Gravity in paradise

How do tax havens shape multinational production

Samuel Delpeuch

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Abstract: How do tax havens shape multinational production ? Most empirical studies on multinational entreprises' activity have validated the gravity equation applied on foreign direct investments, notably due to intra-firm trade that make trade costly within those firms. Yet, tax optimization motives in multinational production represent another important channel for the organization of affiliates' activity. Using aggregate data on affiliates activity by country, we revisit three patterns of multinational production by including fiscal regime in the explanatory variables. In particular, in countries with high level of financial secrecy, multinational entreprises are more active and less sensitive to distance. We then propose a theoretical contribution that adds tax environment to standard gravity models. This paper suggests that tax havens create an additional incentive for firms to produce abroad rather than exporting from the home country. Gravity for multinational production is therefore less likely to prevail in the presence of tax havens.

Keywords: Tax haven; Gravity; Global Production; Multinational Entreprises.

Samuel Delpeuch *

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*Contact: samuel.delpeuch@sciencespo.fr

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Contents

1 Introduction

What do football, Panama, Canada and paradise have in common? They all gave their name to massive leaks of "papers" making tax avoidance cases publicly available. These leaks have contributed to advocate the cause of struggle against profit shifting and fiscal fraud. At the institutional level, the OECD made steps towards stricter international taxation rules by implementing the Base Erosion and Profit Shifting Program aiming at improving access to information (with, for instance, the country-by-country reporting of MNEs' affiliates' activity) and at limiting aggressive fiscal optimization. Proposals coming from the civil society include unitary taxation with formulary apportionment. The difficulty faced by governments and international organisations is twofold. First, harmful practises are often hard to detect: the complexity of the legal and financial arrangements makes it difficult for researchers to identify the issues and even harder for policy makers to fight against them. Second, international fiscal coordination is only in its infancy whereas production is globalized.

In particular, multinational enterprises (hereafter MNEs), defined as firms operating in more than one country, are key catalysers of this phenomenon. Because they are able to organize their production in several places, MNEs make use of countries' specificities to minimize their costs (and in particular their fiscal burden) and to avoid controls.[1] If this could have been considered as a marginal trend couple of decades ago, multinational production (MP) has become of tremendous importance. Since the early 1980s foreign direct investment (FDI) flows are characterized by a sharp increase. Whereas the total number of enterprises operating in more than one country was estimated at 35 000 in 1990 it exceeds 100 000 in 2017. The corresponding number of affiliates has been multiplied by 6 over the same period reaching 850 000 in 2017 (United Nations Conference on Trade and Development [2017]).

The rise of multinational production raises several questions such as: are trade and FDI complements or substitutes? Which firms decide to engage in multinational production? Where and how do multinational firms decide to locate their affiliates? The aim of this paper is to bring answers to these questions by linking them to MNEs fiscal optimization practices. Using aggregate data on affiliates activity by country, we revisit three patterns of multinational production by including fiscal regime in the explanatory variable: (a) the level of financial transparency seems more important than statutory tax levels for MNE location choices and a more transparent jurisdiction tends to be less attractive for affiliates; (b) gravity for multinational production is less likely to hold when destination countries are tax havens; (c) market potential is even more important when controlling for level of banking transparency. This paper then revisits the standard gravity model for multinational production and identifies three channels through which multinational production in tax havens can modify MNEs production choices and helps to understand the observed trend of MP. In this model financial opacity (i) is included in the determination of final profit (ii) makes multinational production relatively cheaper compared to export and (iii) modifies the countries' idiosyncratic remoteness from the rest of world and magnifies importance of market potential. This paper contributes to the existing literature in two ways.

[1]It is useful to define the "origin country" where the parent company is registered and the "destination country" (or countries) where the affiliates are located. The most standard definition of "affiliate" is a firm for which at least 10% of its shares are held by a foreigner.

The first contribution is related to the growing literature on tax havens. In this paper, we explicitly include financial secrecy in the global production determinants. The impact of tax havens on the global economy is mainly approached through tax levels. Hines and Rice [1994] quantify the share of offshore activity for US MNE and discuss the implication of financial offshore centres' tax rates on US tax revenues. Desai et al. [2006a] study the impact of tax competition on economic diversions. Based on empirical evidences showing that countries do compete over tax rate (Devereux et al. [2008]) many models with mobile firms have taken tax rate as endogenously determined (see for instance Krautheim and Schmidt-Eisenlohr [2011]). Dharmapala and Hines [2009] take a broader view on the definition of tax haven and include a governance index together with economic and geographic measure. The multidimensionality of tax havens makes it harder to endogeneise country choices and behaviours but the question of the economic diversion due to the presence of tax haven stills holds. Macroeconomic consequences of banking secrecy are huge. Zucman [2013] estimated the missing wealth (held in tax havens) at 8% worldwide by using discrepancies in balances of payments. Guvenen et al. [2017] show that discrepancies linked with fiscal optimization affect the measure of productivity since artificial location of the value-added in low-tax countries might bias productivity measurement downward in high-tax countries. At the other extreme of the economic spectrum, micro-evidences at the firm level have highlighted harmful practices such as transfer pricing (Vicard [2015],Davies et al. [2018]), localisation of intangible or corporate debt transfers. However, the transmission mechanism from the micro-level of firms' strategies to the macroeconomic consequences of financial offshore centres remains mainly unexplored. The model proposed in this paper contributes to filling this gap.

The second contribution is related with the literature on the multinational production. In particular we include financial secrecy as additional motive for firms to engage in MP and discuss in which context gravity for multinational production prevails. The success of the gravity equation introduced in 1964 by Tinbergen to describe the positive effect of country size and the negative effect of distance on trade flows has spread beyond its initial scope and is also applied on capital flows or FDIs. Empirical research conducted on multinational firm-level database have mostly validated the gravity structure of multinational production. Kleinert and Toubal [2010] use data on German firms and find a negative relation between affiliates acivity and traditional proxy for trade cost, distance first. A similar result is found by Ramondo et al. [2015] using an aggregated bilateral database for MNEs. This empirical trend can seem at odds with international trade models that conceptualize FDI and exports as substitutes. Helpman et al. [2004] describe export and FDI as substitute in order to reach distant markets. By extending the seminal Melitz model (Melitz [2003]) with an additional productivity threshold above which firms engage in MP, they find that higher trade costs increase the amount of FDI relative to export. Because the point of becoming multinational is to avoid trade costs, there is *a priori* no obvious reasons why distance would reduce MP. Part of the puzzle is solved when a direct relation between trade cost and MP is introduced. The best candidate is the impact of intra-firm trade. Irarrazabal et al. [2013] explicitly introduce intra-firm trade in a heterogeneous firms trade model that combines Chaney [2008] and Helpman et al. [2004] and show that it increases the probability to obtain a gravity for FDIs. A second type of link with trade costs arises when affiliates export (case of export platforms). Tintelnot [2017] embeds the Ricardian Eaton and Kortum model (Eaton and Kortum [2002]) model within a multinational firm transposing the comparative advantage across affiliates and estimates this global production model with data from German MNEs. Economists' efforts to reproduce a gravity for MP might be somewhat misleading. Tax havens are likely to be underestimated in databases since these typically are small countries, very remote, and pooled within big entities as extra-territories. A more cautious look at empirical patterns of MP in presence of tax havens shows that gravity is less likely to prevail. This highlights the fact that an evident motivation for going multinational is missing in these models: the ability of firms to lower their fiscal burden by locating activity in most favourable jurisdictions. Thus, fiscal motivation for going MNE can offset the intra-firm effect with respect to trade costs when countries exhibit very low level of transparency. An example can be taken in order to illustrate the trade-off at stake in this paper. Take a US MNE that wants to shift profit by doing transfer pricing in a jurisdiction with a high level of banking secrecy jurisdiction (say in Switzerland). The enterprise sells goods to its affiliate located in Switzerland before benefiting from a possibility to hide profit away from the fiscal jurisdiction. Thus the decision whether to do this operation depends both on the trade cost paid to reach Switzerland (« pro-MP-gravity » intra-firm trade effect) and on the level of banking secrecy (« contra-MP-gravity» effect link with tax haven).

The model designed in this paper directly builds on Irarrazabal et al. [2013] and adds financial secrecy as well as tax rates. Because our goal is to fill the gap between identification of micro-strategies of MNEs (such as transfer pricing) and the macroeconomic consequences of tax avoidance, it is important to keep an explicit mention of the firm and its strategies within the model. For this purpose, Eaton and Kortum type of models are not the best choice since there is no explicit modelization of firms in the seminal paper. Instead, the inclusion of MP in the Melitz model with the Chaney extension provides a clear pricing and production strategy and a global gravity equation.

The rest of paper is organized as follow. In section 2, different measures of financial transparency are added to "traditional" MP determinants and three related empirical patterns are highlighted. The gravity model proposed in section 3 shows how financial transparency affects trade costs effects on both margins of MP. In section 4, a case of export platforms is presented in order to understand why sales of affiliates located in tax havens exhibit higher export ratio. Section 5 concludes.

