Structural Gravity under size asymmetry and non-homotheticity

Badis Tabarki*

Université Paris1 Pantheon-Sorbonne and PSE

Abstract

I propose a structural gravity model with heterogeneous firms, asymmetric countries and indirectly additive preferences nesting non-homotheticity as a general case and the CES as a homothetic exception. By exploiting the flexibility of preferences on the demand side and market size asymmetry on the supply side, the model generates five novel theoretical predictions. First, the intensive margin of trade is orthogonal to the population size of the destination and increases only with its per-capita income in general equilibrium. Second, the responsiveness of the intensive margin to a variation in the variable trade cost decreases with per capita income as richer consumers are less price sensitive. Third, per-capita income dampens the sensitivity of the extensive margin to fixed trade cost. Fourth, I show that the structure of welfare gains from unilateral trade liberalization solely depends on the relative size of the trading partner. Fifth, I highlight two new sources of welfare gain: *an additional gain from tougher selection on the export market and an increase in nominal wage in the liberalizing country.* Finally, using the World Bank's exporter dynamics database, I test the empirical validity of the preferences-driven predictions and I find strong support in the data.

JEL Classification: **F12, F14, F16, D11**

keywords: structural gravity, heterogeneous firms, asymmetric countries, non-homotheticity, unilateral trade liberalization, welfare gains from trade

*I am grateful to my advisors Professors Lionel Fontagné, Mathieu Parenti and Ariell Reshef for invaluable guidance and constant encouragement.**

1 Introduction

By virtue of its solid theoretical foundations, high predictive power and empirical prowess, the Structural Gravity model has always been the workhorse of international trade analysis. This intuitive and tractable model has paved the way for an extensive analysis of the impact of trade barriers on bilateral trade flows under different theoretical environments. Whether trade is assumed to be inter-industry and driven by comparative advantage as in Eaton and Kortum (2002) or intra-industry due to the variety-loving attitude of consumers (Anderson and Van Wincoop, 2003; Chaney, 2008), all of these canonical models aim at predicting the general equilibrium effect of small trade shocks on aggregate trade flows. However, the current paper examines the role that flexibility in consumer preferences play in determining the degree of sensitivity of trade margins to trade costs. It also studies the implications of country-level asymmetry in market size for the structure of welfare gains from trade.

Whereas the sensitivity of trade flows to trade barriers has been studied in great detail, the impact of trading partners' market sizes and in particular, its decomposition into GDP per capita and population size has received less attention. Since the seminal contribution by Linder (1961), per-capita income has been put back into trade theory only during the last decade. By introducing non-homotheticity in a Ricardian framework, Fieler (2011) finds that bilateral trade increases significantly with per-capita income, whereas it remains unaffected by population size. Markusen (2013) derives an identical prediction in a Heckscher Ohlin framework.

More recently, Bertoletti et al. (2018) have addressed this question in a heterogeneous firms framework which abstracts from fixed costs given the presence of a reservation price.[1] They find that the extensive margin of trade (number of exporters) increases with destination's per-capita income, whereas it is orthogonal to its population size. They explain this result with the aid of a peculiar property of indirect additivity: the price elasticity of demand decreases with per-capita and does not vary with population size.[2] Hence, richer destinations are easier to penetrate since their consumers are less price sensitive. They also show that per-capita income dampens the intensive margin (firm export revenues). The linear demand system proposed by Melitz and Ottaviano (2008) generates an opposite prediction: while both trade margins are unaffected by per-capita income, the extensive margin decreases with destination's population size as competition is tougher in larger markets.

[1] under indirect additivity with the Addilog as a functional form.

[2] excluding the CES case, which is a homothetic exception.

By contrast, the Chaney (2008) model predicts that per-capita income and population size affect both margins through the same channel and with the same magnitude. The latter result is mainly driven by the presence of fixed costs and mainly CES demand.[3] Specifically, per-capita income and population size both act as size parameters[4] as they have no impact on consumer preferences under the CES.[5]

In this paper, in order to contribute to this strand of the literature, I proceed as follows. First, by introducing indirectly additive preferences in the Chaney (2008) model, I cover two natures of preferences: (i) non-homotheticity which features an income-decreasing demand elasticity; (ii) the CES which is taken as a homothetic benchmark.[6] Second, I address the following theoretical question: does the dampening effect of per-capita income on the demand elasticity feed back into a greater impact on trade margins, as compared with population size, in general equilibrium? Under non-homotheticity, the model generates a novel prediction regarding income and size effects on trade margins. Specifically, I show that the intensive margin increases only with per-capita income in general equilibrium. Then, I empirically contrast the new prediction (obtained under non-homotheticity) with the standard one (CES-based) in order to identify the nature of preferences that fits better the data. Using the Exporter Dynamics Database (EDD), I find evidence that seems consistent with the novel prediction.

The current paper also studies the impact of non-homotheticity on the degree of sensitivity of trade margins to trade costs. In particular, I show both theoretically and empirically that per-capita income dampens, not only the variable trade cost elasticity of the intensive margin, but also the fixed trade cost elasticity of the extensive margin. This is the second novelty of this paper. Importantly, the flexibility of preferences, under non-homotheticity, breaks the constant link between trade margins and trade costs that is imposed by the rigidity of the CES in the Chaney (2008) model. As for the aggregate trade elasticity, I show that non-homotheticity only generates a variable link between aggregate trade flows and fixed trade barriers. For instance, as per-capita income dampens the fixed trade cost elasticity of the extensive margin, it follows then that sensitivity of bilateral trade flows to fixed trade barriers is decreasing in income. Nevertheless, in line with (Melitz and Ottaviano, 2008; Bertoletti et al., 2018; Arkolakis et al., 2018), the constant link between trade

[3] Recall that fixed costs are required to ensure firm selection since CES demand does not exhibit a choke price.

[4] They reflect respectively the level of individual expenditure and the number of consumers.

[5] The price elasticity of demand σ is exogenous under the CES and thus orthogonal to both parameters.

[6] As illustrated in Parenti et al. (2017), the CES stands as unique common ground for different families of preferences. For example, preferences can be indirectly additive and homothetic only under the CES case.

flows and variable trade costs is maintained despite the flexibility of preferences.
In particular, this result can be seen as straightforward implication of a parametric assumption on the supply side: firm productivity is Pareto distributed. Put differently, the flexibility in the patterns of substitution generates a variable elasticity of trade flows with respect to variable trade costs only when firms are homogeneous. The translog gravity proposed by Novy (2013) is an example of this specific case.

From a modeling perspective, this paper offers a parsimonious extension of the Chaney (2008) model. I expand this canonical model in various directions as follows. First, I introduce indirectly additive preferences and I obtain two novel results under the non-homothetic case, as highlighted above. Second, this exercise is challenging from a technical point of view since seeking generality raises tractability issues. The challenge consists in solving for trade margins in general equilibrium and deriving a gravity equation under a generic indirect sub-utility function which nests two possible natures of preferences (non-homothetic, and CES). In order to meet this technical challenge, I propose a method that I call *the Exponent Elasticity Method* (EEM, hereafter).[7] Beside allowing for a gain in generality without losing in tractability, another peculiar advantage of the EEM is that it generates bi-modal trade costs elasticities of trade margins which are constant under the CES, and variable under non-homotheticity. In other words, the constant or variable nature of these elasticities mirrors the homothetic or non-homothetic nature of consumer preferences.

Third, by implementing the EEM along with imposing the free entry condition, I derive an augmented version of the gravity equation in Chaney (2008) that features an income-decreasing fixed trade cost elasticity of bilateral trade flows. Moreover, the structural aspect of the gravity equation that I derive is reinforced as it exhibits both inward and outward multilateral resistances as in Anderson and Van Wincoop (2003). Using a wide range of non-CES preferences in a heterogeneous firms setting, Arkolakis et al. (2018) also derive a structural gravity equation, yet it only features the multilateral resistance term of the destination as in Chaney (2008). My paper is closely related to Bertoletti et al. (2018), but the gravity equation they derive is not structural. Another related paper in the literature is by Melitz and Ottaviano (2008) who derive a structural gravity equation where the toughness of competition in the destination is jointly determined by its market size and a measure of market access and comparative advantage. Instead, in this paper, the effects

[7] The definition of this method and more details on the necessary steps to implement it are provided in pages 11-14.

of per-capita income, population size and market access on trade margins are studied separately. In particular, the toughness of competition in the importing country and the exporter's ease of market access are solely captured by their respective multilateral resistance terms as in Anderson and Van Wincoop (2003).

Finally, I abstract from assuming that the nominal wage is pinned down exogenously by an outside sector. Instead, I treat it as an endogenous variable throughout the model and solve for it upon closing the model using the trade balance condition. As a result, the welfare analysis is simplified mainly in the absence of the home market effect and of positive net profits at equilibrium. Importantly, these simple amendments pave the way for two new sources of welfare gain, yet under a specific condition. Before proceeding, let us briefly review the existing literature on welfare gains from trade under monopolistic competition.

This line of research has long stressed that the source of the welfare gain is mainly determined by the nature of firms. For instance, while a homogeneous firm model generates only pure variety gains as in Krugman (1980), models with heterogeneous firms predict only gains from selection as in Melitz (2003). Despite the implicit loss of domestic varieties due to firm exit, which raises concerns regarding the net variation of consumed varieties, heterogeneous firms models have only emphasized the selection effect (Melitz, 2003; Melitz and Redding, 2015; Arkolakis et al., 2012, 2018). This question has been addressed by Feenstra (2010) who shows that the increase in the mass of imported varieties and the loss of domestic varieties cancel out when firm productivity is drawn from an unbounded Pareto distribution. Nevertheless, Bertoletti et al. (2018) highlight only pure variety gains as in Krugman (1980) despite firm heterogeneity. specifically, the selection effect is not operative in their model as they abstract from fixed costs and the choke price is orthogonal to the mass of competing firms under indirect additivity.

In this paper, I contribute to this recent literature on welfare gains from trade under firm heterogeneity along two lines. First, I show that in a global equilibrium with asymmetric countries, the source of the welfare gain from unilateral trade liberalization solely depends on the relative market size of the trading partner. Specifically, when the partner is relatively small, the liberalizing economy reaps only pure variety gains as in Krugman (1980) despite firm heterogeneity and the presence of fixed costs. However, only when the partner is relatively large, gains from selection as in Melitz (2003) arise, yet at the expense of a net variety loss. Second, under the latter case, I highlight two new sources of welfare gains from trade: (i) an additional gain from selection as in Melitz (2003), but occurring on the export market; (ii) an increase in nominal wage in the liberalizing economy.

The remainder of the paper is organized as follows. In Section 2, I spell out the model and derive five novel theoretical predictions. Section 3 presents the empirical analysis and tests the validity of the results obtained under non-homotheticity. Finally, Section 4 concludes.

2 Theoretical Framework

2.1 Set up of the model

Asymmetric countries.– Consider a World economy composed of N asymmetric countries that differ both in size and income levels. Let country i be populated by L_i identical agents, each supplying a unit of efficient labor. As each economy involves only one sector producing a differentiated good k, nominal wage w_i is endogenous and corresponds to both per-capita income and individual expenditure on horizontally differentiated varieties of good k. I solve for the nominal wage in general equilibrium upon closing the model using the trade balance condition.[8]

Consumer preferences.– I assume that consumer preferences are indirectly additive:

$$V = \int_{\omega \in \Omega} v(\frac{p_\omega}{w}) d\omega, \quad \text{with } v'(\frac{p_\omega}{w}) < 0 \text{ and } v''(\frac{p_\omega}{w}) > 0 \tag{1}$$

As stressed by Bertoletti and Etro (2016), a peculiar property of this family of preferences is that the price elasticity of demand corresponds to the elasticity of the marginal sub-utility and is thus given by $\sigma(\frac{p}{w}) = -\frac{v''(\frac{p}{w})\frac{p}{w}}{v'(\frac{p}{w})} > 1$. This implies that preferences are always non-homothetic, except under the CES case where the price elasticity of demand ceases to vary with the price-income ratio.[9] In order to shed light on the sensitivity of the theoretical predictions of the model to the nature of preferences (non-homothetic vs CES) and to test their empirical prevalence, I cover two possible cases. A general and realistic non-homothetic case where $\sigma(\frac{p}{w})$ is increasing in the price-income

[8] I purposely abstract from including an outside sector pinning down wages so that general equilibrium effect on wages is not ruled out. Moreover, this ensures the absence of the Home market effect (HME) and thus simplifies the welfare analysis.

[9] $v(\frac{p_\omega}{E}) = (\frac{p_\omega}{E})^{1-\sigma}, \sigma > 1$ is the constant elasticity of substitution.

ratio ($\frac{p}{w}$) and thus decreasing in income (w)[10], opposed to a the CES case where σ is exogenous. Following Bertoletti and Etro (2016), I define $\varsigma(\frac{p}{w}) = -\frac{v'''(\frac{p}{w})\frac{p}{w}}{v''(\frac{p}{w})}$ as a measure of demand curvature and I specify sufficient conditions for both cases to be covered :

$$\sigma'(\frac{p}{w}) = \begin{cases} > 0, & \text{if } \varsigma(\frac{p}{w}) < 1 + \sigma(\frac{p}{w}) \ (non-homothetic) \\ = 0, & \text{if } \varsigma(\frac{p}{w}) = 1 + \sigma(\frac{p}{w}) \ (homothetic : CES) \end{cases} \tag{2}$$

Identical Technology and Costly Trade.– In all countries, firm productivity φ is Pareto distributed over $[1, +\infty[$ with shape parameter θ: G($\varphi_0 < \varphi$) = 1 - $\varphi^{-\theta}$.[11]Any φ-productivity firm based in country i and aiming to serve country j must pay a fixed cost $w_i\ f_{ij}$ (where f_{ij} is measured in efficiency labor units and can be considered as a proxy for bilateral geographical distance) and a variable trade cost that takes the form of an iceberg transport cost $\tau_{ij} > 1$ (considered as a tariff equivalent).[12]

Individual demand and optimal pricing rule.– Using the Roy identity ($x = -\frac{\partial V}{\partial p} / \frac{\partial V}{\partial w}$), the individual demand a φ-productivity exporter from country i captures on destination j can be derived as follows:

$$x_{ij}(\varphi) = \frac{|v'(\frac{p_{ij}(\varphi)}{w_j})|}{|\eta_j|}, \tag{3}$$

where $|\eta_j|$ is the price aggregator in country j reflecting the toughness of competition on this market through the number of domestic and foreign firms competing on its market, as well as their average price competitiveness, as shown below:

[10]Notice that the price increases less than proportionally with destination's per-capita income as the markup decreases less than proportionally with σ. Moreover, only this case is covered as the other alternative (σ increasing in income) does not seem to be plausible and requires additional conditions to guarantee weak convexity and avoid thus issues related to the existence of the equilibrium.

