Uncertainty and entry into export markets *

Rubén Segura-Cayuela[†] Banco de España
Josep M Vilarrubia[‡] Banco de España

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Abstract

We face uncertainty in most economic decisions we take. This is particularly true in the case of a firm entering a foreign market where there is uncertainty about the size of the market, the distribution channels, the adequacy of the firm's product to local tastes, etc. Despite its obvious importance, this ingredient appears to have been largely overlooked by the literature explaining the direction and volume of international trade flows. We incorporate this informational uncertainty into a model with heterogeneous firms similar to the one proposed by Melitz (2003). The model exhibits informational externalities that arise via informational complementarities: once a firm enters a foreign market, information about that market is revealed to other domestic firms who, then, can optimally decide whether to enter that given foreign market. The model delivers an explanation for the recent dynamic evolution of trade flows, at the intensive margin at the country level and the extensive margin at the firm level. The model also provides insights on the persistence of bilateral trade flows, zero trade flows, and why less small firms enter empirically than the Melitz model predicts.

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[†]International Economics Department. Banco de España. Corresponding author: Alcalá 48; 28014 Madrid; Spain. e-mail: rubens at bde dot es.

[‡]International Economics Department. Banco de España. e-mail: josep dot vilarrubia at bde dot es.

1 Introduction and Literature Review

The recent availability of more disaggregated on international trade transactions has allowed trade economists to gain a deeper insight into the microeconomics of trade. A large body of literature (see, for instance, Roberts and Tybout, 1996, Bernard, Jensen, Redding, and Schott, 2007 and Bernard, Redding, and Schott 2007) have documented that exporting firms are very different from strictly domestic firms: they are larger (both in terms of sales and employment) and they are more productive (both in terms of valued added per worker and of total factor productivity). Trade has also been found to be quite persistent both in terms the export status of firms and on their trade volumes. The large increase in trade volumes we have observed in the recent decades has taken place mostly on two margins: at the intensive margin at the country level (over 92% of the increase in trade volume between 1970 and 2005 has taken place among pairs of countries that were already trading in 1970) and at the extensive margin in terms of firms or products (Bernard, Redding, and Schott, 2006).

Parallel to this empirical literature, an emerging theoretical literature (see Melitz, 2003 and Chaney, 2007) has also risen aiming to capture - in its different versions - several of these stylized facts. Despite this effort, there are still some questions lacking a convincing explanation, in particular the persistence of trade flows and the dynamic behavior of the extensive and intensive margin both at the country and firm level. This is mainly because these are static models built for another purpose.[1] For instance, Helpman, Melitz, and Rubinstein (2007) provides an explanation for the relative importance of the intensive versus the extensive margin at the country level but, being a static model is silent about the dynamics of those margins. The same is true for Chaney (2007) when explaining the importance of those margins at the firm level. Also, although the Melitz-Chaney framework does a good job at explaining why exporters are different than importers, it implies too much entry by smaller firms and a ranking of destinations that is at odds with the data, as pointed out by Eaton, Kortum and Kramarz (2005).

We build on these models by introducing an element that has been largely overlooked and which can account for the stylized facts above: *uncertainty*. In principle, there are several ways in which uncertainty could affect a firm's decision to start exports to a given foreign export market. From the demand side, a firm might be uncertain about the exact size of demand for its good in

[1] The original Melitz model is a dynamic model, but only the steady state is characterized.

the foreign market or about the adequacy of the product to local tastes. Another source of uncertainty could come from the supply side as the same firm might also not be fully aware of the legal requirements for selling its good in that particular market or the cost and adequacy of supply chains in the given country. In both cases, the firm can make an investment (for instance, performing a market study) which would reduce the degree of uncertainty and allow for improved decision-making. Nevertheless, an alternative source of information about foreign markets could originate in the observation of the actions and successes (or failures) of its rival domestic firms who also attempt breaking into that market. This gives raise to the existence of information externalities which in turn help explain the existence and persistence of international trade flows, as well as the relative importance of the intensive margin at the country level (since breaking into new markets is subject to uncertainty and could lead to a waiting game) and of the extensive margin at the product level (since most of the increase of aggregate trade flows would come from new firms starting the export on new varieties).

Despite its obvious importance, this ingredient appears to have been largely overlooked by the literature explaining the direction and volume of international trade flows. There are well known contributions that address the issue of entry into a given market under some kind of uncertainty and information externalities, such as Caplin and Leahy (1993) and (1998), or Rob (1991), but to our knowledge nobody has studied these ingredients in an international markets setup or with heterogeneous firms. To this end, we build a model that combines a framework of monopolistic competitive firms which are heterogeneous in their productivity levels as in Melitz (2003) and we model the decision-making process of firms under uncertainty as in Rob (1991). In our setup, firms breaking into export markets need to pay a known one-time sunk cost as well as an unknown per-period cost of presence in the foreign markets. After paying the sunk cost, the firm becomes informed about the true value of the per-period costs and can decide whether to continue operations in the foreign export market (which will do if the per-period revenues cover this per-period fixed cost). Prior knowledge of the per-period cost would allow firms to avoid paying the sunk cost whenever it is not profitable for them. In this setup, we allow firms to get information about this cost from the observation of the actions of the rest of firms in the market. The result is a learning game with endogenous timing where, if there is entry into a given market, more productive firms are the first to attempt entry into the export market while less productive firms optimally post-pone their entry waiting for more information about the true value of the cost to be revealed.

Our model has several implications that we can attempt to take to the data. A first one is that a large degree of uncertainty could preclude the existence of a trade flows for a given country. This will be the case in those instances when not even the most productive firm finds it profitable, in expected terms, to enter the export market. Nevertheless, if some firms find it profitable to enter, that triggers informational externalities that leads to sequential entry in that market: when outsiders observe some entrants being successful they learn about the characteristics of that market triggering further entry. However, it is also possible that entry stops before all the information about a market is revealed whenever the marginal entrant does not find it profitable to attempt entry given that informational externalities stop being strong enough to compensate the risk of entering a non-profitable market. Finally, these forces depend on the elasticity of substitution between products in a given sector among other variables.

In this draft we test for the importance that uncertainty has on the formation of trade links. We test whether variables that are associated with reductions in informational barriers across borders are associated with more trade links. The data confirms our intuition since we find that the presence of an embassy, consulate, or trade promotion office (which we associate with smaller informational uncertainty) is associated with a higher probability of observing a positive trade link between any two countries and, further, conditional on the link being formed, this variable has no effect on the bilateral trade flow.

2 General Setup

We build on the framework by Melitz (2003) and Chaney (2007) with firms interacting over several periods. Time is discrete, infinite, and we index it by t. At the beginning of each period, firms make production and pricing decisions and, at the end of the period, firms outside (who have not entered) the export market make the decision whether to remain out or enter that market given the information available to them (to be defined later).

2.1 Consumers

We consider a world consisting of J countries, indexed by $j = 0, 1, ...J$ where $j = 0$ represents what we indistinctly refer to as the domestic or home country while we refer to $j > 0$ as the foreign countries or export markets. Each country, j, is populated by a continuum of hand-to-mouth representative agents who have per-period preferences defined over the available set of goods Ω_t^j, which consist on an agricultural good A and a bundle of manufacturing goods M, distributed among S sectors. Each sector s contains an endogenously determined set of varieties. That is, per-period preferences are given by:[2]

$$u_t^j = c_{A,t}^j + \alpha \ln c_{M,t}^j, \ \alpha > 0, \text{ where} \tag{1}$$

$$c_{M,t}^j = \prod_{s=1}^{S} \left[\int_{\omega \epsilon \Omega_t^j} x_{st}^j(\omega)^{\frac{\sigma_s - 1}{\sigma_s}} d\omega \right]^{\frac{\sigma_s}{\sigma_s - 1} \cdot \mu_s}, \text{ with } \sum_{s=1}^{S} \mu_s = 1, \ \sigma_s > 1, \tag{2}$$

and consumers are subject to the budget constraint (normalizing the price of A to 1) $P_t^j \cdot c_{M,t}^j + c_{A,t}^j = Y_t^j$, where $x_{st}(\omega)$ represents the quantity consumed of variety ω from sector s at time t, σ_s is the elasticity of substitution between varieties from sector s and it is assumed to be the same for all varieties within a sector regardless of whether they are domestically produced or imported varieties, c_A is the tradable, homogeneous good produced using a constant returns to scale technology which requires one unit of labor per unit produced, P_t^j is the ideal price index of the manufacturing bundle and Y_t^j is income in country j at period t. Throughout the paper we will assume that demand for the homogeneous good A is large enough as for each country to produce that good, which allows us to normalize the wage rate in each country to 1. We also assume this homogeneous good sector is large enough to accommodate any kind of fluctuations in labor demand coming from heterogeneous goods producers, which simplifies the dynamic analysis of the model (that is, we assume that α is small enough). To see this notice that for a given total income of Y_t^j in country j, demands for goods A and M are given by

$$c_{M,t} = \alpha P_t^{j-1}, \, c_{A,t}^j = Y_t^j - \alpha.$$

Thus, the above assumptions allows us to isolate the manufacturing sector from income effects arising from entry and exit in that sector that would complicate the dynamics of the model. In other words, sector A will accommodate any income shocks to the domestic economy (particularly those coming from creation and destruction of firms).[3]

Consumers are endowed with one unit of labor, which they supply inelastically, and a single share of a diversified portfolio of all domestic firms. Whatever profits earned by firms (both domestically and in foreign markets) are completely redistributed to the consumers in units of the homogeneous

[2] Hand-to-mouth consumers are introduced to simplify the analysis and to center it on the supply side of the economy, abstracting from the consumers intertemporal problem.

[3] See Pfluger (2004) for a detailed discussion on this demand structure.

good. Given country j's income, Y_t^j, demand for a given heterogeneous variety of sector s in country j is given by:

$$x_{st}^j(\omega) = \frac{\widehat{p}_{st}^j(\omega)^{-\sigma_s} \cdot \mu_s \cdot \alpha}{P_{st}^{j\ 1-\sigma_s}} = \lambda_{st}^j \widehat{p}_{st}^j(\omega)^{-\sigma_s}, \tag{3}$$

where $\widehat{p}_{st}^j(\omega)$ is the price actually paid by country j's consumers for variety ω of sector s, and P_{st}^j is the ideal price index of sector s in country j which is defined as:

$$P_{st}^j = \left[\int_{\omega \epsilon \Omega_{st}^j} \widehat{p}_{st}^j(\omega)^{1-\sigma_s} d\omega \right]^{1/(1-\sigma_s)}. \tag{4}$$

2.2 Producers, Static Problem

We focus our analysis on the export market and, thus, we do not explicitly model entry and exit in the domestic market by domestic firms. Instead, we assume that the domestic side is determined as in the standard Melitz framework and that the needed regularity conditions are satisfied. We assume that each sector in each country has a continuous, but countable, set N_s^j of firms that produce a differentiated good and interact in monopolistic competition fashion.