2 Three revisited patterns of multinational production

In this section, three patterns of multinational production are revisited by controlling for fiscal determinants. For this purpose I use the database on aggregate bilateral activity of MNEs affiliates proposed by Ramondo et al. [2015]. This database covers 59 countries between 1996 and 2001. This database provides a good description of both margins of MP as it distinguishes the number of affiliates implemented in the destination countries (extensive margin) and the aggregate sales of these affiliates (intensive margin). Contrary to most databases on horizontal FDI that only capture greenfield investments, their database includes merge and acquisitions (M&A) by matching the UNCTAD database with the Thomson and Reuters Financial database. Geographical determinants are taken from CEPII gravity dataset (see Head and Mayer [2014] for a useful toolkit). We extend this database by adding tax levels (from the KPMG corporate tax rate database) and two measures of banking secrecy : a dummy for Offshore Financial Centers (OFC) based on the IMF methodology and a continuous index of financial secrecy (FSI) taken from Tax Justice Network [2018]. Expressions "secrecy jurisdiction", "tax haven" and "offshore financial centers" are used in this paper without distinction. Because the aim of this research is to help thinking on how fiscal optimization can represent an additional advantage of multinational production compared to export, we keep a very broad definition of "financial secrecy" as the investor's propensity to keep wealth away from public authority.[2]

The OFC dummy uses a binary approach of the state of legislation and raises the question of the good definition of tax haven. We first use the list provided by the International Monetary Fund (IMF) of Offshore Financial Centers (OFC). This list of offshore financial centers is based on three criteria : OFCs are defined as (i) countries with high number of financial institutions engaged primarily in business with non-residents; (ii) financial systems with abnormal level of external assets and liabilities with respect to domestic financial needs; and (iii) centers providing low taxation and/or loose financial regulation and/or banking secrecy (Monetary and Exchange Affairs Department [2000]). The OECD also has its own list of tax havens. In this paper, we use the list provided by Dharmapala and Hines [2009] as a robustness check with very similar results (see in appendix A.10 & A.11). The only major difference is the exclusion of the USA from offshore financial centers since their methodology is based on the Hines and Rice [1994] methodology that combines institutional criteria with coporate tax level, that is high in the US. Insofar as the US play a special role in global investment, excluding the US from tax havens also reduces other bias.

A caveat of this approach is to omit degrees of banking secrecy. An alternative approach is to use an index as continuous measure of banking transparency. The Financial Secrecy Index is the result of qualitative surveys on the legal structures of the jurisdiction, on their tax mechanisms as well as their administrative organization. The questionnaire is submitted directly to all jurisdictions. Because of high incentives of countries misreporting, the inputs are then backed by reports of public institutions (Global Forum, OECD) as well as private organizations (IBFD, PwC among other). The Financial Secrecy Index also relies on decentralized contributions of researchers in the field of economics and law. No measure are perfect but their combination is insightful to see how fiscal determinants can

[2]This definition encompasses very low taxation on corporate profits but also facilities for illegal activities such as money laundering, for which punishment in a standard jurisdiction would have been costly

affect patterns of multinational production.

In particular, this section identifies three patterns relating these variables with MP. First, we find that the "tax haven" effect is more important than statutory tax rate in determining MNE locations choices. Second, the gravity effect for multinational production (and mainly the effect of distance on both margin of MP) is mitigated for tax haven compared to standard jurisdictions. Lastly, the importance of market potential seems to be magnified for tax havens.

2.1 Tax rates and banking secrecy

Table 1 presents the summary of the main variables. The extensive margin (number of affiliates) and the intensive margin (amount of sales of affiliates) are both reduced on average for standard jurisdictions compared to offshore financial centres. On average an affiliate located in an offshore financial center sells almost twice as much than an affiliate located in standard jurisdiction. At the country level, the difference is magnified when aggregate sales are normalized by countries' GDP since tax havens are often small countries. This highlights the need to consider other reasons than market size in MNE location choice. Moreover, the continuous FSI-index is consistent with the dummy measure of offshore center status as highlighted by the higher FSI score of OFC than for standard jurisdiction in average.

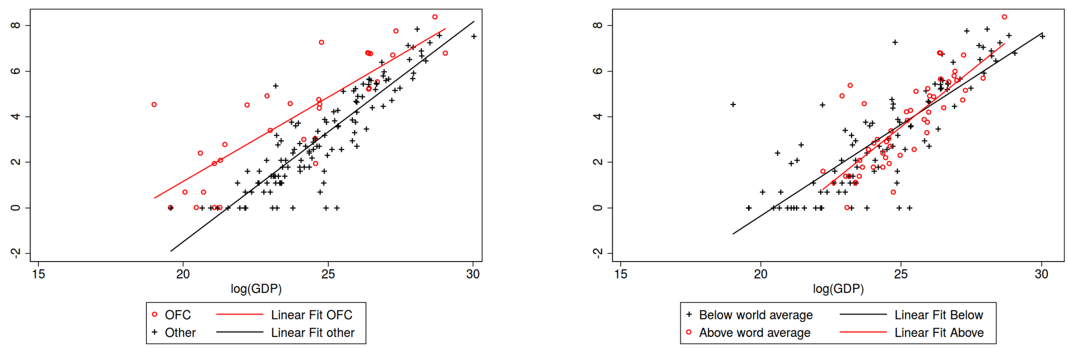
Table 1: Descriptive statistics

	Standard jurisdictions	Offshore Financial Center
Number of affiliates	1804.0	2062.2
	(2601.1)	(1980.3)
Aggregate sales(md)	111.958	153.946
	(297.619)	(183.704)
Sales per affiliates	35,008,561.1	59,160,902.8
	(28,790,782.2)	(38,487,200.7)
Sales/GDP	0.214	0.470
	(0.193)	(0.563)
FSI score	45.53	56.97
	(11.08)	(13.95)
N	47	12

What explains the relative attractivity of tax havens ? Tax levels and financial secrecy are two natural candidates. In the naive gravity regressions presented in columns (1) and (2) of table 2, the coefficients associated with corporate tax and financial secrecy score are both not significant. An important distinction should be made between countries for which firms are submitted to universal (or worldwide) taxation of repatriated profit (UTR) and countries where the territorial taxation regime (TTR) is implemented. The estimated coefficient results of pooling of these two categories. Between 1996 and

2001, both the UK and the USA were submitted to UTR. In such case, the importance of destination country tax level is reduced. The opposite occurs under TTR. Given the little size of UTR sample (10 countries), it is not possible to test the influence of profit taxation regime with regressions.[3] Still, it is useful to focus on more recent and detailed data on the location of US MNE. Graph (a) and (b) of figure 1 relates the log of affiliates number with countries GDP. In the first graph, OFC countries (red circles) are distinguished from the rest of the sample (black crosses) whereas in the second graph, countries whose statutory corporate tax is above world average (red circles) are distinguished from countries with below-average corporate tax. Fitted lines are different is the first case but not clearly in the second. While one often thinks of tax rate as a key variable in investment determination, the role of institutions, rules of law and financial secrecy should be underestimated in explaining multinational production patterns. We expect this pattern to be magnified when the origin country is operating under UTR.

Figure 1: Number of US affiliates by GDP size



(a) Offshore Financial Center

(b) Corporate tax deviation to world average

Notes: These figures display the percentage increase in the number of US owned affiliates against country size (log of GDP). OFC definition is taken from the IMF methodology. The statistics are for the year 2015. Source: BEA.

Pattern 1. *Tax rate levels alone cannot explain tax havens' attractiveness: both margins of multinational production are on average higher in countries with high level of financial secrecy.*

2.2 MP-Gravity revisited

The transposition of the gravity equation to the multinational production is not trivial. If the positive relation observed between trade cost (typically proxied by distance) and the ratio relating FDI and trade flows is well explained by theoretical models that see horizontal FDI as a competing strategy aiming at reaching distant markets without *ad valorem* cost, the gravity behavior of multinational production *per se* is more puzzling. However, whereas bilateral trade databases are very well documented with respect to tax havens, it is harder to construct a comprehensive database that include both margins of multinational production for those countries. In particular, small tax havens are often omitted from the databases, or are pooled with other countries when offshore territories are

[3]The identification effect of such institutional features is typically studied by focusing on reform of one country over time and potential discontinuity

not legally independent (British Islands and Gibraltar for the UK, Madeira for Portugal...). These territories are typically remotte and distant market but do attract huge amount of capital flows and FDIs. This phenomenon is easily visible from the data although it captures fiscal optimization: an important motivation for multinational production.

