Openness and Export Dynamics: New Research Directions

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Introduction

Most modern theories that link openness to patterns of trade flows and the gains from trade rely on the assumption of heterogeneous firms. The basic idea, elegantly laid out by Melitz (2003) and Bernard et al (2003), is that reductions in foreign trade barriers create new opportunities for foreign sales. At the same time, reductions in domestic trade barriers create new competition from abroad, and reduce the share of the domestic market captured by local firms. Efficient firms gain more from the former effect than they lose from the latter, so their size increases when all trade barriers come down. Inefficient firms, in contrast, don't find it profitable to export: the operating profits available to them in foreign markets are more than offset by the shipping and/or foreign market entry costs they would have to bear. Thus they are subjected to the latter effect without gaining from the former and they shrink or exit in consequence. With inefficient firms contracting and efficient firms expanding, economy-wide average productivity improves with openness.

This mechanism has been embedded in models too numerous to list, including variants that focus on multinational behavior (e.g., Helpman, et al, 2004), multiproduct firms (e.g., Bernard et al, forthcoming), transition dynamics (e.g., Ghironi and Melitz, 2005; Constantini and Melitz, 2008), and endogenous innovation (e.g., Atkeson and Burstein, 2008; Constantini and Melitz, 2008). But with few exceptions, this literature has treated trade costs in a very cursory way. Specifically, the costs of breaking into foreign markets and the fixed costs of staying in are assumed to be fixed parameters that are common across firms. Further, the variable costs of exporting are proportional to the physical volume of goods exported.

The treatment of trade costs is important because these costs govern the extent of the resource reallocation that accompanies changes in openness. Moreover, they determine the

transition path between one trade regime and another, and in doing so they determine the short-run current account deficit, which critically affects the political sustainability of reforms. In what follows I quickly review the evidence from firm-level data on the nature these trade costs. Then I turn to new evidence and research directions based on *shipment*-level trade data collected from customs agencies and merged with information on the exporters and importers who are party to the shipments. I will argue that the standard assumptions regarding trade costs are hard to reconcile with patterns found in the shipments data, and that an emerging literature focusing on the formation of buyer-seller relationships promises to yield richer models that do better.

Early evidence on sunk and fixed costs

Early contributions to the micro literature on export market participation were based on the notion that firms faced "beachhead" (market entry) costs when they ventured into foreign markets for the first time (e.g., Dixit, 1989; Baldwin and Krugman, 1989). These one-time costs were meant to capture the fact that, in order to begin exporting, firms must learn bureaucratic procedures, establish distribution channels, and repackage or even re-design their products for foreign consumers. Melitz (2003) incorporates such costs into his model, and many others have followed suit, either by including sunk entry costs or by assuming that the per-period fixed costs of exporting are significant.[1]

Many firm- and plant-level empirical studies claim to support the notion that fixed and/or sunk costs matter. Most of these studies point to the theoretical models developed by Dixit (1989) and Baldwin and Krugman (1989) to motivate their tests. To summarize the empirical version of the Dixit/Baldwin/Krugman model, let the state of firm j in period t be given by its

[1] In a steady state with time-invariant productivity shocks and stable demand, sunk entry costs and per-period fixed costs play exactly the same role. The distinction between fixed costs and sunk costs becomes important when there is uncertainty about future market conditions. Then sunk costs make exporting a forward-looking decision because, once borne, they open the option to continue exporting in the next period without paying market entry costs.

productivity, φ_{jt}, its time-invariant characteristics (like product appeal), z_j, the real effective exchange rate, e_t and a binary variable indicating its beginning-of-period exporting status, y_{jt-1}. Then the exporting decisions of risk-neutral, profit maximizing firms can be characterized by the policy function $y_{jt} = y(\varphi_{jt}, z_j, e_t, \varepsilon_{jt}, y_{jt-1} \mid \theta)$, where θ is a vector of parameters and $\varepsilon_{jt} = (\varepsilon_{1jt}, \varepsilon_{2jt})$ captures transitory shocks to fixed or sunk costs. This function solves:

$$V(\varphi_{jt}, z_j, e_t, \varepsilon_{jt}, y_{jt-1} \mid \theta) = \max_{y(\cdot)} \; E_t \sum_{\tau=t}^{t+H} \delta^{\tau} u(\varphi_{jt}, z_j, e_{\tau}, y_{j\tau-1}, y_{j\tau} \mid \theta).$$