Each individual firm has measure zero and firms are heterogeneous with respect to their productivity level φ which is drawn from the cumulative distribution function $H_s(\varphi)$ with support $[\underline{\varphi}_s, \overline{\varphi}_s]$, where $\overline{\varphi}_s > \underline{\varphi}_s > 0$. Given our structure, no firm has an incentive to produce the same variety as another firm which allows us to simply index firms according to their productivity level (φ). For simplicity, we assume that the distribution and support of productivities are the same in all sectors and countries. Furthermore, we assume that each domestic firm knows the productivity level of every other domestic firm (possibly from repeated interaction in the domestic market, possibly because the price a firm charges in the domestic market reveals information about its productivity). Firms discount future profits at a per-period rate of β.

Firms set their price to maximize their own profits and engage in monopolistic competition, i.e. when setting their own prices, they do not take into account their own effect neither on the wage or on the ideal price index of their sector. The production of one unit of output for a firm with productivity parameter φ has a variable cost of $w^j/\varphi = 1/\varphi$. Sales in the domestic market are only subject to this cost. However, when selling abroad, there are three additional costs that firms need to incur:

Transportation cost We assume transportation costs to be of the iceberg kind and denote them as τ_s^{ij} which represents the number of units that need to be shipped from country j in order for one unit of good to reach country i in sector s. Our assumptions regarding the domestic market imply that $\tau_s^{ii} = 1$, $\tau_s^{ij} > 1$ for $i \neq j$ and we further assume, without loss of generality,that these costs are symmetric i.e. $\tau_s^{ij} = \tau_s^{ji}$.

Sunk cost There is a known one-time sunk cost that a firm needs to pay in order gain access the foreign markets. We denote it by c_s^{ij} which represents the sunk cost that a firm in sector s of country j would need to sink in order to be able to access country i.

Fixed per-period cost We further assume that there is an *unknown* per-period fixed cost to the continued presence of a firm of country i in the foreign export market s in country j which we denote by f_s^{ij} with an analogous interpretation to the sunk cost. The value of this cost is distributed *i.i.d.* across markets and sectors according to the cdf $G_s\left(f^{ij}\right)$ over the range $\left[\underline{f}_s^{ij}, \overline{f}_s^{ij}\right]$.

The presence of fixed export costs implies that not all domestic firms are going to necessarily be active in the export market (even if there was perfect information about its value). These assumptions mean to capture the uncertainty that a firm faces when making the decision on whether to access a foreign market. We assume that the value of f_s^{ij} is revealed to firms that actually access the foreign market (after having paid c_s^{ij}). This introduces an asymmetry in the information set of entrants into the export market with respect to that of non-entrants. Furthermore, we assume that, after having paid c_s^{ij} and observing f_s^{ij}, the firm can costlessly switch off its exporting operations to country i. One possible simple, yet realistic, interpretation of this cost structure is that c_s^{ij} represents the (sunk) cost of adapting the firm's production structure to the possibility of entering export markets while f_s^{ij} represents the cost of sustaining a presence export market i for a firm in sector s.

The market structure implies that firms' pricing decisions are such that a firm in sector s with productivity φ charges a domestic price of:

$$p_s^j(\varphi) = \frac{\sigma_s}{\sigma_s - 1} \cdot \frac{1}{\varphi} \tag{5}$$

that is, firms in a sector charge a common and constant markup (that only depends on the elasticity of substitution with respect to other varieties within the same sector) over their own marginal cost, given by their productivity. Notice that the domestic price paid by country j's consumers differs from the one paid by consumers in country i because of the existence of iceberg transportation costs that, in our setup, introduce a wedge between the domestic and foreign price of any given variety. Thus, the price that a firm in country i charges to consumers in country j is

$$\widehat{p_s^{ij}}(\varphi) = \tau_s^{ij} \cdot p_s^j(\varphi) = \tau_s^{ij} \cdot \frac{\sigma_s}{\sigma_s - 1} \cdot \frac{1}{\varphi}. \tag{6}$$

Given this pricing decision, we can compute the per-period export revenues (gross of fixed and sunk costs) of a firm with productivity φ from sector s in country j that sells its good in country i as:

$$r_{st}^{ij}(\varphi) = \frac{1}{\sigma_s} \lambda_{st}^j \cdot \left(\frac{\sigma_s}{\sigma_s - 1} \cdot \frac{\tau_s^{ij}}{\varphi} \right)^{1-\sigma}, \tag{7}$$

where $r_{st}^{ij}(\varphi)$ only depends on time (t) exclusively via entry (and exit) into export markets (i.e. through the general equilibrium effect that entry of other firms has on the ideal price index).

In the next section we characterize the dynamic path of entry in export markets.

2.3 Dynamic Equilibrium

In what follows we analyze the dynamics of entry for a single sector s in a given market j, that is, the decision of entering a given export market.

We assume that outsiders only learn from the strict past, that is, decisions about entry at time t can only be based on observation of actions and market outcomes at times prior to t. Outsiders can not observe the realized profits (net of fixed costs) of domestic firms active in the export market but they can observe their actions, i.e. whether or not they remain active in the export market following entry. These assumptions amount to assuming that it is hard for a firm to disentangle the exact net profits of exporting for any given firm but can easily observe its presence and whether they are active in a given export market.

When solving for the equilibrium path of entry into export markets, we focus on the role of informational externalities which implies ignoring the general equilibrium effects on price indices (as in Melitz, 2003).[4] That is,

[4] Remember we assume that each firm is a price-taker of zero measure which allows us to ignore any kind of strategic complementary/substitutability.

we do not take into account strategic complementarities/substitutabilities through payoffs. The reason for that is twofold. First, we want to focus our analysis on the role that informational asymmetries and externalities have in this setup. Secondly, introducing strategic complementarities and substitutabilities, although certainly interesting, would complicate our analysis beyond the scope of this paper.[5] We also abstract from other strategical considerations such as firms trying to conceal information from outsiders by attempting to conceal their actions.

Our information structure implies that the only relevant information to a firm when making the entry decision is the identity of the least productive firm that exported in any period prior to t since this determines the upper bound for the per-period fixed export cost: if a firm observes another firm with productivity φ' at time t being active in the export market, this implies that the fixed per-period cost can be at most $r_{st}(\varphi')$ since this firm has learnt the true value of f and it would only choose to remain active if doing so was profitable (that is, it can cover at least the per-period fix cost, but not necessarily the sunk cost). In other words, if a firm is active in the export market, given that c_s^{ij} is sunk, it needs to be the case that per-period revenue is no less than the per-period fixed cost of being in the export market, $f_{st}^{ij} \leq r_{st}^{ij}(\varphi_{st}^{ij})$, where φ_{st}^{ij} is the productivity (and identity) of the least productive firm from country j active in the export market i in sector s at time t. Thus, a firm making the entry decision at time t can infer that the per-period fixed cost is distributed according to $G\left(f_s^{ij} | f_s^{ij} \leq f_{st}^{ij}\right)$ where:

$$G(f_s^{ij} | f_s^{ij} \leq f_{st}^{ij}) = \frac{G(f_s^{ij})}{G(f_{st}^{ij})}$$

We characterize a stationary (Markovian) equilibrium path of entry in the fashion of Rob (1991). Entry flow at any point in time depends only on the state, which in this setup is defined by the existing set of firms which are in the export market and the available information about the fixed cost.

In a given period t, we define χ_{st}^{ij} as the set of domestic firms active in the export market, and denote as δ_{st+1}^{ij} the flow of entrants between t and $t+1$. The equilibrium is going to be sequential in productivity (more productive firms enter first), which means that if a firm with a given productivity is active in the export market, all firms more productive than her should be too This means that it is sufficient to know the identity of the least productive

[5] For instance, if we had strategic complementarities, the solution would be a dynamic global game, with heterogeneous agents and endogenous timing.

active exporter in the previous period, φ_t, to characterize χ_{st}^{ij}. For the same reason, given φ_{st}^{ij}, it is enough to know φ_{st+1}^{ij} to characterize δ_{st+1}^{ij}.[6]

Notice that, given the observation of other firm's action in previous periods, an outsider firm can infer more information regarding the true value of f_s^{ij}. More specifically, if she observes that the identity of the last entrant, φ_{st+1}^{ij}, differs from that of the last active firm, $\widetilde{\varphi_{st+1}^{ij}}$ (with associated per period cost of $\widetilde{f_{st+1}^{ij}}$), this means that either no other firm tried to enter in the previous period, or some did but failed (had negative per-period profits). Thus, at each period t the prior about the distribution of f_s^{ij} is given by

$$G_t(f_s^{ij}) = \begin{cases} G(f_s^{ij}) \text{ over } \left[\underline{f}_s^{ij}, \overline{f}_s^{ij}\right] \text{ if } t = 0 \\ G(f_s^{ij}|f_s^{ij} \leq f_{st}^{ij}) \text{ if } f_{st+1}^{ij} = \widetilde{f_{st+1}^{ij}} < f_{st-t'}^{ij} \ \forall t' > 0 \\ f_{st}^{ij} \text{ otherwise,} \end{cases} \tag{8}$$

where we use the inferred fixed cost from the break-even condition of producers to define the Bayesian updating.

We now compute what the best response is for an outsider firm (i.e. that was not active in the export market) in period t given the behavior followed by the rest of firms. Given $G_t(f_s^{ij})$ and the strategies of the rest of outsiders, an outsider with productivity φ can, in period t, compute what the expected release of new information is going to be in subsequent periods. The release of information in future periods can occur in two ways. If all entrants remain in the export market, an outsider can further truncate its prior about the distribution of f_s^{ij}. On the other hand, if some firms enter the export market and subsequently leave it, the outsider can infer the exact value of f_s^{ij} by equating it to the revenue of the last remaining active firm. This means that, given f_{st}^{ij}, a firm can compute what the expected f_{st+1}^{ij} will be assuming the true cost is not discovered. The firm can, therefore, optimally decide whether to enter today or wait for the arrival of new information given the strategies and action of other firms. Note that, once the firm can compute the expected value of f_{st+1}^{ij}, she can also compute the expected probability that full information regarding the value of f_s^{ij} will be revealed in the next period.