[11]Notice that under the general non-homothetic case, $\sigma(\frac{p}{w})$ is increasing in price and thus firm-specific since firms are heterogeneous. As the cutoff exporter (serving destination j from origin i) is the least productive and charges the highest price, he faces relatively more elastic demand (than an average productivity exporter): $\sigma^*_{ij}(\frac{p^*_{ij}}{w_j}) > \tilde{\sigma}_{ij}(\frac{\tilde{p}_{ij}}{w_j})$. It is then sufficient to assume that θ - $(\sigma^*_{ij} - 1) \in]0, 1[\ \forall i, j$ to ensure that productivity distribution of firms has a finite mean. However, under the CES, only this standard assumption: $\theta > (\sigma - 1)$ is needed as σ is identical across firms.

[12]Notice that as domestic trade involves only a fixed cost f_{ii}, $\tau_{ii} = 1$.

$$|\eta_j| = |\sum_{i=1}^{N} M_i^e \int_{\varphi_{ij}^*}^{+\infty} \frac{p_{ij}(\varphi)}{w_j} v'(\frac{p_{ij}(\varphi)}{w_j}) dG(\varphi)| \tag{4}$$

where M_i^e is the endogenous mass of entrants[13] in origin i and $p_{ij}(\varphi)$ is the profit-maximizing export price charged by a φ-productivity exporter from origin i to consumers in destination j:

$$p_{ij}(\varphi) = \begin{cases} \frac{w_i \tau_{ij}}{\varphi} \frac{\sigma_{ij}(\frac{p_{ij}}{w_j})}{(\sigma_{ij}(\frac{p_{ij}}{w_j})-1)} & \text{general case: non-homothetic} \\ \frac{w_i \tau_{ij}}{\varphi} \frac{\sigma}{(\sigma-1)} & \text{homothetic exception: CES} \end{cases} \tag{5}$$

Incomplete pass-through and destination-specific pricing .– Denote by $\rho_1 = (z_1/p_{ij})\ (dp_{ij}/dz_1)$ the full elasticity of the export price p_{ij} with respect to its first argument z_1. By ranking nominal wage in the origin country w_i first, the advalorem tariff τ_{ij} second, nominal wage in the destination w_j third, and firm productivity φ fourth, I obtain the following elasticities :

$$\rho_1 = \rho_2 = |\rho_4| = \begin{cases} 1 + [\underbrace{\varepsilon_{\sigma(p_{ij}/w_j)}^{\sigma(p_{ij}/w_j)/(\sigma(p_{ij}/w_j)-1)}}_{<0} * \underbrace{\varepsilon_{p_{ij}}^{\sigma(p_{ij}/w_j)}}_{>0}] < 1 & \text{general case: non-homothetic} \\ 1 \text{ since } \sigma \perp p_{ij} & \text{homothetic exception: CES} \end{cases} \tag{6}$$

$$\rho_3 = \begin{cases} [\underbrace{\varepsilon_{\sigma(p_{ij}/w_j)}^{\sigma(p_{ij}/w_j)/(\sigma(p_{ij}/w_j)-1)}}_{<0} * \underbrace{\varepsilon_{w_j}^{\sigma(p_{ij}/w_j)}}_{<0}] \in]0,1[& \text{general case: non-homothetic} \\ 0 \text{ since } \sigma \perp w_j & \text{homothetic exception: CES} \end{cases} \tag{7}$$

Notice that a variation in domestic labor efficiency (w_i), bilateral tariff (τ_{ij}) or firm productivity (φ) is passed on to the final consumer with the same magnitude. This is straightforward implication of the fact that these three arguments enter the marginal cost in a proportionate multiplicative way. In

[13] I solve for it using using the free entry and the labor market clearing conditions as shown below. Importantly, I impose the free entry condition for two reasons. First, to obtain an augmented version of Chaney (2008)'s gravity equation, which additionally features the remoteness index of the origin country. Second, to simplify the welfare analysis as it guarantees zero net profits at equilibrium and restricts thus the potential welfare gains to the consumer side.

line with previous literature (Simonovska, 2015; Bertoletti and Etro, 2016; Bertoletti et al., 2018), non-homotheticity implies incomplete pass-through and higher export prices for richer destinations. By contrast, under the CES case, the pass-through becomes complete and the price ceases to vary with per-capita income of the destination market simply because σ is no longer endogenous. As documented by Bertoletti et al. (2018), the incompleteness of the pass-through generates smaller welfare gains from trade simply because tariff reduction is not fully passed on to consumers. Using a wide range of non-CES preferences, Arkolakis et al. (2018) obtain a similar result. Yet, what is at stake in the current model is the extent to which the nature of preferences determines the magnitude of the income and size[14] effects on trade margins, as well as the nature of the elasticity of these latter with respect to trade costs.

Now let us recall that the mass of entrants M_i^e -in any origin i- in the price aggregator (equation (4)) is endogenous. Using using the free entry and the labor market clearing conditions, I solve for it as follows :

The free entry condition states that in any country (say, i), average expected profits by entrant, conditional on successful entry, must equate the sunk cost of entry and is given by :

$$P(\varphi \geq \varphi_{ii}^*)\,[\int_{\varphi_{ii}^*}^{+\infty} \pi_{ii}(\varphi)\frac{g(\varphi)}{P(\varphi \geq \varphi_{ii}^*)}d\varphi + \sum_{j=1}^{(N-1)} P_{ij}\int_{\varphi_{ij}^*}^{+\infty} \pi_{ij}(\varphi)\frac{g(\varphi)}{P(\varphi \geq \varphi_{ij}^*)}d\varphi\,] = w_i F_e, \qquad (8)$$

where $P_{ij} = \frac{P(\varphi \geq \varphi_{ij}^*)}{P(\varphi \geq \varphi_{ii}^*)}$ is the probability of exporting from country i to country j as in ?. Domestic profits and revenues are, respectively, given by $\pi_{ii}(\varphi) = \frac{r_{ii}(\varphi)}{\sigma_{ii}(wi)} - w_i f_{ii}$, with $r_{ii}(\varphi) = p_{ii}(\varphi)x_{ii}(\varphi)L_i$, $\forall \varphi \geq \varphi_{ii}^*$. Likewise, export profits and revenues can be written as $\pi_{ij}(\varphi) = \frac{r_{ij}(\varphi)}{\sigma_{ij}(wj)} - w_i f_{ij}$, $r_{ij}(\varphi) = p_{ij}(\varphi)x_{ij}(\varphi)L_j\ \forall \varphi \geq \varphi_{ij}^*$, with the pricing rule $p_{ij}(\varphi)$ and individual demand $x_{ij}(\varphi)$ are respectively defined in equations (5) and (3).[15]

Using the Lerner index and rearranging, the free entry condition boils down to :

[14] To be precise, they respectively refer to per-capita income and population size.

[15] The expression of the operating profit $\pi_{ii}^o(\varphi) = \frac{r_{ii}(\varphi)}{\sigma_{ii}(wi)}$ is obtained using the Lerner index: $\frac{p_{ii}(\varphi)-(w_i/\varphi)}{p_{ii}(\varphi)} = \frac{1}{\sigma_{ii}(wi)}$. Importantly, notice that for a seek of generality, I always assume non-homotheticity and consider the CES as a homothetic exception. As a result, the price elasticity of demand faced by φ-productivity exporter from origin i on market j is expressed as a function of nominal wage in the destination w_j, not only for expositional simplicity, but also to put an emphasis on its destination specific aspect. The firm (φ)/origin(w_i) and dyad(τ_{ij})- specific aspects of σ are recalled and put in use only when needed. The same choice of terminology applies to domestic firms facing $\sigma_{ii}(w_i)$ on the domestic market.

$$\tilde{R}_i = \tilde{\sigma}_i^{\varpi}(\tilde{w})[w_i F_e + P(\varphi \geq \varphi_{ii}^*)w_i f_{ii} + \sum_{j=1}^{(N-1)} P(\varphi \geq \varphi_{ij}^*)w_i f_{ij}] \tag{9}$$

where $\tilde{R}_i = \int_{\varphi_{ii}^*}^{+\infty} r_{ii}(\varphi)g(\varphi)d\varphi + \sum_{j=1}^{(N-1)} \int_{\varphi_{ij}^*}^{+\infty} r_{ij}(\varphi)g(\varphi)d\varphi$ stands for the expected average revenues of successful entrants in country i, and $\tilde{\sigma}_i^{\varpi}(\tilde{w}) = \sum_{j=1}^{N}(\frac{w_j L_j}{Y_{\varpi}})\tilde{\sigma}_{ij}(w_j)$ is the weighted average price elasticity of demand that a firm from origin i expects to face while serving the world market. Notice that $\tilde{\sigma}_{ij}(w_j) = \int_{\varphi_{ij}^*}^{+\infty} \sigma_{ij}(\frac{p_{ij}(\varphi)}{w_j})g(\varphi)d\varphi$ is the expected price elasticity of demand to be faced by an average productivity exporter serving destination j from origin i. It is also worth mentioning that $Y_{\varpi} = \sum_{j=1}^{N} w_j L_j = \tilde{w} L_{\varpi}$ is the World GDP, with $\tilde{w}$ is the average per-capita income at the World level and $L_{\varpi} = \sum_{j=1}^{N} L_j$ is the World population.

The labor market clearing condition requires that total labor demand by entrants equates a country's labor endowment. While all entering firms (both successful and unsuccessful) incur the sunk entry cost F_e, only successful entrants use labor to start producing. In particular, labor demand by a φ-productivity successful entrant $ld(\varphi)$ depends on its export status:

$$ld(\varphi) = \begin{cases} [(q_{ii}(\varphi) * \varphi^{-1}) + f_{ii}], & \text{if } \varphi \geq \varphi_{ii}^* \\ [(q_{ij}(\varphi) * \tau_{ij}\varphi^{-1}) + f_{ij}], & \text{if } \varphi \geq \varphi_{ij}^* \end{cases} \tag{10}$$

where $q_{ii}(\varphi) = x_{ii}(\varphi)L_i$ is the market demand captured by φ-productivity firm on the domestic market. Likewise, $q_{ij}(\varphi) = x_{ij}(\varphi)L_j$ is the market demand a φ-productivity exporter reaps on destination j. Using the optimal pricing rule from equation (5), the labor demand per firm can be rewritten as follows:

$$ld(\varphi) = \begin{cases} [w_i^{-1}(\frac{\sigma_{ii}(w_i)-1}{\sigma_{ii}(w_i)})r_{ii}(\varphi) + f_{ii}], & \text{if } \varphi \geq \varphi_{ii}^* \\ [w_i^{-1}(\frac{\sigma_{ij}(w_j)-1}{\sigma_{ij}(w_j)})r_{ij}(\varphi) + f_{ij}], & \text{if } \varphi \geq \varphi_{ij}^* \end{cases} \tag{11}$$

Using firm labor demand from equation (11), the labor market clearing condition can be simplified and written as :

$$L_i = M_i^e\,[\,(F_e + P(\varphi \geq \varphi_{ii}^*)f_{ii} + \sum_{j=1}^{(N-1)} P(\varphi \geq \varphi_{ij}^*)f_{ij})\;+\;w_i^{-1}\mu(\tilde{\sigma}_i^{\varpi})\tilde{R}_i\,], \tag{12}$$

where $\mu(\tilde{\sigma}_i^{\varpi}) = \frac{\tilde{\sigma}_i^{\varpi}(\tilde{w})-1}{\tilde{\sigma}_i^{\varpi}(\tilde{w})}$ is the inverse of the markup that a successful entrant in i would charge while serving the World market. [16]

By plugging the expected average revenues of successful entrants in i from the free entry condition in equation (9) into the labor market condition in equation (12) and rearranging, I obtain the mass of entrants in origin i :

$$M_i^e = \frac{w_i L_i}{\tilde{\sigma}_i^{\varpi}(\tilde{w})\Psi_i} \tag{13}$$

As assumed by Chaney (2008), the mass of entrants is proportional to market size. Moreover, M_i^e decreases proportionally with the average level of price sensitivity at the World level $\sigma_i^{\varpi}(\tilde{w})$, and importantly with $\Psi_i = [w_i F_e + P(\varphi \geq \varphi_{ii}^*)w_i f_{ii} + \sum_{j=1}^{(N-1)} P(\varphi \geq \varphi_{ij}^*)w_i f_{ij}]$ which reflects the degree of remoteness of origin i from all potential destination markets in the World economy.

Using the above expression of the mass of entrants, the price aggregator in (4) can be rewritten as follows:

$$|\eta_j| = (w_j L_j)(\frac{w_j L_j}{Y_{\varpi}})^{-1} \sum_{i=1}^{N} c_i^E (\frac{w_i L_i}{Y_{\varpi}}) f_{ij}^{-1} \int_{\varphi_{ij}^*}^{+\infty} \frac{p_{ij}(\varphi)}{w_j} |v'(\frac{p_{ij}(\varphi)}{w_j})| dG(\varphi) \tag{14}$$

where c_i^E is a proxy for entry conditions in i and is given by:

$$c_i^E = [\sigma_i^{\varpi}(\tilde{w}) w_i (\alpha_e + \alpha_{ii} P(\varphi \geq \varphi_{ii}^*) + P(\varphi \geq \varphi_{ij}^*) + \sum_{j=1}^{(N-2)} \alpha_{ik} P(\varphi \geq \varphi_{ij}^*))]^{-1}\,; \tag{15}$$

where $\alpha_e = \frac{F_e}{f_{ij}}$; $\alpha_{ii} = \frac{f_{ii}}{f_{ij}}$ and $\alpha_{ik} = \frac{f_{ik}}{f_{ij}}$.