Table 2: Regressions

	Naive Gravity			Multilateral Resistance			
				Standard		Poisson	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Margin of MP	Ext.	Int.	Ext.	Ext.	Int.	Ext.	Int.
Home GDP (log)	0.787***	1.277***	1.130***				
	(22.34)	(25.52)	(23.87)				
Destination GDP (log)	0.358***	0.775***					
	(8.97)	(13.74)					
Distance (log)	-0.606***	-0.782***	-0.434***	-0.817***	-1.020***	-0.296***	-0.0523***
	(-13.09)	(-11.88)	(-7.03)	(-16.96)	(-16.13)	(-14.49)	(-16.31)
Common border	0.378	0.340	0.903**	0.339**	0.399*	0.0141	0.0159
	(1.92)	(1.22)	(3.30)	(2.83)	(2.27)	(0.28)	(1.76)
Common language	1.016***	1.236***	1.185***	0.789***	0.846***	0.230***	0.0409***
	(6.97)	(5.89)	(5.82)	(8.70)	(6.57)	(6.37)	(6.34)
Av. Corporate Tax (log)	-0.0171	-0.177					
	(-0.10)	(-0.74)					
Financial Secrecy Score (log)	0.347	-0.0331					
	(1.59)	(-0.11)					
Real Market Potential (log)			0.791***				
			(17.85)				
OFC X Distance				0.369***	0.465***	0.158***	0.0250***
				(5.80)	(5.78)	(5.92)	(6.28)
N	836	843	1112	1091	1092	1089	1092
R^2	0.465	0.518	0.445	0.815	0.859		

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

By re-using the database provided by Ramondo et al. [2015] and explicitly including tax havens, the effect of banking secrecy on MP gravity is investigated. Table 2 summarizes the main effects. In columns (1) and (2) the number of affiliates and the aggregate sales are regressed on traditional gravity determinants (home and destination GDP, geographical factors) but also on tax level and level of financial opacity (measured with the FSI index). In column (3), the real market potential (as calculated by Redding and Venables [2004]) is used instead of destination GDP in order to explain the number of affiliates. For these three regressions, as in the standard gravity model, MP is increasing with both origin and destination countries' size and decreasing with distance. The "border-effect" is not significant and can be interpreted as a mitigation of geographical aspects in the organization of MP. Because this « naive » specification of the gravity equation ignores the multilateral resistance variable (hereinafter MVR), we follow Anderson and van Wincoop [2003] methodology for the regressions (4) and (5). Only bilateral variable are left explicit in the regression of the number of affiliates (column (4)) and of their aggregate sales (column (5)) while country-specific characteristics are absorbed in country-fixed effects. Moreover, because the aim of this exercise is to understand the role of banking secrecy in MP pattern, an interaction between distance and the OFC dummy is added to the regression. Note that because OFC is interacted with a multilateral parameter (distance), it can be included within the regression without being absorbed by fixed-effects. The interaction term is positive and significant: MP for gravity seems less likely to hold for tax havens. Another potential strategy to split the sample according to the destination country status (tax haven or not) using the OFC dummy. But this raises two econometric problems: it reduces the sample size and exacerbates the potential bias linked with unbalanced multilateral samples that ignore part of MVR. In columns (6) and (7), we use a modified Poisson fixed-effect following Santos Silva and Tenreyro [2006] methodology. The log-normalization might indeed leads to biased estimates because of the presence of zeros in the database, especially in the number of affiliate. The effect of distance on both margin is reduced under such specification but remains negative and significant.

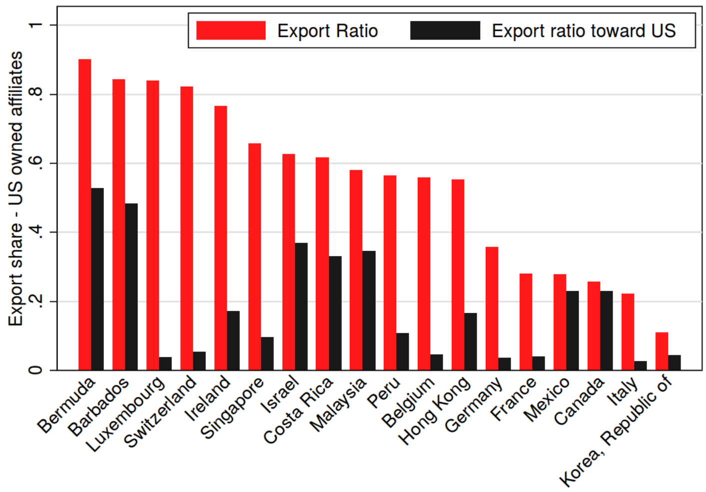
Pattern 2. *Effects of trade costs (typically measured as distance) on both margins of multinational production are in general negative but tend to be reduced when destination countries have high level of banking secrecy.*

2.3 Export Platforms and Tax Havens

Economic geography has emphasized the importance of surrounding markets in the agglomeration forces. When firms are mobile and decide where to locate, their choice is not only determined by the market size but also by the size of surrounding markets augmented by the corresponding trade costs to be paid for reaching those markets. This market potential has been brought to data by Redding and Venables [2004] and Head and Mayer [2004]). Translated to the case of multinational production, market potential does play a role in the location of affiliates. Naive regression summarized in column (3) shows that market potential (using RV measure) is positively related with the number of affiliates. This suggests that affiliates are also used as export platforms: an important part of the affiliates' production being then exported.

The role of export platforms in multinational production has been studied in several papers. Tintelnot [2017] provides a global production model with export platform aiming at determining firms location choices when taking into account the possibility of exporting. from affiliates. Using BEA data, he shows that export platform sales represent on average 43% of multinationals foreign output. This proportion is bigger for small countries and part of the US affiliate export is sold to the US. The maps he proposes shows this ratio for the US affiliates located in Europe. Figure 3 shows the share of export in US-owned affiliates sales. Sales of affiliates located in low-tax countries with high level of banking secrecy are typically high, emphasing the importance of the export platforms role for those countries. The 12 highest ratios among the sample of 59 countries are reported here. France, Mexico, Canada, Italy and Korea are also added in this figure.

Figure 2: Export vs. domestic sales ratio for US-owned affiliates



Notes: These figures display the share of sales corresponding to export for US-owned affiliates. Tintelnot [2017] proposes the same figure for affiliates implemented in Europe. Black bars are exports from US-owned affiliates toward US. The statistics are for the year 2004. Source: BEA.

Pattern 3. *The share of export in aggregate sale and the importance of real market potential in MNEs location choices are exacerbated for tax havens.*

3 A model of gravity with tax regimes

In this section, we propose a theoretical contribution that adds tax environment to standard gravity models. In particular, we start from the model proposed by Irarrazabal et al. [2013] and add tax levels as well as a level of banking secrecy.

3.1 Baseline model

Set-up

There are N countries characterized by their size, their location, their tax rate and their banking secrecy. In order to capture the first pattern from 2 corporate tax rate and level of banking transparency are distinguished. Financial secrecy is given by the ξ parameter and can be interpreted in different ways. This can be thought of as a concealment cost (e.g the wage of lawyers able to implement optimized tax-planning relative to the fee due to tax authority in case of lawsuit), the effectivness of the tax rate (low ξ would capture *ad hoc* deductibles designed for MNEs) or more immediately the state of the legislation on banking secrecy. It follows:

$$\xi_i \in [0:1] \text{ where } \begin{cases} \xi_i = 0 \Rightarrow \text{perfect banking secrecy} \\ \xi_i = 1 \Rightarrow \text{perfect banking transparency} \end{cases}$$

Under the assumption that profits are ultimately earned by the parent company, the fiscal regime determines the after-tax profits. For country *i* 's firms operating in country *j* , profits are given by:

$$\begin{cases} \text{TTR}: \tilde{\pi}_{ij} = (1-\xi_j t_j)\pi_{ij} \\ \text{UTR}: \tilde{\pi}_{ij} = (1-\xi_j t_i)\pi_{ij} \end{cases}$$

In order to stick with the focus done in section 2 on US-owned affiliates, the model presented here focuses on UTR and assumes all countries have the same fiscal regime. However, very few countries are using UTR. A more realistic version of this model should enable both types of regime to co-exist. The location choice of US MNE is indeed determined not only by their tax system but also by the presence of competitors in the location country (through the price index), which in turn depends on their tax regime. This makes the model harder to derive, we let this extension for further research.

Consumer side

In each country, there are two types of goods; manufacturing goods (M-goods) and agricultural goods (A-goods). As frequently done in the trade literature, A-goods are considered to be homogeneous and freely tradable across countries with price equal to 1 whereas M-sector is a continuum of m heterogeneous varieties belonging to a set Θ. Under the assumption that all countries produce the same A-good, wage in a given country boils down to the wage of the manufactring good sector. In addition, the overall utility of a representative consumer is a log-linear function of A and M goods.

$$U = (1-\mu)C_A + \mu \ln(C_M) \tag{1}$$

With

$$C_M = \left(\int_{m\in\Theta} C_m^{\frac{\sigma-1}{\sigma}} dm \right)^{\frac{\sigma}{\sigma-1}} \tag{2}$$

This type of utility function also allows us to keep the share of income spent on M-goods constant as any increase of income will be spent on A-good which marginal utility is higher. As in the standard Dixit-Stiglitz framework (Dixit and Stiglitz [1977]), the two-step maximization procedure on the consumer side leads to (i) an optimal share of income spent on the M-sector and (ii) an optimal quantity of each variety. Optimal consumption of M-good is:

$$C_M = p_m^{-\sigma} \frac{E_m}{\int_{m\in\Theta} p_m^{-(\sigma-1)} dm} \tag{3}$$

Where σ is the elasticity of substitution between varieties. Moreover, for simplicity in the notation, the price index P is defined as: $P \equiv \int_{m\in\Theta} p_m^{-(\sigma-1)} dm$ and the overall demand of country *i* is $B^i \equiv \mu w_i L_i / P_i^{1-\sigma}$ so that equation (3) writes:

$$C_M^i = p_i^{-\sigma} B^i \tag{4}$$

Production side

As in Melitz [2003], firms in each country are heterogeneous in their level of productivity, φ. Firms are distributed according a Pareto distribution G(.) with shape parameter ρ. We assume $(\rho > \sigma - 1)$. Productivity is distributed on the interval $[1 : \infty[$ according to:

$$P(\tilde{\varphi} < \varphi) = G(\varphi) = 1 - \varphi^{-\rho}$$

On the production side, as in Helpman et al. [2004], firms sort into domestic production, export and multinational production (MP) according to their idiosyncratic productivity. There are three fixed costs associated with the three types of production: $f_{dom}, f_{exp}, f_{mne}$ with $f_{dom} \leq f_{exp} \leq f_{mne}$.