[6]We chose to proceed in this way for simplicity. Alternatively we could solve for the equilibrium without sequentiality and then show that it has to be the case. But it is trivial to show that entry has to be sequential. Because of the properties of W, if there is initial entry in period 0 then we have entry of a continuous set of the most productive firms. If this is the case, in period 1 the same is going to happen. And so on. See the Appedix for details.

From the discussion we know that at time t all outsiders have productivities $\varphi \leq \varphi_{st}^{ij}$, where φ_{st}^{ij} is the productivity of the least productive firm from sector s in country j which is active in export market i at time t. For an outsider to make the decision to enter, she has to find it profitable to enter today instead of waiting for the (potential) release of new information. Thus, we are searching for the firm that is indifferent between entering this period and postponing entry for one additional period.[7] We assume that, when indifferent between the two options, a firm decides to enter.

For later use, we find it convenient to define $V^e(\varphi)$ (with corresponding per-period revenue $r_s^{ij}(\varphi)$) as the value of entry (the present discounted of future revenues) that a firm with productivity φ would have under perfect information given that everybody with non-negative profits also decides to enter that market:

$$V^e(\varphi) = \sum_{t=0}^{\infty} \beta^t (r(\varphi) - f_s^{ij}) - c = \frac{1}{1-\beta}(r(\varphi) - f_s^{ij}) - c_s^{ij} \tag{9}$$

We find it convenient to define $f_s^{ij}(\varphi) = r(\varphi) - (1-\beta) \cdot c_s^{ij}$ which corresponds to the maximum fixed cost a firm with productivity φ can incur under no uncertainty. Conversely, we use $\varphi_s^{ij} = \varphi\left(f_s^{ij}\right)$ to denote the productivity (and identity) of the last firm that would have non-negative profits for a given true value of f_s^{ij}, that is

$$\varphi \;\; s.t. \;\; \varphi = r^{-1}(f_s^{ij} + (1-\beta) \cdot c) \tag{10}$$

Define gross revenue for a firm with productivity φ (who is outside the export market) given the state variable (the cutoff productivity to enter the export market) and this period's entry flow as:

$$r(\varphi; \varphi_{st}^{ij}, \varphi_{st+1}^{ij}). \tag{11}$$

[7] The value of waiting for n periods before entering trivially falls at a rate of β^n for firms that weakly prefer to enter than waiting for one period, and since we know that $\beta < 1$, waiting for any number of periods $n > 1$ is strictly dominated by waiting for only one period. The reason is trivial. If waiting for more information until tomorrow does not convince a firm to wait, waiting for two periods is even less preferred, as less information will be released then. Thus, in characterizing the optimal equilibrium path we only need to consider those firms which are deciding between entering today and waiting for one additional period. Of course some firms may be indifferent between entering today and waiting for two periods, but we do not need to worry about this case since these firms do not define the equilibrium path of entry.

Clearly the function $r(\varphi;\varphi_{st}^{ij},\varphi_{st+1}^{ij})$ is increasing in the first argument and decreasing in the other two.[8] This implies that, if there is inefficient entry (by firms with productivity below $\varphi\left(f_s^{ij}\right)$), gross revenue for those firms are below those under perfect information. In terms of our model, this means that $r(\varphi;\varphi_{st}^{ij},\varphi_{st+1}^{ij}) > r(\varphi)\ \forall\varphi$ as long as $\varphi_{t+1} \geq \varphi(f)$.

In what follows we focus our analysis in firms in a given sector of the domestic country breaking into a single foreign market and, therefore, drop the sub and super indexes. The dynamics of the rest of sectors in the rest of foreign markets are analogous.[9]

We use $V^e(\varphi;\varphi_t,\varphi_{t+1})$ to denote the value of entering the foreign markets at time t and $V^w(\varphi;\varphi_t,\varphi_{t+1})$ the value of waiting i.e. of postponing the entry decision for one extra period. We characterize the equilibrium path of entry when information has not been fully revealed. The entry decision when there is full information is trivial, entry stops after this point. We incorporate this possibility later. Notice that we abuse notation by using φ_s and f_s interchangeably.

From the previous discussion, the value of entering in period t is given by:

$$V_t^e(\varphi;\varphi_t,\varphi_{t+1},c) = r(\varphi;\varphi_t,\varphi_{t+1}) - E_t(f|f \leq f_t) - c + E_t\left[\sum_{j=1}^{\infty}\beta^j \max\{0, r(\varphi;\varphi_{t+j},\varphi_{t+j+1}) - f\}|f \leq f_t\right]. \quad (12)$$

That is, if a firm enters the export market today, she gets this period's gross revenues –$r(\varphi;\varphi_t,\varphi_{t+1})$ –, covers the sunk cost c and the fixed cost which, in expected terms, is $E_t(f|f \leq f_t)$ for a given f_t. From the next period onwards, the firm knows the exact value of the per-period fixed cost and earns an infinitely-lived stream of profits if the fixed cost is below her per-period revenues, or exits the export market and gets nothing if the fixed cost is above per-period revenue (but the firm can not recoup the sunk cost c).

[8] Notice the slight abuse of notation. First, the effect of φ_{st}^{ij} and φ_{st+1}^{ij} on revenues goes through λ_{st}^{j}, and second, it is enough to know φ_{st+1}^{ij} (total entry up until today) to determine revenues.

[9] Notice that because of the Cobb-Douglas agregation of sectors we can analyze each sector separately without loss of generality.

The value of waiting and entering the following period if there is still uncertainty is given by:

$$V_t^w(\varphi;\varphi_t,\varphi_{t+1},c) = \beta\left(p_I \cdot E_t\left[\max\{0,\tfrac{1}{1-\beta}\left[r(\varphi)-f\right]-c\}|f_{t+1}\leq f<f(\varphi)\}\right]\right)$$
$$+\beta\times\left((1-p_I)\cdot E_t\left[\sum_{j=1}^{\infty}\beta^j\max\{0,r(\varphi;\varphi_{t+j},\varphi_{t+j+1})-f\}|f\leq f_t\right]\right). \tag{13}$$

In words, if a firm decides to postpone entry, then she gets (and pays) nothing at time t. The payoff to the firm in future periods has two components which depend on the amount of information that is released between t and $t+1$. Firstly, with some probability (p_I), the firm might become perfectly informed about the true value of f in the next period. This will occur whenever there are unsuccessful entrants and the firm can infer the true value of f from the per-period revenues of the remaining least active firm in the export market. In this case, the firm optimally decides whether to enter the export market at time $t+1$ if its revenues are sufficiently large to cover the per-period fixed cost as well as the annuity value of the sunk cost. We refer to p_I as the probability of becoming perfectly informed i.e. of the information set degenerating to a singleton.

The second component of the waiting option corresponds to the payoff that the firm gets in the complementary case, i.e. when perfect information about the true value of f is not released but, nevertheless, some information is still revealed from the fact that the support of f gets further truncated thanks to the mass of (successful) entrants of time t. Since firms are rational, they anticipate this possibility at time t.

Given the flow of entry today, the probability of becoming perfectly informed is given by

$$p_I = \Pr\left(f_{t+1}<f\ <f_t|f\leq f_t\right) = \frac{G\left(f_t\right)-G\left(f_{t+1}\right)}{G\left(f_t\right)}.$$

Using this expression, we can rewrite the value of waiting for one additional period as:

$$V_t^w(\varphi;\varphi_t,\varphi_{t+1},c) = \frac{\beta}{1-\beta}\frac{G(f(\varphi))-G(f_{t+1})}{G(f_t)}\cdot$$
$$\max\left\{0,(r(\varphi)-(1-\beta)\cdot c-E_t(f|f_{t+1}<f<f(\varphi))\right\}+$$
$$\frac{G(f_{t+1})}{G(f_t)}\cdot E_t\left[\sum_{j=1}^{\infty}\beta^j\left(\max\{0,r(\varphi;\varphi_{t+j},\varphi_{t+j+1})-f\}-c\right)|f\leq f_{t+1}\right].$$

That is, if a firm decides to wait and all information is released, it will only enter whenever it is profitable to do so with certainty, $f < f(\varphi)$. If information does not get fully revealed, the firm will be in a similar position as that of today but with $f \leq f_{t+1}$.

We denote by $W_t(\varphi; f_t, f_{t+1,}c)$ the difference between the value of entering or waiting one period for a firm of productivity φ given the value of f_t.and the expected value of f_{t+1},

$$W_t(\varphi; \varphi_t, \varphi_{t+1}, c) = V_t^e(\varphi; \varphi_t, \varphi_{t+1}) - V_t^w(\varphi; \varphi_t, \varphi_{t+1}, c) \tag{14}$$

We can rewrite this as (see Appendix for details):

$$\begin{aligned} W_t(\varphi; \varphi_t, \varphi_{t+1}, c) &= r(\varphi; \varphi_t, \varphi_{t+1}) - E_t(f|f \leq f_t) - c\left(1 - \beta\frac{G(\varphi_{t+1})}{G(\varphi_t)}\right) \\ &+ \frac{\beta}{1-\beta}\frac{G(f_t) - G(f_{t+1})}{G(f_t)} E_t[\max\{0, r(\varphi) - f\} - \\ &\max\{0, (r(\varphi) - (1-\beta)\cdot c - f\}\,|f_{t+1} < f < f_t], \end{aligned}$$

which is very convenient as the last term is always non-negative. We proceed by stating some properties of this function

Lemma 1 $\frac{\partial W(\cdot)}{\partial \varphi} > 0$*, that is, earlier entry is more attractive the more productive a firm is.*

Proof. *See Appendix* ■

Lemma 1 just states that entry is always more attractive for more productive firms. This just follows from the fact that more productive firms can afford larger fixed costs because they have larger revenues, which implies that the incentives to wait for the release of additional information is less valuable for them.

Lemma 2 $\frac{\partial W(\cdot)}{\partial f_{t+1}} \geq 0$*, that is, the lower the entry flow in the current period, the larger the incentive of firms for earlier entry into export markets.*

Proof. *See Appendix* ■

Lemma 2 just states that the less information is going to be released in a given period, the smaller the incentives to wait. That is, if not many firms are going to enter in a given period, the benefits derived from waiting are small when compared to entry.