[16] Notice that μ boils down to $(\sigma - 1/\sigma)$ under the CES since σ is exogenous.

In order to obtain general results, I do not specify a functional form for the sub-utility of a variety $v(\frac{p_\omega}{w})$.[17] This choice is costly both in terms of feasibility and tractability as the integral $\mathbf{I}= \int_{\varphi_{ij}^*}^{+\infty} \frac{p_{ij}(\varphi)}{w_j}|v'(\frac{p_{ij}(\varphi)}{w_j})|dG(\varphi)$ is solvable only under the CES. In order to overcome this mathematical barrier, I follow a two-steps procedure. First, I recall that firm productivity is Pareto distributed and exploit its peculiar property of *constant mean-to-min ratio* to rewrite the integral **I** as follows:

$$\mathbf{I} = (\varphi_{ij}^*)^{-\theta}\tilde{\vartheta}(\tilde{\varphi}_{ij}), \;\; with \;\; \tilde{\vartheta}(\tilde{\varphi}_{ij}) = \frac{\tilde{p}_{ij}(\tilde{\varphi}_{ij})}{w_j}|v'(\frac{\tilde{p}_{ij}(\tilde{\varphi}_{ij})}{w_j})| \;\; and \;\; \tilde{\varphi}_{ij} = \frac{\theta}{\theta-1}\varphi_{ij}^* \tag{16}$$

Second, I propose a simple and intuitive method that I call the "Exponent Elasticity Method" (EEM, hereafter). Using this method, a multiplicative equivalent of the integral **I**, modulo a constant κ, can be obtained as follows:

$$\mathbf{I} \equiv \tilde{\Phi}_{ij}[w_i; \tau_{ij}; w_j; \varphi_{ij}^*(w_i, \tau_{ij}, w_j, f_{ij}, L_j, |\eta_j|)] \equiv \kappa \; w_i^{\epsilon_1^F} \tau_{ij}^{\epsilon_2^F} w_j^{\epsilon_3^F} f_{ij}^{\epsilon_5^F} L_j^{\epsilon_6^F} |\eta_j|^{\epsilon_7^F}, \tag{17}$$

The $\tilde{\Phi}_{ij}[.]$ function captures the expected average capacity of exporters from i to penetrate market j depending on the cost of labor in the origin (w_i), variable and fixed barriers to bilateral trade (τ_{ij}, f_{ij}) and destination j's characteristics (w_j, L_j, $|\eta_j|$). It is also worth mentioning that the $\varphi_{ij}^*(.)$ function corresponds to the implicit expression of the export productivity cutoff (to serve j from i) in partial equilibrium. This implicit export cutoff function stems from the zero export profit condition which is given by:

$$\varphi_{ij}^*: \quad [p_{ij}^*(\varphi_{ij}^*) - w_i\tau_{ij}(\varphi_{ij}^*)^{-1}]\frac{|v'(\frac{p_{ij}^*(\varphi_{ij}^*)}{w_j})|}{|\eta_j|}L_j - w_i f_{ij} = 0 \tag{18}$$

As its name suggests, the EEM has a peculiar property: *the exponent of an argument embodies the elasticity of the function with respect to the argument at question.* Importantly, as one of the arguments of the $\tilde{\Phi}_{ij}[.]$ function is endogenous[18] (the export cutoff $\varphi_{ij}^*(.)$), the exponent $\epsilon_{\#}^F$ of an argument (ranked #)[19] in (17) contains the **full** elasticity of $\tilde{\Phi}_{ij}[.]$ with respect to the argument

[17]Under the CES case, the sub-utility function is given by $v(\frac{p_\omega}{w}) = (\frac{p_\omega}{w})^{1-\sigma}$

[18]nominal wage is also endogenous, but I take it as given until I close the model and solve for it using the trade balance condition.

[19]w_i is ranked first , τ_{ij} second, w_j third, φ_{ij}^* fourth, f_{ij} fifth, L_j sixth and $|\eta_j|$ seventh.

at question. Specifically, this elasticity corresponds to *the sum of the direct effect of the argument (on the "pure" intensive margin)*[20] *and its indirect effect, channeled through the export cutoff(the extensive margin).* and can be written as:

$$\epsilon^F_{\#} = \underbrace{\tilde{\epsilon}_{\#}}_{intensive} + \underbrace{\epsilon_4 * \epsilon_{4\#}}_{extensive} = \begin{cases} \epsilon^F_1 = \tilde{\epsilon}_1 + \epsilon_4 * \epsilon_{41} \\ \epsilon^F_2 = \tilde{\epsilon}_2 + \epsilon_4 * \epsilon_{42} \\ \epsilon^F_3 = \tilde{\epsilon}_3 + \epsilon_4 * \epsilon_{43} \\ \epsilon^F_5 = 0 + \epsilon_4 * \epsilon_{45} \\ \epsilon^F_6 = 0 + \epsilon_4 * \epsilon_{46} \\ \epsilon^F_7 = 0 + \epsilon_4 * \epsilon_{47}, \end{cases} \tag{19}$$

where $\tilde{\epsilon}_1 = \varepsilon^{\tilde{\vartheta}}_{w_i}$, $\tilde{\epsilon}_2 = \varepsilon^{\tilde{\vartheta}}_{\tau_{ij}}$, $\tilde{\epsilon}_3 = \varepsilon^{\tilde{\vartheta}}_{w_j}$ [21], $\epsilon_4 = \varepsilon^{\tilde{\Phi}_{ij}}_{\varphi^*_{ij}} = -\theta + \tilde{\epsilon}_4 = -\theta + \varepsilon^{\tilde{\vartheta}}_{\varphi^*_{ij}}$.[22] Moreover, The set $(\epsilon_{41}, ..., \epsilon_{47})$ contains the elasticity of the export cutoff φ^*_{ij} with respect to each of its determinants in partial equilibrium, with $\epsilon_{41} = \varepsilon^{\varphi^*_{ij}}_{w_i}$, $\epsilon_{42} = \varepsilon^{\varphi^*_{ij}}_{\tau_{ij}}$, $\epsilon_{43} = \varepsilon^{\varphi^*_{ij}}_{w_j}$, $\epsilon_{45} = \varepsilon^{\varphi^*_{ij}}_{f_{ij}}$, $\epsilon_{46} = \varepsilon^{\varphi^*_{ij}}_{L_j}$ and $\epsilon_{47} = \varepsilon^{\varphi^*_{ij}}_{|\eta_j|}$.

By recalling that under indirect additivity, the price elasticity of demand inherits the properties of the marginal sub-utility and using the pass-through defined in equations (6) and (7), the first set of elasticities $S'(\tilde{\epsilon}_1, \tilde{\epsilon}_2, \tilde{\epsilon}_3, \tilde{\epsilon}_4)$ can be written more explicitly as follows:[23]

$$S' = \{\tilde{\epsilon}_1 = \tilde{\rho}_1(1 - \tilde{\sigma}_{ij}(w_j));\ \tilde{\epsilon}_2 = \tilde{\rho}_2(1 - \tilde{\sigma}_{ij}(w_j));\ \ \tilde{\epsilon}_3 = (1 - \tilde{\rho}_3)(\tilde{\sigma}_{ij}(w_j) - 1);\ \tilde{\epsilon}_4 = |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j) - 1)\} \tag{20}$$

In order to compute the second set of elasticities $S''(\epsilon_{41}, ..., \epsilon_{47})$ while keeping the functional form of sub-utility unspecified, I apply the EEM to the implicit export cutoff function in (18) and obtain the following explicit equivalent:

[20] Only price determinants such as w_i, τ_{ij} and w_j(beyond the CES case) have such an impact on the absolute price competitiveness of any single exporter. Noticeably, this latter remains orthogonal to the population size of the destination L_j simply because population size has no impact on consumer preferences under indirect additivity: $\sigma_{ij}(w_j) \perp L_j$, as highlighted by Bertoletti et al. (2018)

[21] Notice that these elasticities are partial as they do not take into account the indirect effect channeled through the export cutoff. This latter is captured by the "extensive" component of the full elasticity as indicated in (19).

[22] Notice that in $\tilde{\epsilon}_4$), it is the average productivity exporter that is at question (and not the cutoff productivity exporter) as $\tilde{\vartheta}(\tilde{\varphi}_{ij})$ and $\tilde{\varphi}_{ij} = \frac{\theta}{\theta-1}\varphi^*_{ij}$.

[23] Recall that under the general non-homothetic case, the price elasticity of demand is firm-specific (and thus the pass-through as well). $\tilde{\sigma}_{ij}(w_j)$ refers then to the price elasticity of demand faced by an average productivity exporter from origin i while serving destination j.

$$\varphi_{ij}^* \equiv \kappa_1 \, w_i^{\frac{(1-\epsilon_1^*)}{\epsilon_4^*}} \, \tau_{ij}^{-\frac{\epsilon_2^*}{\epsilon_4^*}} \, w_j^{-\frac{(\epsilon_3^*+1+\delta^*)}{\epsilon_4^*}} \, f_{ij}^{\frac{1}{\epsilon_4^*}} \, L_j^{-\frac{1}{\epsilon_4^*}} \, |\eta_j|^{\frac{1}{\epsilon_4^*}}, \tag{21}$$

where $\epsilon_1^* = \varepsilon_{w_i}^{\vartheta_{ij}^*}$, $\epsilon_2^* = \varepsilon_{\tau_{ij}}^{\vartheta_{ij}^*}$, $\epsilon_3^* = \varepsilon_{w_j}^{\vartheta_{ij}^*}$ $\epsilon_4^* = \varepsilon_{\varphi_{ij}^*}^{\vartheta_{ij}^*}$, δ^* = - $\varepsilon_{w_j}^{\sigma_{ij}^*}$ and $\vartheta_{ij}^*(\varphi_{ij}^*) = \frac{p_{ij}^*(\varphi_{ij}^*)}{w_j}|v'(\frac{p_{ij}^*(\varphi_{ij}^*)}{w_j})|$.[24]

Similarly, firm-level export revenues in partial equilibrium can be written more explicitly using the EEM:

$$r_{ij}(\varphi) \equiv \kappa_2 \, w_i^{\epsilon_1} \, \tau_{ij}^{\epsilon_2} \, w_j^{(\epsilon_3+1)} \, \varphi^{\epsilon_4} \, L_j \, |\eta_j|^{-1}, \tag{22}$$

where $(\epsilon_1, \epsilon_2, \epsilon_3, \epsilon_4)$ are defined in (20), but need to be applied to the case of a random φ-productivity successful exporter $\varphi > \varphi_{ij}^*$ as the price elasticity of demand is firm-specific under the general non-homothetic case.[25] Moreover, the elasticities regrouped in the second set $S''(\epsilon_{41}, ..., \epsilon_{47})$ can be now explicitly written as follows:

$$S'' = \begin{cases} \epsilon_{41} = \varepsilon_{w_i}^{\varphi_{ij}^*} = \frac{(1-\epsilon_1^*)}{\epsilon_4^*} = \frac{[1-\rho_1^*(1-\sigma_{ij}^*(w_j))]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} \\ \epsilon_{42} = \varepsilon_{\tau_{ij}}^{\varphi_{ij}^*} = -\frac{\epsilon_2^*}{\epsilon_4^*} = 1 \\ \epsilon_{43} = \varepsilon_{w_j}^{\varphi_{ij}^*} = -\frac{(\epsilon_3^*+1+\delta^*)}{\epsilon_4^*} = -\frac{[(1-\rho_3^*)(\sigma_{ij}^*(w_j)-1)+1+\delta^*]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} \\ \epsilon_{45} = \varepsilon_{f_{ij}}^{\varphi_{ij}^*} = \frac{1}{\epsilon_4^*} = \frac{1}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} \\ \epsilon_{46} = \varepsilon_{L_j}^{\varphi_{ij}^*} = -\frac{1}{\epsilon_4^*} = -\frac{1}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} \\ \epsilon_{47} = \varepsilon_{|\eta_j|}^{\varphi_{ij}^*} = \frac{1}{\epsilon_4^*} = \frac{1}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} \end{cases} \tag{23}$$

Using the explicit expressions of the above elasticities included in S' and S" (from (20) and (23)), I obtain the final set of full elasticities $S^F(\epsilon_1^F, ..., \epsilon_7^F)$:

[24] Likewise, the superscript (*) indicates that the cutoff productivity exporter is at question.

[25] Recall that the CES case stands as an exception where σ is exogenous and thus identical across firms.

$$S^F = \begin{cases} \epsilon_1^F = \tilde{\rho}_1(1-\tilde{\sigma}_{ij}(w_j)) + [\,[|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)-\theta]\,\frac{[1-\rho_1^*(1-\sigma_{ij}^*(w_j))]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)}\,] < 0 \\ \epsilon_2^F = \tilde{\rho}_2(\,1-\tilde{\sigma}_{ij}(w_j)\,) + [\,|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)-\theta\,] = -\theta < 0 \\ \epsilon_3^F = (1-\tilde{\rho}_3)(\,\tilde{\sigma}_{ij}(w_j)-1\,) + [\,[\,\theta-|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)\,]\,\frac{[(1-\rho_3^*)(\sigma_{ij}^*(w_j)-1)+1+\delta^*]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)}\,] > 1 \\ \epsilon_5^F = -\frac{[\,\theta-|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)\,]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} < 0 \\ \epsilon_6^F = \frac{[\,\theta-|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)\,]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} > 0 \\ \epsilon_7^F = -\frac{[\,\theta-|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)\,]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} < 0 \end{cases} \tag{24}$$

It is worth mentioning that the implementation of the EEM allows for a substantial gain in tractability while preserving the general aspect of preferences. Importantly, it enables me to solve for the general equilibrium incrementally.