However, contrary to the baseline Meltiz model, there is a fixed and exogeneous number of potential entrants as in Chaney [2008] and Irarrazabal et al. [2013]. In each country, there are a total mass of potential entrants in the traded-good sector proportional to the size of the domestic demand ($\mu w_i L_i$). This assumption is equivalent to Eaton and Kortum's assumption of a given number of goods. This also implies that the 0-profit condition no longer holds and that there exist residual profits (π) that are equally redistributed to shareholders.This ownership structure is similar as Chaney [2008]. However, we extend slightly the framework by reasoning in terms of net profit (ie. by including tax rate and propensity to hide profits). Therefore, the question of the redistribution of profit is important. In order to keep the same tracktability as in standard trade model, we make the assumption that countries tax revenus are put in common and also equaly redistributed around the world. Therefore, this model says nothing on the impact of offshore finance on income distribution but remains focused on the way tax havens shape global production. Adding the market clearing condition therefore yields:

$$Y_i = (1 + \pi) w_i L_i \tag{5}$$

Moreover, behaving as monopolists in a Dixit-Stiglitz world, optimal pricing of firms yields a constant mark-up that directly depends on the degree of substitutability across varieties:

$$p_i(\varphi) = \left(\frac{\sigma}{\sigma - 1}\right) \frac{w_i}{\varphi} \tag{6}$$

Thanks to the simplyfing assumption of exogeneous number of potential entrants, I can focus only on the two cases of interest (a) exporting firms and (b) multinational production. Therefore, under UTR, the (net) profit conditions are given by:

$$\begin{cases} \tilde{\pi}^{exp}(\varphi) = (1 - \xi_i t_i) \left[\frac{B^j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{w_i \tau_{ij}}{\varphi} \right)^{1-\sigma} \right] - f_{ij}^{exp} \\ \\ \tilde{\pi}^{mne}(\varphi) = (1 - \xi_j t_i) \left[\frac{B^j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{w_j}{\varphi} \right)^{1-\sigma} \right] - f_{ij}^{mne} \end{cases} \tag{7}$$

Where τ_{ij} are the *ad valorem* iceberg trade costs paid by the exporting firms to reach country *j* form country *i*. $\tau_{ij} > 1$ so that more than one unit of good has to be shipped so that 1 unit arrives in destination country.

Productivity thresholds

The decision rule whether to export from country *i* or to become a multinational coporation with an affiliate in country *j* is defined by the thresholds that equalize the profits. The threshold of interest is the parameter $\bar{\varphi}_{MNE}$ that determines the number of firms implemented in the rest of the world. The zero-profit condition gives this productivity threshold:

$$\begin{cases} \tilde{\pi}^{exp}(\bar{\varphi}_{exp}) = 0 \\ \tilde{\pi}^{mne}(\bar{\varphi}_{mne}) - \tilde{\pi}^{exp}(\bar{\varphi}_{mne}) = 0 \end{cases}$$

For calculation purposes, we follow Irarrazabal et al. [2013] notation and the equilibrium for the MNEs is given by:

$$\bar{\varphi}_{ij}^{mne} = \lambda_1 \left(\frac{\Omega_{ij}}{Y_j}\right)^{1/(\sigma-1)} \frac{w_i \tau_{ij}}{P_j} \tag{8}$$

where $\Omega_{ij} = \dfrac{(f_{mne} - f_{exp})}{((1-\xi_j t_i)(w_{ij}\tau_{ij})^{\sigma-1} - (1-\xi_i t_i))}$ with $w_{ij} = w_j/w_i$and λ_1[4] constant that depends on the parameters.

$\Omega_{ij}$is key in this model. This is a measure of the difference between the fixed costs of opening an affiliate and exporting, relative to the marginal costs of the two types of production. Following Irarrazabal et al. [2013], this can be interpreted as the relative cost of FDI. In our case, this relative cost depends on the taxation regimes of the home and the destination countries. Quite intuitively, this relative cost is increasing in the destination country's transparency ξ_j and decreasing in the home country's transparency ξ_i. Moreover, higher trade cost lower the relative cost of going MNE compared to serving foreign markets by exporting. Anticipating the comparative statics, it is still useful to observe that because $\sigma > 1$, *ceteris paribus*, the productivty threshold is decreasing in ξ_i and increasing in ξ_j relfecting the fact that the share of entreprises deciding to create an affiliate in country *j* is bigger the lower its transparency compared to country i.

Price index and threshold at equilibrium

The aggregate demand of country *j* B^j is not given. It depends on which firms are present in market *j*. Note that country *j* is kept in the price aggregator derived below. Insofar as there are no internal trade costs, nor export/MNE entry cost for country j's firms willing to operate domestically, the price index for country *j* boils down to the weighted sum of all domestic producers and can be added to the overall weighted average of competitors operating in country *j*.[5].

$$P_j^{1-\sigma} = \sum_k w_k L_k \left[\int_{\bar{\varphi}_{exp}}^{\bar{\varphi}_{mne}} \left(\frac{\sigma-1}{\sigma} \frac{\varphi}{\tau_{kj} w_k}\right)^{\sigma-1} dG(\varphi) + \int_{\bar{\varphi}_{mne}}^{\infty} \left(\frac{\sigma-1}{\sigma} \frac{\varphi}{w_k}\right)^{\sigma-1} dG(\varphi) \right] \tag{9}$$

At the equilibrium, one needs to plug the productivity thershold of equation (8). Ultimately, the equilibrium price index can be expressed as a function of the parameters and is of the following form (see the derivation in appendix A.2):

$$P_j = \lambda_2 \times Y_j^{1/\rho - 1/(\sigma-1)} \times \Theta_j \times \left(\frac{Y}{1+\pi}\right)^{\rho} \tag{10}$$

[4] $\lambda_1 = \left(\frac{\sigma}{\mu}\right)^{1/(\sigma-1)} \left(\frac{\sigma}{1-\sigma}\right)$

[5] To see this, first note that $\tau_{jj} = 1$ such that $\varphi_{jj}^{exp} = \varphi_j^{dom}$ Also note that $\tau_{jj} w_{ij} = 1$ and that $t_j(\xi_j - \xi_j) = 0$, leading to $\Omega_{jj} \longrightarrow \infty$. Therefore, $\varphi_{jj}^{mne} = \infty$. Consequently, the local production is taken into account in the price index.

where λ_2 is a constant parameter[6]
and $\Theta_j = \sum_k \left(\frac{Y_k}{Y}\right)(w_k\tau_{kj})^{-\rho}\left\{\Omega_{kj}^{(\sigma-1-\rho)/(\sigma-1)}\left((w_k\tau_{kj})^{\sigma-1}-1\right)+\left(f_{kj}^{exp}(1-\xi_k t_k)\right)^{(\sigma-1-\rho)/(\sigma-1)}\right\}^{-\rho}$

The Θ coefficient is a revisited multilateral resistance variable (also known in the literature as the remoteness from the rest of the world). Comparative statics (see appendix A3) show that Θ_j is decreasing when the transparency of other countries increases and increasing when the *j*-country become more transparent. This makes intuitive sense: if other countries become more transprent, the *j*-country becomes comparatively more attractive for world investors. The opposite occurs when the home transprency is increased. On a theoretical level, it determines both margin of MP through the cut-off threshold (φ). Joining equations (8) and (10), and rearranging, we can express the productivity threshold in terms of the parameters:

$$\bar{\varphi}_{ij}^{mne} = \lambda_1/\lambda_2 \times \Omega_{ij}^{1/(\sigma-1)} \times \frac{w_i\tau_{ij}}{\Theta_j} \times \left(\frac{Y}{Y_j}\right)^{1/\rho} \times (1+\pi)^{-1/\rho} \tag{11}$$

Intensive margin of multinational production

Plugging (10) within the overall demand function gives the amount of sale per country i's firm in country *j* s_{ij}:

$$S_{ij} = \lambda_3(1+\pi)^{(\sigma-1)/\rho} \times \left(\frac{Y_j}{Y}\right)^{(\sigma-1)/\rho} \times \left(\frac{\Theta_j}{w_j}\right)^{\sigma-1} \times (\bar{\varphi}_{ij}^{mne})^{\sigma-1} \tag{12}$$

where $\lambda_3 = (\lambda_2/\lambda_1)^{\sigma-1} \times \sigma$. In addition , as in Chaney [2008] and Irarrazabal et al. [2013] π turns out to be constant.[7]