Also, the appendix shows that $(\partial W(\cdot)/\partial f_{t+1}) \propto \max\{g(f_{t+1}) \times (f(\varphi) - f_{t+1}), 0\}$. Whenever $f(\varphi) < f_{t+1}$, by waiting the firm may ensure a positive net present value. Thus, reducing f_{t+1} decreases the probability of that happening, which in turn makes entry more attractive. If $f(\varphi) > f_{t+1}$ then changing f_{t+1} does not have any effect on that probability, as the firm is almost certain to have zero net present value from entry, which in turn implies that the relative value of entry does not change.

Lemma 3 *If $f_{t+1} < f_t$, and $W(\varphi_{t+1}; \varphi_t, \varphi_{t+1}, c) = 0$, then it must be the case that $W(\varphi_{t+1}; \varphi_{t+1}, \varphi_{t+1}, c) > 0$.*

Proof. *See Appendix* ■

$W(\varphi_{t+1}; \varphi_t, \varphi_{t+1}, c) = 0$ is the condition required for entry today up to f_{t+1} given entry yesterday up to f_t (see Proposition 1 for a discussion of this). Lemma 3 just states that if in period t there was entry up to the firm characterized by f_{t+1} then, in period $t+1$, a firm with a slightly lower productivity (the most productive firm that did not enter in period t) strictly prefers to enter if she is the only entrant.

Proposition 1 *(zero trade flows)*

$$W_t(\overline{\varphi}; \overline{\varphi}, \overline{\varphi}, c) = r\left(\overline{\varphi}\right) - E\left(f\right) - c(1 - \beta G(\overline{\varphi})) > 0 \qquad \text{(Condition 1)}$$

is a necessary and sufficient condition for positive trade flows to exist.

Proof. *See Appendix* ■

Proposition 1 just states that in order to have entry into a given market, it has to be profitable to do so at least for the most productive firm if she is the only one to enter. Notice the difference with what we would have if we did not consider the option to wait. In that case the most productive firm would enter if $r\left(\overline{\varphi}\right) > E\left(f\right) - c(1-\beta)$. That is, given the option to wait, firms are more reluctant to enter. The reason is that information is valuable because it may allow them to save the sunk cost and thus, they only enter if it is profitable enough to compensate for the risk of doing a mistake, $G(\overline{\varphi})$.

Proposition 2 *(sequential entry) Given $r\left(\overline{\varphi}\right) - E\left(f\right) - c(1 - \beta \cdot G(\overline{\varphi})) > 0$, the last firm to attempt entry at time t will be the one with productivity $\widetilde{\varphi}$ such that $W(\widetilde{\varphi}; \varphi_t, \varphi_{t+1}, c) = 0$ unless the distribution of priors about f has previously collapsed because of the existence of unsuccessful entrants to the export market. In that case entry stops. Entry is characterized by the fix point of that condition, $W(\varphi_{t+1}; \varphi_t, \varphi_{t+1}, c) = 0$*

Proof. *See Appendix* ■

Thus the equilibrium sequence of entry is characterized by the equation $W(\varphi_{t+1};\varphi_t,\varphi_{t+1},c)=0$ unless somebody enters the export market but does not remain active the following period, that is, someone actually makes a mistake. In other words, there is entry until the true cost is revealed. Analyzing the law of motion defined by $W(\varphi_{t+1},\varphi_t,\varphi_{t+1},c)=0$ more closely,

$$r(\varphi;\varphi_t,\varphi_{t+1})-E_t(f|f\leq f_t)=c\cdot\left(1-\beta\frac{G(\varphi_{t+1})}{G(\varphi_t)}\right). \tag{15}$$

What this equation shows is that in order to be indifferent between entering today and waiting for an additional period, the cost of waiting (potentially lost revenue today, $r(\varphi;\varphi_t,\varphi_{t+1})-E_t(f|f\leq f_t)$ needs to be equal to the expected gain thanks to the reduced uncertainty next period. The expected gain from this reduced uncertainty is just given by the fact that with some probability information might be released, allowing the firm to save the sunk cost in those cases where it would not have been optimal to enter.

The last part of the equilibrium characterization consists of establishing whether it is the case that the equilibrium path of entry always leads to full information. To see this, notice that the law of motion implies convergence to a productivity level which we denote by φ_∞ and that is defined by

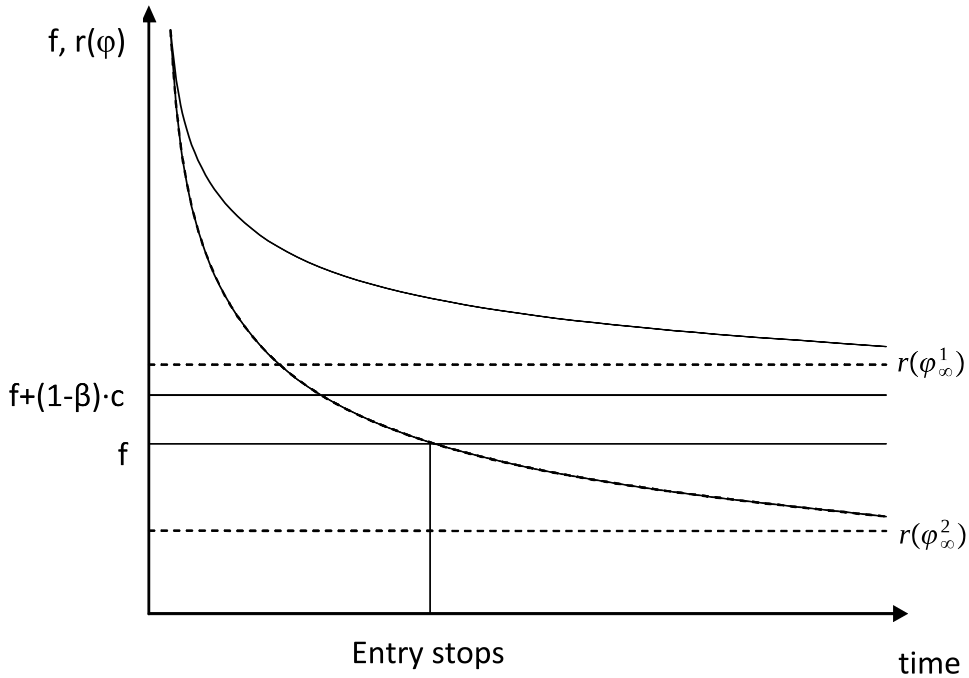
$$r(\varphi_\infty;\varphi_\infty,\varphi_\infty)-E_t(f|f\leq f_\infty)=c(1-\beta). \tag{16}$$

It is obvious that if $E_t(f|f\leq f_\infty)<f$, entry is going to stop before full information is revealed. The next proposition summarizes the long run properties of the equilibrium:

Proposition 3 *Given* $r(\overline{\varphi})-E(f)-c(1-\beta\cdot G(\overline{\varphi}))>0$*, there are two types of equilibria. In the first one (if* $f<E_t(f|f\leq f_\infty)$*) the last entrant converges (possibly not in finite time) to* φ_∞ *defined in* (16)*. In the second case (if* $f\geq E_t(f|f\leq f_\infty)$*), entry stops when one or more firms make a mistake.*

Proof. *In text* ■

Figure 1 summarizes these 2 cases.



The first case, where the productivity of the last entrant converges to φ^1_∞, reflects those instances where entry does not reveal enough information (or at sufficiently fast pace) as to convince outsiders to attempt entry and sink the cost even when, under perfect information, these outsiders would have positive profits from entry into export markets. The other possibility is the one depicted by the second case (φ^2_∞) where entry is faster and only stops due to the existence of unsuccessful entrants and the true value of f being revealed. The following corollary summarizes which conditions make it more likely to have full information being revealed:

Corollary 4 *Full information is more likely to be revealed when the demand of the sector is less elastic, the actual fixed cost is large, the tails of the distribution are thick, and firms are more impatient (that is the smaller β is).*

The corollary is just a straightforward interpretation of the condition $f \geq E_t(f|f \leq f_\infty)$. The more elastic the demand of a sector is, the smaller the number of firms that the market can support (everything else being equal) and thus the less likely the two curves are going to cross. The thicker the tail of the distribution of f, the more weight firms put on low values of f. Expecting f to be low with high probability is going to lead to more entry, making it more likely for the two curves to cross. Finally, the more impatient firms are, the less they value the option of waiting for more information, which leads to more entry and makes it more likely that full information will be revealed.

The next section discusses the properties of the equilibrium in more details along with some additional implications of the model.

2.4 Properties of the equilibrium

2.4.1 Hysteresis and the lack of entrance of small firms

Notice that, when information is fully revealed, by construction some firms have made a mistake and stay in the market with negative net present value (inclusive of sunk costs), that is, we have long-run hysteresis. Although empirically relevant, we see this as a flaw of our model, consequence of having discrete time and not having an exogenous probability of death. We conjecture that with continuous time we would have still two types of equilibria, one with full information being revealed, but where there are no mistakes and with convergence to the true cost, as in Caplin and Leahy (1993).

One interesting result is the fact that we can generate an explanation for what Eaton, Kortum and Kramarz (2005) denote as the failure of the Zip's Law. These authors note that in the data we observe less entrance by small firms than that predicted by Melitz model. In our model, this would correspond to the case when information stops being revealed at some point. In other words, one could argue that a reason why we observe less entry of smaller than the Melitz model would predict is due to the existence of uncertainty, and that informational externalities are, in some cases, not strong enough as to fully lift this uncertainty.

2.4.2 Asymmetric trade flows and "contagion" effects

From our framework, and similar to Helpman, Melitz, and Rubinstein (2007), it is obvious that we can account for the existence of asymmetric trade flows (or, more concretely, for the asymmetric existence of positive trade flows). As long as there are different degrees associated with different markets and/or informational flows are not symmetric between two countries, we would expect to see these asymmetric flows, even if the true fixed costs are the same. This implication is something we investigate carefully in the empirical section.