where the net current-period payoff from exporting is:

$$u(\varphi_{jt}, z_j, e_t, y_{jt-1}, y_{jt} \mid \cdot) = \begin{cases} \pi(\varphi_{jt}, z_i, e_t \mid \cdot) - \gamma_F + \varepsilon_{1it} & if \quad y_{jt} = 1, y_{jt-1} = 1 \\ \pi(\varphi_{jt}, z_i, e_t \mid \cdot) - \gamma_F - \gamma_S z_i + \varepsilon_{2it} & if \quad y_{jt} = 1, y_{jt-1} = 0 \\ 0 & if \quad y_{jt} = 0 \end{cases}$$

Here $\pi(\cdot)$ is gross current exporting profits, and γ_F and γ_S are average fixed and sunk exporting costs, respectively.

Sunk entry costs make firms want to avoid repeatedly starting and stopping foreign sales, so they induce firms to consider future market conditions when they decide whether to export today. In addition, since firms won't start exporting unless they expect to eventually recoup their entry costs, sunk costs place a lower bound on the expected gross export profit stream of a new market entrant. Fixed costs bound exporting profits too, but since they are borne each period that a firm exports, they do not in themselves create a role for expectations about future market conditions.

Early empirical studies tested for sunk costs by looking for evidence that current exporting status depended upon lagged exporting status, controlling for other sources of persistence in exporting behavior, both observed and unobserved. As Greenaway and Kneller

(2007) note in their survey, "Exporting next period is strongly correlated with exporting this period, even when other determinants of persistence have been controlled for." (p. F140) For many firms, having exported in the previous period increases the probability of exporting in the current period by more than 50 percentage points (Roberts and Tybout, 1997).

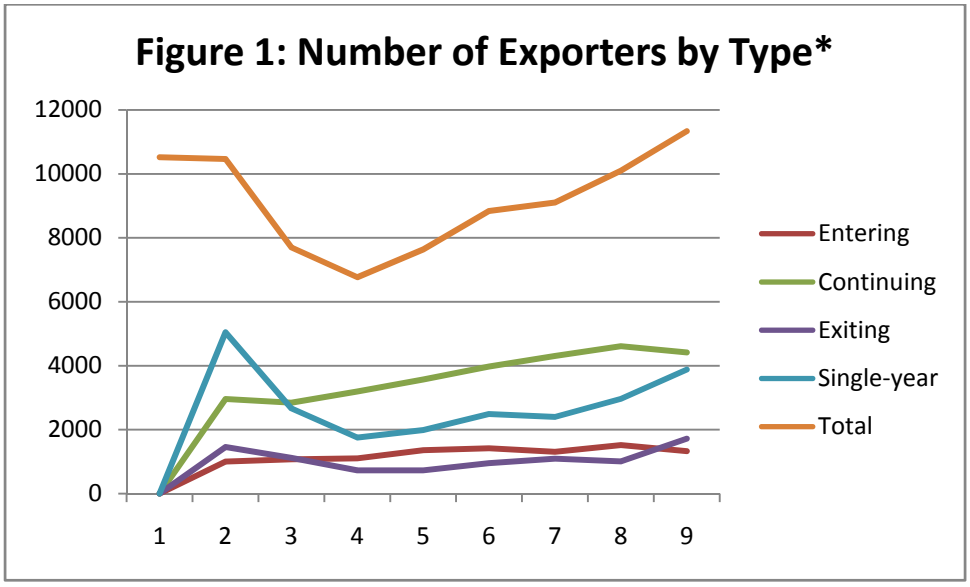
More recently, Das et al (2007) have used the structure of the dynamic optimization problem sketched above to put dollar magnitudes on sunk entry costs and per period fixed costs. They find that on average, entry costs are large ($700,000) and fixed costs are modest ($15,000) for Colombian manufacturing firms.[2] They further show that, given their estimates, expectations about future market conditions can matter a lot for small-scale exporters. For example, a devaluation that is viewed as a transitory shock is predicted to induce about half as many firms to export as a devaluation that is perceived as a permanent change in the exchange rate process. However, most of the exports in a typical industry come from a handful of dominant firms, and for these exporters expectations about future market conditions are unimportant. Their *current* operating profits from exporting dwarf market entry costs, even during periods when markets are unfavorable to exporters. One implication is that the credibility of policy reforms has a much bigger impact on the number of exporters than on the value of total exports. Another implication is that export promotion schemes that subsidize market entry are much less efficient in terms of their impact on total exports than schemes that subsidize export sales.

