) for all the regularised firm-level variables, so to account for the constraints of the log range. All estimates in this Section include industry-level and country-level controls, and exclude the outlier observations identified in Section 3.4.2.

Baseline results for the prediction H2 are presented in Table 3.7.

Table 3.7: Hypothesis H2 – Regression Estimates, Dropping Outliers

	Estimate Coefficients							
Variables	TP no. 1		TP no. 2		TP no. 3		TP no. 4	
Tax Differential - $\Delta\tau$	0.1183	**	0.1449	**	0.1437	**	0.1336	**
	0.0359		*0.0450*		*0.0427*		*0.0506*	
Transfer Pricing System - *T*	0.0068		-0.0164	**	0.0119		-0.0007	
	0.0094		*0.0034*		*0.0065*		*0.0049*	
Labor Expenses	-0.0061		-0.0048		-0.0079		-0.0077	
	0.0232		*0.0227*		*0.0228*		*0.0229*	
PPE	-0.0083		-0.0088		-0.0025		-0.0061	
	0.0266		*0.0259*		*0.0267*		*0.0262*	
Inventories	0.0295		0.0169		0.0136		0.0271	
	0.0450		*0.0465*		*0.0443*		*0.0457*	
Industry-level Controls	Y		Y		Y		Y	
Country-level Controls	Y		Y		Y		Y	
Observations	638		638		638		638	
Obs. - Transfer Pricing Syst.	68		102		363		105	
F-statistics	8.23	†	8.89	†	8.59	†	8.17	†
R-squared - adjusted	0.1286		0.1386		0.1341		0.1276	

This table presents the estimate coefficients for the baseline regression model, excluding outlier observations from the sample, for each of the four transfer pricing systems. Each column refers to one of the four transfer pricing systems. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. The variable for the transfer pricing system *T* refers to an indicator variable with value 1 if the foreign country is classified as a component of the transfer pricing group, and zero otherwise. The classification of countries on each transfer pricing system is presented in Appendix Q. Details about all variables are presented in Section 3.3 and Table 3.2. All estimates include industry-level and country-level controls. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.
† F-statistic significative at <0.01 level.
** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.
Source: by author.

First, we observe that the effect of the profit shifting incentive $\Delta\tau$ is significative for all results in Table 3.7, thus reinforcing the hypothesis H1. For the effect of each of the transfer pricing systems T on the volume of intra-firm transactions, results in Table 3.7 are significative only the transfer pricing system no. 2. The estimate effect is negative, therefore indicating that Brazilian firms have lower volume of transactions with related parties located in foreign countries that adopt the transfer pricing system no. 2. We emphasise that all estimates in this Section include the effect of the profit shifting incentive $\Delta\tau$ and country-level controls, hence the estimate effect in Table 3.7 is strongly attributed to the transfer pricing rules. In this case, it suggests that the application of transfer pricing system no. 2 can inhibit leastwise a portion of the profit shifting in Brazilian firms.

We explore some further variations in the model. First, we test the hypothesis H2 under the effect of the monotone transformation $\log(1 + \Delta\tau)$ for the tax differential. Later, we estimate the effect of the variable T under the direct linear regression between the regularised variables. Results are presented in Tables 3.8 and 3.9 respectively.

Table 3.8: Hypothesis H2 – Regression Estimates, Variable Transformation $\log(1 + \Delta\tau)$

	Estimate Coefficients							
Variables	TP no. 1		TP no. 2		TP no. 3		TP no. 4	
Tax Differential - $\log(1 + \Delta\tau)$	0.1271	**	0.1616	**	0.1564	**	0.1474	**
	0.0390		*0.0494*		*0.0469*		*0.0558*	
Transfer Pricing System - T	0.0079		-0.0171	**	0.0114		-0.0003	
	0.0095		*0.0035*		*0.0066*		*0.0050*	
Labor Expenses	-0.0061		-0.0051		-0.0082		-0.0081	
	0.0232		*0.0227*		*0.0228*		*0.0230*	
PPE	-0.0082		-0.0084		-0.0021		-0.0057	
	0.0267		*0.0259*		*0.0268*		*0.0262*	
Inventories	0.0302		0.0160		0.0147		0.0276	
	0.0450		*0.0465*		*0.0442*		*0.0456*	
Industry-level Controls	Y		Y		Y		Y	
Country-level Controls	Y		Y		Y		Y	
Observations	638		638		638		638	
Obs. - Transfer Pricing Syst.	68		102		363		105	
F-statistics	8.18	†	8.87	†	8.48	†	8.10	†
R-squared - adjusted	0.1279		0.1384		0.1325		0.1265	

This table presents the estimate coefficients for the baseline regression model, excluding outlier observations from the sample, for each of the four transfer pricing systems. Each column refers to one of the four transfer pricing systems. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. The variable for the transfer pricing system T refers to

an indicator variable with value 1 if the foreign country is classified as a component of the transfer pricing group, and zero otherwise. The classification of countries on each transfer pricing system is presented in Appendix Q. Details about all variables are presented in Section 3.3 and Table 3.2. All estimates include industry-level and country-level controls. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.
† F-statistic significative at <0.01 level.
** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.
Source: by author.

Table 3.9: Hypothesis H2 – Regression Estimates, Direct Linear Model

	Estimate Coefficients								
Variables	TP no. 1		TP no. 2		TP no. 3		TP no. 4		
Tax Differential - $\Delta\tau$	0.1322	**	0.1641	**	0.1627	**	0.1497	*	
	0.0407		*0.0533*		*0.0505*		*0.0595*		
Transfer Pricing System - *T*	0.0084		-0.0184	**	0.0133		-0.0014		
	0.0110		*0.0040*		*0.0076*		*0.0056*		
Labor Expenses	-0.0046		-0.0037		-0.0061		-0.0060		
	0.0199		*0.0195*		*0.0195*		*0.0200*		
PPE	-0.0138		-0.0143		-0.0081		-0.0115		
	0.0268		*0.0262*		*0.0269*		*0.0264*		
Inventories	0.0224		0.0092		0.0069		0.0200		
	0.0438		*0.0453*		*0.0428*		*0.0444*		
Industry-level Controls	Y		Y		Y		Y		
Country-level Controls	Y		Y		Y		Y		
Observations	638		638		638		638		
Obs. - Transfer Pricing Syst.	68		102		363		105		
F-statistics	8.17	†	8.80	†	8.49	†	8.10	†	
R-squared - adjusted	0.1276		0.1369		0.1326		0.1265		

This table presents the estimate coefficients for the baseline regression model, excluding outlier observations from the sample, for each of the four transfer pricing systems. Each column refers to one of the four transfer pricing systems. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. The variable for the transfer pricing system *T* refers to an indicator variable with value 1 if the foreign country is classified as a component of the transfer pricing group, and zero otherwise. The classification of countries on each transfer pricing system is presented in Appendix Q. Details about all variables are presented in Section 3.3 and Table 3.2. All estimates include industry-level and country-level controls. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.
† F-statistic significative at <0.01 level.
** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.
Source: by author.

We observe that Tables 3.8 and 3.9 provide the same results as ones in Table 3.7, since we find significative negative effect only for the transfer pricing system no. 2. The estimate effect is rather small for all variations in the model; estimate coefficients of -0.0164, -0.0171 and -0.0184 in Tables 3.7-3.9 respectively. In overall, results support the hypothesis H2, since indicates that the application of the transfer pricing system no. 2 may reduce the effect of the profit shifting incentive $\Delta\tau$ in Brazilian firms. We find no significative results for the other transfer pricing systems under our baseline investigation approach.

3.4.4 Complementary Analyses

The regression model in Section 3.3 derives separate effects for the profit shifting incentive $\Delta\tau$ and the transfer pricing system T, and hypotheses H1 and H2 are tested by means of the parameters γ and μ respectively. Nonetheless, detailed inspection of the estimates in Sections 3.4.2 and 3.4.3 provides some additional insights that may contribute to our analysis. In first place, we notice in Tables 3.7-3.9 that the estimate effect of the transfer pricing system no. 3 would be considered significative under a weaker sig. criterion of <0.1 level. In this case, it suggests the existence of a possible magnitude effect with respect to the variable T and the profit shifting evidences. Therefore, we adjust the baseline model applied in Section 3.4.3 to include an interaction term between variables T and $\Delta\tau$, thus to capture this magnitude effect. Results are presented in Table 3.10.

Table 3.10: Hypothesis H2 – Regression Estimates, Magnitude Effect

	Estimate Coeffcients							
Variables	TP no. 1		TP no. 2		TP no. 3		TP no. 4	
Tax Differential - $\Delta\tau$	0.0930	*	0.1539	**	0.1569	**	0.1336	**
	0.0367		*0.0465*		*0.0530*		*0.0503*	
Transfer Pricing System - T	-0.0150		-0.0047		0.0159	*	-0.0007	
	0.0112		*0.0040*		*0.0063*		*0.0049*	
Interaction - $\Delta\tau \cdot T$	0.1194		-0.1491	**	-0.0498		-	[a]
	0.0920		*0.0459*		*0.0711*		-	
Labor Expenses	-0.0049		-0.0028		-0.0065		-0.0077	
	0.0233		*0.0227*		*0.0230*		*0.0229*	
PPE	-0.0107		-0.0110		-0.0036		-0.0061	
	0.0269		*0.0260*		*0.0269*		*0.0262*	
Inventories	0.0261		0.0209		0.0116		0.0271	
	0.0460		*0.0462*		*0.0454*		*0.0457*	
Industry-level Controls	Y		Y		Y		Y	
Country-level Controls	Y		Y		Y		Y	
Observations	638		638		638		638	
Obs. - Transfer Pricing Syst.	68		102		363		105	
F-statistics	7.78	†	8.42	†	8.02	†	8.18	†
R-squared - adjusted	0.1297		0.1402		0.1337		0.1276	

This table presents the estimate coefficients for the regression model adjusted by the inclusion of an interaction term between variables $\Delta\tau$ and T, excluding outlier observations from the sample, for each of the four transfer pricing systems. Each column refers to one of the four transfer pricing systems. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. The variable for the transfer pricing system T refers to an indicator variable with value 1 if the foreign country is classified as a component of the transfer pricing group, and zero otherwise. The classification of countries on each transfer pricing system is presented in Appendix Q. Details about all variables are presented in Section 3.3 and Table 3.2. All estimates include industry-level and country-level controls. Variables related with the amount of intra-firm transactions and labor expenses are regularised with respect to the total net revenues for each firm, for each year. Variables related with PPE and inventories are regularised with respect to the total assets for each firm, for each year. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.

† F-statistic significative at <0.01 level.

** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.

[a] Regression including the interaction $\Delta\tau \cdot T$ for the transfer pricing system no. 4 are impaired by multicollinearity issue, due to the fact that the variable T refers to the foreign country Argentina only; see Appendix Q. Hence, results are equal to the estimate coefficients without the interaction term.

Source: by author.

Regarding the prediction H2, Table 3.10 provides two main outcomes. First, we obtain a significative estimate of the magnitude effect for the transfer pricing system no. 2. In special, the estimate coefficients for the profit shifting incentive $\Delta\tau$ and the interaction term $\Delta\tau \cdot T$ are equal to 0.1539 and -0.1491 respectively, and a simple means test shows that the absolute

value of both coefficients are statistically equal. It states that the positive slope of the fitted line with respect to the variable $\Delta\tau$ is completely cancelled by the negative slope regarding the interaction term $\Delta\tau \cdot T$, thus the net effect is statistically equal to zero. Therefore, it indicates that the implementation of the transfer pricing system no. 2 completely neutralises the profit shifting incentive for the observations in our sample. We understand that this is a relevant result, since it implies the effectiveness of the transfer pricing system no. 2 as an anti-shifting mechanism for the case of Brazilian firms. We emphasise that all estimates in Table 3.10 include industry-level and country-level controls, and exclude outliers, thus the effect captured by the interaction term $\Delta\tau \cdot T$ refers to the magnitude effect of the transfer pricing systems in each group of countries.

Second, Table 3.10 also shows that the discrete effect of the variable T becomes significative for the transfer pricing system no. 3 if the interaction term $\Delta\tau \cdot T$ is included in the estimation, with the interaction term not significative itself. This is consistent with the outcomes presented in Tables 3.7-3.9. The estimate effect is curiously positive, thus indicating that Brazilian firms have higher volume of intra-firm transactions with related parties located in countries that implement the transfer pricing system no. 3. This is an interesting outcome, since it suggests that the characteristics of the transfer pricing system no. 3 may ease the profit shifting away from Brazil. Remark that the effect of the profit shifting incentive $\Delta\tau$ remains positive and significative in this case, therefore the variable T intensifies the profit shifting effect with respect to the dependent variable.

Advancing in our analyses, baseline results present deviations in the effects of the firm-level covariates depending on variations in the exogenous controls. Specifically, we observe that the firm-level covariates are no more significative after the inclusion of industry-specific controls in our estimates, e.g. see Tables 3.3-3.6, Tables 3.7-3.9. Therefore, we investigate if the baseline results remain the same after changes in the covariates for the production factors in the matrix X within the baseline model. We explore three types of firm-level factors that may affect firms' outputs: the amount of capital expenditures, the financing structure, and the cost structure. All covariates are included in the baseline model for each firm, for each year. Results are presented in Table 3.11, for the transfer pricing systems no. 1-3.