Also, the model delivers what we have termed as *"contagion"* effects. Notice than in the standard Melitz model, the more firms were present in a given market yesterday the less likely a given firm is going to enter today because of general equilibrium effects. This is because the increased size of exporters puts pressure on endowments, namely labor, which drives up their cost and reduces the incentives to export of other firms. In our model, we have an additional force, that works on the opposite direction. The more firms are present in a given market, the more information is released to outsiders, which could potentially overcome the general equilibrium forces (unfortunately we are silent about this second force as our structure kills those general equilibrium effects). Whether this is empirically relevant is something we plan to evaluate in the future.

2.4.3 A view of the recent history of world trade from our framework

Imagine we are back in the aftermath of WWII, traditional trade routes and relations have been disrupted and assume that no country is trading with each other. Which trade flows would our model predict?

Countries would start trading with other countries and in sectors for which they have better information. Once these links have been formed, no more trading partners and/or sectors would be added to those flows unless new information comes about or uncertainty is somehow reduced. However, those countries and in those sectors on which they started trading, more information is going to be revealed thanks to informational externalities from those firms that attempt entry to those who stay out. As this information is revealed more firms are going to enter those given sectors in those particular countries, which in turn is going to reveal even more information in a dynamic that feeds off itself. Thus, our model would predict dynamics consistent with what we observe in the data, this is that most of the recent increases in trade volumes have occurred at the intensive margin at the country level (between countries that were already trading) and at the extensive margin at the firm level (new firms/products enter those markets where other firms are also trading).Of course we do not claim that this is the whole story, but we claim that uncertainty and informational externalities through the action of exporters might contribute to explain these dynamics.

3 Empirical Exercise

One important prediction of our model is that the existence of informational asymmetries could cause bilateral trade flows between two countries to be zero in the case where not even the most productive firms finds it profitable to attempt entry into the export market. This is the first prediction that we set out to test using sectoral data on bilateral trade flows.

3.1 Data Description

We pool data from a variety of sources. Sectoral data on bilateral trade flows has been obtained from Feenstra et al. (2005) which provides a thorough description of the dataset. These data contain information about bilateral trade flows between 1962 and 2000 among a 183 countries and regions at the 4-digit SITC level. For computational purposes, we collapse these data into 69 two-digit SITC industries. For instance, industry 73 refers to "Metalworking machinery" and industry 83 includes "Travel goods, handbags, and other similar containers". We merge these data with the dataset from Ruiz and Vilarrubia (2007) to obtain data on bilateral characteristics such as distance, the presence of land border, trade agreements, currency unions, etc. as well as individual country characteristics such as GDP, GDP per capita, landlocked and island status.

One of the proxies that we use for the existence of informational flows or, equivalently, for the absence of informational asymmetries in a given bilateral relationship is the presence of an embassy, a consulate or a trade promotion office. These data are obtained from Rose (2005) and they include data on the total number of these offices from a given country present in every other country in the sample as well as information on the number of employees in this function. Another important set of variables also from Rose (2005) are those relating to a country's general attractiveness and geopolitical importance such as the number of guides available for the destination country (Zagat's, Lonely Planet, Economist City Guides, Michelin and Baedeker) and the number of Condé-Nast Top 100 destinations in the country in the former category and in a first set as well as indicator for natural resources (proven oil reserves and proven natural gas reserves) and military spending. In terms of our analysis, there are two drawbacks to this impressive dataset. Firstly, it is only available for 21 exporting countries which report their presence vis-à-vis around 200 countries and territories. Secondly, data is only available for years 2002 and 2003 which causes our analysis to focus on cross-section results instead of the potentially richer panel effects that we might observe.

After merging all these data together we are left with a cross-section (for year 2000) of bilateral trade flows corresponding to 21 exporters, with respect to 159 importers, in 63 two-digit SITC industries[10] and with all the aforementioned information about the bilateral relationship characteristics as well as individual country characteristics. The Data Appendix provides detailed information on the dataset, exporters, importers, industries as well as summary statistics of the variables subsequently used in the estimation.

The presence of a significant portion of zero's in bilateral trade flows has already been documented in the literature. For instance, Helpman, Melitz, and Rubinstein, (2007) report that over half of all potential bilateral flows take a value of zero meaning that they would not be taken into account properly if one were to use the traditional gravity equation approach in logarithms. Given that we are interested in exploiting this feature of the data, we investigate the importance of zero flows in our data. We find that just over two thirds of our trade flows do indeed correspond to zeroes. The reason for this number – significantly larger than the one found by Helpman, Melitz, and Rubinstein – is that, even though we use a restricted set of exporters for which we believe data is more likely to be available, we are considering industry flows at the two-digit SITC level. This intuition is confirmed by the fact that if we collapse the industry dimension of our data and examine the fraction of zeros in aggregate bilateral trade flows this is only around 7%. These more disaggregated flows are more likely to contain a significantly higher fraction of zeros than aggregate bilateral flows. Furthermore, as one would expect, the degree of heterogeneity across industries is rather large with industries such as Electric current (35) where just over 98% of all observations correspond to zeros, and industries such as Electrical Machinery (77) where the fraction of zeros is just 37%. Table A4 in the data appendix shows the fraction of zeros in bilateral trade flows for each industry.

3.2 Econometric Procedure

In order to investigate the role of informational asymmetries, we employ a two-stage procedure very similar to the one developed by Helpman, Melitz, and Rubinstein (2007) which aims to correct for two effects: (1) the importance of the extensive and an intensive margin in adjusting the total volume

[10] We drop those industries that belong to category 9 in the SITC classification (Commodities and transactions not classified elsewhere in the SITC).

of trade, and (2) the existence of a big amount of zero bilateral trade flows in international trade. This procedure constitutes an extension of the classic Heckman (1979) sample selection correction procedure augmented in order to take into account the heterogeneous nature of the agents determining aggregate bilateral trade among countries. In this setup, parameter identification requires the existence of a variable that affects the probability of observing a non-zero flow between two countries (alternatively, a variable which affects both decisions in opposite directions, as does the land border dummy variable, would also work). More formally, in a first stage, these authors estimate a probit equation of the type:

$$\rho_{ij}^{T} = \Pr\left[1(T_{ij}) = 1\right] = \Phi(X_{ij}, Z_{ij}, \varepsilon_{ij}^{T}), \tag{17}$$

where $1(T_{ij})$ is an indicator function that takes a value of 1 when the there is a positive trade flow from country i to country j in sector s and zero otherwise; Φ is the cdf of the standardized normal distribution, X_{ij} correspond to variable which affect both the probability and the volume of trade, Z_{ij} are variable that are used for our exclusion restriction i.e. those that affect the probability of observing a positive volume of trade without actually affecting the trade volume if these was to be positive. The error term, ε_{ij}^{T}, is assumed to be contain an exporter and an importer fixed effect with the following structure $\varepsilon_{ij}^{T} = \delta_i^T + \delta_j^T + \nu_{ij}^T$ where ν_{ij}^T is assumed to be well-behaved error term. If we estimate equation (17) using non-linear methods such as a probit, the use of exporter and importer dummies to capture its respective fixed effect might introduce bias in the coefficients of the rest of variables $(X_{ij,}\ Z_{ij})$ but not on their estimated marginal effects.[11] As a robustness check, we also estimate equation (17) using a linear probability method where the we can safely use a full set of exporter and importer dummies to capture the fixed effects.

We include in X_{ij} variables such as (the log of) bilateral distance as well as dummy variables for the presence of a land border, of a common language, and common membership in a regional free trade area or a currency union. Given our assumption on the error structure, we can not use among X_{ij} any variable which are either exporter or importer specific such GDP, population or land area. Following this regression, we construct the inverse Mills ratio which is included as a regressor in the next step. Also with the results from the first stage, we are able to construct a polynomial approximation that accounts for the correction for firm size heterogeneity. Next, we include these two terms in the gravity estimation of trade volumes:

[11] See Fernández-Val (2007)

$$T_{ij} = f(X_{ij}, \eta_{ij}, h(\omega_{ij}), \varepsilon_{ij}^{G}), \tag{18}$$

where η_{ij} corresponds to the inverse Mills ratio and $h(\omega_{ij})$ is the polynomial approximation to the correction for firm heterogeneity; and ν_{ij} is an error term which, again contains an exporter and importer fixed effect as $\varepsilon_{ij}^{G} = \delta_{i}^{G} + \delta_{j}^{G} + \nu_{ij}^{G}$ where ν_{ij}^{G} is a well-behaved error term.

In terms of our setup, we run the above equation for every sector s. and the variable we use as the one that affects the probability of trading but not the volume of trade (Z_{ij}) is a dummy variable that accounts for the presence of an embassy or trade promotion office of country i in country j. We argue that the presence of an embassy (or consulate) or a trade office reduces informational asymmetries that might exist between the source and the destination country thus increasing the possibility that firms in country i actually do enter market j.

As Rose (2005) rightfully points out there is a potential source of endogeneity on the decision to set up an embassy or a foreign trade promotion office: the decision of country i to set up an office in country j might be related to the potential that market j offers to firms in country i. We recognize this possibility and attempt to correct introducing another stage in our procedure, where we proxy the probability of setting up a foreign mission on a set of variables that attempt to capture the general attractiveness of a country as well as its geopolitical importance. A first set of instruments includes the number of Zagat's guides, the number of Condé-Nast Top 100 destinations in the country, the number of Lonely Planet guides, the number of Economist city guides. As a robustness check, we extend our instrument set to include information about other guides (Michelin and Baedeker). It is important to note that, unlike Rose (2005), we do not include in any of the specifications where we estimate the probability of the existence of an embassy or trade promotion office variables such as the volume of oil and gas proven reserves since our measure of aggregate bilateral trade includes trade in precisely those commodities and their inclusion could bias our estimates in later stages. More specifically, we run a probit model the probability that country i has set up a foreign mission in country j and thus, for every sector s, we run the regression:

$$\rho_{ij}^{Z} = \Pr[1(Z_{ij} = 1) = \Phi(X_{ij}, \omega_{ij}, \varepsilon_{\imath j}^{Z}), \tag{19}$$

where we also include the bilateral characteristics of country i and j as well as the aforementioned set(s) of instruments (ω_{ij}) and an error term where we, again, allow for exporter and importer fixed effects, $\varepsilon_{ij}^{Z} = \delta_{i}^{Z} +$

$\delta_j^Z + \nu_{ij}^Z$. We estimate this equation and include its predicted value $\widehat{\rho_{ij}^Z}$ as a regressor in equation (17) instead of Z_{ij}. We perform two robustness checks regarding this stage. Firstly, we estimate equation (19) using a linear probability model instead of a probit. For the second robustness check, we merge the estimation of equation (19) and (17),

3.3 Aggregate Results

Table 1 reports the results for the estimation of equations (17) and (18). In the first panel of table 1, we report the marginal effects corresponding to the first-stage estimation where we estimate a probit on the existence of a positive (as opposite to zero) trade flow. Our variable of interest, the presence of a foreign office, increases the probability of observing a trade flow between a country pair by around 5.8% with the coefficient being very robust across our specifications. Among the variables, we find that increased distance between any two countries reduces the probability of one setting up an embassy or trade promotion office in the other while sharing a land border or a common language do not appear to have a robust statistical effect on this probability. These results need to be taken with some caution since they might be conditioned by two facts. First of all, we only have data on bilateral trade promotion offices for a small subset of exporting countries. Secondly, the decision to set up a trade promotion office might be endogenous to the existence and the volume of trade and correlated to other variables. While we do not have a solution for the first problem, we believe we are able to correct for the second one later on. We do not report the *pseudo*-R^2 for these regression but it is around 0.46 for all of them. As a robustness check, we redo the estimation using the linear probability method with the results remaining qualitatively very similar for this stage. The results are reported in the last three columns of the first panel in Table 1.