General Equilibrium.– I start with solving respectively for the general equilibrium price aggregator by plugging the the integral (**I**) equivalent[26] from equation (17) into the price aggregator from equation (14):

$$|\eta_j| = \kappa_3 \;\; w_j^{(\frac{1+\epsilon_3^F}{1-\epsilon_7^F})} \;\; L_j^{(\frac{1+\epsilon_3^F}{1-\epsilon_7^F})} \;\; (\frac{w_j L_j}{Y_w})^{\frac{1}{(\epsilon_7^F-1)}} \;\; \Psi_j^{\frac{1}{(\epsilon_7^F-1)}}, \tag{25}$$

where $\Psi_j = [\sum_{i=1}^N (\frac{w_i L_i}{Y_w}) f_{ij}^{(\epsilon_5^F-1)} \tau_{ij}^{\epsilon_2^F} w_i^{\epsilon_1^F}]^{-1}$ is a reminiscent of the inward multilateral resistance term in Anderson and Van Wincoop (2003). For instance, this index reflects how far is destination j from the rest of the world. Importantly, as shown in the general equilibrium price indices above, $|\eta_j|$ is decreasing in Ψ_j.[27] This implies that the more remote is a destination, the fewer are the firms serving it and thus the more relaxed is competition on its market.[28]

[26]Recall that this corresponds to the penetration capacity function $\tilde{\Phi}_{ij}[.]$

[27]Since $\epsilon_7^F < 0$, as indicated in (24)

[28]Regardless of the nature of preferences, a straightforward implication of Pareto distribution is that a tariff variation affects only the extensive margin, while the intensive margin remains silent. As a result, the toughness of competition is characterized solely with the number of competing firms, while the average price level is not taken into account.

2.2 Income vs Size effects on trade margins in general equilibrium[29]

The intensive margin of trade

I start with plugging the general equilibrium price index from equation (25) into the firm-level export revenues from equation (22). Using the EEM[30] and rearranging, I can solve for the intensive margin in general equilibrium as follows:[31]

$$r_{ij}(\varphi) \equiv \kappa_4 \; w_i^{\epsilon_1} \; \tau_{ij}^{\epsilon_2} \; \varphi^{\epsilon_4} \; w_j^{\zeta-1} \; \underbrace{(\frac{w_j L_j}{Y_w})^{\frac{1}{(1-\epsilon_7^F)}} \; \Psi_j^{\frac{1}{(1-\epsilon_7^F)}}}_{Chaney(2008)}, \tag{26}$$

where $\zeta = 1 + [\,(1+\epsilon_3) - (\frac{1+\epsilon_3^F}{1-\epsilon_7^F})\,]$ captures the gross positive income effect on firm-level export revenues. It is easy to notice that the remoteness of the destination Ψ_j and its relative market size, (RMS, hereafter), $(\frac{w_j L_j}{Y_w})$ both affect positively the intensive margin and with the same magnitude. These two channels, already highlighted in Chaney (2008), are put aside for two reasons. First, in order to disentangle the different channels through which income and size affect separately the intensive margin. Second, because it makes it easier to highlight the implications of non-homotheticity and thus to compare the results with the Chaney (2008) benchmark.

Size effect.– The general equilibrium expression of the intensive margin in (26) clearly indicates that the RMS is the unique channel through which population size (L_j) can affect firm-level export revenues. For instance, it is readily verified that a population size enlargement implies larger market demand- a proportional increase in the number of consumers-, but also, tougher competition - a proportional increase in the mass of domestic competitors.[32] Given their identical magnitude, these two opposite effects always cancel out regardless of the nature of preferences.

Income effect.– Contrary to population size, the magnitude of the income effect and the channels through which it affects the intensive margin crucially depend on the nature of preferences:[33]

[29] To avoid confusion, "income" refers to per-capita income (w_j), "size" to population size (L_j) and "market size" to their scalar ($w_j L_j$).

[30] It greatly simplifies the analysis of the income effect by allowing ζ to capture the gross positive income effect

[31] I purposely abstract from simplifying the expression below to disentangle the different channels through which income and size affect the intensive margin in general equilibrium.

[32] Recall that the mass of domestic entrants is proportional to market size as indicated in equation (13).

[33] See Appendix A.1 for a detailed proof.

$$\zeta = \begin{cases} > 1 & \text{if preferences are non-homothetic} \\ 1 & \textit{otherwise} \end{cases} \tag{27}$$

When preferences are CES, σ is exogenous and demand is iso-elastic, the gross positive income effect boils down to a proportional increase in individual demand (ζ equates unity, as indicated above). This positive impact on individual demand is then ruled out by a proportional increase in the mass of domestic competitors. Put differently, as the homothetic aspect of the CES implies that consumer preferences are unaffected by per-capita income, this latter acts only as a size parameter. As a result, the Chaney (2008) result is replicated, as the RMS stands as the unique channel through which income and size would have a positive and identical impact on the intensive margin.

By contrast, when preferences are non-homothetic, the price elasticity of demand is decreasing in income ($\sigma_j'(w_j) < 0$), any φ-productivity exporter charges then a higher markup to richer destinations where consumers are less price sensitive. In spite of charging higher prices, the exporting firm reaps larger individual demand for two reasons. First, as the export price increases less than proportionally with the destination's income level ($\rho_3 < 1$, $\forall \varphi$), the exported variety provides the consumer with a higher level of marginal sub-utility. This, in turn, increases individual demand for this variety. Second, and importantly, these two partial equilibrium effects (higher price and larger individual demand) prevail in general equilibrium as they dominate the total income effect on export revenues of all other active exporters (intensive) as well as infra-marginal ones (extensive).[34] Therefore, the gross positive income effect is more than proportional ($\zeta > 1$) and dominates thus the negative competition effect (-1), yielding thus a net positive income effect:

$$\zeta_n = \zeta - 1 \begin{cases} > 0 & \text{if preferences are non-homothetic} \\ = 0 & \textit{otherwise} \end{cases} \tag{28}$$

[34] See Appendix A.1 for a detailed decomposition of the income effect in general equilibrium.

The extensive margin of trade

Now by plugging the general equilibrium price index from equation (25) into the export cutoff from equation (21), I can solve for the extensive margin in general equilibrium as follows:

$$\varphi^*_{ij} \equiv \kappa_5 \; w_i^{(\frac{1-\epsilon^*_1}{\epsilon^*_4})} \; \tau_{ij} \; f_{ij}^{\frac{1}{\epsilon^*_4}} \; w_j^{\Delta_5} \; L_j^{\Delta_6} \; \underbrace{(\frac{w_j L_j}{Y_w})^{\frac{1}{\epsilon^*_4(\epsilon^F_7 - 1)}} \; \Psi_j^{\frac{1}{\epsilon^*_4(\epsilon^F_7 - 1)}}}_{Chaney(2008)}, \tag{29}$$

where $\Delta_5 = \frac{1}{\epsilon^*_4} \, [\, (\frac{1+\epsilon^F_3}{1-\epsilon^F_7}) - (\epsilon^*_3 + 1 + \delta^*) \,]$ and $\Delta_6 = \frac{1}{\epsilon^*_4} \, [\, (\frac{1+\epsilon^F_6}{1-\epsilon^F_7}) - 1 \,]$.

Size effect.– Regardless of the nature of preferences, it is readily verified that the unique channel through which population size L_j could affect the toughness of firm selection into exporting is the RMS as highlighted in Chaney (2008). For instance, since $\epsilon^F_6 = |\epsilon^F_7|$, Δ_6 collapses always to zero whether preferences are CES or non-homothetic.

Income effect.– Contrary to population size, per-capita income can affect the extensive margin through an additional channel conditionally on non-homotheticity. Specifically, when preferences are non-homothetic, the price elasticity of demand is increasing in price and decreasing in income, which implies that $\Delta_5 < 0$.[35] A new "preference" channel arises then: *an increase in per-capita income makes selection into exporting less tough as infra-marginal exporters face henceforth a less elastic demand (as consumers become less price sensitive once they get richer).*
Nevertheless, under the CES case, σ is identical across firms, Δ_5 collapses to zero and the new "preference" channel is shut down. As a result, per-capita income and population size act again interchangeably as size parameters. Their impact on the extensive margin is solely channeled through the RMS ($\Delta_5 = \Delta_6 = 0$). The Chaney (2008) result is thus replicated.

$$\Delta_5 \begin{cases} < 0 & \text{if preferences are non-homothetic} \\ = 0 & \textit{otherwise} \end{cases} \tag{30}$$

[35] See Appendix A.2 for a detailed proof.

2.3 Generalized Structural Gravity and Trade Elasticity

In this section, I derive a generalized structural gravity equation[36] and I shed light on the extent to which the nature of preferences affects the sensitivity of trade flows to variations in trade barriers. Bilateral exports from origin i to destination j are given by:

$$X_{ij} = M_i^e \int_{\varphi_{ij}^*}^{+\infty} r_{ij}(\varphi) g(\varphi) d\varphi \tag{31}$$

Using individual demand from equation (3), the equilibrium mass of entrants in (13) and rearranging, bilateral exports can be rewritten as:

$$X_{ij} = [\tilde{\sigma}_i^{\varpi}(\tilde{w})]^{-1} \; \frac{w_i L_i}{\Psi_i} \; \frac{w_j L_j}{|\eta_j|} \; \underbrace{\int_{\varphi_{ij}^*}^{+\infty} \frac{p_{ij}(\varphi)}{w_j} |v'(\frac{p_{ij}(\varphi)}{w_j})| g(\varphi) d\varphi}_{\tilde{\Phi}_{ij}[.]}, \tag{32}$$

where $\sigma_i^{\varpi}(\tilde{w})$ is the average price elasticity of demand at the World level and Ψ_i measures the degree of remoteness of origin i from all potential destination markets in the World economy.[37] Noticeably, a straightforward implication of the free entry condition is that it allows the average degree of price sensitivity at the world level $\sigma_i^{\varpi}(\tilde{w})$ and remoteness from destination markets Ψ_i to have a deterrent impact on entry in any origin i. Moreover, as mentioned in the above equation, the integral is equivalent to the penetration capacity function $\tilde{\Phi}_{ij}[.]$. Hence, using its explicit expression from equation (17) and then by plugging the general equilibrium price index from (25) in the bilateral trade equation above, I obtain a *generalized structural gravity equation* as follows:

$$X_{ij} = \kappa_6 \; [\tilde{\sigma}_i^{\varpi}(\tilde{w})]^{-1} \; \frac{Y_i Y_j}{Y_{\varpi}} \; \frac{\Psi_j}{\Psi_i} \; w_i^{\epsilon_1^F} \; \tau_{ij}^{\epsilon_2^F} \; f_{ij}^{\epsilon_5^F}, \tag{33}$$

where $\epsilon_1^F = \tilde{\rho}_1(\, 1 - \tilde{\sigma}_{ij}(w_j)\,) + [\; [\, |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j) - 1) - \theta\,] \; \frac{[1-\rho_1^*(1-\sigma_{ij}^*(w_j))]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} \;\;] < 0,$

[36] For sake of generality, preferences are assumed to be indirectly additive. This family encompasses two possible natures of preferences: non-homothetic (the general case) and CES which stands as a homothetic exception.

[37] $\Psi_i = [w_i F_e + P(\varphi \geq \varphi_{ii}^*) w_i f_{ii} + \sum_{j=1}^{(N-1)} P(\varphi \geq \varphi_{ij}^*) w_i f_{ij}]$, as indicated in equation (13)

$$\epsilon_2^F = \tilde{\rho}_2(\ 1 - \tilde{\sigma}_{ij}(w_j)\ ) + [\ |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j) - 1) - \theta\ ] = -\theta < 0 \text{ and } \epsilon_5^F = -\frac{[\ \theta - |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)\ ]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} < 0.$$

This generalized structural gravity equation can be considered as an augmented version of Chaney (2008)'s gravity equation in three respects. Firstly, its structural aspect is reinforced since it exhibits, not only the inward multilateral resistance term (Ψ_j measures the easiness of penetrating destination j), but also the outward multilateral resistance term (Ψ_i captures the toughness of exporting from origin i) as in Anderson and Van Wincoop (2003). These multilateral resistance terms have opposite effects on bilateral trade and affect it through different margins. While the positive impact of the former Ψ_j occurs at both margins (extensive and intensive)[38] as in Chaney (2008), the negative impact of the latter Ψ_i occurs only at the extensive margin. This effect is absent in the Chaney (2008) model since the free entry condition is not imposed and can be explained as follows: *the more remote is an origin i from destination markets (mainly due to its geographical location which entails higher fixed costs of exporting: high f_{ij} $\forall$ j),*[39] *the lower are expected export profits, the fewer are entrants and thus exporters.*[40]

Secondly, in spite of generating a constant elasticity of aggregate trade flows to the variable trade cost, it allows per-capita income to determine the degree of sensitivity of trade margins to variable trade cost variation, conditionally on non-homotheticity. In line with Chaney (2008), the constant nature of the variable trade cost elasticity ($\epsilon_2^F = -\theta$) stems from a parametric assumption on the supply side: firm productivity is Pareto distributed.[41] Using the definition of the elasticity of bilateral trade to the variable trade cost (ϵ_2^F), its absolute value can be decomposed into an (intensive: firm-level export revenues) and (extensive: Number of exporting firms) component capturing the elasticity of each margin to the variable trade cost:

$$|\varepsilon_{\tau_{ij}}^{X_{ij}}| = |\epsilon_2^F| = \underbrace{\tilde{\rho}_2(\ \tilde{\sigma}_{ij}(w_j) - 1\ )}_{\iota:intensive} + \underbrace{[\ \theta - |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j) - 1)\ ]}_{\chi:extensive} = \theta \qquad (34)$$

[38] As competition is more relaxed in remote destinations, this, not only, offers easier entry conditions for prospective exporters, but also, allows successful ones to reap large market shares. Hence, the remoteness of the destination respectively magnifies the extensive and intensive margins of trade.