Table 3.11: Hypotheses H1 and H2 – Regression Estimates, Model Variations for Transfer Pricing Systems no. 1-3

Variables	Estimate Coefficients																	
	Transfer Pricing System no. 1						Transfer Pricing System no. 2						Transfer Pricing System no. 3					
Tax Differential - $\Delta\tau$	0.0802	**	0.0692	**	0.0771	**	0.1081	**	0.1086	**	0.1140	**	0.1102	**	0.1124	**	0.1162	**
	0.0249		*0.0238*		*0.0248*		*0.0283*		*0.0295*		*0.0301*		*0.0313*		*0.0327*		*0.0334*	
Transfer Pricing System - T	-0.0064		-0.0115		-0.0049		-0.0063	*	-0.0054		-0.0075	*	0.0113	**	0.0106	**	0.0101	*
	0.0069		*0.0072*		*0.0070*		*0.0030*		*0.0030*		*0.0030*		*0.0042*		*0.0041*		*0.0041*	
Interaction - $\Delta\tau \cdot T$	0.0512		0.0848		0.0576		-0.0693	*	-0.0800	*	-0.0714	*	-0.0186		-0.0309		-0.0247	
	0.0560		*0.0567*		*0.0568*		*0.0312*		*0.0316*		*0.0302*		*0.0460*		*0.0461*		*0.0470*	
Firm-level Covariates Type	CAPEX		FS		CS		CAPEX		FS		CS		CAPEX		FS		CS	
Industry-level Controls	Y		Y		Y		Y		Y		Y		Y		Y		Y	
Country-level Controls	Y		Y		Y		Y		Y		Y		Y		Y		Y	
Observations	974		979		979		974		979		979		974		979		979	
Obs. - Transfer Pricing Syst.	113		117		117		154		155		155		561		561		561	
F-statistics	11.76	†	10.22	†	10.70	†	12.52	†	10.77	†	11.51	†	12.28	†	10.42	†	10.96	†
R-squared - adjusted	0.01172		0.1166		0.1142		0.1244		0.1227		0.1226		0.1221		0.1188		0.1169	

This table presents the estimate coefficients for the regression models of different firm-level covariates in matrix X, including the interaction term between variables $\Delta\tau$ and T, excluding outlier observations from the sample, for the transfer pricing systems no. 1-3. Numbers in plain refer to the estimate coefficients. Numbers in italic refer to the estimates' standard errors. Standard errors are obtained from the White's covariance matrices, to account for heteroscedastic consistency. Outliers are selected based on the traditional Bonferroni adjustment on studentised residuals of the baseline estimates in Table 3.3. Derivation of the baseline model is presented in Section 3.3. The variable for the transfer pricing system T refers to an indicator variable with value 1 if the foreign country is classified as a component of the transfer pricing group, and zero otherwise. The classification of countries on each transfer pricing system is presented in Appendix Q. Firm-level covariates are segregated into three types: CAPEX refers to the amount of capital expenditures of each firm, for each year; FS refers to the components of the financial structure of each firm, for each year, and is composed by the amounts of the short term leverage, long term leverage and shareholders equity; CS refers to the components of the operational cost structure of the each firm, for each year, and is composed by the amounts of operational costs and operational expenses. All estimates include industry-level and country-level controls. All variables are regularised. Estimates are computed with respect to the monotone transformation log(1 + variable) for the dependent variable and the firm-level covariates. Fixed controls for industry effects refer to an indicator variable for the firm's industry sector. Controls for country effects refer to the ratio between annual GDP of the foreign country and the annual GDP in Brazil, and the distance between Brazil and the foreign country.

† F-statistic significative at <0.01 level.

** t-statistic significative at <0.01 level; * t-statistic significative at <0.05 level.

Source: by author.

We observe that the effect of the profit shifting incentive $\Delta\tau$ is positive and significative for all variations of the model in Table 3.11. Estimates are relevant in magnitude and direction, and they are fully consistent with the baseline analyses in Sections 3.4.2 and 3.4.3. Hence, our results represent a strong evidence of the confirmation of the prediction H1, for it shows that Brazilian firms have a larger volume of intra-firm transactions with related parties located in jurisdictions with lower income tax rates. This represents a robust evidence of profit shifting in Brazil.

Moreover, Table 3.11 shows that the transfer pricing system no. 2 produces a negative effect over the volume of intra-firm transfers. This effect is observed from both the discrete and the magnitude effects, and it is significative for all three variations of the model. This result is consistent with the baseline results in Section 3.4.3 and the complementary analyses in Table 3.10, for it indicates that the application of the transfer pricing no. 2 mitigates leastwise a portion of the transfer pricing incentive $\Delta\tau$. This is a relevant support of the hypothesis H2.

Table 3.11 also shows that the transfer pricing system no. 3 produces a positive effect over the volume of intra-firm transactions. This effect is significative for all three variations of the model, and it is consistent with the outcomes in Table 3.10. It indicates that Brazilian firms have larger amounts of internal transactions with related parties located in countries that have lower tax rates and implement the transfer pricing system no. 3. This is also a relevant support of the hypothesis H2.

In summary, our complementary analyses reinforce the results obtained from the baseline approach, thus providing robustness for the support of both predictions H1 and H2. Regarding the fundamental profit shifting prediction H1, we obtain supporting evidences from absolutely all tests applied in this study. All results indicate that Brazilian firms have a higher volume of intra-firm transactions with related parties located in countries with lower income tax rates. This represents a robust evidence for the confirmation of the prediction H1. Regarding prediction H2, overall results show that the transfer pricing system no. 2 has a negative magnitude effect on the volume of intra-firm transactions in Brazil. Moreover, results also show that the transfer pricing system no. 3 has a positive discrete effect on intra-firm transactions in Brazil. Hence, our results indicate that significative differences in

transfer pricing rules across countries produce different effects on the volume of intra-firm transactions in Brazil, thus supporting the prediction H2.

3.5 Conclusion

This study investigates tax-induced profit shifting in Brazil, and analyses how differences on transfer pricing rules across countries influence the shifting behaviour. Results show that the volume of transactions with foreign related parties is positively associated with the tax differential between Brazil and the foreign country. Results are significative in magnitude and direction, and are robust for a series of variations in model settings. This represents a strong evidence of profit shifting in Brazilian firms, consistent with the same evidences obtained from other countries.

Moreover, our results also indicate that relevant differences in transfer pricing rules across countries produce different effects on the shifting behaviour of firms. In special, we find that the volume of intra-firm transactions may decrease or increase, depending on the transfer pricing system of the foreign country. It suggests that some transfer pricing rules are more effective than others in curtailing the shifting behaviour, and that firms are still able to find vulnerabilities in current rules and to take advantage of them towards the profit shifting strategy. This regulatory effect is captured at a global level in our study. On this account, the separate effects of specific transfer pricing provisions remain to be analysed in future research.

Recent studies suggest that if the tax-avoidance incentives are somewhat weak, it becomes difficult to observe the shifting behaviour of firms (Davies, Martin, Parenti & Toubal, 2018). The puzzle is to check whether profit shifting is non-existent under weak incentives, or if this is a matter of methodological limitations (Beer, de Mooji & Liu, 2018). The Brazilian context provides a salient set of incentives for firms to shift profits away from the country, which combines an extreme income tax rate, great complexity in tax system and a quite peculiar transfer pricing regulation, thus the evidences of profit shifting are strong as expected. This allows further investigations related with the effect of anti-shifting measures, variations in firm-level factors, and the use of multiple profit shifting channels.

FINAL REMARKS

We conclude this study with some additional points for discussion derived from the outcomes of all three previous Sections.

First, this full study claims that the predominant assumption that tax rules imply tax enforcement is not fully valid. Existing studies propose several methods to rank countries from low-to-high tax enforcement, based on information about countries' TP rules. However, evidences show that similar TP rules produce varying impacts on different countries, and that the enforcement rankings developed in these studies depend directly on which TP provisions are included on the analysis. Our results show that the perception of tax enforcement by firms and TP rules have a somewhat weak association between each other, for they represent distinct information about the factors that may inhibit profit shifting.

On this account, one may argue that the "perception" of tax enforcement is not the "effective" enforcement exercised by the tax authorities, so the results might be hampered. We agree with this conceptual distinction, but we also understand that the shifting behaviour of firms is influenced in fact by how they perceive the true enforcement. Hence, we understand that our results are based on the appropriate factor that affects the profit shifting incentives.

Second, the classification of TP systems proposed in this study is based on a comprehensive set of regulatory characteristics. It is plausible to expect that countries prioritise some provisions over others, e.g. some countries may highlight the documentation requirements, while others focus on penalisation rates. However, any attempt to assign weights to different TP topics would be arbitrary at this point. The existence of relevant differences on TP rules across countries and the changes in domestic tax provisions over time may give a hint about the regulatory preferences of each country, for this may be a direction for future research.

Third, we emphasise the original profit shifting evidences obtained in Section 3. Brazilian firms have strong incentives to transfer taxable profits away from Brazil, since they are subjected to an extremely high corporate taxation, one of the most complex tax systems in the world, and the most distinguished set of TP rules in the world. The clear

identification of the main profit shifting incentive $\Delta\tau$ in all of our results is a direct consequence of this scenario. Therefore, it provides a favourable set for the investigation of the additional factors that influence the shifting behaviour of firms. We analyse the effect of the TP systems of the foreign related parties. Further investigations may include the impact of both TP rules and additional enforcement measures, the interaction between TP provisions and other tax rules, how changes in TP rules and tax rates affect the volume of profit shifting, and the effect of substitute vs. complementary shifting schemes.

It is important to highlight here that a profit shifting strategy is not equivalent to a tax-evasion case, since a firm may attain to all the regulatory requirements implemented by the TP rules of all countries involved in its activities, and still shift profits away from the high-tax country. This is possible because of three main factors. The first one is that the arm's length principle is a subjective condition, for both the taxpayers and tax authorities. Existing rules allow for adjustments of the TP by considering pricing conditions determined in contractual arrangements, e.g. payment terms, volume of units negotiated, interest rates, product warranties, sales commissions, freight and insurance costs, customs. All these factors provide significant margins for TP adjustments (the arm's length range) thus to seek the shifting objectives, while attaining to the TP rules.

The second refers to the TP methods. In special, anecdotal evidences show that firms perform specific transactions in order to obtain valid support for the chosen TP. At the end, if the documentation requirements are not appropriately set at the closing financial year, firms may always choose the Cost-Plus method to compute the TP, which is (most-) entirely determined by internal information.

Finally, the third refers to the limitations of the anti-shifting measures with respect to the legitimate economic activities of firms. In special, profit shifting has two components, namely the TP and internal outputs. Tax rules logically require the arm's length condition only for the TP, so firms can shift profits by following a two-stages strategy: first determine a TP that is both accepted for tax purposes and is fit for the profit shifting; then intensify the profit shifting by means of intra-firm outputs. Hence, firms achieve the profit shifting, while they comply with all TP requirements.

REFERENCES

Allingham, M. G., & Sandmo, A. (1972). Income tax evasion: A theoretical analysis. *Journal of public economics*, *1*(3-4), 323-338.

Alm, J. (2012). Measuring, explaining, and controlling tax evasion: lessons from theory, experiments, and field studies. *International Tax and Public Finance*, *19*(1), 54-77.

Alm, J. (2018). What Motivates Tax Compliance?. *Journal of Economic Surveys*, 1-36.

Alm, J., & Torgler, B. (2006). Culture differences and tax morale in the United States and in Europe. *Journal of economic psychology*, *27*(2), 224-246.

Anderson, M. J. (2001). A new method for non-parametric multivariate analysis of variance. *Austral ecology*, *26*(1), 32-46.

Avi-Yonah, R. S. (2000). Globalization, tax competition, and the fiscal crisis of the welfare state. *Harvard law review*, 1573-1676.

Bartelsman, E. J., & Beetsma, R. M. (2003). Why pay more? Corporate tax avoidance through transfer pricing in OECD countries. *Journal of public economics*, *87*(9-10), 2225-2252.

Becker, J., Davies, R. B., & Jakobs, G. (2017). The economics of advance pricing agreements. *Journal of Economic Behavior & Organization, 134*, 255-268.

Beer, S., de Mooij, R., & Liu, L. (2018). International Corporate Tax Avoidance: A Review of the Channels, Magnitudes, and Blind Spots. *Journal of Economic Surveys*.

Beer, S., & Loeprick, J. (2015). Profit shifting: drivers of transfer (mis) pricing and the potential of countermeasures. *International Tax and Public Finance*, *22*(3), 426-451.

Beer, S., & Loeprick, J. (2017). Taxing income in the oil and gas sector—Challenges of international and domestic profit shifting. *Energy Economics, 61*, 186-198.

Bernard, A. B., Jensen, J. B., & Schott, P. K. (2006). *Transfer pricing by US-based multinational firms* (No. w12493). National Bureau of Economic Research.

Beuselinck, C., Deloof, M., & Vanstraelen, A. (2015). Cross-jurisdictional income shifting and tax enforcement: evidence from public versus private multinationals. *Review of Accounting Studies*, *20*(2), 710-746.