The second panel of table 1 shows the results of the estimating equation (18) but does not report neither the exporter and importer fixed effects nor the coefficients that account for the sample selection problem – η_{ij} or the polynomial approximation to $h(\omega_{ij})$ – that we obtained from the first stage. It is, however, important to point that these later set of coefficients are found to be jointly significant different from zero as the $F - test$ at the bottom of the table shows. The coefficients on the rest of variables are in line with the findings of the literature: the elasticity of trade volume to distance is around -0.7 which is slightly below what other studies have

Table 1: Estimation with aggregate trade flows

Panel 1: Existence of trade flows

Dependent variable is dummy for the presence of a non-zero trade flow between exporter and importer.

	Probit			OLS		
Presence of a trade office dummy	0.058***	0.059***	0.060***	0.078***	0.078***	0.075***
	(0.017)	(0.017)	(0.017)	(0.012)	(0.012)	(0.012)
Distance (log)	-0.050***	-0.050***	-0.051***	-0.021***	-0.021***	-0.027***
	(0.017)	(0.017)	(0.017)	(0.007)	(0.007)	(0.008)
Land border dummy	-0.282*	-0.281*	-0.291	-0.028	-0.028	-0.024
	(0.145)	(0.146)	(0.151)	(0.021)	(0.021)	(0.021)
Common language dummy		-0.007	-0.007		0.003	0.003
		(0.017)	(0.018)		(0.013)	(0.013)
Free trade area dummy						-0.024*
						(0.013)
Currency union dummy						-0.077***
						(0.012)
Observations	1325	1325	1313	3291	3291	3291
R-squared	0.4584	0.4585	0.4401	0.29	0.29	0.29

Included but not reported are exporter and importer fixed effects.
Marginal effects reported. Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Panel 2: Gravity equation

Dependent variable is the log of the bilateral trade flow.

	OLS			OLS		
Distance (log)	-0.640***	-0.698***	-0.699***	-1.078***	-1.071***	-1.053***
	(0.075)	(0.073)	(0.075)	(0.039)	(0.038)	(0.043)
Land border dummy	1.763***	1.553***	1.611***	0.845***	0.762***	0.753***
	(0.197)	(0.192)	(0.194)	(0.159)	(0.156)	(0.156)
Common language dummy		0.597***	0.606***		0.535***	0.540***
		(0.071)	(0.072)		(0.071)	(0.071)
Free trade area dummy			0.031			0.193**
			(0.086)			(0.088)
Currency union dummy			-0.471***			-0.347**
			(0.131)			(0.138)
Observations	3089	3089	3089	3089	3089	3089
R-squared	0.99	0.99	0.99	0.99	0.99	0.99
F (selection process variables)	19.28	15.81	11.50	37.70	31.85	19.85
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00

Included but not reported are exporter and importer fixed effects.
Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

found; the coefficient on the land border and common language dummy are higher than those found in other studies but we attribute this to the sample selection induced by our choice of Z_{ij} variable. This same problem and its high correlation with the border dummy for our sample of exporters might also be causing the negative sign for the currency union area and the insignificant coefficient for the free trade area dummy. The results in this second stage using the variables obtained using a linear probability model in the first stage are, again, qualitatively very similar. The coefficient on the distance is slightly larger in absolute value and close to -1.07 while those for the border and the common language dummy have a relatively smaller magnitude; the coefficient on membership of the same free trade is, in this specification positive and significant while that for the currency union remains negative and significant.

Using a very similar dataset, Rose (2005) finds that an additional trade promotion office increases trade by about 6% to 8% (depending on the specification) with the first office having a much larger impact than subsequent ones. Our findings are consistent with his' but suggest that the impact he finds occurs at the intensive margin (by creating new trade linkages) rather than at the extensive margin (by increasing trade in existing ones).

We correct for the potential endogeneity of the decision to set up a trade promotion office as described in the previous section. To that effect we estimate equation (19) with a probit using as dependent variables the two aforementioned sets as well as a set of bilateral characteristics such as distance and dummies for the presence of a common border, a common language, membership in the same free trade area and currency union. Given that the results are very extremely similar, we only report those for the extended instrument set. Table 2 reports the results of the estimation using a probit as well as a linear probability method.

The results of these estimations are presented in the first panel of table 2. As one would expect, an increased attractiveness of a country is positively associated with probability of a country setting up an embassy, consulate or trade promotion office there and the same is true for its geopolitical importance capture by its GDP and its proven oil and gas reserves. Given that the variables regarding the number of guides available for the importing country are quite correlated with one another, we only find a significative coefficient for the number of Zagat's guides available for the importing country while the rest of variables have no statistical significance. We also attribute the negative sign on the number of Condé -Nast guides in the importing country to this moderate correlation among explanatory variables. While the expanded instrument set does not significantly improve the quality of the fit and that both estimations deliver very highly correlated prediction for ρ^Z_{ij}, in subsequent stages we use the predictions obtained from the second set of instruments (the second column in panel 1). The second panel in table 2 shows the results of the probit estimation for the probability of observing a positive flows in a given bilateral relationship as shown in equation (17) but with the dependent variable Z_{ij} substituted by $\widehat{\rho}^Z_{ij}$. We find that our instrument from the previous stage does a good job at predicting the existence of a positive trade flow and the estimated coefficient is slightly higher than that we obtained if when we did not take into account its potential endogeneity. Depending on the specification, the presence of an embassy or trade promotion office increases the probability of observing a positive trade flow between any two countries by between 7% and 8.1%. Finally, we estimate the gravity equation including as regressors the inverse Mills ratio (η_{ij}) and the polynomial approximation that accounts for firm heterogeneity ($h(\omega_{ij})$), we find that all variables, with the exception of membership in a currency union, have the expected signs but that their magnitudes are different from previous estimates in the literature. In order to compare our results, for our last specification, we also report the results of estimating a plain gravity equation without taking into consideration the existence of zero trade flows. The contrast is striking, the elasticity of distance which would have been about -1.25 in a standard gravity estimation drops to -0.46 which is even smaller than the estimate we had obtained without taking into account the endogeneity of setting up trade promotion offices and embassies. The coefficient for the dummy on a land border also changes quite strikingly and suggest the presence of a border effect of about 650%, which is quite large relative to recent estimates using gravity equations as well as other kind of estimation. We believe this might be the result of our sample of exporters to which we also attribute the negative coefficient for the currency union dummy.

Table 2: Instrumenting the presence of an Embassy

Panel 1: Estimating the probability of the presence of an embassy or trade promotion office

Estimation method is probit.

Number of Zagat's guides in importer	0.327***	0.334***
	(0.016)	(0.019)
Number of Condé-Nast guides in importer	-1.266***	-1.265***
	(0.285)	(0.167)
Number of Lonely Planet guides in importer	-0.115	-0.297
	(0.315)	(0.370)
Number of Economist city guides in importer	0.068	0.068
	(0.379)	(0.222)
Number of Michelin guides in importer		--
		--
Number of Baedker guides in importer		-0.161
		(0.185)
Distance (log)		-0.417***
		(0.039)
Land border dummy		-0.227
		(0.210)
Common language dummy		0.266***
		(0.026)
Free trade area dummy		0.033
		(0.107)
Currency union dummy		--
		--
Observations	2517	2517
Pseudo-R2	0.5251	0.5251

Included but not reported are exporter and importer fixed effects.
Marginal effects presented. Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Panel 2: Estimating the probability of existence of a trade flow

Estimation method is probit

Probability of presence of an embassy	0.070**	0.081**	0.081*
	(0.035)	(0.039)	(0.040)
Distance (log)	-0.055***	-0.052***	-0.054***
	(0.019)	(0.018)	(0.019)
Land border dummy	-0.268*	-0.263*	-0.273
	(0.144)	(0.145)	(0.151)
Common language dummy		-0.011	-0.010
		(0.022)	(0.023)
Free trade area dummy			--
			--
Currency union dummy			--
			--
			--
Observations	1325	1325	1313
Pseudo-R2	0.4441	0.4443	0.4426

Included but not reported are exporter and importer fixed effects.
Marginal effects presented. Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 2: Instrumenting the presence of an Embassy (cont'd)

Panel 3: Gravity equation
Estimation method is OLS

				Standard Gravity
Distance (log)	-0.153	-0.526***	-0.457***	-1.249***
	(0.136)	(0.118)	(0.114)	(0.038)
Land border dummy	2.581***	1.867***	2.025***	0.623***
	(0.287)	(0.262)	(0.247)	(0.129)
Common language dummy		0.555***	0.567***	0.639***
		(0.071)	(0.072)	(0.068)
Free trade area dummy			0.060	-0.023
			(0.087)	(0.101)
Currency union dummy			-0.445***	-0.601***
			(0.140)	(0.181)
Observations	3089	3089	3089	3089
R-squared	0.99	0.99	0.99	0.86
F(selection procedure variables)	18.13	11.16	9.32	
Prob > F	0.00	0.00	0.00	

Included but not reported are exporter and importer fixed effects.
Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

4 Conclusions and extensions

In this paper we have emphasized an element that has been largely overlooked in the international trade literature, uncertainty. We build a setup based on the current workhorse model of international trade – the Melitz model – where firms are faced with uncertainty and informational externalities when breaking into foreign export markets . We have shown that such a simple modification helps explain some of the not so well understood facts present in the data. Uncertainty and learning from the actions of others (informational externalities) may be an important ingredient explaining why some small firms do not enter, the persistence of trade volumes (or the lack of them) and, more importantly, the recent dynamic evolution of the relative importance of the extensive and intensive margins, both at the country and the firm/product level.