[39] I focus only on geography and abstract from the cost of labor in the origin w_i because it also corresponds to individual expenditure on the differentiated good and thus has a positive impact on entry as well.

[40] For any given level of trade barriers and destination characteristics.

[41] Even under non-CES preferences, this constant link between trade flows and the variable trade cost is maintained due to this parametric assumption (Melitz and Ottaviano, 2008; Bertoletti et al., 2018; Arkolakis et al., 2018). Moreover, Eaton and Kortum (2002) find a similar result in a Ricardian framework, where country-level efficiency is Frechet distributed.

As highlighted by Chaney (2008), σ magnifies the sensitivity of the intensive margin, whereas it dampens the sensitivity of the extensive margin to tariff variation. As non-homotheticity implies that the price elasticity of demand is decreasing in income, a new theoretical prediction arises: *When preferences are indirectly additive and non-homothetic, per-capita income affects the sensitivity of trade margins to variation in variable trade cost in two opposite ways: it dampens the sensitivity of the intensive margin, whereas it magnifies the sensitivity of the extensive margin.*

Thirdly, another novelty of this generalized structural gravity equation is that it features a bi-modal fixed trade cost elasticity of bilateral trade flows. This latter can be either constant or variable depending on the nature of preferences. Specifically, in contrast to the CES case where this elasticity is constant as in Chaney (2008), non-homotheticity breaks this constant link, yielding an income-decreasing fixed trade cost elasticity of bilateral trade. By referring to the earliest definition of (ϵ_5^F) in equation (19), the absolute value of the elasticity of aggregate trade flows with respect to the fixed trade cost can be decomposed as follows:

$$|\varepsilon_{f_{ij}}^{X_{ij}}| = |\epsilon_5^F| = \underbrace{0}_{\iota:intensive} + \underbrace{\frac{[\,\theta - |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)\,]}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)}}_{\chi:extensive} = \begin{cases} \frac{\theta}{\sigma-1} - 1 \text{ (CES case)} \\ \frac{\theta}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} - \gamma \text{ (non-homothetic case)} \end{cases} \tag{35}$$

where $\gamma = \frac{|\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)}{|\rho_4^*|(\sigma_{ij}^*(w_j)-1)} < 1$ is orthogonal to destination's per-capita income w_j as the effects of income on both elasticities cancel out.[42] Under non-homotheticity, the fixed trade cost elasticity of bilateral trade is decreasing in destination's per-capita income: $\frac{d|\epsilon_5^F|}{dw_j} < 0$. Intuitively, this can be explained as follows: *an increase in destination's per-capita income* ($w_j' > w_j$) *lowers the export cutoff* (${\varphi^*}'_{ij} < \varphi_{ij}^*$)*, which in turn generates a more than proportional increase in the cutoff export price* (${p^*}'_{ij} > p_{ij}^*$))*.*[43] *As the price elasticity of demand is increasing in the price-income ratio, the "new" cutoff exporter faces then a more elastic demand* (${\sigma^*}'_{ij} > \sigma_{ij}^*$)*, which in turn lowers the fixed trade cost elasticity of bilateral trade* ($|\epsilon_5^F|' < |\epsilon_5^F|$). The mechanism underlying this result is the following: *as rich destinations are the easiest to penetrate, the productivity level of infra-marginal exporters is the lowest*[44]*, these latter capture then very small market shares upon a reduction in the*

[42] I show this more formally using the exponential form, proposed by Bertoletti and Etro (2016), in a supplementary appendix.

[43] Due to a joint increase in the cutoff marginal cost and in markups when the destination gets richer.

[44] Compared with poorer export destinations which are more selective.

fixed trade cost. Hence, rich destinations are the least elastic to a variation in fixed trade barriers as long as they are the least selective.

Last, but not least, it is worth mentioning that it is necessary to assume that the liberalizing country j is a small open economy. This additional assumption ensures that any variation in the variable or fixed cost of importing in destination j ($\tau_{ij},\ f_{ij}\ \forall i$) has no impact on entry conditions in any source country i ($\tilde{\sigma}_i^{\varpi}(\tilde{w}),\ \Psi_i$).[45]

2.4 Solving for nominal wages in general equilibrium

In this short section, I close the model and I solve for the nominal wage in the destination w_j using the trade balance condition (TB):

$$(TB)_j : \underbrace{\sum_{i=1}^{(N-1)} X_{ji}}_{j's\,exports} = \underbrace{\sum_{i=1}^{(N-1)} X_{ij}}_{j's\,imports} \tag{36}$$

By plugging bilateral trade flows from the structural gravity from equation (33) in the trade balance condition above and rearranging, I solve for the relative wage in destination j as follows:

$$w_j = (\frac{\Psi_j}{\tilde{\Psi}_{Row}})^{\frac{1}{(\epsilon_1^F-1)}}\ \Lambda^{\frac{1}{(\epsilon_1^F-1)}}, \tag{37}$$

where $\tilde{\Psi}_{Row} \equiv \sum_{i=1,i\neq j}^{(N-1)}(\frac{L_i}{L_\varpi})\Psi_i$ is the weighted average degree of remoteness of all destinations in the World, excluding j and Λ is a general equilibrium object that is orthogonal to bilateral tariffs.[46] To gain some intuition on this result, the general equilibrium expression of the relative wage can be interpreted as follows: the more a destination is relatively remote (compared to the World average), the lower is the relative wage of its workers. For instance, a remote destination is characterized by relaxed competition as fewer firms compete on its market. As a result, this destination is easy to penetrate for all origins and accumulates trade deficits. This, in turn, imposes a downward adjustment of nominal wage in this destination so as the price competitiveness of its exporters is

[45] $\frac{d\tilde{\sigma}_i^{\varpi}(\tilde{w})}{d\tau_{ij}} = \frac{d\tilde{\sigma}_i^{\varpi}(d\tilde{w})}{df_{ij}} = \frac{d\Psi_i}{d\tau_{ij}} = \frac{d\Psi_i}{df_{ij}} = 0.$

[46] See Appendix A.3 for a detailed derivation.

boosted and trade balance is restored. With the aid of this intuitive reasoning, I highlight two new sources of welfare gains from trade that I present and explain in the next section.

2.5 Welfare Analysis

In order to define the structure of the welfare gains from trade, I identify the channels affecting consumer welfare in a destination j upon it cuts tariffs on imports from a trading partner i. I start with disentangling pure variety gains as in Krugman (1980) from gains from selection, due to Melitz (2003). Then, I highlight two new sources of welfare gains from unilateral trade liberalization: *(i) an additional gain from selection that occurs on the export market, (ii) an increase in nominal wage in the liberalizing country.* Importantly, I show that Melitz (2003)'s selection effect and the two additional welfare channels highlighted above, are operative only when the trading partner i is relatively large compared to the World economy. A mirror image of this result is that the liberalizing economy reaps only pure variety gains as in Krugman (1980) when the trading partner is relatively small.

Using the extensive margin in general equilibrium from equation (29), the productivity cutoff to serve destination j from its trading partner i, the export cutoff to serve it from any other origin o and the domestic cutoff in j can be respectively written as:

$$\begin{cases} \varphi^*_{ij} \equiv \kappa_5 \; w_i^{(\frac{1-\epsilon^*_1}{\epsilon^*_4})} \; \tau_{ij} \; f_{ij}^{\frac{1}{\epsilon^*_4}} \; w_j^{\Delta_5} \; L_j^{\Delta_6} \; (\frac{w_j L_j}{Y_w})^{\frac{1}{\epsilon^*_4(\epsilon^F_7-1)}} \; \Psi_j^{\frac{1}{\epsilon^*_4(\epsilon^F_7-1)}}, \\ \varphi^*_{oj} \equiv \kappa_5 \; w_o^{(\frac{1-\epsilon^*_1}{\epsilon^*_4})} \; \tau_{oj} \; f_{oj}^{\frac{1}{\epsilon^*_4}} \; w_j^{\Delta_5} \; L_j^{\Delta_6} \; (\frac{w_j L_j}{Y_w})^{\frac{1}{\epsilon^*_4(\epsilon^F_7-1)}} \; \Psi_j^{\frac{1}{\epsilon^*_4(\epsilon^F_7-1)}}, \\ \varphi^*_{jj} \equiv \kappa_5 \; w_j^{(\frac{1-\epsilon^*_1}{\epsilon^*_4})} \; f_{jj}^{\frac{1}{\epsilon^*_4}} \; w_j^{\Delta_5} \; L_j^{\Delta_6} \; (\frac{w_j L_j}{Y_w})^{\frac{1}{\epsilon^*_4(\epsilon^F_7-1)}} \; \Psi_j^{\frac{1}{\epsilon^*_4(\epsilon^F_7-1)}} \end{cases} \tag{38}$$

Let me now introduce a key parameter of the welfare analysis ξ_1. This elasticity captures the potential impact of a reduction in the variable cost of importing from an origin i on the toughness of competition in the liberalizing country j. This "pro-competitive" effect[47] occurs only when the trading partner i is relatively large compared to the World economy. As shown below, this is visible through changes in destination j's remoteness index Ψ_j depending on the relative market size of its partner i:[48]

[47]To avoid confusion, this term solely refers to an increase in the intensity of competition on market j.

[48]The expression of ξ_1 is obtained using the definition of Ψ_j from equation (25).

$$\xi_1 = -\varepsilon_{\tau_{ij}}^{\Psi_j} = (\frac{w_i L_i}{Y_\varpi}) \underbrace{\epsilon_2^F}_{<0} f_{ij}^{(\epsilon_5^F - 1)} \tau_{ij}^{\epsilon_2^F} w_i^{\epsilon_1^F} \Psi_j^{-1} = \begin{cases} < 0 & \text{if } (\frac{w_i L_i}{Y_\varpi}) >> 0^+ \\ 0 & \text{otherwise} \end{cases} \tag{39}$$

To gain some intuition on the dependence of the sign of ξ_1 on the GDP share of the origin i, consider these two opposite cases. When country j unilaterally liberalizes trade with a relatively small partner i, it experiences a slight increase in the mass of firms competing on its market, with negligible impact on the toughness of competition ($\xi_1 = 0$). By contrast, when the favored partner i is relatively large, the mass of competing firms increases tremendously and competition on the destination market j becomes tougher ($\xi_1 < 0$). This "pro-competitive" effect has a mirror image: upon unilaterally liberalizing trade with a relatively large partner i, a destination j becomes less remote from the World economy. However, when the favored partner is relatively small, the remoteness index of the destination remains unchanged.

Now I define the following elasticities so as each of which captures a specific welfare channel. using the productivity cutoffs from equation (38) along with the wage equation in (37), their final expressions can be written as follows:

$$\begin{cases} |\xi_2| = |-\varepsilon_{\tau_{ij}}^{\varphi_{ij}^*}| = 1 - \frac{\xi_1}{\epsilon_4^*(\epsilon_7^F - 1)} \leq 1 \\ \xi_3^d = -\varepsilon_{\tau_{ij}}^{\varphi_{jj}^*} = \frac{\xi_1}{\epsilon_4^*(\epsilon_7^F - 1)} \geq 0 \\ \xi_4^o = -\varepsilon_{\tau_{ij}}^{\varphi_{oj}^*} = \frac{\xi_1}{\epsilon_4^*(\epsilon_7^F - 1)} \geq 0 \\ \xi_5 = -\varepsilon_{\tau_{ij}}^{w_j} = \frac{\xi_1}{(\epsilon_1^F - 1)} \geq 0 \end{cases} \tag{40}$$

where $|\xi_2|$ captures the increase in the mass of imported varieties from partner i, and thus mirrors pure variety gains as in Krugman (1980). As for the selection effect highlighted by Melitz (2003), it is captured by ξ_3^d which reflects the $\widetilde{exit}$ of the least productive domestic firms in the liberalizing country j.[49] Moreover, ξ_4^o capture the $\widetilde{loss}$ of varieties imported from any other origin o. It is worth mentioning that the $\widetilde{loss}$ of imported varieties captured by ξ_4^o mirrors the $\widetilde{exit}$ of the least productive firms serving destination j from any origin o due to tougher selection on the export market j, which leads to an $\widetilde{increase}$ in average export productivity. This additional gain from selection (on the export market) represents a new welfare channel and is complementary to the selection

[49] For sake of precision, "tilde" is used hereafter to indicate that the effect at question is potential since its existence crucially depends on the value of ξ_1, which in turn mirrors the relative market size of the trading partner i. Specifically, the welfare channel at question is considered as being potential as long as it is operative when ($\xi_1 < 0$), whereas it vanishes when ($\xi_1 = 0$).

effect, due to Melitz (2003) which occurs on the domestic market. Finally, ξ_5 captures the impact of unilateral trade liberalization on the nominal wage in the liberalizing country w_j. In particular, this effect is positive when the partner is relatively large ($\xi_1 < 0$), and thus can be considered as another new source of welfare gains from trade. However, this new welfare channel vanishes when the trading partner is relatively small ($\xi_1 = 0$), as it is the case for the selection effects (both on the domestic and the export markets) mentioned above.