Chow, G. C. (1960). Tests of equality between sets of coefficients in two linear regressions. *Econometrica: Journal of the Econometric Society*, 591-605.

Clausing, K. A. (2003). Tax-motivated transfer pricing and US intrafirm trade prices. *Journal of Public Economics*, *87*(9-10), 2207-2223.

Cristea, A. D., & Nguyen, D. X. (2016). Transfer pricing by multinational firms: New evidence from foreign firm ownerships. *American Economic Journal: Economic Policy*, *8*(3), 170-202.

Davies, R. B., Martin, J., Parenti, M., & Toubal, F. (2018). Knocking on tax haven's door: Multinational firms and transfer pricing. *Review of Economics and Statistics*, *100*(1), 120-134.

Desai, M. A., Foley, C. F., & Hines Jr, J. R. (2006). The demand for tax haven operations. *Journal of Public economics*, *90*(3), 513-531.

Dharmapala, D. (2014). What do we know about base erosion and profit shifting? A review of the empirical literature. *Fiscal Studies*, *35*(4), 421-448.

Dharmapala, D., & Riedel, N. (2013). Earnings shocks and tax-motivated income-shifting: Evidence from European multinationals. *Journal of Public Economics*, *97*, 95-107.

Fowlkes, E. B., & Mallows, C. L. (1983). A method for comparing two hierarchical clusterings. *Journal of the American statistical association*, *78*(383), 553-569.

Games, P. A., & Howell, J. F. (1976). Pairwise multiple comparison procedures with unequal n's and/or variances: a Monte Carlo study. *Journal of Educational Statistics, 1(2)*, 113-125.

Glass, G. V., Peckham, P. D., & Sanders, J. R. (1972). Consequences of failure to meet assumptions underlying the fixed effects analyses of variance and covariance. *Review of educational research, 42(3),* 237-288.

Gordon, A. D. (1987). A review of hierarchical classification. *Journal of the Royal Statistical Society. Series A (General)*, 119-137.

Gower, J. C. (1971). A general coefficient of similarity and some of its properties. *Biometrics*, 857-871.

Gower, J. C., & Krzanowski, W. J. (1999). Analysis of distance for structured multivariate data and extensions to multivariate analysis of variance. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, *48*(4), 505-519.

Greene, W. H. (2000). *Econometric analysis, 4th edition*. International edition, New Jersey: Prentice Hall, 201-215.

Harwell, M. R., Rubinstein, E. N., Hayes, W. S., & Olds, C. C. (1992). Summarizing Monte Carlo results in methodological research: The one-and two-factor fixed effects ANOVA cases. *Journal of educational statistics, 17(4),* 315-339.

Heckemeyer, J. H., & Overesch, M. (2017). Multinationals' profit response to tax differentials: Effect size and shifting channels. *Canadian Journal of Economics/Revue canadienne d'économique*, *50*(4), 965-994.

Hines Jr, J. R., & Rice, E. M. (1994). Fiscal paradise: Foreign tax havens and American business. *The Quarterly Journal of Economics*, *109*(1), 149-182.

Ignat, I., & Feleagă, L. (2017). A European map regarding the strictness of the transfer pricing regulations. *Journal of Accounting and Management Information Systems*, *16*(4), 534-559.

Jacob, M. (2018). A note on tax research. *Revista Contabilidade & Finanças*, *29*(78), 339-342.

Kant, C. (1988). Endogenous transfer pricing and the effects of uncertain regulation. *Journal of International Economics*, *24*(1-2), 147-157.

Knoll, B., & Riedel, N. (2014). Transfer Pricing Laws. *CESifo DICE Report*, *12*(4), 22-26.

Legendre, P., & Legendre, L. F. (2012). *Numerical ecology* (Vol. 24). Elsevier.

Levene, H. (1960). Robust tests for equality of variances. In. I. Olkin et. al. (Eds.), *Contributions to probability and statistics: Essays in honor of Harold Hotlling*, 278-292. Stanford, CA: Stanford University Press.

Lix, L. M., Keselman, J. C., & Keselman, H. J. (1996). Consequences of assumption violations revisited: A quantitative review of alternatives to the one-way analysis of variance F test. *Review of educational research, 66(4)*, 579-619.

Lohse, T., & Riedel, N. (2013). Do Transfer Pricing Laws Limit International Income Shifting? Evidence from European Multinationals. CESifo Working Paper 4404, Munich.

Lohse, T., Spengel, C., & Riedel, N. (2012). The increasing importance of transfer pricing regulations-a worldwide overview. *Working paper/Oxford University Centre for Business Taxation Said Business School*, *12*.

Mantel, N. (1967). The detection of disease clustering and a generalized regression approach. *Cancer research, 27(2 Part 1),* 209-220.

Marques, M., & Pinho, C. (2016). Is transfer pricing strictness deterring profit shifting within multinationals? Empirical evidence from Europe. *Accounting and Business Research, 46*(7), 703-730.

McArdle, B. H., & Anderson, M. J. (2001). Fitting multivariate models to community data: a comment on distance-based redundancy analysis. *Ecology*, *82*(1), 290-297.

Meilă, M. (2007). Comparing clusterings—an information based distance. *Journal of multivariate analysis*, *98*(5), 873-895.

Nicolay, K., Nusser, H., & Pfeiffer, O. (2017). On the interdependency of profit shifting channels and the effectiveness of anti-avoidance legislation. *ZEW-Centre for European Economic Research Discussion Paper*, (17-066).

OECD, (2013). Action Plan on Base Erosion and Profit Shifting.

OECD, (2017). Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations.

Overesch, M. (2006). Transfer pricing of intrafirm sales as a profit shifting channel-Evidence from German firm data. *ZEW-Centre for European Economic Research Discussion Paper*, (06-084).

Rathke, A. A. T. (2014). *Transfer pricing e income shifting: evidências de empresas abertas brasileiras* (Master dissertation, Universidade de São Paulo).

Rathke, A. A. T., & Rezende, A. J. (2016). *Exploring the characteristics of transfer pricing systems across countries*. Conference Paper, Association for Public Economic Theory, In: *PET 16-Rio*.

Reiss, P. T., Stevens, M. H. H., Shehzad, Z., Petkova, E., & Milham, M. P. (2010). On Distance-Based Permutation Tests for Between-Group Comparisons. *Biometrics*, *66*(2), 636-643.

Riedel, N. (2018). Quantifying international tax avoidance: A review of the academic literature. *Review of Economics*, *69*(2), 169-181.

Saunders-Scott, M. (2013). How does transfer-pricing enforcement affect reported profits? *mimeo*

Sokal, R. R. (1958). A statistical method for evaluating systematic relationship. *University of Kansas science bulletin*, *28*, 1409-1438.

Swenson, D. L. (2001). Tax reforms and evidence of transfer pricing. *National Tax Journal*, 7-25.

Taylor, G., & Richardson, G. (2012). International corporate tax avoidance practices: evidence from Australian firms. *The International Journal of Accounting*, *47*(4), 469-496.

Tukey, J. W. (1949). Comparing individual means in the analysis of variance. *Biometrics, 5(2)*, 99-114.

Yitzhaklt, S. (1974). A note on income tax evasion: A theoretical analysis. *Journal of public economics*, *3*, 201-202.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica, 48(4)*, 817-838.

APPENDICES

Appendix A: TP Variables – Mean Values by Year, Regularised

Variables by TP Topic	Binary/ Numeric	Years						
		2010	2011	2012	2013	2014	2015	2016
1. Implementation of TP system								
1.1 Maturity (years) of TP system	N	0.2576	0.2722	0.2867	0.3005	0.3142	0.3274	0.3400
1.2 TP regulation is incorporated into domestic tax system	B	0.8864	0.9091	0.9091	0.9318	0.9318	0.9318	0.9318
1.3 TP system follows the arm's length principle	B	0.9773	0.9773	0.9773	0.9773	0.9773	0.9773	0.9773
1.4 TP system overrides OECD TP guidelines	B	0.4545	0.4545	0.4545	0.4318	0.4091	0.4318	0.4318
2. Related-party status								
2.1 TP system has specific provision on tax havens/favourable tax regimes	B	0.3864	0.3864	0.4091	0.4091	0.4091	0.4318	0.4318
2.2 Related-party status/interdependence: statutory threshold	B	0.6364	0.6364	0.6364	0.6591	0.6591	0.6818	0.6818
2.3 Related-party status/interdependence: de facto relationship	B	0.9545	0.9773	0.9773	0.9773	0.9773	1.0000	1.0000
2.4 Related-party status/interdependence: under common control	B	0.8636	0.8864	0.9091	0.9091	0.9091	0.9091	0.9091
2.5 TP provisions applicable/specific provision on permanent establishments - PE	B	0.3636	0.3864	0.4091	0.4545	0.4773	0.5000	0.5227
3. TP methods and comparables								
3.1 TP system implements CUP method	B	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3.2 TP system implements RP method	B	0.9545	0.9545	0.9773	0.9773	0.9773	0.9773	0.9773
3.3 TP system implements C+ method	B	0.9545	0.9545	0.9773	0.9773	0.9773	0.9773	0.9773
3.4 TP system implements PS method	B	0.9091	0.9091	0.9545	0.9773	0.9773	0.9773	0.9773
3.5 TP system implements TNM method	B	0.9091	0.9318	0.9545	0.9773	0.9773	0.9773	0.9773
3.6 TP system implements country-specific methods	B	0.1818	0.1818	0.1591	0.1364	0.1364	0.1364	0.1136
3.7 TP system allows for non-prescribed alternative methods	B	0.1818	0.2273	0.2500	0.2955	0.2727	0.2955	0.2955
3.8 Foreign comparables are accepted (statutory rule or in practice)	B	0.8182	0.8409	0.8409	0.8409	0.8409	0.8409	0.8409
3.9 TP system accepts set-offs/bundled transactions	B	0.3182	0.3182	0.3409	0.2955	0.2955	0.2955	0.2955
4. Priority of TP methods								
4.1 Priority of methods: best for transaction	B	0.3864	0.3864	0.4773	0.5227	0.5455	0.5682	0.5909
4.2 Priority of methods: traditional transactional-based methods	B	0.4318	0.3864	0.3409	0.3864	0.3864	0.3409	0.3409
4.3 Priority of methods: CUP	B	0.2727	0.2727	0.2273	0.1591	0.1591	0.1591	0.1364
4.4 Priority of methods: domestic priority rule	B	0.1136	0.1136	0.1136	0.1364	0.1591	0.1818	0.1591

5. Provisions on internal services and cost-sharing arrangements								
5.1 Management fees/head office expenses are accepted/deductible by TP system/domestic tax rule	B	0.9545	0.9545	0.9545	0.9545	0.9545	0.9545	0.9545
5.2 TP system/domestic tax rule has specific provision/requirements for management fees/head office expenses	B	0.2273	0.2273	0.2500	0.2500	0.2500	0.2500	0.2500
5.3 TP system/domestic tax rule levy withholding tax on management fees/head office expenses	B	0.5000	0.4773	0.4773	0.4773	0.4773	0.4773	0.4773
5.4 Commissionaire arrangements are accepted by TP system/domestic tax rule	B	0.7955	0.7955	0.7955	0.8182	0.8409	0.8409	0.8409
5.5 Cost-sharing/cost-contribution arrangements are accepted/deductible by TP system/domestic tax rule	B	0.8864	0.8864	0.8864	0.9091	0.9318	0.9318	0.9318
5.6 TP system/domestic tax rule has specific provision/requirements for cost-sharing/cost-contribution arrangements	B	0.2727	0.2500	0.2727	0.2955	0.2955	0.2955	0.2955
5.7 TP system/domestic tax rule levy withholding tax on cost-sharing/cost-contribution arrangements	B	0.3864	0.3636	0.3636	0.3636	0.3636	0.3636	0.3636
6. Disclosure of TP information								
6.1 TP system has statutory requirements/provision for TP documentation	B	0.6364	0.6591	0.6818	0.7500	0.7500	0.7500	0.7500
6.2 Disclosure of specific TP return	B	0.6364	0.6364	0.6591	0.7045	0.7500	0.7500	0.7500
6.3 Disclosure of specific TP return is conditioned/does not apply for all transactions/taxpayers	B	0.3182	0.3182	0.3864	0.4091	0.4318	0.4545	0.4545
6.4 TP return includes at most only general info on intra-firm transactions (short disclosure)	B	0.2727	0.2727	0.2955	0.2955	0.3182	0.3182	0.3182
6.5 TP return includes info about TP methods/calculations (long disclosure)	B	0.3636	0.3636	0.3636	0.4091	0.4318	0.4318	0.4318
6.6 Deadline (months from year-end) to prepare/issue TP return	N	0.7343	0.7394	0.7285	0.7083	0.6919	0.6919	0.6944
6.7 TP system established specific deadline for submission of full TP doc (when requested)	B	0.8182	0.8409	0.8636	0.9091	0.9091	0.9091	0.9091
6.8 Deadline (months from year-end) to submit full TP doc (when requested)	N	0.4659	0.4489	0.4375	0.4280	0.4167	0.4167	0.4091
7. Statute of limitations								
7.1 Statute of limitations (months) for general TP assessment	N	0.5188	0.5178	0.5138	0.5138	0.5206	0.5343	0.5366
7.2 TP system/domestic tax rule has special statute of limitations for intentional non-compliance/omission	B	0.3182	0.3182	0.3182	0.3182	0.3182	0.3182	0.3182
7.3 Statute of limitations (months) for intentional non-compliance/omission	N	0.3912	0.3907	0.3910	0.3808	0.3819	0.3865	0.3887
8. TP penalisation								
8.1 TP system determines specific TP penalisation	B	0.2727	0.2727	0.3182	0.3182	0.3409	0.3182	0.3182
8.2 Max TP penalisation (percentage of unpaid tax) for general tax adjustment	N	0.1598	0.1620	0.1586	0.1591	0.1649	0.1677	0.1728