New evidence on exporting costs: marketing, search and learning

The finding that sunk costs are large explains why only a minority of firms venture into foreign markets, and why the likelihood that a current exporter will continue exporting is greater

[2] . "Sunk entry costs are identified by differences in exporting frequencies across plants that have comparable expected profit streams, but differ in terms of whether they exported in the previous period. . . Given profit streams and sunk costs, the frequency of exit among firms with positive gross profit streams identifies fixed costs." (Das, et al, 2007).

than the likelihood a non-exporter will enter foreign markets. But it is difficult to reconcile big sunk costs with a new set of stylized facts that are emerging from transactions-level data on international shipments. Specifically, in a typical year, one-third to one-half of all the commercial exporters observed in customs data did not export in the previous year. Most of these firms ship tiny amounts (worth several thousand dollars), and most will revert to exclusive reliance on domestic sales in the following year. [3] Figure 1 depicts these patterns over a 9 year period for the case of Colombian exporters.

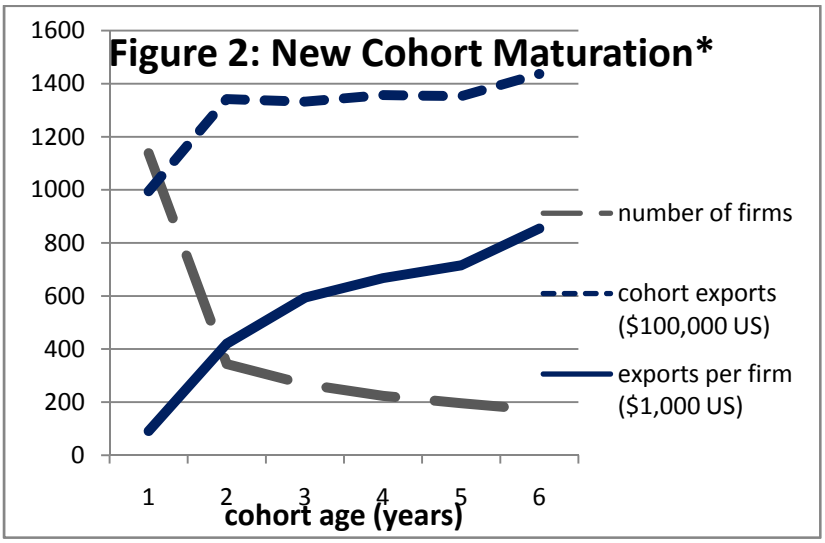


*Based on Eaton et al (2008). For each year *t*, "entering" firms did not export *t*-1 but do export in t and *t*+1, "continuing" firms exported in *t*-1 and continue exporting in t and *t*+1, "exiting" firms exported in *t*-1 and continue to export in *t*, but will not export in *t*+1, and "single year" exporters export in *t*, but not in *t*-1 or *t*+1.

Further clues about export dynamics emerge if one follows a cohort of new exporters through time as it matures. Defining the year *t* cohort to be the set of firms first observed to be exporting from Colombia to the United States in year *t*, figure 2 shows the average number of cohort members, average total exports, and average exports per surviving cohort member as a

[3] Das et al's (2007) model accommodates the frequent entry and exit of small-scale exporters by assigning large variances to the transitory shocks to sunk and fixed costs (that is, the ε's). Thus many firms draw small sunk and fixed costs in some periods, and these firms quickly exit when their draws prove less favorable in the future. This explanation works only if one is willing to accept large year-to-year fluctuations in fixed and entry costs.

function of cohort age. (Cohort *t* is one year old in year *t+1*, etc.) Notice that, although the number of cohort members drops dramatically after one year, the attrition rate is much lower thereafter, suggesting that new exporters go through a shakedown process. Also, among the cohort members who survive the early years, exports per firm grow very rapidly, so the total exports of a typical cohort expand *despite* rapid early attrition. Finally, successful members of each cohort typically have larger initial export sales than other cohort members, and as they expand, they do so both by increasing sales per buyer and by increasing the number of buyers they ship to in the U.S. market (not pictured).[4]