Insofar as our ultimate goal is to investigate the role of geography, market size or taxation in the production location choices of MNE, one needs to derive the aggregate sales of affiliates of country *i* located in country *j* (AS_{ij}) that directly depend on the number of affiliates originated from country *i* and located in country *j*. Thus, integrating over the productivity level starting from productivity threshold $\bar{\varphi}_{mne}$ gives the intensive margin of multinational production.

$$AS_{ij} = \mu \times \frac{Y_i \times Y_j}{Y} \times \Omega_{ij}^{1-\rho/(\sigma-1)} \times \left(\frac{w_i\tau_{ij}}{\Theta_j}\right)^{-\rho} \tag{13}$$

Extensive margin of multinational production

The extensive margin of multinational production is determined by the choice of firms whether to locate in country j. Typically, one wants to look at the number of affiliates located in the destination country. The number of affiliate located in country *j* is simply given by:

[6] $\lambda_2 = \lambda_1^{\sigma-\rho-1}\left(\frac{\rho\sigma^{1-\sigma}}{(\rho-\sigma-1)(\sigma-1)^{1-\sigma}}\right)^{\rho}$

[7] The derivation is exactly identical as in Irarrazabal et al.: $\pi = \dfrac{\frac{\mu}{\sigma}\frac{\sigma-1}{\rho}}{1+\frac{\mu}{\sigma}\frac{\sigma-1}{\gamma}}$

$$n_{ij} = w_i L_i \int_{\varphi_{mne}}^{\infty} dG(\varphi) \tag{14}$$

Using the Pareto shape of firms' distribution and the cut-off of MNE, equations (11) and (14) give:

$$n_{ij} = \lambda_1/\lambda_2 \times \frac{Y_i Y_j}{Y} \times \left(\frac{\Theta_j}{\tau_{ij}}\right)^{\rho} \times \Omega_{ij}^{-\rho/\sigma-1} \tag{15}$$

MP gravity for tax haven

The main contribution of the model is related with the link between trade cost and multinational production pattern. The second pattern according to which gravity for MP prevails less for tax havens is linked with the structural equations on both margins. Before summarizing the important results, it is useful to derive the elasticity of the cut-off determining the share of MNEs relative to exporters with respect to trade costs (χ) (see derivation in appendix A.6). Importantly, we ignore price index movements in these comparative statics.[8]

$$\chi = \frac{-(1-\xi_i t_i)}{(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1} - (1-\xi_i t_i)} \tag{16}$$

We find that this coefficient is positive (ie the elasticity of MNE/exporters with respect to trade cost is positive) only if: $(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1} < (1-\xi_i t_i)$. Holding everything else constant, this happens when ξ_j is high (transparent destination country) and ξ_i is low (tax haven origin country). Therefore, any underestimation of tax havens in databases is "pro-gravity" and, as previously exposed, gravity does not hold when flows are oriented toward tax havens. A more rigorous link with the pattern is found by differentiating structural gravity equations with respect to ξ and τ.

Proposition 1. *The effect of trade cost on the number of affiliates is:*

- *mitigated by the level of banking secrecy* $\left(\frac{\partial \ln n_{ij}}{\partial ln \tau_{ij} \partial \ln \xi_j} \geq 0\right)$ *of destination country*
- *magnified by the level of banking secrecy of the origin country* $\left(\frac{\partial \ln n_{ij}}{\partial \ln \tau_{ij} \partial \ln \xi_i} \leq 0\right)$

Proposition 2. *The effect of trade cost on the aggregate sales of affiliate is:*

- *mitigated by the level of banking secrecy* $\left(\frac{\partial \ln AS_{ij}}{\partial ln \tau_{ij} \partial \ln \xi_j} \geq 0\right)$ *of destination country*
- *magnified by the level of banking secrecy of the origin country* $\left(\frac{\partial \ln AS_{ij}}{\partial \ln \tau_{ij} \partial \ln \xi_i} \leq 0\right)$

see proof in appendix (A.7 & A.8)

As a side note, on top of the elasticity χ, structural parameters σ and ρ determine the magnitude of margins movements with respect to distance. Any decrease in ρ (typically interpreted as increase in firms heterogenity with a fat-tail distribution) makes both aggregates sales and number of affiliate more sensitive to any change in trade barriers. At the extreme, with homogeneous firms, the level of

[8]We believe that the general equilibrium counterpart of these comparative statics (that is with price index effects) does not change the result as this is the case in Irarrazabal et al. [2013] model

trade barriers can determines the strategic choice of all firms whereas more heterogeneity dampens these trends. Moreover, σ only shows up in the elasticity of the aggregate sales with respect to trade costs and not in the determinantion of the number of affiliates. Intuitively, the entry decision is a simple rule that depends on the productivity distribution with respect to the MP-entry cut-off, whereas once the affiliate is created, the aggregate sales does depend on firms market power that directly relates with the degree of substituability of goods.

4 Tax havens and export platforms

So far, we only added fiscal concerns to the basic market access motives for multinational enterprises. In reality, affiliates not only serve the country in which they are implemented by they are also used as export platforms by the parent company that might prefer occur lower trade cost and/or benefit from advantageous fiscal advantageous, rather than exporting from country i to all countries. Pattern 3 reminds that market potential is an important measure of country actractivness and espcially so for small coutries and/or countries with high level of banking secrecy and that tax havens are often used as export platforms. This extension captures this feature of MNEs' organisation by allowing affiliates to export.

We therefore compare the strategies of serving a set of N foreign countries directly from the domestic country$i$ compared to exporting from an export-platform located in a country j. The cost of opening an export-platform is equivalent to the cost of creating an affiliate. We have:

$$\begin{cases} \tilde{\pi}^{exp}(\varphi) = \sum_{k}^{N} \left[(1-\xi_i t_i) \left[\frac{B^k}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{w_k \tau_{ik}}{\varphi} \right)^{1-\sigma} \right] - f_{ik}^{exp} \right] \\ \tilde{\pi}^{ep}(\varphi) = (1-\xi_j t_i) \frac{B^j}{\sigma} \left(\frac{\sigma w_j}{(\sigma-1)\varphi} \right)^{1-\sigma} - f_{ij}^{mne} + \sum_{k \neq j}^{N} \left[(1-\xi_j t_i) \left[\frac{B^k}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{w_k \tau_{ik}}{\varphi} \right)^{1-\sigma} \right] - f_{ij}^{exp} \right] \end{cases} \tag{17}$$

The difference between the two profit functions gives the indifference threshold above which firms engage in multinational production with export platforms, $\tilde{\varphi}^{ep}$

$$\varphi^{ep} = \lambda_1 \times \left(\Omega_{ij}^{ep}\right)^{1/\sigma-1} \times w_{ij} \times \left(\frac{\sum_{k \neq j} Y_k^{1/1-\sigma} \tau_{ik}}{\sum_{k \neq j} P_k} + \frac{Y_j^{1/1-\sigma}}{P_j} \right) \tag{18}$$

where Ω_{ij}^{ep} is a measure of the relative cost of export platforms. This relative cost includes the difference in fixed costs of exporting from the export platforms towards each country of the region net of the fixed cost of exporting from the home country. Ω_{ij}^{ep} also includes the relative variable cost represented by the iceberg trade cost separating the export platform to the region compared to the trade cost between the home country and the final destinations.

Another difference with the first model is the impact of the destination country size. If the MNE can access the export platform's country at 0-trade cost, the gain is marginal compared to the overall market size of the region that the firm wants to reach. The size of the market matters less in the choice of FDI in this framework. Instead, this model emphasises the importance of market potential. Following standard definition of market potential, we denote the market potential of country *j* (MP_j) as $MP_j = \sum_k Y_k \tau_{jk}^{1-\sigma}/P_k^{1-\sigma}$. Therefore, the export platform threshold can be rewritten as:

$$\varphi^{ep} = \lambda_1 \times w_{ij} \times \left(\Omega_{ij}^{ep}\right)^{1/\sigma-1} \times \left(MP_j^{1/(1-\sigma)} + Y_j^{1/1-\sigma}/P_j\right) \tag{19}$$

The entry cut-off of the export platform thus depends on the market potential of destination countries. Regarding the price index, the framework becomes more complicated. Market *j* is not only served by foreign affiliates located in country *j* and by foreign exporters but also by foreign export platforms. As noticed in figure 2, market *j* is even served by *j*-owned affiliates located abroad and re-exporting towards *j*. In what follows, we only derive the partial equilibrium, keeping the price index as constant.

Similarly as in the baseline model, aggregate sales are derived by aggregating sales of each affiliates over the support of all firms that decided to open an export platform. Note that those sales are partly realized from the domestic market AS_{ij}^{loc} and from surrounding markets AS_{ij}^{exp}. We have :

$$AS_{ij}^{tot} = \mu \times Y_i \times w_i^{-\rho} \times \left(\Omega_{ij}^{ep}\right)^{1-\rho/(\sigma-1)} \times \left(\underbrace{MP_j^{1/1-\sigma}}_{\text{export}} + \underbrace{(Y_j^{1/1-\sigma}/P_j)}_{\text{domestic}}\right)^{\sigma-1-\rho} \tag{20}$$

The export-ratio boils (R) down to:

$$R = \left(\frac{MP_j^{1/1-\sigma}}{MP_j^{1/1-\sigma} + Y_j^{1/1-\sigma}/P_j}\right)^{\sigma-1-\rho} \tag{21}$$

Banking secrecy and export sales

Up to this point the set of country *K* was exogeneous. From the parent company perspective, the decision whether to export directly from the home country or from its export platform takes the following form. Any country *n* is inculded in the set *K* if condition (22) holds.

$$(1-\xi_j t_i)\left(\frac{B^n}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{w_j \tau_{jn}}{\phi}\right)^{1-\sigma}\right) - f_{jn}^{exp} \geq (1-\xi_i t_i)\left(\frac{B^n}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{w_j \tau_{in}}{\phi}\right)^{1-\sigma}\right) - f_{in}^{exp} \tag{22}$$

Holding every thing else constant, the probability that country *n* is included in *K* decreases with ξ_j, that is, increases with banking secrecy of the export platform. Because the market potential MP_j is a sum of the demand of all countries included in the set *K*, MP_j is also decreasing in ξ_j.