In this draft we have tested empirically for the importance that uncertainty has on the formation of trade links and the data confirms our intuition. In the future we plan to take to the data what we believe is one of the most interesting prediction of our framework and a much more conclusive test, the contagion effect, which we have not done yet because of data availability.

It is important to point out that in this paper we have abstracted from several interesting issues. This was deliberate, as another intention of this paper was to build a simple framework that would allow us to easily build on it. Among other things, we have abstracted from correlated costs across sectors and/or countries. In the future, we plan to study the dynamics of entry once informational externalities cross the country-sector dimension, that is, when information about a sector in a given country may help learning about the same sector in other countries or other sectors in the same countries. Also, this framework can be useful to think about the role of private information in multiproduct firms and whether this is an explanation for the fact that these firms enter more markets per product than single product firms. Also the role of informational externalities (and perhaps also private information) may be an important ingredient when considering the boundaries of the firm. This setup also seems well-suited to understand FDI flows since the decision to setup a foreign subsidiary might be subject to the same uncertainties that we have emphasized in this model. Finally, most of the uncertainty about new markets may have a lot to do with institutional ingredients. In this matter this framework may help shed some light on the recent debate on the impact of institutions on trade.

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5 Theory Appendix

5.1 Derivation of $W_t(\varphi, \varphi_t, \varphi_{t+1}, c)$

Notice that we can write $V_t^e(\varphi, \varphi_t, \varphi_{t+1}, c)$ as

$$\begin{aligned} V_t^e(\varphi; \varphi_t, \varphi_{t+1}, c) &= r(\varphi; \varphi_t, \varphi_{t+1}) - E_t(f|f \leq f_t) - c+ \\ \frac{G(f_t) - G(f_{t+1})}{G(f_t)} E_t &\left[\sum_{j=1}^{\infty} \beta^j \max\{0, r(\varphi; \varphi_{t+j}, \varphi_{t+j+1}) - f\} | f_{t+1} \leq f \leq f_t \right] + \\ &\frac{G(f_{t+1})}{G(f_t)} E_t \left[\sum_{j=1}^{\infty} \beta^j \max\{0, r(\varphi; \varphi_{t+j}, \varphi_{t+j+1}) - f\} | f \leq f_{t+1} \right], \quad (20) \end{aligned}$$

that is, we can decompose it in two terms, one containing what happens after today if information is fully revealed today and another if not. Notice that if information is fully revealed then from tomorrow and on $r(\varphi, \varphi_{t+j}, \varphi_{t+j+1}) = r(\varphi)$ and we can rewrite $V_t^e(\varphi, \varphi_t, \varphi_{t+1}, c)$ (after some algebra) as:

$$\begin{aligned} V_t^e(\varphi; \varphi_t, \varphi_{t+1}, c) &= r(\varphi; \varphi_t, \varphi_{t+1}) - E_t(f|f \leq f_t) - c+ \\ &\frac{\beta}{1-\beta} \frac{G(f_t) - G(f_{t+1})}{G(f_t)} E_t \left[\max\{0, r(\varphi) - f\} | f_{t+1} \leq f \leq f_t \right] + \\ &\frac{G(f_{t+1})}{G(f_t)} E_t \left[\sum_{j=1}^{\infty} \beta^j \max\{0, r(\varphi; \varphi_{t+j}, \varphi_{t+j+1}) - f\} | f \leq f_{t+1} \right] \end{aligned}$$

Now it is easy to see that

$$\begin{aligned} W_t(\varphi; \varphi_t, \varphi_{t+1}, c) &= r(\varphi; \varphi_t, \varphi_{t+1}) - E_t(f|f \leq f_t) - c \left(1 - \beta \frac{G(\varphi_{t+1})}{G(\varphi_t)}\right) \\ &+ \frac{\beta}{1-\beta} \frac{G(f_t) - G(f_{t+1})}{G(f_t)} E_t[\max\{0, r(\varphi) - f\} - \\ &\max\{0, (r(\varphi) - (1-\beta) \cdot c - f\} | f_{t+1} < f < f_t], \end{aligned}$$

which is the expression on the main text.

5.2 Proof that the Equilibrium is Sequential in Productivities

In a given period t define as χ_t as the set of domestic firms active in the export market, and denote as δ_{t+1} as the flow of entrants between t and

$t+1$, and lets not restrict the identity of those already in the market and those that will enter today to be continuous in productivity. In this case

$$W_t(\varphi;\chi_t,\delta_{t+1},c) = V_t^e(\varphi;\chi_t,\delta_{t+1},c) - V_t^w(\varphi;\chi_t,\delta_{t+1},c),$$

where this expressions can be found by replacing φ_t and φ_{t+1} by χ_t and δ_{t+1} respectively on the main text. It is straightforward to check that it is still the case that $\partial W_t(\varphi;\chi_t,\delta_{t+1},c)/\partial\varphi > 0$. This means that no matter who is already in the market and who enters this period, entry is more attractive for more productive firms. This immediately implies that if a firm $\varphi\prime$ enters in t, all firms outside the market with $\varphi > \varphi\prime$ will too. Finally, when there is nobody in the market, this immediately implies that if the last firm that enters in the first period has productivity $\varphi\prime\prime$, then all firms with $\overline{\varphi} > \varphi\prime > \varphi\prime\prime$ will enter too. *Q.E.D.*

This result allows us to simplify the analysis on the text and look only for sequential entry, simplifying the analysis and notation.

5.3 Proof of Lemma 1

We take the derivative of the $W(\cdot)$ with respect to $r(\varphi;\varphi_t,\varphi_{t+1})$ and use the fact that $\partial r(\varphi;\varphi_t,\varphi_{t+1})/\partial\varphi > 0$, which implies that $sign\left(\partial W(\cdot)/\partial r(\varphi;\varphi_t,\varphi_{t+1})\right) = sign\left(\partial W(\cdot)/\partial\varphi\right)$. This yields, after rearranging terms,

$$\frac{\partial W(\cdot)}{\partial r(\varphi,\cdot,\cdot)} = 1 + \frac{\beta}{1-\beta}\frac{G(f_t) - G(f_{t+1})}{G(f_t)} +$$
$$\frac{\beta}{1-\beta}\cdot\frac{\partial}{\partial r(\varphi,\cdot,\cdot)}E_t[\max\{0, r(\varphi) - f\} - \max\{0,(r(\varphi) - (1-\beta)\cdot c - f\}\,|f_{t+1} < f < f_t].$$

Notice that $\max\{0,\partial r(\varphi,\cdot,\cdot) - f\} \geq \max\{0,(\partial r(\varphi,\cdot,\cdot) - (1-\beta)\cdot c - f\}$ which immediately implies that $\partial W(\cdot)/\partial r(\varphi,\cdot,\cdot) > 0$. *Q.E.D.*

5.4 Proof of Lemma 2

Taking the derivative of $W(\cdot)$ with respect to f_{t+1} and after rearranging terms it is straightforward to check that

$$\left(\frac{\partial W(\cdot)}{\partial f_{t+1}}\right) = \frac{\partial r(\varphi,\cdot,\cdot)}{\partial f_{t+1}} + \beta\frac{g(f_{t+1})}{G(f_t)}c +$$
$$\frac{\beta}{1-\beta}E_t[\max\{0, r(\varphi) - f_{t+1}\} - \max\{0,(r(\varphi) - (1-\beta)\cdot c - f_{t+1}\}$$

Notice that $\partial r(\varphi,\cdot,\cdot)/\partial f_{t+1} > 0$ (less entry increases profits today). Also, the third term is trivially positive as it is the expectation of a positive number (the first max is always larger than the second). This completes the proof.

Q.E.D.

5.5 Proof of Lemma 3

Notice that the last term of $W(\varphi;\varphi_{t+1},\varphi_{t+1},c)$ cancels out for $\varphi = \varphi_{t+1}$,

$$W(\varphi_{t+1};\varphi_{t+1},\varphi_{t+1},c) = r(\varphi_{t+1};\varphi_t,\varphi_{t+1}) - E_t(f|f \le f_{t+1}) - c\left(1-\beta\frac{G(\varphi_{t+1})}{G(\varphi_t)}\right).$$

Adding and substracting $E_t(f|f \le f_t)$ we get

$$W(\varphi_{t+1};\varphi_{t+1},\varphi_{t+1},c) = r(\varphi_{t+1};\varphi_t,\varphi_{t+1}) - E_t(f|f \le f_t) - c\left(1-\beta\frac{G(\varphi_{t+1})}{G(\varphi_t)}\right) - \\ E_t(f|f \le f_{t+1}) + E_t(f|f \le f_t) - E_t(f|f \le f_{t+1}),$$

which because of Condition (15) simplifies to

$$W(\varphi_{t+1};\varphi_{t+1},\varphi_{t+1},c) = E_t(f|f \le f_t) - E_t(f|f \le f_{t+1}) > 0.$$

Q.E.D.

5.6 Proof of Proposition 1

Straighforward. To have entry in period 0 we need that the value of entry relative to waiting for the most productive firm, if he was the only firm to enter, is positive, that is $W_t(\overline{\varphi};\overline{\varphi},\overline{\varphi},c) = r\left(\overline{\varphi},\overline{\varphi},\overline{\varphi}\right) - E\left(f\right) - c(1-\beta c(1-\beta G(\overline{\varphi}))) > 0$, which replacing by its expression translates into Condition 1 in the main text.. Thus, at least firm $\overline{\varphi}$ enters the export market if the condition is satisfied. If Condition 1 is not satisfied, Lemma 1 ensures that nobody enters.