8.3 Max TP penalisation (percentage of unpaid tax) in case of high level of negligence/fraud/intentional avoidance	N	0.1118	0.1141	0.1110	0.1108	0.1131	0.1142	0.1162
8.4 TP system determined fixed TP penalty for failure in documentation/info disclosure	B	0.1591	0.1591	0.2045	0.2045	0.2273	0.2045	0.2045
8.5 TP system determined variable TP penalty for failure in documentation/info disclosure	B	0.4318	0.4318	0.4318	0.4545	0.4318	0.4773	0.4773
8.6 TP system/domestic tax rule allows the appeal for penalty relief/reduction	B	0.5682	0.5909	0.6136	0.6364	0.6136	0.6136	0.5909
9. Advanced-pricing agreements - APA (or APA-like provisions)								
9.1 APA/APA-like options are available	B	0.6818	0.7273	0.7727	0.8409	0.8864	0.8864	0.8864
9.2 Max APA/APA-like term of agreement (months)	N	0.3750	0.3778	0.4063	0.4347	0.4293	0.4293	0.4293
9.3 Unilateral APA/APA-like options	B	0.2273	0.2273	0.2500	0.2727	0.3409	0.3409	0.3409
9.4 Bilateral/multilateral APA/APA/like options	B	0.6136	0.6364	0.6818	0.7273	0.7727	0.7727	0.7727
9.5 Possible roll-back application of APA/APA-like options	B	0.5455	0.5909	0.6364	0.7045	0.7955	0.7955	0.7955
10. Competent authority - CA procedure								
10.1 CA procedure is available	B	0.7273	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
10.2 CA procedure proposed (usually) after tax assessment	B	0.5682	0.5227	0.5455	0.5455	0.5455	0.5455	0.5455
10.3 CA procedure proposed also before/during tax assessment	B	0.1591	0.1591	0.1591	0.1591	0.1591	0.1591	0.1591
10.4 Double-tax resolution is likely to be achieved via CA procedure	B	0.3636	0.3864	0.3864	0.3864	0.3864	0.4091	0.4091
10.5 CA procedure prevents/suspends tax payment	B	0.5000	0.5000	0.5000	0.5227	0.5227	0.5000	0.5000
10.6 CA procedure is rarely applied by taxpayers (if observable)	B	0.5682	0.5455	0.5455	0.5455	0.5227	0.5227	0.5227

This table presents all the $C = 57$ TP variables in each TP topic. Variables refer to TP characteristics analysed in this study, as described in Section 1.2. We indicate whether the variable is binary (B) or numeric (N). Mean values are computed by year, all regularised for the range [0,1]. For binary variables referring to qualitative TP characteristics, mean value is interpreted as a frequency information.

Source: by author.

Appendix B. TP Topics by Country – Mean Values by Topic, Regularised

	TP Topics									
Countries	1. Implementation of TP system	2. Related-party status	3. TP methods and comparables	4. Priority of TP methods	5. Provisions on internal services and cost-sharing arrangements	6. Disclosure of TP information	7. Statute of limitations	8. TP penalisation	9. Advanced-pricing agreements - APA (or APA-like provisions)	10. Competent authority - CA procedure
AR	0.8469	0.6000	0.7778	0.5000	0.8571	0.6319	0.3000	1.0000	0.0000	0.1667
AU	0.6786	0.6000	0.8413	0.5000	0.5714	0.6319	0.4000	0.3656	0.8048	0.6667
AT	0.5357	0.6000	0.7778	0.5000	0.4490	0.2500	0.3000	0.0000	0.5143	0.8333
BE	0.5612	0.6000	0.6508	0.5000	0.4286	0.6250	0.5405	0.4024	0.8048	0.6667
BR	0.6020	0.7429	0.3333	0.2500	0.7143	0.4853	0.2500	0.4333	0.0000	0.1667
CA	0.5969	0.7143	0.7778	0.4286	0.4286	0.8333	0.3500	0.3392	0.9190	0.5476

CL	0.8520	0.8286	0.6825	0.2500	0.5918	0.4821	0.5333	0.1186	0.2810	0.1667
CN	0.7959	0.8000	0.7778	0.2500	0.7143	0.5944	0.5000	0.3333	0.9190	0.5000
CO	0.6735	0.9143	0.6667	0.2500	0.7143	0.7431	0.2500	0.4267	0.7369	0.1667
CZ	0.8724	0.6000	0.6667	0.2500	0.4286	0.3423	0.1500	0.0117	0.6714	0.1667
DN	0.5969	0.7714	0.7778	0.5000	0.4286	0.7917	0.2667	0.5085	0.6000	0.6667
EC	0.8112	1.0000	0.7619	0.4643	0.7143	0.7083	0.1500	0.3450	0.6952	0.3333
FI	0.6224	0.4000	0.7778	0.2500	0.4286	0.7917	0.3000	0.3508	0.4000	0.3333
FR	0.7500	1.0000	0.6667	0.2500	0.4286	0.5774	0.1500	0.6014	0.7190	0.5952
DE	0.9235	0.8000	0.8889	0.5000	0.5714	0.4583	0.6333	0.5058	0.5190	0.6667
GR	0.5408	0.6286	0.6190	0.2500	0.6327	0.7262	0.2500	0.4519	0.2952	0.8333
HU	0.6276	0.2571	0.7778	0.0357	0.4694	0.3792	0.2821	0.3625	0.7905	0.1667
IN	0.8316	0.8000	0.6508	0.2500	0.4286	0.6488	0.1964	0.3417	0.6357	0.5000
ID	0.6684	0.6000	0.6667	0.2500	0.7143	0.6865	0.2500	0.0867	0.8381	0.5000
IE	0.4949	0.3429	0.6667	0.2500	0.4286	0.4375	0.2000	0.1714	0.3631	0.4524
IT	0.8980	1.0000	0.7778	0.6071	0.5714	0.6375	0.6095	0.2833	0.6619	0.6190
JP	0.9082	0.6286	0.7778	0.2500	0.7143	0.5694	0.3083	0.0121	0.9190	0.8333
LU	0.2500	0.4000	0.5556	0.0000	0.4286	0.2500	0.6667	0.0188	0.0000	0.8333
MY	0.5714	0.8000	0.6349	0.2500	0.9184	0.7222	0.8762	0.3078	0.7190	0.5238
MX	0.8520	0.4857	0.7778	0.5000	0.7755	0.5625	0.2500	0.2104	0.9190	0.3333
NL	0.5765	0.5714	0.6667	0.0000	0.7143	0.6111	0.2500	0.1833	0.9190	0.6667
NO	0.5918	0.4000	0.6667	0.0000	0.4286	0.7431	0.5667	0.0225	0.0000	0.1667
PE	0.8316	0.8000	0.7143	0.3929	0.7959	0.6652	0.3000	0.5188	0.6095	0.6905
PH	0.3929	0.4000	0.6032	0.1429	0.7143	0.3333	0.6000	0.1140	0.1143	0.6905
PL	0.6276	1.0000	0.7143	0.3571	0.7143	0.6771	0.3000	0.1958	0.7190	0.5000
PT	0.5765	0.8857	0.7778	0.2500	1.0000	0.7278	0.2000	0.6940	0.6714	0.7143
RO	0.5663	0.8000	0.7778	0.5000	0.7143	0.4940	0.6667	0.1754	0.7190	0.5000
RU	0.8418	0.6857	0.6508	0.5000	0.2857	0.5942	0.1286	0.3621	0.5119	0.1667
SK	0.6224	0.8000	0.7778	0.2500	0.4286	0.5982	0.5000	0.1800	0.6048	0.6667
SI	0.5612	0.7714	0.7619	0.3571	0.5714	0.7917	0.5000	0.3834	0.0000	0.1667
ES	0.6020	1.0000	0.6667	0.2500	1.0000	0.7194	0.2000	0.5088	0.9429	0.6667
SE	0.5510	0.4000	0.6667	0.2500	0.4286	0.4167	0.3000	0.1900	0.5190	0.6667
CH	0.2500	0.6000	0.6667	0.0000	0.5714	0.2500	0.5000	0.0725	0.8524	0.1667
TH	0.5000	0.4000	0.7778	0.2500	0.7143	0.2917	0.4833	0.2250	0.5190	0.3333
UA	0.8520	0.8000	0.5079	0.4643	0.2857	0.5079	0.8048	0.2095	0.4083	0.5000
UK	0.5918	1.0000	0.8730	0.2857	0.4286	0.2917	0.8000	0.3625	0.9190	0.6667
US	1.0000	0.4000	1.0000	0.2500	0.7143	0.4514	0.7667	0.3567	0.9190	0.5000
VE	0.8265	0.6000	0.6667	0.2500	0.4286	0.5875	0.6048	0.4667	0.6714	0.3333
VN	0.8061	0.6000	0.6667	0.2500	0.0000	0.5833	0.5714	0.2232	0.3048	0.1667

This table presents mean values of TP characteristics for individual countries for the complete period. It comprises the mean value all $C = 57$ variables divided into 10 sets of TP topics. All means are regularised for the range [0,1]. Means are based on qualitative a quantitative TP characteristics described in Appendix A, thus implying data-frequency interpretation
Source: by author.

Appendix C: Dissimilarity Matrix $D_{2010\text{-}2016}$ for the Complete Period of 2010-2016

	Pairwise dissimilarities d_{ij}																					
	AR	AU	AT	BE	BR	CA	CL	CN	CO	CZ	DN	EC	FI	FR	DE	GR	HU	IN	ID	IE	IT	JP
AR	0.0	189.6	207.9	178.6	87.5	181.4	123.4	144.1	94.8	140.4	179.4	106.9	142.5	156.0	172.3	151.7	151.7	150.5	144.3	147.0	176.4	196.9
AU	189.6	0.0	79.8	80.5	198.8	74.5	156.3	97.1	113.1	130.5	61.0	154.1	120.1	85.7	99.9	120.9	161.4	134.3	109.3	108.2	114.8	103.4
AT	207.9	79.8	0.0	101.6	219.3	106.0	162.2	159.1	164.3	108.3	81.0	189.4	128.5	106.5	108.1	136.7	144.4	144.6	127.1	72.5	132.5	121.5
BE	178.6	80.5	101.6	0.0	187.3	117.5	143.8	145.8	112.2	112.0	81.3	158.8	111.2	109.4	136.7	120.1	161.2	100.0	111.8	108.7	101.2	145.4
BR	87.5	198.8	219.3	187.3	0.0	204.0	115.8	170.7	107.5	139.1	204.6	119.8	165.1	189.4	186.3	168.2	180.8	169.8	153.2	168.4	178.9	219.5
CA	181.4	74.5	106.0	117.5	204.0	0.0	160.9	108.0	104.9	134.4	61.4	123.4	109.2	89.3	112.1	102.9	141.1	130.0	78.8	108.7	133.1	85.2
CL	123.4	156.3	162.2	143.8	115.8	160.9	0.0	139.5	82.1	88.7	171.7	96.5	135.7	143.0	176.1	119.4	132.6	123.7	107.7	138.6	156.3	166.4
CN	144.1	97.1	159.1	145.8	170.7	108.0	139.5	0.0	87.4	110.5	126.7	111.9	126.2	117.9	137.3	143.6	137.9	114.5	91.9	131.2	139.8	88.2
CO	94.8	113.1	164.3	112.2	107.5	104.9	82.1	87.4	0.0	87.3	117.1	67.0	95.4	101.0	166.0	107.8	118.0	106.0	70.0	119.9	133.5	146.4
CZ	140.4	130.5	108.3	112.0	139.1	134.4	88.7	110.5	87.3	0.0	116.0	119.6	81.0	108.7	142.8	137.2	73.6	107.7	86.0	79.4	131.3	133.9
DN	179.4	61.0	81.0	81.3	204.6	61.4	171.7	126.7	117.1	116.0	0.0	140.7	75.3	62.2	80.5	76.2	138.7	114.4	106.1	96.2	104.8	127.9
EC	106.9	154.1	189.4	158.8	119.8	123.4	96.5	111.9	67.0	119.6	140.7	0.0	127.4	122.5	146.7	112.3	137.7	134.5	88.6	164.5	129.3	159.2
FI	142.5	120.1	128.5	111.2	165.1	109.2	135.7	126.2	95.4	81.0	75.3	127.4	0.0	114.7	151.3	116.6	98.6	126.8	100.6	96.4	138.7	153.5
FR	156.0	85.7	106.5	109.4	189.4	89.3	143.0	117.9	101.0	108.7	62.2	122.5	114.7	0.0	87.8	115.6	127.8	100.8	116.4	96.6	117.1	116.7
DE	172.3	99.9	108.1	136.7	186.3	112.1	176.1	137.3	166.0	142.8	80.5	146.7	151.3	87.8	0.0	129.5	149.8	152.6	156.9	112.7	80.8	139.0
GR	151.7	120.9	136.7	120.1	168.2	102.9	119.4	143.6	107.8	137.2	76.2	112.3	116.6	115.6	129.5	0.0	144.7	109.2	94.7	122.4	128.0	147.9
HU	151.7	161.4	144.4	161.2	180.8	141.1	132.6	137.9	118.0	73.6	138.7	137.7	98.6	127.8	149.8	144.7	0.0	142.3	109.6	104.0	162.4	156.4
IN	150.5	134.3	144.6	100.0	169.8	130.0	123.7	114.5	106.0	107.7	114.4	134.5	126.8	100.8	152.6	109.2	142.3	0.0	103.4	120.7	117.6	95.5
ID	144.3	109.3	127.1	111.8	153.2	78.8	107.7	91.9	70.0	86.0	106.1	88.6	100.6	116.4	156.9	94.7	109.6	103.4	0.0	97.1	140.0	96.8
IE	147.0	108.2	72.5	108.7	168.4	108.7	138.6	131.2	119.9	79.4	96.2	164.5	96.4	96.6	112.7	122.4	104.0	120.7	97.1	0.0	131.0	143.0
IT	176.4	114.8	132.5	101.2	178.9	133.1	156.3	139.8	133.5	131.3	104.8	129.3	138.7	117.1	80.8	128.0	162.4	117.6	140.0	131.0	0.0	140.4
JP	196.9	103.4	121.5	145.4	219.5	85.2	166.4	88.2	146.4	133.9	127.9	159.2	153.5	116.7	139.0	147.9	156.4	95.5	96.8	143.0	140.4	0.0
LU	183.3	147.9	85.0	137.2	179.4	163.9	140.4	185.3	178.3	119.0	146.4	190.1	142.2	144.6	134.4	125.1	143.4	148.7	139.2	80.8	152.6	165.3
MY	191.3	110.0	133.1	97.2	201.1	119.6	152.2	129.4	120.4	145.6	93.2	149.3	126.2	119.7	116.4	107.2	158.9	130.4	114.8	155.7	114.7	118.2
MX	155.3	113.8	152.8	152.6	176.2	112.9	143.4	86.1	110.7	126.9	145.9	113.9	122.4	142.6	145.5	154.3	139.5	164.1	112.8	144.7	117.9	111.7
NL	182.1	77.8	100.9	92.9	202.6	97.4	173.1	92.0	129.4	113.5	80.6	153.0	115.4	104.2	108.1	102.7	135.8	118.5	95.9	86.0	80.8	93.6
NO	148.7	166.9	157.8	126.9	145.9	151.5	106.0	160.8	114.4	82.1	125.3	136.1	65.3	160.7	158.6	111.4	96.5	140.2	108.4	105.9	143.5	180.9
PE	106.7	114.0	152.1	109.2	127.8	113.9	112.8	106.6	61.1	110.4	108.6	76.1	105.8	102.6	138.0	108.8	141.0	118.7	90.6	144.8	140.4	125.5