Proposition 3. ***Export ratio in tax havens***
Hodling everything else equal, the share of export in affiliate total sales is higher in tax haven than in standard jurisdiction $\left(\frac{\partial R}{\partial \xi_j}\right) \leq 0$.

5 Conclusion

This paper first looks empirically at the impact of financial secrecy on the organization of multinational production. First, both margins of multinational production are on average higher in countries with high level of financial secrecy. Second, the negative relationship between affiliate activity and distance is reduced when destination countries have a high level of banking secrecy. Third, sales of affiliates located in tax havens are characterized by a higher share of export. However, The strength of these patterns is significantly reduced by the lack of information that characterizes tax havens: only few of them are included in bilateral databases and offshore territories are often pooled with big countries. Legal progress should help future research in this direction.[9]

A gravity-generating model with heterogeneous firms that sort into exporter and multinational enterprises taking into account countries' level of financial secrecy is well-suited for understanding those patterns. Higher level of financial secrecy decreases the relative cost of going MNE and tend to increase the number of firms willing/able to engage in multinational production regardless of the way global profit are taxed. Moreover, higher level of financial secrecy moves the organization of multinational production away from gravity. Finally, high presence of multinational in spite of the small size of tax havens is explained by their role as export-platform in which the effect of market size is reduced. This model is a starting point for further related researches. First, it would be interesting to combine the intra-firm trade dynamic proposed by Irarrazabal et al. [2013] with the fiscal optimization motive. This would provide a comprehensive framework for thinking about transfer pricing that implies both aspects. Such an attempt would certainly need a more detailed micro-foundation of firms strategies with, in particular, pricing to markets. Second, structural estimation of the model with firm-level data base would improve the analysis. In particular, deviation from gravity could provide an additional measure of countries. Finally, these diversions can constitute a global inefficiency and losses of welfare. The ownership structure with equal redistribution of profits is also badly-suited for thinking about the link between inequality and tax havens. Quantifying these losses and improving the ownership structure of the model would certainly help policy makers understand consequences of tax havens and enhance international cooperation to fight profit shifting and tax avoidance.

[9]See for instance the bill recently adopted by UK parliament imposing public registers of firms' beneficial ownership on UK's Overseas Territories

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A Appendices

A.1 Derivation of the MNE and EP thresholds

$$\bar{\varphi}_{ij}^{exp} = \lambda_1 \left(\frac{f_{ij}^{exp}}{Y_j} \right)^{1/(\sigma-1)} (1 - \xi_i t_i)^{1/(1-\sigma)} \frac{w_j \tau_{ij}}{P_j}$$

And

$$\begin{aligned}
0 &= \tilde{\pi}^{mne}(\bar{\varphi}_{mne}) - \tilde{\pi}^{exp}(\bar{\varphi}_{mne}) \\
&= (1 - \xi_j t_i) \left[\frac{B^j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{w_j}{\varphi} \right)^{1-\sigma} \right] - f_{ij}^{mne} - (1 - \xi_i t_i) \left[\frac{B^j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{w_i \tau_{ij}}{\varphi} \right)^{1-\sigma} \right] + f_{ij}^{exp} \\
(f_{ij}^{mne} - f_{ij}^{exp}) &= \left(\frac{B^j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \right) \right)^{1-\sigma} \left[(1 - \xi_j t_i) \left(\frac{w_j}{\varphi} \right)^{1-\sigma} - (1 - \xi_i t_i) \left(\frac{w_i \tau_{ij}}{\varphi} \right)^{1-\sigma} \right]
\end{aligned}$$

Given that $w_{ij} = w_i / w_j$, simplfying the constants, factorizing by w_i and replacing B in terms of expenditure and price index gives:

$$\begin{aligned}
(f_{ij}^{mne} - f_{ij}^{exp}) &= \left(\lambda_1 \frac{Y_j}{P_j^{1-\sigma}} \right)^{1-\sigma} (w_i)^{1-\sigma} \left[(1 - \xi_j t_i) \left(\frac{w_{ij}}{\varphi} \right)^{\sigma-1} - (1 - \xi_i t_i) \left(\frac{\tau_{ij}}{\varphi} \right)^{1-\sigma} \right] \\
\varphi^{1-\sigma} &= \frac{1}{(f_{ij}^{mne} - f_{ij}^{exp})} \left(\lambda_1 \frac{Y_j}{P_j^{1-\sigma}} \right)^{1-\sigma} (w_i)^{1-\sigma} \left[(1 - \xi_j t_i) (w_{ij})^{\sigma-1} - (1 - \xi_i t_i) (\tau_{ij})^{1-\sigma} \right]
\end{aligned}$$

Factorizing by $\tau_{ij}^{1-\sigma}$

$$\begin{aligned}
\varphi^{1-\sigma} &= \frac{1}{(f_{ij}^{mne} - f_{ij}^{exp})} \left(\lambda_1 \frac{Y_j}{P_j^{1-\sigma}} \right)^{1-\sigma} (w_i \tau_{ij})^{1-\sigma} \left[(1 - \xi_j t_i) (w_{ij} \tau_{ij})^{\sigma-1} - (1 - \xi_i t_i) \right] \\
\bar{\varphi}_{ij}^{mne} &= \lambda_1 \left(\frac{f_{ij}^{mne} - f_{ij}^{exp}}{Y_j} \right)^{1/(\sigma-1)} P_j^{-1} (w_i \tau_{ij}) \left[(1 - \xi_j t_i)(w_{ij} \tau_{ij})^{\sigma-1} - (1 - \xi_i t_i) \right]^{1/(1-\sigma)} \\
\bar{\varphi}_{ij}^{mne} &= \lambda_1 \left(\frac{\Omega_{ij}}{Y_j} \right)^{1/(\sigma-1)} \frac{w_i \tau_{ij}}{P_j}
\end{aligned}$$

where $\Omega_{ij} = (f_{mne} - f_{exp})/((1 - \xi_j t_i)(w_{ij} \tau_{ij})^{\sigma-1} - (1 - \xi_i t_i))$

In case of export platform:

- the size of the destination country becomes the size of all the countries included in the set of destination countries.
- the difference in fixed cost includes the difference of fixed cost of exporting from the export-platforme towards each countries of the region compared to the these fixed cost from the home country
- the same holds for the difference in variable costs.

We therefore have:

$$\Omega_{ij}^{ep} = \frac{\left(f_{ij}^{mne} - f_{ij}^{exp}\right) + \sum_k f_{jk}^{exp} - f_{ik}^{exp}}{\left((w_{ij}\tau_{ij})^{\sigma-1} + \left(\frac{\sum_k \tau_{jk}}{\sum_k \tau_{ik}}\right)^{\sigma-1}\right)((1-\xi_j t_i) - (1-\xi_i t_i))}$$

that yields:

$$\varphi^{ep} = \lambda_1 \times \left(\frac{\Omega_{ij}^{ep}}{\sum_k Y_k}\right)^{1/\sigma-1} \times \frac{w_{ij}\sum_k \tau_{ik}}{\sum_k P_k}$$