Now using the elasticities in (38), the different sources of welfare gains from trade can be captured by the following summary statistic:

$$\Gamma = \underbrace{[\, |\xi_2| - (\, \xi_3^d + \sum_{o=1, o\neq i,j}^{(N-2)} \xi_4^o) \,]}_{\Theta_v \,:Net\ Variety\ Effect} + \underbrace{[\, \xi_3^d + \sum_{o=1, o\neq i,j}^{(N-2)} \xi_4^o \,]}_{\Theta_s \,:Melitz(domestic)+Additional\ selection(export)} + \underbrace{\xi_5}_{impact\ on\ nominal\ wage} \tag{41}$$

Importantly, in such a global equilibrium with asymmetric countries, it is insightful to stress that the relative size of the trading partner shapes the structure of welfare gains for the liberalizing country. For instance, it is readily verified from equation (40) that when its partner i is relatively small ($\xi_1 = 0$), the liberalizing economy j reaps only pure variety gains as in Krugman (1980). By contrast, when partner i is relatively large ($\xi_1 < 0$), the magnitude of the gross variety gain[50] is reduced, the selection effect as in Melitz (2003) is operative, and two new sources of welfare gains arise: an additional selection effect on the export market and an increase in nominal wage in the liberalizing country. In order to shed more light on the mechanisms underlying these two different structures of welfare gains, I proceed to a two-cases analysis as follows:

Case 1: the trading partner i is relatively small

Under this case, the liberalizing economy reaps only small gains from variety as in Krugman (1980) despite firm heterogeneity and the presence of fixed costs. The absence of the gains from selection as in Melitz (2003) -along with the two new welfare channels mentioned above- is due to the fact that the arrival of few newly imported varieties from partner i has a negligible impact on the intensity of competition on the destination market j ($\xi_1 = 0$). As a result, neither the least productive

[50] It refers to the increase in the mass of imported varieties from country i.

domestic firms in country j, nor the least productive exporters serving this destination from all other origins ($\forall o \neq i$) are forced to exit the market. It is worth mentioning that despite the rigidity of labor supply in this one sector model, firm exit can only be caused by tougher competition on the final good market since unilateral trade liberalization by country j does not entail any positive demand shock on its domestic labor market. Melitz and Ottaviano (2008) studied the welfare implications of unilateral trade liberalization using a linear demand system exhibiting a choke price that is decreasing in the number of competing firms. They find that, in the short run, the liberalizing economy gains always from selection[51] as in Melitz (2003) regardless of the size of the partner as an increase in the number of competing firms translates mechanically into tougher competitive conditions for domestic firms. Moreover, the authors show that the liberalizing economy experiences a welfare loss in the long rue due to changes in the patterns of entry (Home Market Effect). By contrast, as I depart from a different theoretical setting involving only one sector, many asymmetric countries, indirectly additive preferences and fixed costs, I obtain different results. In particular, in the current paper, the toughness of competition on a given destination j is mainly captured by its remoteness index[52] Ψ_j which varies significantly only when the the trading partner is relatively large.[53] As a result, the selection effect [54] is not operative when the trading partner is relatively small and the liberalizing country reaps only pure variety gains in the short run. As for the long run effects, in contrast to Melitz and Ottaviano (2008), the liberalizing economy does not experience a welfare loss since the Home Market Effect is not operative in the absence of a freely traded outside sector, as in Demidova and Rodriguez-Clare (2013). Finally, there is no significant[55] variation in nominal wages in the liberalizing country j, this can be explained as follows. Given the small relative size of partner i, the arrival of few newly imported varieties from this country has a negligible impact on destination j's remoteness index ($\xi_1 = 0$). This implies that the degree of easiness of penetrating market j from any other origin ($\forall o \neq i$) remains unchanged. Hence, there is no variation in country j's imports from all other sources. This, in turn, implies that there is no necessary adjustment of nominal wage in country j to restore trade balance. Therefore, the liberalizing country enjoys only pure variety gains as in Krugman (1980) despite firm heterogeneity. Using indirectly additive preferences, Bertoletti et al. (2018) find a similar result, yet the mechanism is different. Specifically, they abstract from fixed costs and highlight only pure variety gains since

[51]It also enjoys net variety gains and a pro-competitive reduction in domestic markups.

[52]Along with the mass of domestic competitors.

[53]See equation (39).

[54]Both on the domestic market as in Melitz (2003) and on the export market (additional selection effect).

[55]Notice that when the partner is relatively small, the impact of unilateral trade liberalization on the remoteness index of the liberalizing country is negligible, which implies a negligible effect on nominal wages in this country.

the choke price is orthogonal to the mass of competing firms under indirect additivity. Instead, I incorporate fixed costs in the model and I show that despite their presence, the liberalizing economy gains only from variety since the intensity of competition on its market remains unchanged when its partner is relatively small, and thus all other welfare channels are washed out.

Case 2: the trading partner i is relatively large

Under this case, the arrival of a large number of newly imported varieties from partner i makes competition tougher on the destination market j. This pro-competitive effect is mirrored by a significant decrease in destination j's remoteness index upon reducing the variable cost of importing from partner i ($\xi_1 < 0$). Importantly, this increase in the intensity of competition in the liberalizing economy has three major consequences that shape the structure of its welfare gains. First, it forces the least productive domestic firms in country j to exit the market, gains from selection as in Melitz (2003) are thus recovered. Second, due to tougher competitive conditions on market j, the least productive exporters serving this destination from all other origins ($\forall o \neq i$) are also forced to exit this export market. This additional selection effect occurring on the export market leads to an increase in average export productivity and can be then considered as a new source of welfare gain. Nevertheless, due to these two waves of firm exit, the liberalizing economy j experiences a net variety loss for country j. For instance, the less than proportional[56] increase in the mass of varieties imported from partner i does not compensate the total variety loss implied by the exit of domestic firms and the least productive exporters from all other origins.[57] Third, this variety loss reflects the fact that the liberalizing country j is importing less from all other sources ($\forall o \neq i$) and accumulating trade surpluses. Hence, an upward adjustment of the nominal wage in country j is needed so that its exporters become less price competitive, export less to all other countries, and thus trade balance is restored. This increase in the nominal wage in the liberalizing economy is the second new welfare channel highlighted in this paper. In contrast to Demidova and Rodriguez-Clare (2013), the impact of unilateral trade liberalization on nominal wage in the liberalizing country is overturned. For instance, in their two-country model, unilateral trade liberalization implies a downward adjustment of nominal wage in the liberalizing economy to boost the price competitiveness of its exporters so that they export more and trade balance is restored. Moreover, the authors emphasized that despite the decrease in nominal wage it entails, unilateral trade liberalization is welfare improving since the selection effect and the decrease in average price it implies dominate the negative impact on nominal

[56] Notice that the pro-competitive effect reduces the magnitude of the gross variety gain, see the expression of $|\xi_2|$ in equation (40).

[57] In spite of being relatively large, partner i's GDP share can not exceed $\frac{1}{2}$.

wage. By contrast, I find that nominal wage and the domestic cutoff vary in the same direction: they both increase upon unilaterally liberalizing trade with a relatively large partner. Seen this way, the increase in nominal wage arises as an additional source of welfare gains. Importantly, it is complementary to Melitz (2003)'s selection effect on the domestic market along with the new selection effect on the export market, and the sum of these gains outweighs the previously mentioned net variety loss. Finally, the structure of welfare gains can be summarized as follows:

$$\Gamma = \begin{cases} |\xi_2| = 1 & \text{if } i \text{ is relatively small} \\ \underbrace{\Theta_v}_{<0} + \underbrace{\Theta_s}_{>0} + \underbrace{\xi_5}_{>0} & \text{if } i \text{ is relatively large} \end{cases} \tag{42}$$

3 Empirical Analysis

3.1 Purpose of the Analysis

This empirical investigation has two main objectives. First, separately estimate the impact of a destination j's income level w_j and population size L_j on the number of firms based in any foreign country i and able to sell varieties of good k on its market ($N_{ij,k}$: extensive margin) and on the revenues each foreign exporter earns on its market ($r_{ij,k}$: intensive margin).[58] The theoretical prediction is that if preferences are CES, then per-capita income and population size act both as size parameters and thus should affect positively trade margins through the same channel: the relative market size RMS effect highlighted in **?**. By contrast, if preferences are non-homothetic (general case), the major implication of non-homotheticity[59] occurs at the intensive margin: while per-capita income shapes consumer preferences and would affect it positively regardless of the RMS, population size would affect it positively if and only if the RMS channel is operative.

Second, after classifying destinations into three income categories (low, middle and high-income), I estimate the differential effect of variable and fixed trade costs $\tau_{ij,k}$[60] on trade margins depending

[58] By multiplying both margins, I obtain the value of destination j's total imports of good k from origin i $X_{ij,k}$ and estimate the impact of country j's characteristics on its bilateral imports at the industry level.

[59] Another implication of non-homotheticity occurs at the extensive margin. Compared to the homothetic case, per-capita income would have an additional positive effect through the *preferences* channel. For instance, as an increase in per-capita income in a destination lowers the degree of price sensitivity of its consumers, this offers then easier entry conditions for foreign exporters and positively affect the extensive margin. Yet, I consider this implication as minor from a purely empirical point of view as the RMS and the *preferences* channels are difficult to disentangle while estimating the income effect on the extensive margin.

[60] $\tau_{ij,k} = (1 + \widetilde{adv}_{ij,k})$, where $\widetilde{adv}_{ij,k}$ is the weighted average advalorem tariff set by destination j on imports of a HS2-defined good k from origin i. The choice of weighted average advalorem tariffs at the HS2-industry level and not

on the income level of the destination. Under non-homotheticity, the are two novel theoretical predictions. The first is that per-capita income dampens the sensitivity of the intensive margin to variable trade cost, whereas it magnifies the variable trade cost elasticity of the extensive margin. Hence, if preferences are non-homothetic, the impact of tariff variation on the intensive (extensive) margin should be the mildest (strongest) for high-income destinations. The second is that per-capita income dampens the sensitivity of the extensive margin to fixed trade cost. Finally, I conclude by identifying the nature of preferences (CES vs non-homothetic) that fits better the data.

3.2 Data Sources

Data on both margins of trade are retrieved from *the World Bank's Exporter Dynamics Database*. This dataset provides precise information on the number of exporters from origin i serving destination j in HS2-defined industry k in year t $N_{ij,k,t}$ (extensive margin) and the average revenue per exporter $r_{ij,k,t}$ (intensive margin) for 218 countries and 97 HS2-defined industries during the 1997-2014 period. Data on weighted average advalorem tariffs at the HS2-industry level are collected from *MacMap* and *WITS*. As for data on time-invariant gravity variables such as physical distance, contiguity, common language and colonial ties, it is collected from *CEPII's GeoDist database*. Moreover, the *World Bank's World Development Indicators* reports data on country-specific variables such as per-capita income w and population size L. Finally, the *United Nations's Historical Classification database* provides a time-varying classification of all countries by income categories.

3.3 Econometric Challenges and Solutions

As stressed by Yotov et al. (2016), estimating the structural gravity model is challenging as it is subject to numerous econometric issues that should be addressed properly. Specifically, to to obtain econometrically sound estimates of the parameters of interest, I have to address the following issues: presence of zero trade flows; heteroskedasticity in trade data; endogeneity of the trade policy variable ($\tau_{ij,k}$); gradual adjustment to trade policy changes; and, unobservable multilateral resistance terms.

Following Yotov et al. (2016), I meet these challenges as follows. In order to take into account the information contained in zero trade flows and to control for heteroscedasticity of trade data, I use

at the HS6-product level is dictated by the fact that data on both margins of trade is available only at HS2-industry level as mentioned in the subsection below.

the Poisson Pseudo Maximum Likelihood (PPML)[61] estimator recommended by Silva and Tenreyro (2006). To account for endogeneity of trade policy, I use lagged tariffs ($\tau_{ij,k,(t-1)}$) and I also resort to panel data to utilize the cleansing property of country-pair fixed effect.[62] In line with Trefler (2004) who severely criticized trade estimations performed with panel data pooled over consecutive years, Olivero and Yotov (2012) proved that it produces suspicious estimates of trade elasticity. To avoid such a critique, I use only the years: 1999, 2002, 2005, 2008, 2011 and 2014, which is comparable to the 3-year intervals in Trefler (2004). Finally, time-varying, directional (source and destination), country-sector-specific dummies control for the multilateral resistance terms ($\Psi_{i,k}$; $\Psi_{j,k}$) and expenditures ($Y_{i,k}$; $Y_{j,k}$) at the industry k level.

3.4 Econometric Specifications

1) Income vs Size effects on trade margins

$$T_{ij,k,t} = exp[\beta_0 + \beta_1 lnLAG\_TARIFF_{ij,k,t} + \beta_2 lnINCOME_{j,t} + \beta_3 lnSIZE_{j,t} + \beta_4 lnMRT_{j,k,t} + \nu_{i,k,t} + \gamma_{ij}] + \epsilon_{ij,k,t} \tag{43}$$

Here $T_{ij,k,t}$ is a trade covariate which refers to each trade margin (intensive: $r_{ij,k,t}$; extensive: $N_{ij,k,t}$), as well as their scalar ($X_{ij,k,t}$) which corresponds to the value of bilateral trade in commodity k between partners i and j in year t. Moreover, $lnLAG\_TARIFF_{ij,k,t}$ is the first lag of the logarithm of the variable trade cost. $lnINCOME_{j,t}$, $lnSIZE_{j,t}$ and $lnMRT_{j,k,t}$ correspond to the logarithm of destination j's per-capita income, population size and multilateral resistance term, respectively. $\nu_{i,k,t}$ encompasses the time varying and sector-specific source country dummy variables that account for the (log of) outward multilateral resistances and total shipments. γ_{ij} captures the country-pair fixed effects which absorb time-invariant components of trade cost (such as, distance, contiguity, common language and colonial links) and best address the endogeneity of its time-varying component (tariffs). Notably, as multilateral resistances are not directly observable, I construct the inward multilateral resistance term based on the theoretically-derived remoteness index of destination j (Ψ_j)[63] as follows:

$$MRT_{j,k,t} = \sum_{i=1}^{N} (\frac{X_{i,k,t}}{X_{\varpi,k,t}})\ distance_{ij}, \tag{44}$$

[61] I also estimate and report OLS estimates to allow for an immediate comparison with PPML estimates.

[62] Using pairwise fixed effect purifies the gravity estimation from any potential linkage between the endogenous trade policy covariate (tariff) and the error term. It also absorbs the set of time-invariant components of trade cost as stressed by Yotov et al. (2016)

[63] See equation (25) in page 11

where $X_{\varpi,k,t} = \sum_{i=1}^{N} X_{i,k,t}$ is the value of total World exports of good k in year t. $MRT_{j,k,t}$ reflects then destination j's geographical remoteness form World's best exporters of good k. Finally, $\epsilon_{ij,k,t}$ is a Poisson error term.