PH	142.4	170.3	106.8	130.8	162.7	169.6	106.0	170.7	137.4	111.2	163.4	152.3	125.3	162.2	158.1	127.5	126.4	139.6	111.6	97.1	171.6	157.7
PL	174.5	111.9	118.8	95.5	187.6	86.9	132.9	140.1	104.1	120.8	69.3	96.9	118.4	101.0	124.7	70.6	120.9	107.5	73.1	135.2	99.2	131.5
PT	129.2	99.7	151.2	107.1	178.8	113.5	145.9	94.1	85.6	149.6	107.1	121.7	135.5	98.3	150.0	118.6	140.4	114.2	93.1	138.7	144.2	105.0
RO	180.3	136.5	102.1	141.9	194.4	106.4	123.6	131.3	123.7	110.4	116.5	125.8	115.0	121.2	108.3	119.3	98.0	151.8	89.5	113.2	123.2	147.4
RU	146.9	185.3	183.7	160.4	144.3	169.9	111.8	163.8	128.7	93.8	153.8	121.5	110.9	148.5	163.1	149.7	106.0	143.6	141.7	135.1	142.6	193.1
SK	192.8	95.0	93.8	111.9	211.5	103.7	155.7	114.4	138.3	104.2	74.4	153.4	100.2	104.0	118.9	105.0	102.7	102.4	98.2	102.8	94.3	105.3
SI	131.0	136.4	167.1	127.1	143.6	145.7	122.4	127.5	101.8	110.2	114.5	142.6	81.3	149.4	159.7	118.9	127.1	133.3	130.0	117.9	143.0	173.6
ES	163.5	103.2	130.4	134.4	207.0	73.7	170.9	115.7	110.9	168.8	101.4	118.6	152.6	105.2	130.4	120.2	154.8	153.4	98.1	140.7	124.2	114.9
SE	166.3	81.9	67.9	87.7	177.8	93.0	155.0	135.2	133.1	98.8	79.3	168.2	116.1	92.7	76.4	99.2	102.5	121.3	96.9	42.6	96.6	122.5
CH	171.0	135.8	97.2	145.3	183.5	148.3	133.8	127.6	123.8	79.6	155.5	155.0	134.2	150.9	161.7	165.5	97.5	164.6	123.8	97.9	162.5	167.0
TH	147.2	141.0	135.6	120.2	142.6	150.8	98.6	133.0	119.9	91.7	159.8	147.1	137.9	155.0	127.4	136.2	109.1	142.5	117.5	96.1	142.3	162.3
UA	170.7	182.0	172.5	166.9	165.6	163.2	108.2	167.5	151.1	133.6	172.3	148.7	160.0	142.0	153.5	148.9	172.3	144.9	160.3	146.2	132.9	160.5
UK	200.2	70.9	88.6	86.6	200.3	106.7	138.9	113.2	121.8	116.3	84.8	156.0	132.8	68.0	89.1	146.4	138.6	110.4	123.4	100.1	107.1	120.8
US	163.2	102.5	150.7	127.1	198.4	118.1	156.5	111.1	155.4	138.8	142.2	158.1	162.3	136.9	124.6	167.3	170.3	143.0	121.6	146.7	143.3	90.3
VE	112.9	137.9	169.8	110.2	124.0	125.1	94.9	105.1	77.2	102.1	145.7	92.8	119.3	125.1	148.6	125.5	130.5	102.0	99.7	119.5	111.4	140.8
VN	124.2	149.5	162.2	160.4	137.9	141.4	102.4	97.9	93.7	78.2	145.0	129.9	110.2	142.2	168.8	132.4	124.5	111.2	106.6	119.7	170.3	140.2

Pairwise dissimilarities d_{ij} - Continued

	LU	MY	MX	NL	NO	PE	PH	PL	PT	RO	RU	SK	SI	ES	SE	CH	TH	UA	UK	US	VE	VN
AR	183.3	191.3	155.3	182.1	148.7	106.7	142.4	174.5	129.2	180.3	146.9	192.8	131.0	163.5	166.3	171.0	147.2	170.7	200.2	163.2	112.9	124.2
AU	147.9	110.0	113.8	77.8	166.9	114.0	170.3	111.9	99.7	136.5	185.3	95.0	136.4	103.2	81.9	135.8	141.0	182.0	70.9	102.5	137.9	149.5
AT	85.0	133.1	152.8	100.9	157.8	152.1	106.8	118.8	151.2	102.1	183.7	93.8	167.1	130.4	67.9	97.2	135.6	172.5	88.6	150.7	169.8	162.2
BE	137.2	97.2	152.6	92.9	126.9	109.2	130.8	95.5	107.1	141.9	160.4	111.9	127.1	134.4	87.7	145.3	120.2	166.9	86.6	127.1	110.2	160.4
BR	179.4	201.1	176.2	202.6	145.9	127.8	162.7	187.6	178.8	194.4	144.3	211.5	143.6	207.0	177.8	183.5	142.6	165.6	200.3	198.4	124.0	137.9
CA	163.9	119.6	112.9	97.4	151.5	113.9	169.6	86.9	113.5	106.4	169.9	103.7	145.7	73.7	93.0	148.3	150.8	163.2	106.7	118.1	125.1	141.4
CL	140.4	152.2	143.4	173.1	106.0	112.8	106.0	132.9	145.9	123.6	111.8	155.7	122.4	170.9	155.0	133.8	98.6	108.2	138.9	156.5	94.9	102.4
CN	185.3	129.4	86.1	92.0	160.8	106.6	170.7	140.1	94.1	131.3	163.8	114.4	127.5	115.7	135.2	127.6	133.0	167.5	113.2	111.1	105.1	97.9
CO	178.3	120.4	110.7	129.4	114.4	61.1	137.4	104.1	85.6	123.7	128.7	138.3	101.8	110.9	133.1	123.8	119.9	151.1	121.8	155.4	77.2	93.7
CZ	119.0	145.6	126.9	113.5	82.1	110.4	111.2	120.8	149.6	110.4	93.8	104.2	110.2	168.8	98.8	79.6	91.7	133.6	116.3	138.8	102.1	78.2
DN	146.4	93.2	145.9	80.6	125.3	108.6	163.4	69.3	107.1	116.5	153.8	74.4	114.5	101.4	79.3	155.5	159.8	172.3	84.8	142.2	145.7	145.0
EC	190.1	149.3	113.9	153.0	136.1	76.1	152.3	96.9	121.7	125.8	121.5	153.4	142.6	118.6	168.2	155.0	147.1	148.7	156.0	158.1	92.8	129.9
FI	142.2	126.2	122.4	115.4	65.3	105.8	125.3	118.4	135.5	115.0	110.9	100.2	81.3	152.6	116.1	134.2	137.9	160.0	132.8	162.3	119.3	110.2
FR	144.6	119.7	142.6	104.2	160.7	102.6	162.2	101.0	98.3	121.2	148.5	104.0	149.4	105.2	92.7	150.9	155.0	142.0	68.0	136.9	125.1	142.2