A.2 Derivation of the price index

$$\begin{aligned}
P_j^{1-\sigma} &= \sum_k w_k L_k \left\{ \int_{\varphi_{exp}}^{\varphi_{mne}} \left(\frac{\sigma-1}{\sigma}\frac{\varphi}{w_k\tau_{kj}}\right)^{1-\sigma} dG(\varphi) + \int_{\varphi_{mne}}^{\infty} \left(\frac{\sigma-1}{\sigma}\frac{\varphi}{w_k}\right)^{1-\sigma} dG(\varphi) \right\} \\
&= \left[\frac{\rho\left(\frac{\sigma}{1-\sigma}\right)^{1-\sigma}}{\rho-\sigma+1}\right] \sum_k w_k L_k \left\{ (\varphi_{ik}^{mne} - \varphi_{ik}^{exp})^{\sigma-1-\rho} (w_k\tau_{kj})^{1-\sigma} - (\varphi_{ik}^{mne})^{\sigma-1-\rho} \right\} \\
&= \lambda_2^1 \sum_k w_k L_k (w_k\tau_{kj})^{1-\sigma} \left\{ (\varphi_{ik}^{mne})^{\sigma-1-\rho} \left((w_k\tau_{kj})^{\sigma-1} - 1\right) + (\varphi_{ik}^{exp})^{\sigma-1-\rho} \right\} \\
&= \lambda_2^1 \sum_k w_k L_k (w_k\tau_{kj})^{1-\sigma} \times \\
&\left\{ \left(\left(\frac{\Omega_{ij}}{Y_j}\right)^{1/(1-\sigma)} \frac{w_i\tau_{ij}}{P_j}\right)^{\sigma-1-\rho} \left((w_k\tau_{kj})^{\sigma-1} - 1\right) + \left(\left(\frac{f_{ij}^{exp}}{Y_j}(1-\xi_i t_i)\right)^{1/(1-\sigma)} \frac{w_j\tau_{ij}}{P_j}\right)^{\sigma-1-\rho} \right\} \\
P_j^{-\rho} &= \lambda_2 \sum_k w_k L_k (w_k\tau_{kj})^{-\rho} \left\{ \left(\left(\frac{\Omega_{ij}}{Y_j}\right)^{1/(1-\sigma)}\right)^{\sigma-1-\rho} \left((w_k\tau_{kj})^{\sigma-1} - 1\right) + \left(\left(\frac{f_{ij}^{exp}}{Y_j}(1-\xi_i t_i)\right)^{1/(1-\sigma)}\right)^{\sigma-1-\rho} \right\} \\
&= \lambda_2 \sum_k w_k L_k (w_k\tau_{kj})^{-\rho} \left\{ \left(\frac{\Omega_{ij}}{Y_j}\right)^{(\sigma-1-\rho)/(1-\sigma)} \left((w_k\tau_{kj})^{\sigma-1} - 1\right) + \left(\frac{f_{ij}^{exp}}{Y_j}(1-\xi_i t_i)\right)^{(\sigma-1-\rho)/(1-\sigma)} \right\} \\
&= \lambda_2 Y_j^{-1+\rho/(\sigma-1)} \frac{Y}{(1+\pi)} \sum_k \left(\frac{Y_k}{Y}\right) (w_k\tau_{kj})^{-\rho} \left\{ \Omega_{ij}^{(\sigma-1-\rho)/(1-\sigma)} \left((w_k\tau_{kj})^{\sigma-1} - 1\right) + \left(f_{ij}^{exp}(1-\xi_i t_i)\right)^{(\sigma-1-\rho)/(1-\sigma)} \right\} \\
P_j &= \left(\lambda_2 Y_j^{-1+\rho/(\sigma-1)} \frac{Y}{(1+\pi)} \sum_k \left(\frac{Y_k}{Y}\right) (w_k\tau_{kj})^{-\rho} \left\{ \Omega_{ij}^{(\sigma-1-\rho)/(1-\sigma)} \left((w_k\tau_{kj})^{\sigma-1} - 1\right) + \left(f_{ij}^{exp}(1-\xi_i t_i)\right)^{(\sigma-1-\rho)/(\sigma-1)} \right\}\right)^{-\rho} \\
P_j &= \lambda_2 \times Y_j^{1/\rho-1/(\sigma-1)} \times \Theta_j
\end{aligned}$$

A.3 Derivation of sales per affiliate

$$
\begin{aligned}
S_{ij} &= p(\varphi)^{1-\sigma} \times Q_j \\
&= p(\varphi)^{1-\sigma} \times \frac{B_j}{\sigma} \\
&= \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \frac{1}{\sigma} \times \left(\frac{w_j}{\varphi_{mne}}\right)^{1-\sigma} \times \mu \frac{Y_j}{P_j^{1-\sigma}} \\
&= \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \frac{1}{\sigma} \mu \times w_j^{1-\sigma} \times \varphi_{mne}^{\sigma-1} \times Y_j \times \left(\lambda_2 \times Y_j^{1/\rho-1/(\sigma-1)} \times \Theta_j\right)^{\sigma-1} \\
&= (\lambda_2/\lambda_1)^{\sigma-1} \times Y_j^{(\sigma-1)/\rho} \times \Theta_j^{\sigma-1} \times w_j^{1-\sigma} \times \varphi_{mne}^{\sigma-1} \times \left(\frac{1+\pi}{Y}\right)^{(\sigma-1)/\rho} \\
&= \lambda_1/\lambda_2(1+\pi)^{(\sigma-1)/\rho} \times \left(\frac{Y_j}{Y}\right)^{(\sigma-1)/\rho} \times \left(\frac{\Theta_j}{w_j}\right)^{\sigma-1} \times (\bar{\varphi}_{ij}^{mne})^{\sigma-1}
\end{aligned}
$$

A.4 Derivation of the aggregate sale

$$
\begin{aligned}
AS_{ij} &= w_i L_i \int_{\bar{\varphi}_{mne}}^{\infty} S_{ij} dG(\varphi) \\
&= w_i L_i \int_{\bar{\varphi}_{mne}}^{\infty} \lambda_1/\lambda_2(1+\pi)^{(\sigma-1)/\rho} \times \left(\frac{Y_j}{Y}\right)^{(\sigma-1)/\rho} \times \left(\frac{\Theta_j}{w_j}\right)^{\sigma-1} \times (\bar{\varphi}_{ij}^{mne})^{\sigma-1} dG(\varphi) \\
&= \lambda_1/\lambda_2(1+\pi)^{(\sigma-1)/\rho} \times \left(\frac{Y_j}{Y}\right)^{(\sigma-1)/\rho} \times \left(\frac{\Theta_j}{w_j}\right)^{\sigma-1} \times Y_i \int_{\bar{\varphi}_{mne}}^{\infty} (\bar{\varphi}_{ij}^{mne})^{\sigma-1} dG(\varphi) \\
&= \lambda_1/\lambda_2(1+\pi)^{(\sigma-1)/\rho} \times \left(\frac{Y_j}{Y}\right)^{(\sigma-1)/\rho} \times \left(\frac{\Theta_j}{w_j}\right)^{\sigma-1} \times Y_i \times \varphi_{mne}^{-\rho+\sigma-1} \\
&= \lambda_1/\lambda_2(1+\pi)^{(\sigma-1)/\rho} \times \left(\frac{Y_j}{Y}\right)^{(\sigma-1)/\rho} \times \left(\frac{\Theta_j}{w_j}\right)^{\sigma-1} \times Y_i \times \left(\lambda_1/\lambda_2 \Omega_{ij}^{1/(\sigma-1)} \frac{w_i \tau_{ij}}{\Theta_j} \left(\frac{Y}{Y_j}\right)^{1/\rho} (1+\pi)^{-1/\rho}\right)^{-\rho+\sigma-1} \\
&= \lambda_5 \times \frac{Y_i Y_j}{Y} \times \left(\frac{\Theta_n}{\tau_{ij}}\right)^{\rho} \times (w_{ij}\tau_{ij})^{\sigma-1} \times \Omega_{ij}^{1-\rho/(\sigma-1)}
\end{aligned}
$$

where

$$
\begin{aligned}
\lambda_5 &= \frac{\rho}{\rho-(\sigma-1)}\left(\lambda_1/\lambda_2\right)^{-\rho+\sigma-1} \times \lambda_1/\lambda_2 \\
&= \frac{\rho}{\rho-(\sigma-1)} \times \left(\frac{\lambda_1}{\lambda_2}\right)^{-\rho+\sigma-1} \times \left(\frac{\lambda_1}{\lambda_2}\right)^{1-\sigma} \times \sigma \\
&= \frac{\rho}{\rho-(\sigma-1)} \times \left(\frac{\lambda_1}{\lambda_2}\right)^{-\rho} \times \sigma \\
&= \lambda_1 \times \lambda_1^{\rho-\sigma+1} \times \left(\frac{\rho}{\rho-(\sigma-1)}\right)^{-1} \times \left(\frac{\sigma}{1-\sigma}\right)^{\sigma-1} \times \sigma \times \left(\frac{\rho}{\rho-(\sigma-1)}\right) \\
&= \lambda_1^{1-\sigma} \times \left(\frac{\sigma}{1-\sigma}\right)^{\sigma-1} \times \sigma \\
&= \left(\frac{\mu}{\sigma}\right) \times \left(\frac{\sigma}{1-\sigma}\right)^{1-\sigma} \times \sigma \times \left(\frac{\sigma}{1-\sigma}\right)^{\sigma-1} \\
&= \mu
\end{aligned}
$$

A.5 Derivation of equilibrium number of firms

$$
\begin{aligned}
n_{ij} &= w_i L_i \int_{\varphi_{mne}}^{\infty} dG(\varphi) \\
&= Y_i \frac{\rho}{\rho-(\sigma-1)} \left(\lambda_3 \times \Omega_{ij} \times \frac{w_i \tau_{ij}}{\Omega_j} \times \left(\frac{Y}{Y_j}\right)^{1/\rho} \times (1+\pi)^{-1/\rho}\right)^{-\rho} \\
&= \lambda_4 \times \frac{Y_i Y_j}{Y} \times \left(\frac{\Theta_j}{\tau_{ij}}\right)^{\rho} \times \Omega_{ij}^{-\rho/\sigma-1}
\end{aligned}
$$

A.6 Trade costs' elasticity of cut-off

Holding P constant;

$$
\frac{\partial \varphi^{mne}}{\partial \tau_{ij}} = \lambda_1 \left(\frac{1}{Y_j}\right) \frac{w_i}{P_j} \left(\frac{1}{\sigma-1} \frac{\partial \Omega_{ij}}{\partial \tau_{ij}} \times \Omega_{ij}^{1/(\sigma-1)-1} \tau_{ij} + \Omega_{ij}^{1/(\sigma-1)}\right)
$$