2) Is the variable trade cost elasticity of trade margins income-specific?

$$T_{ij,k,t} = exp[\beta_0 + \beta_1 IC1^c_{j,t} * lnLAG\_TARIFF_{ij,k,t} + \beta_2 IC2^c_{j,t} * lnLAG\_TARIFF_{ij,k,t} + \beta_3 IC3^c_{j,t} * lnLAG\_TARIFF_{ij,k,t} + \beta_4 lnDIST_{ij} + \beta_5 BRDR_{ij} + \beta_6 LANG_{ij} + \beta_7 CLNY_{ij} + \nu_{i,k,t} + \mu_{j,k,t}] + \epsilon_{ij,k,t} \quad (45)$$

Here $T_{ij,k,t}$ is the same endogenous variable as in the first specification (42). Yet, it is the income effect on the sensitivity of trade margins to tariff variation that is now at stake. To capture such a gradual reactivity of trade margins depending on the income level of the destination, I interact the lagged tariff with the following dummies. $IC1^c_{j,t}$, $IC2^c_{j,t}$ and $IC3^c_{j,t}$ indicate whether the destination j is classified as a low-income, middle-income or high-income country in year t, respectively. Specifically, I classify destinations by income categories using two methods. The first consists in resorting to the distribution of GDP per capita. Low-income destinations are destinations with a GDP per capita below the 25th percentile of the distribution, while middle-income destinations are those with GDP per capita between the 25th and 75th percentile of the distribution. High-income destinations are those whose GDP per capita exceeds the 75th percentile. The second simply adopts the United Nations's historical classification. Notice that the superscript (c) of income category dummies indicates the classification method in use, such as (a) refers to the first method and (b) to the second. $lnDIST_{ij}$ is the logarithm of bilateral distance. $BRDR_{ij}$, $LANG_{ij}$ and $CLNY_{ij}$ are indicator variables that capture the presence of contiguous borders, common language and colonial ties, respectively. $\nu_{i,k,t}$ and $\mu_{j,k,t}$ denote the directional, time-varying country-sector specific fixed effects, which account for the multilateral resistances and market size, respectively, on the exporter and on the importer side. Importantly, due to the high dimensionality of these fixed effects, pairwise fixed effects are absent from this specification [64] so as to obtain a reasonable magnitude[65] of the coefficients of interest (β_1;β_2;β_3). Finally, $\epsilon_{ij,k,t}$ is a Poisson error term.

[64] They are substituted with a standard set of time-invariant gravity variables such as: distance, contiguity, common language and colonial links. This modeling choice implies that the first lag of tariffs stands as the unique (ad-hoc) solution to address endogeneity.

[65] It would be ideal to include all of these fixed effects in the specification, but this generates unrealistically low estimates hovering around zero.

3) Is the fixed trade cost elasticity of the extensive margin income-specific?

Similarly, in order to test empirically the income effect on the sensitivity of the extensive margin to fixed trade barriers, I adopt the following specification:

$$T_{ij,k,t} = exp[\beta_0 + \beta_1 lnLAG\_TARIFF_{ij,k,t} + \beta_2 IC1^c_{j,t} * lnDIST_{ij} + \beta_3 IC2^c_{j,t} * lnDIST_{ij}$$

$$+ \beta_4 IC3^c_{j,t} * lnDIST_{ij} + \beta_5 BRDR_{ij} + \beta_6 LANG_{ij} + \beta_7 CLNY_{ij} + \nu_{i,k,t} + \mu_{j,k,t}] + \epsilon_{ij,k,t} (46)$$

3.5 Gravity Estimation Results

Results exposed in the empirical appendix clearly show that non-homotheticity outperforms the CES empirically. They also raise concerns regarding the plausibility of the Pareto assumption. First, CES preferences imposes a similarity between per-capita income and population size both in terms of the channels through which they affect trade margins in general equilibrium as well as the magnitude of their effects. It fails then to explain why while destination's per-capita income w_j has a positive and significant impact on the intensive margin and thus on bilateral trade, its population size has no significant impact on it (as shown in tables A). By contrast, non-homotheticity allows individual income to determine the degree of price sensitivity of the consumer and explains this empirical result as follows: *as per-capita income dampens the price elasticity of demand, any exporter would charge higher prices to richer destinations and even by doing so, it provides foreign consumer with a higher marginal sub-utility since its export price increases less then proportionally with destination's individual income level. This positive income effect persists in general equilibrium and dominates the negative impact of competition, yielding thus a net positive income effect as shown in equation(28).*

Second, results in table (B) validate the second theoretical prediction of the model: *the variable trade cost elasticity of the intensive margin is decreasing in destination's per-capita income since richer consumers are less price sensitive.* However, the CES-based prediction is in stark contrast with this empirical result as long as the degree of price sensitivity is assumed to exogenous in a CES world. Moreover, results in table (C) validate the third theoretical prediction of the model: *the fixed trade cost elasticity of the extensive margin is decreasing in destination's per-capita income since richer destinations are easier to penetrate, which implies relatively low productivity level of infra-marginal exporters. As a result, they capture small export market shares upon a reduction in* *fixed trade barriers. This is reflected by the mild reaction of the extensive margin in rich destinations.* A mirror image of this result is visible in table (D) where bilateral imports of low-income destinations exhibit the highest degree of sensitivity to bilateral distance.

Nevertheless, results in tables (E) do not validate the prediction that per-capita income magnifies the sensitivity of the extensive margin to variable trade cost. Moreover, the model predicts the aggregate trade elasticity to be constant identical across destination based on the assumption of identical technology. However, estimates in table (F) show that high-income countries are the least elastic to trade. The combination of these results points into a two-ways direction: (i) either firm productivity is Pareto distributed but the shape parameter of the Pareto varies across sectors and destinations as suggested by recent estimates of Fontagné and Orefice (2018); (ii) or firm productivity is not Pareto distributed and would rather be Log-Normal as suggested by recent findings by (Bas et al., 2017; Fernandes et al., 2018).

4 Conclusion

By introducing indirectly additive preferences, imposing free entry and allowing for endogenous wages in the Chaney (2008) model, this paper generates two novel theoretical predictions that stem from the non-homothetic nature of preferences. First, the intensive margin of trade increases significantly with only per-capita income of the destination, whereas it remains unresponsive to its population size. Second, per-capita income dampens, not only, the variable trade cost elasticity of the intensive margin, but also, the fixed trade cost elasticity of the extensive margin. Moreover, the model delivers an augmented version of Chaney (2008)'s gravity equation exhibiting multilateral resistances of both trading partners. Finally, the model sheds more light on the importance of size asymmetry in shaping the structure of the gains from trade and highlights two new sources of welfare gains from unilateral trade liberalization. The first consists in an additional selection effect, due to Melitz (2003), but occurring on the export market. The second is an increase in nominal wage in the liberalizing country.

Empirical Appendix

1) Main Results (with pair clustering)

Table (A): Destination's income vs size effects on trade margins:

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	X	N	r	ln_X	ln_N	ln_r
ln_ LAG_TARIFF	-2.012***	-0.915***	-0.948***	-1.421***	-0.468***	-0.953***
	(0.296)	(0.106)	(0.288)	(0.106)	(0.0406)	(0.0824)
ln_INCOME	0.682***	0.138	0.360***	0.511***	0.169***	0.342***
	(0.0952)	(0.0866)	(0.0910)	(0.0467)	(0.0273)	(0.0410)
ln_SIZE	0.353	0.534***	-0.200	0.519***	0.286***	0.233**
	(0.266)	(0.134)	(0.303)	(0.128)	(0.0576)	(0.114)
ln_MRT	0.556***	0.131***	0.293***	0.263***	0.103***	0.160***
	(0.0531)	(0.0108)	(0.0354)	(0.0138)	(0.00658)	(0.00964)
Observations	219,444	219,444	219,444	176,338	176,338	176,338
R-squared				0.635	0.787	0.564
pair FE	Yes	Yes	Yes	Yes	Yes	Yes
origin-sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Zeros included	Yes	Yes	Yes	No	No	No
Estimator	PPML	PPML	PPML	OLS	OLS	OLS
pairwise clustering	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table (B): Income-decreasing variable trade cost elasticity of the intensive margin:

	(1)	(2)	(3)	(4)
VARIABLES	r	ln_r	r	ln_r
$IC1^a * ln\_LAG\_TARIFF$	-2.610***	-1.948***		
	(0.420)	(0.326)		
$IC2^a * ln\_LAG\_TARIFF$	-1.820***	-1.666***		
	(0.384)	(0.234)		
$IC3^a * ln\_LAG\_TARIFF$	-1.654***	-0.920***		
	(0.299)	(0.239)		
ln_DIST	-0.481***	-0.624***	-0.477***	-0.623***
	(0.0285)	(0.0239)	(0.0284)	(0.0239)
BRDR	0.177***	0.311***	0.176***	0.309***
	(0.0632)	(0.0666)	(0.0633)	(0.0666)
LANG	0.0255	0.151***	0.0141	0.147***
	(0.0625)	(0.0445)	(0.0625)	(0.0444)
CLNY	0.158**	0.0787	0.165**	0.0810
	(0.0741)	(0.0740)	(0.0745)	(0.0738)
$IC1^b * ln\_LAG\_TARIFF$			-2.543***	-1.951***
			(0.627)	(0.435)
$IC2^b * ln\_LAG\_TARIFF$			-2.863***	-2.040***
			(0.269)	(0.256)
$IC3^b * ln\_LAG\_TARIFF$			-0.915***	-0.774***
			(0.250)	(0.211)
Observations	217,938	177,312	217,938	177,312
R-squared	0.898	0.687	0.898	0.687
destination-sector-year FE	Yes	Yes	Yes	Yes
origin-sector-year FE	Yes	Yes	Yes	Yes
Income classification method	a	a	b	b
Zeros included	Yes	No	Yes	No
Estimator	PPML	OLS	PPML	OLS
pairwise clustering	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table (C): Income-decreasing fixed trade cost elasticity of the extensive margin:

	(1)	(2)	(3)	(4)
VARIABLES	N	ln_N	N	ln_N
ln_ LAG_TARIFF	-1.053***	-0.641***	-0.994***	-0.612***
	(0.241)	(0.138)	(0.248)	(0.139)
$IC1^a * ln\_DIST$	-1.255***	-1.008***		
	(0.0862)	(0.0439)		
$IC2^a * ln\_DIST$	-1.040***	-0.804***		
	(0.0342)	(0.0329)		
$IC3^a * ln\_DIST$	-0.999***	-0.777***		
	(0.0474)	(0.0461)		
BRDR	0.257***	0.229***	0.259***	0.229***
	(0.0815)	(0.0824)	(0.0816)	(0.0840)
LANG	0.971***	0.552***	0.949***	0.545***
	(0.101)	(0.0537)	(0.102)	(0.0543)
CLNY	0.919***	0.582***	0.933***	0.579***
	(0.111)	(0.0944)	(0.111)	(0.0960)
$IC1^b * ln\_DIST$			-1.240***	-1.034***
			(0.121)	(0.0613)
$IC2^b * ln\_DIST$			-1.125***	-0.849***
			(0.0381)	(0.0357)
$IC3^b * ln\_DIST$			-0.973***	-0.761***
			(0.0437)	(0.0418)
Observations	217,938	177,312	217,938	177,312
R-squared	0.880	0.766	0.880	0.766
destination-sector-year FE	Yes	Yes	Yes	Yes
origin-sector-year FE	Yes	Yes	Yes	Yes
Income classification method	a	a	b	b
Zeros included	Yes	No	Yes	No
Estimator	PPML	OLS	PPML	OLS
pairwise clustering	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table (D): Income effect on the fixed trade cost elasticity of bilateral trade flows:

	(1)	(2)	(3)	(4)
VARIABLES	X	ln_X	X	ln_X
ln_ LAG_TARIFF	-3.498***	-2.193***	-3.487***	-2.165***
	(0.416)	(0.254)	(0.416)	(0.254)
$IC1^a * ln\_DIST$	-1.505***	-1.689***		
	(0.0921)	(0.0675)		
$IC2^a * ln\_DIST$	-1.274***	-1.409***		
	(0.0485)	(0.0480)		
$IC3^a * ln\_DIST$	-1.278***	-1.409***		
	(0.0643)	(0.0705)		
BRDR	0.373***	0.531***	0.371***	0.537***
	(0.0946)	(0.117)	(0.0945)	(0.119)
LANG	0.416***	0.709***	0.427***	0.712***
	(0.114)	(0.0790)	(0.115)	(0.0798)
CLNY	0.627***	0.658***	0.621***	0.652***
	(0.126)	(0.135)	(0.127)	(0.137)
$IC1^b * ln\_DIST$			-1.658***	-1.744***
			(0.127)	(0.0948)
$IC2^b * ln\_DIST$			-1.260***	-1.440***
			(0.0538)	(0.0518)
$IC3^b * ln\_DIST$			-1.289***	-1.407***
			(0.0613)	(0.0638)
Observations	217,938	177,312	217,938	177,312
R-squared	0.913	0.722	0.913	0.722
destination-sector-year FE	Yes	Yes	Yes	Yes
origin-sector-year FE	Yes	Yes	Yes	Yes
Income classification method	a	a	b	b
Zeros included	Yes	No	Yes	No
Estimator	PPML	OLS	PPML	OLS
pairwise clustering	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table (E): Income effect on the variable trade cost elasticity of the extensive margin:

	(1)	(2)	(3)	(4)
VARIABLES	N	ln_N	N	ln_N
$IC1^a * ln\_LAG\_TARIFF$	-1.583***	-1.109***		
	(0.547)	(0.407)		
$IC2^a * ln\_LAG\_TARIFF$	-1.437***	-0.757***		
	(0.311)	(0.173)		
$IC3^a * ln\_LAG\_TARIFF$	-0.0824	-0.104		
	(0.356)	(0.151)		
ln_DIST	-1.067***	-0.829***	-1.067***	-0.828***
	(0.0324)	(0.0294)	(0.0323)	(0.0295)
BRDR	0.300***	0.287***	0.301***	0.288***
	(0.0784)	(0.0786)	(0.0784)	(0.0787)
LANG	0.951***	0.544***	0.948***	0.541***
	(0.0944)	(0.0530)	(0.0946)	(0.0531)
CLNY	0.947***	0.586***	0.950***	0.588***
	(0.112)	(0.0956)	(0.112)	(0.0954)
$IC1^b * ln\_LAG\_TARIFF$			-1.269**	-0.900*
			(0.608)	(0.547)
$IC2^b * ln\_LAG\_TARIFF$			-1.679***	-1.085***
			(0.357)	(0.211)
$IC3^b * ln\_LAG\_TARIFF$			-0.280	-0.0805
			(0.261)	(0.111)
Observations	217,938	177,312	217,938	177,312
R-squared	0.880	0.764	0.880	0.765
destination-sector-year FE	Yes	Yes	Yes	Yes
origin-sector-year FE	Yes	Yes	Yes	Yes
Income classification method	a	a	b	b
Zeros included	Yes	No	Yes	No
Estimator	PPML	OLS	PPML	OLS
pairwise clustering	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table (F): Income effect on the variable trade cost elasticity of bilateral trade flows:

	(1)	(2)	(3)	(4)
VARIABLES	X	ln_X	X	ln_X
$IC1^a * ln\_LAG\_TARIFF$	-3.377***	-3.057***		
	(0.723)	(0.599)		
$IC2^a * ln\_LAG\_TARIFF$	-3.932***	-2.422***		
	(0.582)	(0.351)		
$IC3^a * ln\_LAG\_TARIFF$	-2.594***	-1.025***		
	(0.586)	(0.327)		
ln_DIST	-1.294***	-1.454***	-1.294***	-1.451***
	(0.0494)	(0.0432)	(0.0496)	(0.0432)
BRDR	0.384***	0.598***	0.383***	0.598***
	(0.0950)	(0.114)	(0.0950)	(0.114)
LANG	0.416***	0.695***	0.406***	0.687***
	(0.113)	(0.0779)	(0.113)	(0.0779)
CLNY	0.640***	0.665***	0.648***	0.669***
	(0.126)	(0.136)	(0.126)	(0.135)
$IC1^b * ln\_LAG\_TARIFF$			-3.213***	-2.851***
			(0.930)	(0.819)
$IC2^b * ln\_LAG\_TARIFF$			-4.610***	-3.125***
			(0.517)	(0.405)
$IC3^b * ln\_LAG\_TARIFF$			-2.084***	-0.854***
			(0.612)	(0.261)
Observations	217,938	177,312	217,938	177,312
R-squared	0.914	0.721	0.914	0.721
destination-sector-year FE	Yes	Yes	Yes	Yes
origin-sector-year FE	Yes	Yes	Yes	Yes
Income classification method	a	a	b	b
Zeros included	Yes	No	Yes	No
Estimator	PPML	OLS	PPML	OLS
pairwise clustering	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Theoretical Appendix

A.1) Gross positive income effect on the intensive margin:

This effect is captured by ζ, which is given by: $\zeta = 1 + [(1+\epsilon_3) - (\frac{1+\epsilon_3^F}{1-\epsilon_7^F})]$.
Using the first and second of elasticities, respectively from equations (20) and (24), I show that this gross effect exceeds unity only under non-homotheticity as follows:
First, when preferences are homothetic (CES case), it is readily verified that $(1+\epsilon_3) = (\frac{1+\epsilon_3^F}{1-\epsilon_7^F}) = \sigma$. Hence, ζ collapses to 1.
Second, when preferences are non-homothetic, I need to rewrite $(\frac{1+\epsilon_3^F}{1-\epsilon_7^F})$ as follows, so as to decompose the general equilibrium effect of income into an "intensive"(impact on export revenues of active exporters) and an "extensive"(impact on inframarginal exporters) components as follows:

Denote by $\Delta_1 = (1+\epsilon_3) = [\rho_3 + (1-\rho_3)\sigma_{ij}(w_j)]$, which capture the impact of income variation on the export revenues of the firm (φ) at question[66] Likewise, $\Delta_2 = (\frac{1+\epsilon_3^F}{1-\epsilon_7^F}) = \Delta_3 + \Delta_4$ such as:

• $\Delta_3 = \Delta_{31}\ \Delta_{32} = \Delta_{31}\ [\tilde{\rho}_3 + (1-\tilde{\rho}_3)\tilde{\sigma}_{ij}(w_j)]$ embodies the income effect on the "instensive" margin, with $\Delta_{31} = \frac{|\rho_4^*| * (\sigma_{ij}^*(w_j)-1)}{\theta + |\rho_4^*|(\sigma_{ij}^*(w_j)-1) - |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)} < 1$ since $\theta > |\rho_4^*|(\sigma_{ij}^*(w_j)-1)$ and $|\rho_4^*|(\sigma_{ij}^*(w_j)-1) > |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)$ as σ is increasing in price.

• $\Delta_4 = \Delta_{41}\ \Delta_{42} = \Delta_{41}\ [(1-\rho_3^*)(\sigma_{ij}^*(w_j)-1)+1+\delta^*]$ embodies the income effect on the "extensive" margin,
with $\Delta_{41} = \frac{\theta - |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)}{\theta + |\rho_4^*|(\sigma_{ij}^*(w_j)-1) - |\tilde{\rho}_4|(\tilde{\sigma}_{ij}(w_j)-1)} \approx 0$.

Therefore, $\zeta = 1 + [\underbrace{\Delta_1}_{>1} - [\underbrace{\Delta_{31}}_{<1}\ \Delta_{32} + \underbrace{\Delta_{41}}_{\approx 0}\ \Delta_{42}\ ] > 1$.

A.2) direct[67] income effect on the extensive margin

This effect is captured by Δ_5, which can be written, using the Δs defined above, as :
$\Delta_5 = \frac{1}{\epsilon_4^*}[\Delta_2 - \Delta_{42}]$ and its sign crucially depends on the nature of preferences:
• Under the CES, it easy to verify that $\Delta_2 = \Delta_{42} = \sigma$. Hence, Δ_5 collapses to 0.
• Under non-homotheticity, $\Delta_2 - \Delta_{42} = \underbrace{\Delta_{31}}_{<1}\ \Delta_{32} - \underbrace{(1-\Delta_{41})}_{\approx 1}\ \Delta_{42} < 0$
since $\Delta_{32} = [\tilde{\rho}_3 + (1-\tilde{\rho}_3)\tilde{\sigma}_{ij}(w_j)] < \Delta_{42} = [(1-\rho_3^*)(\sigma_{ij}^*(w_j)-1)+1+\delta^*]$, as $\sigma_{ij}^*(w_j) > \tilde{\sigma}_{ij}(w_j)$.

[66] the absence of superscript indicates that a random exporter is at question.
[67] the common (RMS) channel put aside

A.3) Solving for nominal wage in the liberalizing country j

I solve for the nominal wage in destination j w_j using the trade balance condition (TB):

$$(TB)_j : \underbrace{\sum_{i=1}^{(N-1)} X_{ji}}_{j's\,exports} = \underbrace{\sum_{i=1}^{(N-1)} X_{ij}}_{j's\,imports} \tag{47}$$

Using equation (33), bilateral trade flows can be written as:

$$\begin{cases} X_{ji} = \kappa_6 \ [\tilde{\sigma}_j^{\varpi}(\tilde{w})]^{-1} \ \frac{Y_j Y_i}{Y_\varpi} \ \frac{\Psi_i}{\Psi_j} \ w_j^{\epsilon_1^F} \ \tau_{ji}^{\epsilon_2^F} \ f_{ji}^{\epsilon_5^F} \\ X_{ij} = \kappa_6 \ [\tilde{\sigma}_i^{\varpi}(\tilde{w})]^{-1} \ \frac{Y_i Y_j}{Y_\varpi} \ \frac{\Psi_j}{\Psi_i} \ w_i^{\epsilon_1^F} \ \tau_{ij}^{\epsilon_2^F} \ f_{ij}^{\epsilon_5^F} \end{cases} \tag{48}$$

By plugging bilateral trade flows in the trade balance condition above, normalizing nominal wage in all other countries to unity $w_i = 1 \ \forall i \neq j$, along with simplifying by $[\tilde{\sigma}_j^{\varpi}(\tilde{w})]^{-1}$ and L_j, and rearranging, I obtain the following general equilibrium expression of nominal wage in country j:

$$w_j = (\frac{\Psi_j}{\tilde{\Psi}_{Row}})^{\frac{1}{(\epsilon_1^F - 1)}} \ \Lambda^{\frac{1}{(\epsilon_1^F - 1)}}, \tag{49}$$

where $\tilde{\Psi}_{Row} \equiv \sum_{i=1, i\neq j}^{(N-1)} (\frac{L_i}{L_\varpi}) \Psi_i$ is the weighted average degree of remoteness of all destinations in the World, excluding j, and Λ is a general equilibrium object that is orthogonal to bilateral tariffs, as shown below:

$$\Lambda = \frac{\acute{\Psi}_j}{\Phi_j^{OUT}} \frac{(\Phi_j^{IN})^{-1}}{\acute{\Psi}_{Row}}, \quad \begin{cases} (\Phi_j^{IN})^{-1} = \sum_{i=1, i\neq j}^{(N-1)} (\frac{L_i}{L_\varpi}) \tau_{ij}^{\epsilon_2^F} \ f_{ij}^{\epsilon_5^F} \\ \Phi_j^{OUT} = \sum_{i=1, i\neq j}^{(N-1)} (\frac{L_i}{L_\varpi}) \tau_{ji}^{\epsilon_2^F} \ f_{ji}^{\epsilon_5^F} \end{cases} \tag{50}$$

Notice that $\acute{\Psi}_j = \frac{\Psi_j}{w_j}$ refers to the remoteness index of country j (as an origin) from all other destinations (derived in equation (13)) adjusted by its domestic cost of labor (and thus orthogonal to w_j). Moreover, Φ_j^{OUT} is an equivalent measure of the country j's outward multilateral resistance term. As they are both decreasing in bilateral tariffs, the ratio $\frac{\acute{\Psi}_j}{\Phi_j^{OUT}}$ is thus orthogonal to τ_{ji}. Similarly, $\acute{\Psi}_{Row} = \sum_{i=1,i\neq j}^{(N-1)} (\frac{L_i}{L_\varpi})\Psi_i$ is the weighted average outward multilateral resistance term of all other countries. Moreover, $(\Phi_j^{IN})^{-1}$ is an inverse measure of country j's inward multilateral resistance term. Hence, as they are both decreasing in bilateral tariffs, their ratio is thus orthogonal to τ_{ij}.

References

Anderson, J. E. and Van Wincoop, E. (2003). Gravity with gravitas: a solution to the border puzzle. *American economic review*, 93(1):170–192.

Arkolakis, C., Costinot, A., Donaldson, D., and Rodríguez-Clare, A. (2018). The elusive pro-competitive effects of trade. *The Review of Economic Studies*, 86(1):46–80.

Arkolakis, C., Costinot, A., and Rodriguez-Clare, A. (2012). New trade models, same old gains? *American Economic Review*, 102(1):94–130.

Bas, M., Mayer, T., and Thoenig, M. (2017). From micro to macro: Demand, supply, and heterogeneity in the trade elasticity. *Journal of International Economics*, 108:1–19.

Bertoletti, P. and Etro, F. (2016). Monopolistic competition when income matters. *The Economic Journal*, 127(603):1217–1243.

Bertoletti, P., Etro, F., and Simonovska, I. (2018). International trade with indirect additivity. *American Economic Journal: Microeconomics*, 10(2):1–57.

Chaney, T. (2008). Distorted gravity: the intensive and extensive margins of international trade. *American Economic Review*, 98(4):1707–21.

Demidova, S. and Rodriguez-Clare, A. (2013). The simple analytics of the melitz model in a small economy. *Journal of International Economics*, 90(2):266–272.

Eaton, J. and Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, 70(5):1741–1779.

Feenstra, R. C. (2010). Measuring the gains from trade under monopolistic competition. *Canadian Journal of Economics/Revue canadienne d'économique*, 43(1):1–28.

Fernandes, A. M., Klenow, P. J., Meleshchuk, S., Pierola, M. D., and Rodriguez-Clare, A. (2018). *The intensive margin in trade*. The World Bank.

Fieler, A. C. (2011). Nonhomotheticity and bilateral trade: Evidence and a quantitative explanation. *Econometrica*, 79(4):1069–1101.

Fontagné, L. and Orefice, G. (2018). Letâs try next door: Technical barriers to trade and multi-destination firms. *European Economic Review*, 101:643–663.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review*, 70(5):950–959.

Linder, S. B. (1961). *An essay on trade and transformation*. Almqvist & Wiksell Stockholm.

Markusen, J. R. (2013). Putting per-capita income back into trade theory. *Journal of International Economics*, 90(2):255–265.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *econometrica*, 71(6):1695–1725.

Melitz, M. J. and Ottaviano, G. I. (2008). Market size, trade, and productivity. *The review of economic studies*, 75(1):295–316.

Melitz, M. J. and Redding, S. J. (2015). New trade models, new welfare implications. *American Economic Review*, 105(3):1105–46.

Novy, D. (2013). International trade without ces: Estimating translog gravity. *Journal of International Economics*, 89(2):271–282.

Olivero, M. P. and Yotov, Y. V. (2012). Dynamic gravity: endogenous country size and asset accumulation. *Canadian Journal of Economics/Revue canadienne d'économique*, 45(1):64–92.

Parenti, M., Ushchev, P., and Thisse, J.-F. (2017). Toward a theory of monopolistic competition. *Journal of Economic Theory*, 167:86–115.

Silva, J. S. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, 88(4):641–658.

Simonovska, I. (2015). Income differences and prices of tradables: Insights from an online retailer. *The Review of Economic Studies*, 82(4):1612–1656.

Trefler, D. (2004). The long and short of the canada-us free trade agreement. *American Economic Review*, 94(4):870–895.

Yotov, Y. V., Piermartini, R., Monteiro, J.-A., and Larch, M. (2016). *An advanced guide to trade policy analysis: The structural gravity model*. World Trade Organization Geneva.