DE	134.4	116.4	145.5	108.1	158.6	138.0	158.1	124.7	150.0	108.3	163.1	118.9	159.7	130.4	76.4	161.7	127.4	153.5	89.1	124.6	148.6	168.8
GR	125.1	107.2	154.3	102.7	111.4	108.8	127.5	70.6	118.6	119.3	149.7	105.0	118.9	120.2	99.2	165.5	136.2	148.9	146.4	167.3	125.5	132.4
HU	143.4	158.9	139.5	135.8	96.5	141.0	126.4	120.9	140.4	98.0	106.0	102.7	127.1	154.8	102.5	97.5	109.1	172.3	138.6	170.3	130.5	124.5
IN	148.7	130.4	164.1	118.5	140.2	118.7	139.6	107.5	114.2	151.8	143.6	102.4	133.3	153.4	121.3	164.6	142.5	144.9	110.4	143.0	102.0	111.2
ID	139.2	114.8	112.8	95.9	108.4	90.6	111.6	73.1	93.1	89.5	141.7	98.2	130.0	98.1	96.9	123.8	117.5	160.3	123.4	121.6	99.7	106.6
IE	80.8	155.7	144.7	86.0	105.9	144.8	97.1	135.2	138.7	113.2	135.1	102.8	117.9	140.7	42.6	97.9	96.1	146.2	100.1	146.7	119.5	119.7
IT	152.6	114.7	117.9	80.8	143.5	140.4	171.6	99.2	144.2	123.2	142.6	94.3	143.0	124.2	96.6	162.5	142.3	132.9	107.1	143.3	111.4	170.3
JP	165.3	118.2	111.7	93.6	180.9	125.5	157.7	131.5	105.0	147.4	193.1	105.3	173.6	114.9	122.5	167.0	162.3	160.5	120.8	90.3	140.8	140.2
LU	0.0	165.7	192.9	125.8	101.0	179.5	65.7	164.3	197.2	124.2	174.9	125.4	143.8	171.3	81.5	91.6	105.3	134.2	125.8	174.1	151.4	153.1
MY	165.7	0.0	126.1	98.2	135.9	111.7	126.1	84.3	105.8	102.2	181.1	116.4	145.6	116.9	115.4	154.7	128.9	158.0	118.1	141.0	135.6	173.8
MX	192.9	126.1	0.0	96.3	152.1	129.9	173.9	123.3	145.3	111.5	146.2	151.8	158.1	122.1	126.9	126.8	121.0	145.3	151.8	128.7	88.2	143.2
NL	125.8	98.2	96.3	0.0	128.8	145.2	148.2	96.8	112.0	130.1	157.0	70.8	136.9	86.9	60.4	104.3	139.3	166.3	94.6	107.4	128.9	156.6
NO	101.0	135.9	152.1	128.8	0.0	150.2	103.9	123.6	177.0	126.0	110.2	114.1	68.4	182.8	118.9	122.3	124.8	141.1	161.4	186.6	126.8	98.8
PE	179.5	111.7	129.9	145.2	150.2	0.0	124.6	96.8	69.8	147.8	136.3	151.8	126.7	113.3	140.4	173.0	134.1	157.6	134.7	128.3	95.4	122.1
PH	65.7	126.1	173.9	148.2	103.9	124.6	0.0	143.4	148.9	101.3	160.5	133.4	143.5	165.7	103.9	117.3	86.9	151.2	146.8	165.7	131.5	143.5
PL	164.3	84.3	123.3	96.8	123.6	96.8	143.4	0.0	99.7	85.0	142.4	79.8	132.2	86.3	97.0	147.3	136.3	176.7	123.6	149.9	129.3	163.6
PT	197.2	105.8	145.3	112.0	177.0	69.8	148.9	99.7	0.0	145.2	166.9	118.9	135.9	67.9	134.6	180.7	158.0	190.1	119.8	120.6	126.8	164.6
RO	124.2	102.2	111.5	130.1	126.0	147.8	101.3	85.0	145.2	0.0	147.3	99.3	157.4	121.8	98.1	109.4	94.5	148.6	112.5	162.6	115.4	156.6
RU	174.9	181.1	146.2	157.0	110.2	136.3	160.5	142.4	166.9	147.3	0.0	140.8	117.3	174.9	148.5	146.6	141.0	113.2	174.1	188.1	131.2	124.5
SK	125.4	116.4	151.8	70.8	114.1	151.8	133.4	79.8	118.9	99.3	140.8	0.0	116.2	111.4	77.8	125.4	145.2	170.1	97.3	150.0	154.0	129.3
SI	143.8	145.6	158.1	136.9	68.4	126.7	143.5	132.2	135.9	157.4	117.3	116.2	0.0	159.2	132.9	143.7	146.4	157.5	153.0	185.5	135.0	104.2
ES	171.3	116.9	122.1	86.9	182.8	113.3	165.7	86.3	67.9	121.8	174.9	111.4	159.2	0.0	119.1	147.9	169.5	179.2	126.7	131.3	156.7	197.0
SE	81.5	115.4	126.9	60.4	118.9	140.4	103.9	97.0	134.6	98.1	148.5	77.8	132.9	119.1	0.0	106.8	81.8	147.1	89.1	138.9	117.2	138.1
CH	91.6	154.7	126.8	104.3	122.3	173.0	117.3	147.3	180.7	109.4	146.6	125.4	143.7	147.9	106.8	0.0	102.9	152.8	130.2	164.9	136.1	128.9
TH	105.3	128.9	121.0	139.3	124.8	134.1	86.9	136.3	158.0	94.5	141.0	145.2	146.4	169.5	81.8	102.9	0.0	148.6	127.2	132.5	96.1	149.1
UA	134.2	158.0	145.3	166.3	141.1	157.6	151.2	176.7	190.1	148.6	113.2	170.1	157.5	179.2	147.1	152.8	148.6	0.0	155.6	170.3	105.5	116.0
UK	125.8	118.1	151.8	94.6	161.4	134.7	146.8	123.6	119.8	112.5	174.1	97.3	153.0	126.7	89.1	130.2	127.2	155.6	0.0	107.0	134.4	160.2
US	174.1	141.0	128.7	107.4	186.6	128.3	165.7	149.9	120.6	162.6	188.1	150.0	185.5	131.3	138.9	164.9	132.5	170.3	107.0	0.0	136.4	157.8
VE	151.4	135.6	88.2	128.9	126.8	95.4	131.5	129.3	126.8	115.4	131.2	154.0	135.0	156.7	117.2	136.1	96.1	105.5	134.4	136.4	0.0	99.2
VN	153.1	173.8	143.2	156.6	98.8	122.1	143.5	163.6	164.6	156.6	124.5	129.3	104.2	197.0	138.1	128.9	149.1	116.0	160.2	157.8	99.2	0.0

This table presents the dissimilarity matrix $D_{2010\text{-}2016} = [d_{ij}]$ for the complete period of 2010-2016. Pairwise dissimilarities d_{ij} refer to the Gower (1971) measure for mix variables and are computed with respect to all $C = 57$ TP variables presented in Appendix A, at the individual level. This dissimilarity matrix $D_{2010\text{-}2016}$ is applied for t hierarchical clustering analysis, via average linkage method. Results for the hierarchical clustering analysis is presented in Figure 1 and Table 1.1.

Source: by author.

Appendix D: TP Variables – Mean Values by TP System, Regularised

Variables by TP Topic	Binary/ Numeric	Average Contribution of TP Variables in each TP Syste			
		TP Syst. #1	TP Syst. #2	TP syst. #3	TP syst. #4
1. Implementation of TP system					
1.1 Maturity (years) of TP system	N	0.1924	0.3061	0.4158	0.3980
1.2 TP regulation is incorporated into domestic tax system	B	0.5102	1.0000	0.9940	1.0000
1.3 TP system follows the arm's length principle	B	1.0000	1.0000	1.0000	0.5000
1.4 TP system overrides OECD TP guidelir	B	0.2857	0.7013	0.3155	1.0000
2. Related-party status					
2.1 TP system has specific provision on tax havens/favourable tax regimes	B	0.0000	0.6883	0.3512	1.0000
2.2 Related-party status/interdependence: statutory threshold	B	0.4286	0.8701	0.6488	0.3571
2.3 Related-party status/interdependence: d facto relationship	B	0.8980	1.0000	0.9940	1.0000
2.4 Related-party status/interdependence: under common control	B	0.8571	0.7922	0.9524	1.0000
2.5 TP provisions applicable/specific provision on permanent establishments - PE	B	0.2857	0.1948	0.6429	0.0000
3. TP methods and comparables					
3.1 TP system implements CUP method	B	1.0000	1.0000	1.0000	1.0000
3.2 TP system implements RP method	B	1.0000	0.9740	1.0000	0.5000
3.3 TP system implements C+ method	B	1.0000	0.9740	1.0000	0.5000
3.4 TP system implements PS method	B	1.0000	0.9091	1.0000	0.5000
3.5 TP system implements TNM method	B	1.0000	0.9221	1.0000	0.5000
3.6 TP system implements country-specific methods	B	0.0000	0.1429	0.1250	1.0000
3.7 TP system allows for non-prescribed alternative methods	B	0.2857	0.1948	0.3036	0.0000
3.8 Foreign comparables are accepted (statutory rule or in practice)	B	0.7755	0.9091	0.8095	1.0000
3.9 TP system accepts set-offs/bundled transactions	B	0.1429	0.1299	0.4643	0.0000
4. Priority of TP methods					
4.1 Priority of methods: best for transaction	B	0.2245	0.4935	0.5774	0.5000
4.2 Priority of methods: traditional transactional-based methods	B	0.3061	0.0909	0.5536	0.0000
4.3 Priority of methods: CUP	B	0.1429	0.4156	0.1310	0.0000
4.4 Priority of methods: domestic priority rule	B	0.0000	0.2468	0.0595	1.0000
5. Provisions on internal services and cost-sharing arrangements					
5.1 Management fees/head office expenses are accepted/deductible by TP system/domestic tax rule	B	1.0000	0.9091	0.9583	1.0000
5.2 TP system/domestic tax rule has specifi provision/requirements for management fees/head office expenses	B	0.1429	0.0909	0.3214	0.5000
5.3 TP system/domestic tax rule levy withholding tax on management fees/head office expenses	B	0.4490	0.4545	0.4583	1.0000

5.4 Commissionaire arrangements are accepted by TP system/domestic tax rule	B	1.0000	0.6883	0.8095	1.0000
5.5 Cost-sharing/cost-contribution arrangements are accepted/deductible by TI system/domestic tax rule	B	1.0000	0.6883	0.9762	1.0000
5.6 TP system/domestic tax rule has specifi provision/requirements for cost-sharing/cos contribution arrangements	B	0.0000	0.1429	0.4524	0.0000
5.7 TP system/domestic tax rule levy withholding tax on cost-sharing/cost-contribution arrangements	B	0.4490	0.3636	0.2917	1.0000
6. Disclosure of TP information					
6.1 TP system has statutory requirements/provision for TP documentati	B	0.3673	0.8052	0.7857	0.5000
6.2 Disclosure of specific TP return	B	0.0612	0.8961	0.7679	1.0000
6.3 Disclosure of specific TP return is conditioned/does not apply for all transactions/taxpayers	B	0.0000	0.6883	0.4107	0.0000
6.4 TP return includes at most only general info on intra-firm transactions (short disclosure)	B	0.0612	0.3377	0.3750	0.0000
6.5 TP return includes info about TP methods/calculations (long disclosure)	B	0.0000	0.5584	0.3929	1.0000
6.6 Deadline (months from year-end) to prepare/issue TP return	N	0.9592	0.6097	0.6819	0.7857
6.7 TP system established specific deadline for submission of full TP doc (when requested)	B	0.6531	0.9351	0.9107	1.0000
6.8 Deadline (months from year-end) to submit full TP doc (when requested)	N	0.5728	0.4045	0.4239	0.1833
7. Statute of limitations					
7.1 Statute of limitations (months) for gene TP assessment	N	0.4806	0.5117	0.5369	0.5500
7.2 TP system/domestic tax rule has special statute of limitations for intentional non-compliance/omission	B	0.5714	0.3636	0.2500	0.0000
7.3 Statute of limitations (months) for intentional non-compliance/omission	N	0.3832	0.4091	0.3878	0.2750
8. TP penalisation					
8.1 TP system determines specific TP penalisation	B	0.1429	0.2597	0.3631	0.5000
8.2 Max TP penalisation (percentage of unpaid tax) for general tax adjustment	N	0.1032	0.1516	0.1430	0.6875
8.3 Max TP penalisation (percentage of unpaid tax) in case of high level of negligence/fraud/intentional avoidance	N	0.0836	0.0944	0.0885	0.6125
8.4 TP system determined fixed TP penalty for failure in documentation/info disclosure	B	0.3673	0.1429	0.1429	0.5000
8.5 TP system determined variable TP penalty for failure in documentation/info disclosure	B	0.0000	0.6623	0.4345	1.0000
8.6 TP system/domestic tax rule allows the appeal for penalty relief/reduction	B	0.1429	0.5584	0.7262	1.0000
9. Advanced-pricing agreements - APA (or APA-like provisions)					
9.1 APA/APA-like options are available	B	0.7959	0.6623	0.9524	0.0000

9.2 Max APA/APA-like term of agreement (months)	N	0.4558	0.2814	0.4928	0.0000
9.3 Unilateral APA/APA-like options	B	0.0816	0.1429	0.4345	0.0000
9.4 Bilateral/multilateral APA/APA/like options	B	0.5714	0.6623	0.8333	0.0000
9.5 Possible roll-back application of APA/APA-like options	B	0.7143	0.3506	0.9048	0.0000
10. Competent authority - CA procedure					
10.1 CA procedure is available	B	0.5714	0.4545	0.9940	0.0000
10.2 CA procedure proposed (usually) after tax assessment	B	0.3061	0.0130	0.9048	0.0000
10.3 CA procedure proposed also before/during tax assessment	B	0.1429	0.0909	0.2083	0.0000
10.4 Double-tax resolution is likely to be achieved via CA procedure	B	0.1429	0.0909	0.6310	0.0000
10.5 CA procedure prevents/suspends tax payment	B	0.2857	0.0909	0.8036	0.0000
10.6 CA procedure is rarely applied by taxpayers (if observable)	B	1.0000	1.0000	0.1548	1.0000
Countries		CZ, HU, LU, PH, RO, CH, T	CL, CO, EC, FI, NO, PE, RU, SI, UA, VE, VN	AU, AT, BE, CA, CN, DE, FR, DE, GR, IN, ID, IE, IT JP, MY, MX, NL, PL, PT, SK, ES, SE, UK, US	AR, BR

This table presents descriptive groups-by-variables means for TP characteristics. It comprises the mean value of al
= 57 variables for each TP system. All means are regularised for the range [0,1]. TP systems are obtained from analys
in Sections 1.3.1 and 1.3.2. Means are based on qualitative and quantitative TP characteristics described in Appen
A, thus implying data-frequency interpretation.
Source: by author.