Computing separately $\dfrac{\partial \Omega_{ij}}{\partial \tau_{ij}}$:

$$
\frac{\partial \Omega_{ij}}{\partial \tau_{ij}} = (f^{mne} - f^{exp}) \left(-\frac{(\sigma-1)(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-2} w_{ij}}{\left[(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1} - (1-\xi_i t_i)\right]^2}\right)
$$

Including it in the expression dervied above $(\sigma-1)$ cancels out, the mutliplication by τ_{ij} of the first part bring the power of $(\tau_{ij} w_{ij})$ back to $(\sigma-1)$.

$$
\begin{aligned}
\frac{\partial \varphi^{mne}}{\partial \tau_{ij}} &= K \times \frac{(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1} - (1-\xi_i t_i) - (1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1}}{(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1} - (1-\xi_i t_i)} \\
&= K \times \left(-\frac{(1-\xi_i t_i)}{(1-\xi_j t_i)(\tau_{ij} w_{ij})^{\sigma-1} - (1-\xi_i t_i)}\right)
\end{aligned}
$$

with $K = \lambda_1 \times \left(\dfrac{1}{Y_j}\right) \dfrac{w_i}{P_j} \geq 0$

A.7 Proof of proposition 1

Proof. First step:
Holding P constant, we derive $\ln n_{ij}$ with respect to τ_{ij} as function of χ:

$$\begin{aligned}
\frac{d\ln n_{ij}}{d\ln \tau_{ij}} &= -\rho - \left(\frac{-\rho}{\sigma-1}\frac{d\ln \Omega_{ij}}{d\ln \tau_{ij}}\right) \\
&= -\rho\left(1-\left(\frac{1}{\sigma-1}\frac{d\ln \Omega_{ij}}{d\ln \tau_{ij}}\right)\right) \\
&= -\rho\left(1-\left(\frac{1}{\sigma-1}\frac{d\ln \Omega_{ij}}{d\ln \tau_{ij}}\right)\right) \\
&= -\rho\left(1-\left(\frac{1}{\sigma-1}\frac{d\Omega_{ij}/d\tau_{ij}}{\Omega_{ij}/\tau_{ij}}\right)\right) \\
&= -\rho\left(1-\left(\frac{1}{\sigma-1}\frac{\tau_{ij}d\Omega_{ij}/d\tau_{ij}}{\Omega_{ij}}\right)\right) \\
&= -\rho\left(1-\frac{1}{\sigma-1}\left((f^{mne}-f^{exp})\left(-\frac{(\sigma-1)(1-\xi_j t_i)(\tau_{ij}w_{ij})^{\sigma-2}w_{ij}}{[(1-\xi_j t_i)(\tau_{ij}w_{ij})^{\sigma-1}-(1-\xi_i t_i)]^2}\tau_{ij}\right)\frac{(1-\xi_j t_i)(\tau_{ij}w_{ij})^{\sigma-1}-(1-\xi_i t_i)}{(f^{mne}-f^{exp})}\right)\right) \\
&= -\rho\left(1-\frac{(1-\xi_j t_i)(\tau_{ij}w_{ij})^{\sigma-1}}{(1-\xi_j t_i)(\tau_{ij}w_{ij})^{\sigma-1}-(1-\xi_i t_i)}\right) \\
&= -\rho\chi
\end{aligned}$$

Second step:
$\frac{d\chi}{d\xi_j} \leq 0$ since increase in ξ_j decreases the denominator, increase the fraction in absolute terms and thus decreases χ and $\frac{d\chi}{d\xi_i} \geq 0$ since increases in ξ both decrease the numerator and increases the denominator resulting an increase of χ.

Third step:
Thus $\frac{\partial \ln n_{ij}}{\partial \ln \tau_{ij}\partial \xi_j} = -\rho\frac{d\chi}{d\xi_j} \geq 0$ and $\frac{\partial \ln n_{ij}}{\partial \ln \tau_{ij}\partial \xi_i} = -\rho\frac{d\chi}{d\xi_i} \leq 0$ □

A.8 Proof of proposition 2

Proof.

$$\begin{aligned}
\frac{d\ln AS_{ij}}{d\ln \tau_{ij}} &= -\rho + (\sigma-1) + \left(\frac{\partial \ln \Omega_{ij}}{\partial \ln \tau_{ij}}\right)\left(1-\frac{\rho}{\sigma-1}\right) \\
&= (\sigma-1-\rho) - (\sigma-1-\rho)\left(\frac{\tau_{ij}d\Omega_{ij}/d\tau_{ij}}{\Omega_{ij}}\right)\left(\frac{1}{\sigma-1}\right) \\
&= (\sigma-1-\rho)\left(1-\left(\frac{1}{\sigma-1}\frac{\tau_{ij}d\Omega_{ij}/d\tau_{ij}}{\Omega_{ij}}\right)\right) \\
&= (\sigma-1-\rho)\chi \text{ as seen in proof of prop 1}
\end{aligned}$$

As ρ is assumed to greater than $(\sigma-1)$, the first term is negative, which brings the proof back as in the proof of proposition 1 □

A.9 Proof of proposition 3

Proof. Let $\Phi \equiv \dfrac{\partial MP_j}{\partial \xi_j}$. We have seen that $\Phi < 0$

$$\frac{\partial R}{\partial \xi_j} = (\sigma - 1 - \rho) R^{\sigma-2-\rho} \left(\frac{\left(\frac{1}{1-\sigma}\right) MP_{ij}^{1/1-\sigma} \Phi (Y_j^{1/1-\sigma}/P_j - 1)}{\left(MP_{ij} + Y_j^{1/1-\sigma}/P_j\right)^2} \right)$$

Thus, since $\sigma > 1$, as long as $(Y_j^{1/1-\sigma}/P_j) > 1$, $\left(\dfrac{\left(\frac{1}{1-\sigma}\right) MP_{ij}^{1/1-\sigma} \Phi (Y_j^{1/1-\sigma}/P_j - 1)}{\left(MP_{ij} + Y_j^{1/1-\sigma}/P_j\right)^2} \right) > 0$ holds.

Because we have assumed $\gamma > \sigma - 1$, $\dfrac{\partial R}{\partial \xi_j} < 0$ $\square$

A.10 Robustness check

Table 3: Robustness check

	Multilateral Resistance			
	Standard		**Poisson**	
	(4)	(5)	(6)	(7)
Margin of MP	Ext.	Int.	Ext.	Int.
Distance (log)	-0.770***	-0.969***	-0.274***	-0.0491***
	(-16.78)	(-16.54)	(-14.17)	(-16.53)
Common border	0.347**	0.407*	0.0130	0.0163
	(2.84)	(2.30)	(0.25)	(1.78)
Common language	0.790***	0.845***	0.228***	0.0407***
	(8.67)	(6.58)	(6.28)	(6.31)
OFC X Distance	0.367***	0.499***	0.154***	0.0257***
	(5.45)	(5.62)	(5.95)	(6.03)
N	1091	1092	1089	1092
R^2	0.814	0.858		

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.11 List of tax havens

	OFC (FMI)	Hines and Rice (2004)	Included in the database
Andorra	1	1	0
Anguilla	1	1	0
Antigua	1	1	0
Aruba	1	1	0
Bahamas	1	1	0
Bahrain	1	1	0
Barbados	1	1	0
Belize	1	1	0
Bermuda	1	1	0
British Virgin Island	1	1	0
Campione	1	0	0
Channel Island	0	1	0
Cayman Island	1	1	0
Cook Islands	1	1	0
Costa Rica	1	1	1
Cyprus	1	1	0
Djibouti	1	0	0
Dominica	1	1	1
Gibraltar	1	1	0
Grenada	1	1	0
Guam	1	0	0
Guernsey	1	0	0
Hong Kong	1	1	0
Ireland	1	1	1
Isle of Man	1	1	0
Israel	1	1	1
Japan	1	1	1
Jersey	1	0	0
Jordan	0	1	0
Lebanon	1	1	1
Liberia	1	1	0
Liechtenstein	1	1	0
Luxembourg	1	1	1
Macao	1	1	0
Mauritius	1	0	0
Madeira	1	1	0
Malaysia (Labuan)	1	1	0

	OFC (FMI)	Hines and Rice (2004)	Included in the database
Malta	1	1	0
Marianas	1	0	0
Marshall Islands	1	1	0
Micronesia	1	1	0
Monaco	1	1	0
Montserrat	1	1	0
Nauru	1	1	0
Netherlands	1	0	1
Netherlands Antilles	1	1	0
Niue	1	1	0
Panama	1	1	0
Philippines	1	1	0
Seychelles	1	1	0
Singapore	1	1	1
St Kitts and Nevis	1	1	0
St Lucia	1	1	0
Switzerland	1	1	1
Tahiti	1	1	0
Tangier	1	1	0
Thailand	1	0	1
UK	1	0	0
Uruguay	1	0	1
USA	1	0	1
Vanuatu	1	1	0
Western Samoa	1	0	0
Turks and Caicos Islands	0	1	0