5.7 Proof of Proposition 2

We know from Proposition 1 that at least the top firm enters in period 1 if *Condition* 1 is satisfied. By continuity of the function $W(\varphi;\varphi_t,\varphi_{t+1},c)$ on both φ and φ_{t+1} and Lemma 1 and 2, there exist a firm $\widetilde{\varphi}_1$ such that $W(\widetilde{\varphi}_1;\varphi_0,\widetilde{\varphi}_1,c) = 0$ and $W(\varphi;\varphi_0,\widetilde{\varphi}_1,c) > 0$ for all $\varphi > \widetilde{\varphi}_1$ (and increasing in φ) which implies that all these firms enter the market. Now in period 2 two things can happen. Uncertainty can totally reveal and we reach an equilibrium in which the last entrant is given by $W(\varphi_1; \varphi_0, \varphi_1, c) = 0$, where the last firm that will produce will have productivity equal to φ_1 if there was no mistake, or it will be the φ such that $r(\varphi) > f$ if there were mistakes. On the other hand, if uncertainty did not reveal and we had entry up to a level φ_1 given by the condition above, by Lemma 3 we know that $W(\varphi_1; \varphi_1, \varphi_1, c) > 0$, which implies that the marginal firm that did not enter yesterday wants to enter today. This condition in period 2 is equivalent to *Condition 1* for the first period, which implies that the reasoning done for the first period goes through now. This keeps going until entry hits the real value of the fixed cost.$Q.E.D.$

6 Data Appendix

Table A1: List of exporters and importers

List of Exporters	List of Importer			
Australia	Afghanistan, I.R. of	Dominican Republic	Kuwait	Qatar
Brazil	Albania	Ecuador	Lao People's Dem.Rep	Romania
Canada	Algeria	Egypt	Latvia	Russia
China,P.R.: Mainland	Angola	El Salvador	Lebanon	Rwanda
France	Argentina	Equatorial Guinea	Liberia	Samoa
Germany	Armenia	Estonia	Libya	Saudi Arabia
India	Australia	Ethiopia	Lithuania	Senegal
Indonesia	Austria	Falkland Islands	Macedonia, FYR	Seychelles
Italy	Bahamas, The	Fiji	Madagascar	Sierra Leone
Japan	Bahrain, Kingdom of	Finland	Malawi	Singapore
Korea	Bangladesh	France	Malaysia	Slovak Republic
Mexico	Barbados	French Polynesia	Mali	Slovenia
Netherlands	Belarus	Gabon	Malta	Somalia
Poland	Belize	Gambia, The	Mauritania	South Africa
Russia	Benin	Georgia	Mauritius	Spain
Spain	Bermuda	Germany	Mexico	Sri Lanka
Sweden	Bolivia	Ghana	Moldvoa	St. Kitts and Nevada
Switzerland	Brazil	Greece	Mongolia	Sudan
Turkey	Bulgaria	Greenland	Morocco	Suriname
United Kingdom	Burkina Faso	Guatemala	Mozambique	Sweden
United States	Burundi	Guinea	Myanmar	Switzerland
	Cambodia	Guinea-Bissau	Nepal	Syrian Arab Republic
	Cameroon	Guyana	Netherlands	Tanzania
	Canada	Haiti	Netherlands Antilles	Thailand
	Central African Rep.	Honduras	New Caledonia	Togo
	Chad	Hungary	New Zealand	Trinidad and Tobago
	Chile	Iceland	Nicaragua	Tunisia
	China,P.R.: Mainland	India	Niger	Turkey
	China,P.R.:Hong Kon	Indonesia	Nigeria	Uganda
	China,P.R.:Macao	Iran, I.R. of	North Korea	Ukraine
	Colombia	Iraq	Norway	United Arab Emirates
	Congo, Dem. Rep. of	Ireland	Oman	United Kingdom
	Congo, Republic of	Israel	Pakistan	United States
	Costa Rica	Italy	Panama	Uruguay
	Cuba	Jamaica	Papua New Guinea	Uzbekistan
	Cyprus	Japan	Paraguay	Venezuela, Rep. Bol.
	Czech Republic	Jordan	Peru	Vietnam
	Côte d'Ivoire	Kazakhastan	Philippines	Yemen, Republic of
	Denmark	Kenya	Poland	Zambia
	Djibouti	Korea	Portugal	Zimbabwe

Table A2: SITC Classification

Code	Description
0	**Food and live animals**
0	Live animals other than animals of division 03
1	Meat and meat preparations
2	Dairy products and birds' eggs
3	Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof
4	Cereals and cereal preparations
5	Vegetables and fruit
6	Sugars, sugar preparations and honey
7	Coffee, tea, cocoa, spices, and manufactures thereof
8	Feeding stuff for animals (not including unmilled cereals)
9	Miscellaneous edible products and preparations
1	**Beverages and tobacco**
11	Beverages
12	Tobacco and tobacco manufactures
2	**Crude materials, inedible, except fuels**
21	Hides, skins and furskins, raw
22	Oil-seeds and oleaginous fruits
23	Crude rubber (including synthetic and reclaimed)
24	Cork and wood
25	Pulp and waste paper
26	Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)
27	Crude fertilizers, other than those of division 56, and crude minerals (excluding coal, petroleum and precious stones)
28	Metalliferous ores and metal scrap
29	Crude animal and vegetable materials, n.e.s.
3	**Mineral fuels, lubricants and related materials**
32	Coal, coke and briquettes
33	Petroleum, petroleum products and related materials
34	Gas, natural and manufactured
35	Electric current
4	**Animal and vegetable oils, fats and waxes**
41	Animal oils and fats
42	Fixed vegetable fats and oils, crude, refined or fractionated
43	Animal or vegetable fats and oils, processed; waxes of animal or vegetable origin; inedible mixtures or preparations of animal or vegetable fats or oils, n.e.s.
5	**Chemicals and related products, n.e.s.**
51	Organic chemicals
52	Inorganic chemicals
53	Dyeing, tanning and colouring materials
54	Medicinal and pharmaceutical products
55	Essential oils and resinoids and perfume materials; toilet, polishing and cleansing preparations
56	Fertilizers (other than those of group 272)
57	Plastics in primary forms
58	Plastics in non-primary forms
59	Chemical materials and products, n.e.s.

Table A2: SITC Classification (cont'd)

Code	Description
6	**Manufactured goods classified chiefly by material**
61	Leather, leather manufactures, n.e.s., and dressed furskins
62	Rubber manufactures, n.e.s.
63	Cork and wood manufactures (excluding furniture)
64	Paper, paperboard and articles of paper pulp, of paper or of paperboard
65	Textile yarn, fabrics, made-up articles, n.e.s., and related products
66	Non-metallic mineral manufactures, n.e.s.
67	Iron and steel
68	Non-ferrous metals
69	Manufactures of metals, n.e.s.
7	**Machinery and transport equipment**
71	Power-generating machinery and equipment
72	Machinery specialized for particular industries
73	Metalworking machinery
74	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.
75	Office machines and automatic data-processing machines
76	Telecommunications and sound-recording and reproducing apparatus and equipment
77	Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., of electrical household-type equipment)
78	Road vehicles (including air-cushion vehicles)
79	Other transport equipment
8	**Miscellaneous manufactured articles**
81	Prefabricated buildings; sanitary, plumbing, heating and lighting fixtures and fittings, n.e.s.
82	Furniture, and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings
83	Travel goods, handbags and similar containers
84	Articles of apparel and clothing accessories
85	Footwear
87	Professional, scientific and controlling instruments and apparatus, n.e.s.
88	Photographic apparatus, equipment and supplies and optical goods, n.e.s.; watches and clocks
89	Miscellaneous manufactured articles, n.e.s.
9	**Commodities and transactions not classified elsewhere in the SITC**
91	Postal packages not classified according to kind
93	Special transactions and commodities not classified according to kind
96	Coin (other than gold coin), not being legal tender
97	Gold, non-monetary (excluding gold ores and concentrates)

Table A3: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Value of bilateral trade (1000's US$)	229839	15798.9	256376.3	0	5.61E+07
Number of embassies, consulates, trade offices	229839	1.136	1.900	0	43
Presence of an embassy	229839	0.680	0.466	0	1
Distance (in log(km))	227079	8.724	0.772	5.277	9.894
Border dummy (1 = yes)	229839	0.027	0.161	0	1
Log of Exporter's GDP	229839	26.953	1.235	24.097	29.459
Log of Importer's GDP	192648	23.525	2.318	16.440	29.459
Log of Exporter's Population	229839	18.111	1.302	15.801	20.970
Log of Importer's Population	224181	15.876	1.860	10.752	20.970
Common Language dummy (1 = yes)	229839	0.128	0.334	0	1
Religious similarity (100 = identical)	209967	33.201	30.687	0	99.8
Regional Trade Agreement dummy	229839	0.073	0.260	0	1
Currency Union dummy	229839	0.015	0.120	0	1
Number of Zagat's guides in importer	229839	0.404	3.127	0	40
Number of Condé-Nast guides in importer	229839	0.574	3.058	0	38
Number of Lonely Planet guides in importer	229839	0.213	0.848	0	10
Number of Economist City guides in importer	229839	0.128	0.540	0	6
Proven oil reserves (in barrels)	229839	6.300E+10	2.640E+11	0	2.62E+12
Number of Michelin guides in importer	229839	0.242	1.202	0	13
Number of Baedeker guides in importer	229839	0.275	0.804	0	6
Proven gas reserves	229839	9.570E+12	4.480E+13	0	4.79E+14
Military spending	229839	5.480E+10	2.980E+11	0	3.71E+12

Table A4: Share of zeros in bilateral trade flows, by industry

SITC 2	Fraction of 0s	SITC 2	Fraction of 0s	SITC 2	Fraction of 0s
0	87.5%	32	88.2%	66	47.4%
1	76.0%	33	65.7%	67	46.7%
2	69.6%	34	91.6%	68	58.6%
3	74.9%	35	98.2%	69	43.7%
4	59.3%	41	91.4%	71	49.1%
5	61.6%	42	77.7%	72	39.5%
6	68.0%	43	84.5%	73	65.3%
7	66.0%	51	54.9%	74	39.6%
8	74.5%	52	62.5%	75	56.9%
9	63.0%	53	57.5%	76	46.5%
11	67.1%	54	46.8%	77	37.0%
12	73.8%	55	53.7%	78	38.9%
21	88.9%	56	80.9%	79	64.8%
22	86.4%	57	89.4%	81	66.6%
23	76.7%	58	52.0%	82	57.2%
24	78.3%	59	52.0%	83	75.4%
25	83.8%	61	74.5%	84	61.4%
26	66.0%	62	51.5%	85	67.3%
27	70.2%	63	67.2%	87	50.2%
28	78.0%	64	49.4%	88	63.3%
29	70.2%	65	45.8%	89	41.6%