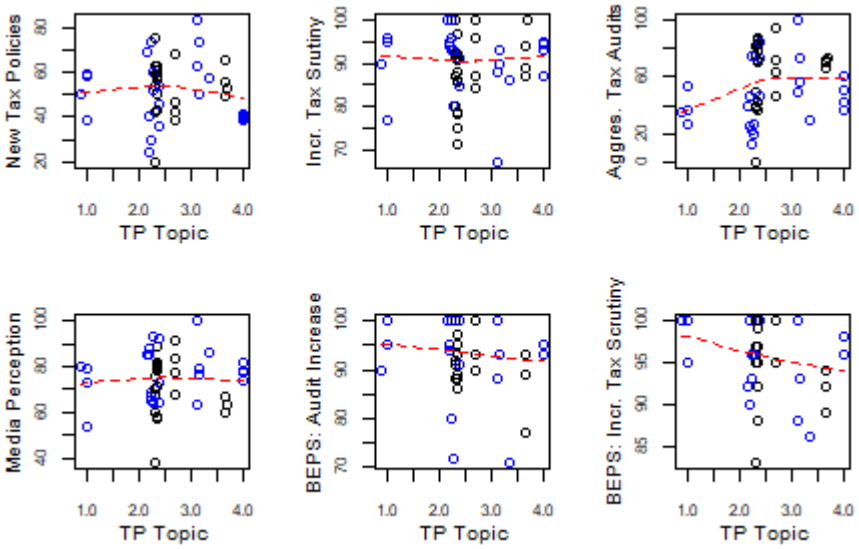
Appendix E: TP Variables – Descriptive Statistics

Variables by TP Topic	Binary/ Numeric	mean	s.d.	min.	max.
1. Implementation of TP system					
1.1 Maturity (years) of TP system	N	0.3966	0.2650	0.0000	1.0000
1.2 TP regulation is incorporated into domestic tax system	B	0.9167	0.2793	0.0000	1.0000
1.3 TP system follows the arm's length principle	B	1.0000	0.0000	1.0000	1.0000
1.4 TP system overrides OECD TP guidelir	B	0.2708	0.4491	0.0000	1.0000
2. Related-party status					
2.1 TP system has specific provision on tax havens/favourable tax regimes	B	0.2500	0.4380	0.0000	1.0000
2.2 Related-party status/interdependence: statutory threshold	B	0.5833	0.4982	0.0000	1.0000
2.3 Related-party status/interdependence: d facto relationship	B	1.0000	0.0000	1.0000	1.0000
2.4 Related-party status/interdependence: under common control	B	0.9167	0.2793	0.0000	1.0000

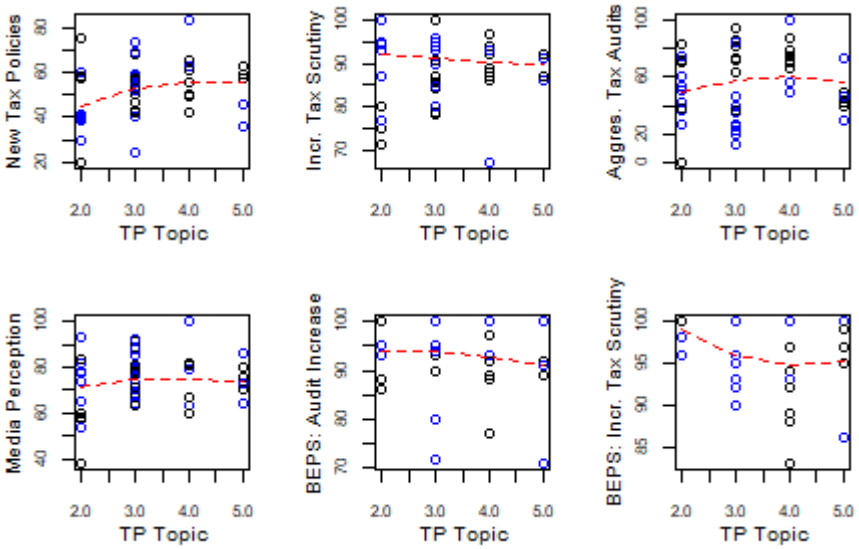
2.5 TP provisions applicable/specific provision on permanent establishments - PE	B	0.7083	0.4593	0.0000	1.0000
3. TP methods and comparables					
3.1 TP system implements CUP method	B	1.0000	0.0000	1.0000	1.0000
3.2 TP system implements RP method	B	1.0000	0.0000	1.0000	1.0000
3.3 TP system implements C+ method	B	1.0000	0.0000	1.0000	1.0000
3.4 TP system implements PS method	B	1.0000	0.0000	1.0000	1.0000
3.5 TP system implements TNM method	B	1.0000	0.0000	1.0000	1.0000
3.6 TP system implements country-specific methods	B	0.1667	0.3762	0.0000	1.0000
3.7 TP system allows for non-prescribed alternative methods	B	0.3333	0.4764	0.0000	1.0000
3.8 Foreign comparables are accepted (statutory rule or in practice)	B	0.9167	0.2793	0.0000	1.0000
3.9 TP system accepts set-offs/bundled transactions	B	0.5833	0.4988	0.0000	1.0000
4. Priority of TP methods					
4.1 Priority of methods: best for transaction	B	0.6667	0.4764	0.0000	1.0000
4.2 Priority of methods: traditional transactional-based methods	B	0.4167	0.4982	0.0000	1.0000
4.3 Priority of methods: CUP	B	0.0000	0.0000	0.0000	0.0000
4.4 Priority of methods: domestic priority rule	B	0.0833	0.2791	0.0000	1.0000
5. Provisions on internal services and cost-sharing arrangements					
5.1 Management fees/head office expenses are accepted/deductible by TP system/domestic tax rule	B	0.9167	0.2793	0.0000	1.0000
5.2 TP system/domestic tax rule has specifi provision/requirements for management fees/head office expenses	B	0.3333	0.4764	0.0000	1.0000
5.3 TP system/domestic tax rule levy withholding tax on management fees/head office expenses	B	0.1667	0.3766	0.0000	1.0000
5.4 Commissionaire arrangements are accepted by TP system/domestic tax rule	B	0.8333	0.3766	0.0000	1.0000
5.5 Cost-sharing/cost-contribution arrangements are accepted/deductible by TI system/domestic tax rule	B	1.0000	0.0000	1.0000	1.0000
5.6 TP system/domestic tax rule has specifi provision/requirements for cost-sharing/cos contribution arrangements	B	0.4167	0.4982	0.0000	1.0000
5.7 TP system/domestic tax rule levy withholding tax on cost-sharing/cost-contribution arrangements	B	0.0833	0.2791	0.0000	1.0000
6. TP Documentation and Disclosure					
6.1 TP system has statutory requirements/provision for TP documentati	B	0.5833	0.4982	0.0000	1.0000
6.2 Disclosure of specific TP return	B	0.7292	0.4491	0.0000	1.0000
6.3 Disclosure of specific TP return is conditioned/does not apply for all transactions/taxpayers	B	0.4792	0.5086	0.0000	1.0000
6.4 TP return includes at most only general info on intra-firm transactions (short disclosure)	B	0.3333	0.4764	0.0000	1.0000

6.5 TP return includes info about TP methods/calculations (long disclosure)	B	0.3958	0.4942	0.0000	1.0000
6.6 Deadline (months from year-end) to prepare/issue TP return	N	0.7130	0.2349	0.2778	1.0000
6.7 TP system established specific deadline for submission of full TP doc (when requested)	B	0.9167	0.2793	0.0000	1.0000
6.8 Deadline (months from year-end) to submit full TP doc (when requested)	N	0.5028	0.2629	0.2000	1.0000
7. Statute of limitations					
7.1 Statute of limitations (months) for gene TP assessment	N	0.5361	0.2684	0.2000	1.0000
7.2 TP system/domestic tax rule has special statute of limitations for intentional non-compliance/omission	B	0.4167	0.4982	0.0000	1.0000
7.3 Statute of limitations (months) for intentional non-compliance/omission	N	0.4806	0.2599	0.1500	1.0000
8. TP penalisation					
8.1 TP system determines specific TP penalisation	B	0.4167	0.4982	0.0000	1.0000
8.2 Max TP penalisation (percentage of unpaid tax) for general tax adjustment	N	0.0825	0.0856	0.0000	0.3000
8.3 Max TP penalisation (percentage of unpaid tax) in case of high level of negligence/fraud/intentional avoidance	N	0.0997	0.1300	0.0000	0.5000
8.4 TP system determined fixed TP penalty for failure in documentation/info disclosure	B	0.0000	0.0000	0.0000	0.0000
8.5 TP system determined variable TP penalty for failure in documentation/info disclosure	B	0.5417	0.5053	0.0000	1.0000
8.6 TP system/domestic tax rule allows the appeal for penalty relief/reduction	B	0.8333	0.3767	0.0000	1.0000
9. Advanced-pricing agreements - APA (or APA-like provisions)					
9.1 APA/APA-like options are available	B	0.9167	0.2793	0.0000	1.0000
9.2 Max APA/APA-like term of agreement (months)	N	0.4913	0.2291	0.0000	0.7778
9.3 Unilateral APA/APA-like options	B	0.8333	0.3767	0.0000	1.0000
9.4 Bilateral/multilateral APA/APA/like options	B	0.9167	0.2793	0.0000	1.0000
9.5 Possible roll-back application of APA/APA-like options	B	0.6042	0.4942	0.0000	1.0000
10. Competent authority - CA procedure					
10.1 CA procedure is available	B	0.8333	0.3767	0.0000	1.0000
10.2 CA procedure proposed (usually) after tax assessment	B	0.8333	0.3767	0.0000	1.0000
10.3 CA procedure proposed also before/during tax assessment	B	0.0833	0.2793	0.0000	1.0000
10.4 Double-tax resolution is likely to be achieved via CA procedure	B	0.5833	0.4982	0.0000	1.0000
10.5 CA procedure prevents/suspends tax payment	B	0.6458	0.4833	0.0000	1.0000
10.6 CA procedure is rarely applied by taxpayers (if observable)	B	0.2500	0.4380	0.0000	1.0000

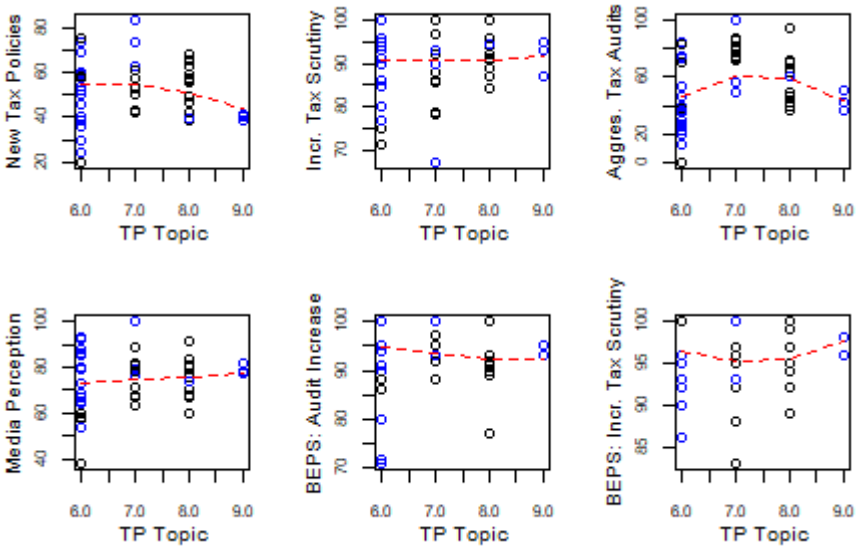
This table presents the descriptive means for all 57 TP characteristics *k*, segregated by TP top
All means are regularised for the range [0,1]. Column s.d. refers to the standard deviatic
Means are based on qualitative and quantitative TP characteristics, thus implying da
frequency interpretation.
Source: by author.



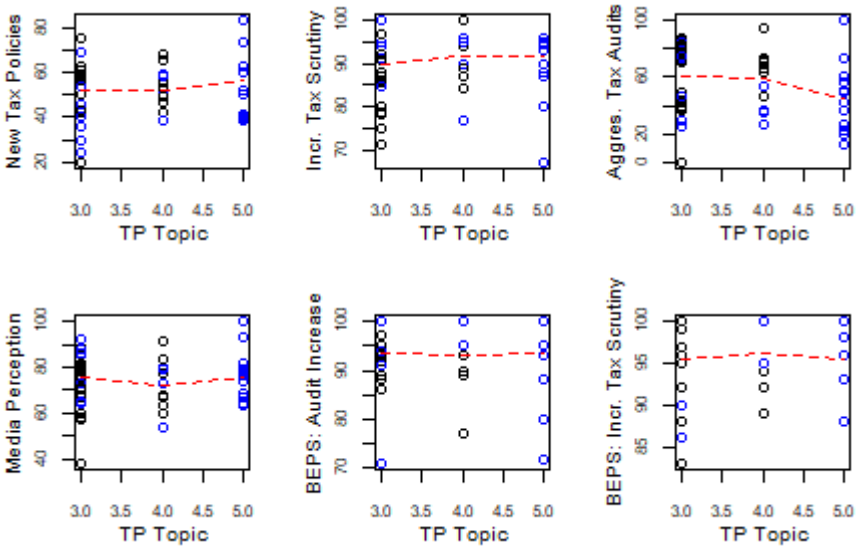
Appendix F: Tax enforcement variables y_b and TP index x_1 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_1 for TP characteristics related with the implementation of TP rules. Variables y_b and x_1 defined in Section 2.3 and Table 2.1.
Source: by author.



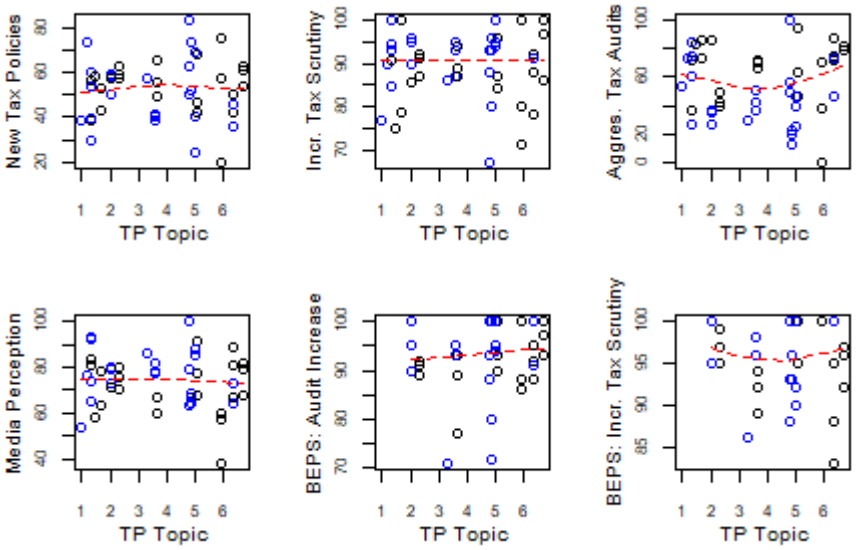
Appendix G: Tax enforcement variables y_b and TP index x_2 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_2 for TP characteristics referring to the related-party status. Variables y_b and x_2 defined in Section 2.3 and Table 2.1.
Source: by author.



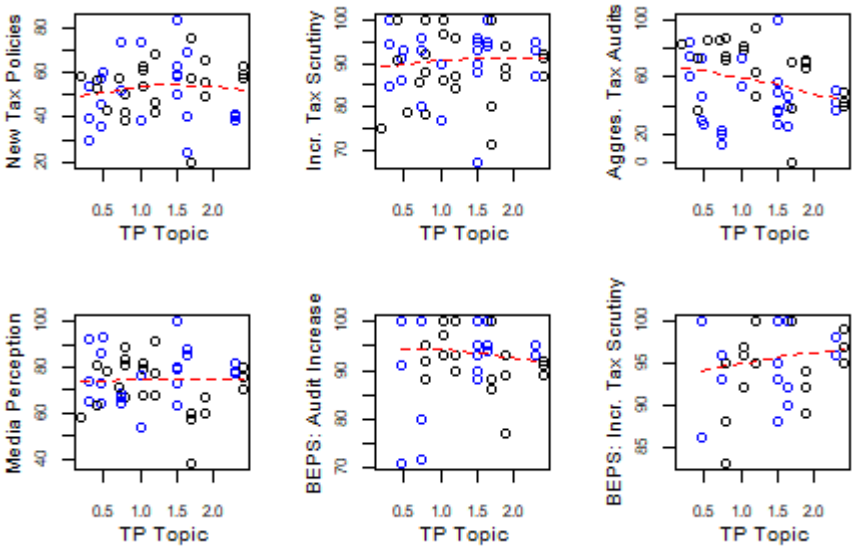
Appendix H: Tax enforcement variables y_b and TP index x_3 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_3 for TP characteristics related with the TP methods and comparables. Variables y_b and x_3 defined in Section 2.3 and Table 2.1.
Source: by author.



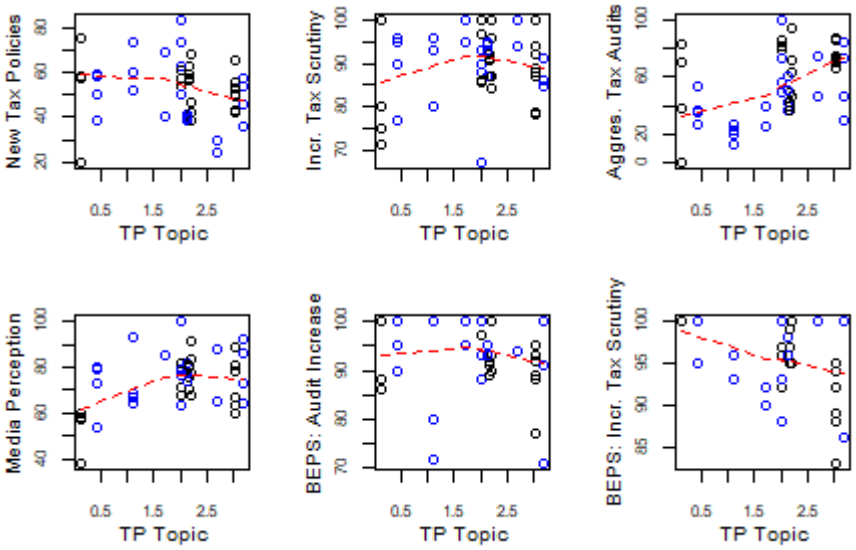
Appendix I: Tax enforcement variables y_b and TP index x_4 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_4 for TP characteristics related with the priority of TP methods. Variables y_b and x_4 defined in Section 2.3 and Table 2.1.
Source: by author.



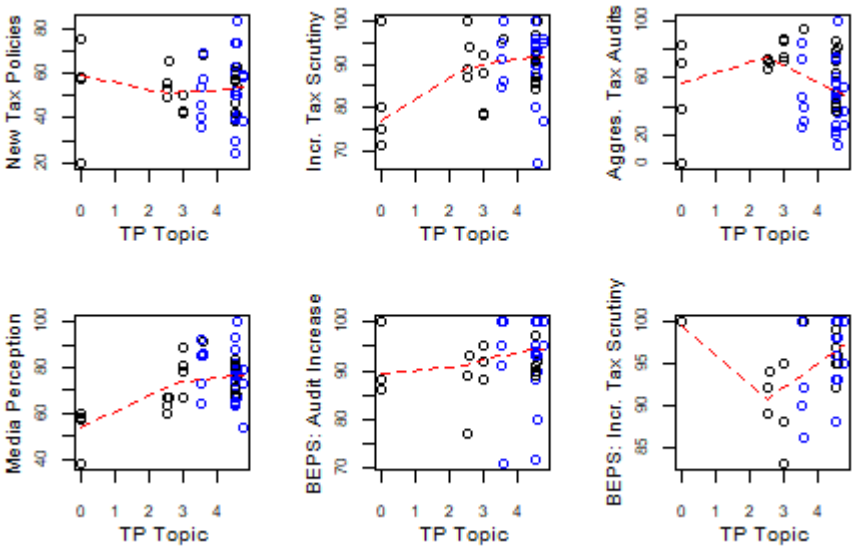
Appendix J: Tax enforcement variables y_b and TP index x_5 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_5 for TP characteristics related with cost-sharing provisions and internal services. Variables y_b and x_5 defined in Section 2.3 and Table 2.1.
Source: by author.



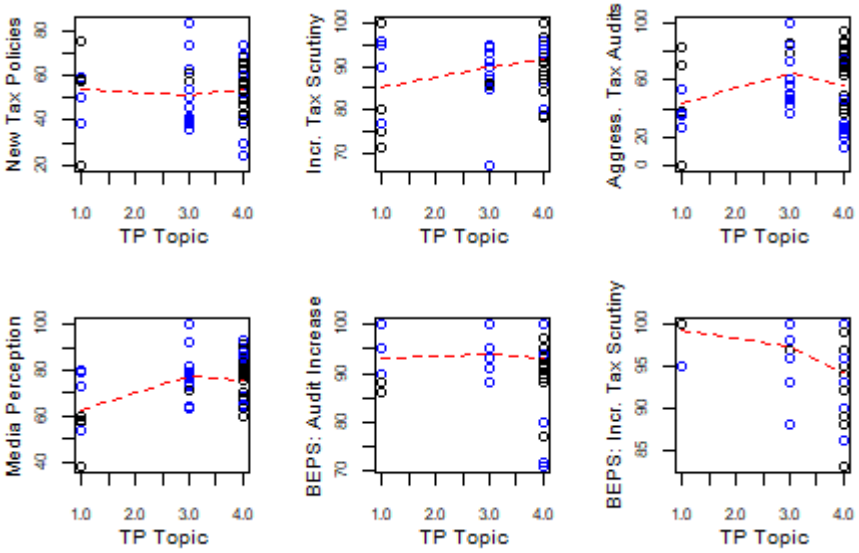
Appendix K: Tax enforcement variables y_b and TP index x_6 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_6 for TP characteristics related with the TP documentation requirements and disclosures. Variables y_b and x_6 defined in Section 2.3 and Table 2.1.
Source: by author.



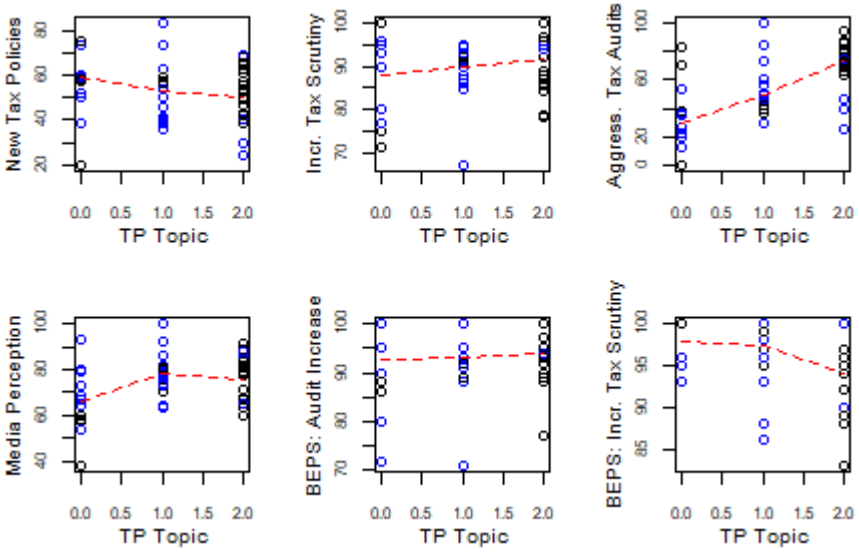
Appendix L: Tax enforcement variables y_b and TP index x_7 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_7 for TP characteristics related with the statute of limitations. Variables y_b and x_7 defined in Section 2.3 and Table 2.1. **Source:** by author.



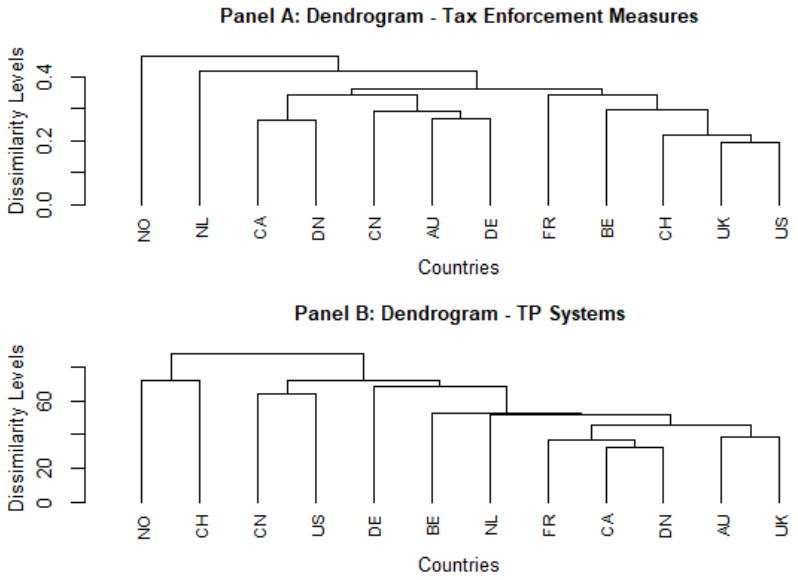
Appendix M: Tax enforcement variables y_b and TP index x_8 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_8 for TP characteristics related with the TP penalisation rules. Variables y_b and x_8 defined in Section 2.3 and Table 2.1. **Source:** by author.



Appendix N: Tax enforcement variables y_b and TP index x_9 – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_9 for TP characteristics related with APA and APA-like rules. Variables y_b and x_9 defined in Section 2.3 and Table 2.1.
Source: by author.



Appendix O: Tax enforcement variables y_b and TP index x_{10} – observed vs. fitted data. This figure presents the scatter plots for the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$, and the TP index x_{10} for TP characteristics related with the competent authority procedures. Variables y_b and x_{10} defined in Section 2.3 and Table 2.1.
Source: by author.



Appendix P: Dendrograms. Panel A presents the dendrogram from the hierarchical clustering of countries based on the tax enforcement variables y_b, $B = 6 : b \in (1,\ldots,B)$. Panel B presents the dendrogram from the hierarchical clustering of countries based on the TP informative variables $v_k : k \in (1,\ldots,57)$. Pairwise distances are computed based on the Gower (1971) measure, as described in Section 2.3.
Source: by author.

Appendix Q: Transfer Pricing Systems - Groups of Countries Based on Transfer Pricing Rules

	Groups of Countries			
	TP System 1	TP System 2	TP System 3	TP System 4
Countries	ARE, BOL, CAY, CHE, CZE, HKG, LUX, MCO, MDI, PRY, SGP, ZAF	CHL, COL, CRI, PER, RUS, URY	AUS, AUT, BEL, CAN, CHN, DEU, DNK, ESP, FRA, GBR, GRC, IND, ITA, JPN, MEX, MAR, NLD, POL, PRT, SVK, SWE, TUR, USA	ARG, BRA

This table presents the segregation of all 43 countries into 4 groups, based on the characteristics the transfer pricing rules of each country, including Brazil. Segregation of countries into grou derive from the hierarchical clustering method described in Section 3.3 and from the results Table 2. Merging of countries into the same group indicates that these countries share simil transfer pricing characteristics. Separate groups imply significative differences in countrie transfer pricing rules.
Source: by author.