*Based on Eaton et al (2009)

Several theories are available for these findings, and for related earlier results based on 6-digit product-level trade flows (Besedes and Prusa, 2006). One was developed by Rauch and Watson (2003) before these patterns were documented. These authors model the behavior of developed-country buyers who engage in costly search for developing-country suppliers. Suppliers are heterogeneous in terms of their productivity *and* their capabilities to deliver

[4] These statements are based on Eaton et al (2009), who use U.S. customs records to keep track of the identification of exporters and importers for shipments from Colombia to the U.S.

specialized products, but only their productivity is costlessly observable. When a buyer meets a seller, she can either invest in training him to produce the desired product and place a major order immediately, or she can place a small trial order and thereby learn about his capabilities, deciding afterward whether to reject him or invest in training him. The former strategy can lead to rapid order fulfillment, but it can also lead to investments in sellers who are incapable of delivering. The latter strategy reduces risk, but it is costly because it takes time to discover a seller's capabilities through trial orders. In equilibrium buyers immediately reject sellers with low productivity, they place small trial orders with sellers who have moderate productivity (then either train or reject them when their capabilities are revealed), and they immediately invest in training sellers with high productivity.

The Rauch/Watson characterization of international buyer-seller matching accounts for several patterns in the shipments data that are inconsistent with the simple sunk cost model. In particular it explains why (1) many exporters ship small amounts and then exit the destination market, (2) sellers who start with larger export volumes are more likely to remain in the export market, and (3) on average, the successful members of each cohort experience rapid export growth after their first year. However, the Rauch/Watson has some limitations. It treats suppliers as passive agents who do not search for buyers, and it does not account for the fact that buyers use multiple suppliers.

Arkolakis (2008a, 2008b) shifts the search process from buyers to sellers in his interpretation for the stylized facts mentioned above. More precisely, he argues that exporters can easily find a few customers in a destination market, but after the low-hanging fruit has been picked they must ferret out after increasingly hard-to-find buyers. Thus the costs of building a clientele rise more than proportionately with export sales. This characterization of marketing

costs means that non-exporting firms who experience favorable productivity shocks should find it easy to establish a toe-hold in foreign markets, counter to the standard sunk cost specification. But the more market inroads these new exporters make, the tougher the sledding becomes, and the more their growth rates slow down. By assuming that exporters' productivity shocks follow a Brownian motion, Arkolakis is able to explain the large volume of short-lived, small-scale exporting episodes, the surge in shipments among a small set of successful new exporters, and the growth slowdown as firms' exporting relationships mature.

Eaton et al (2009) also develop a model in which sellers search for buyers, but they add seller-side learning. As in Arkolakis's models, costs are convex in search intensity. However, each time an exporter meets a buyer, he (the seller) receives a noisy signal about his product's appeal to consumers in the destination market. A large order from a new buyer signals that the product is likely to be popular with others, while a small order signals the opposite. Each time a match is made and a signal is conveyed, the exporter updates his priors concerning his product's appeal and adjusts his search intensity. Early signals are the most informative, so they result in the largest adjustments in search intensity. Matches between buyers and sellers endure from one period to the next, subject to an exogenous hazard of separation.

More formally, Eaton et al assume that firm j is able to discover new buyers at the rate λ_j when it spends $c(\lambda_j)$ on search activities, and that its existing matches break up at some exogenous rate. Further, they assume that j's expected profit stream from its next match can be written as $\tilde{\pi}(\bar{z}_j^n, \sigma_j^n, e_t, \varphi_{jt})$, where e_t is the real effective exchange rate, φ_{jt} is j's current productivity, and $\bar{z}_j^n$ and $\sigma_{z_j}^n$ are the mean and standard deviation of the posterior distribution

that summarizes *j*'s beliefs about its product's appeal after it has experienced *n* matches.[5] These beliefs are based on a standard Bayesian updating process which in turn reflects the size of the orders that have been placed by buyers whom seller *j* has previously met. Assuming that e_t and φ_{jt} follow first-order Markov processes, Eaton et al then find *j*'s optimal search intensity as the solution to:

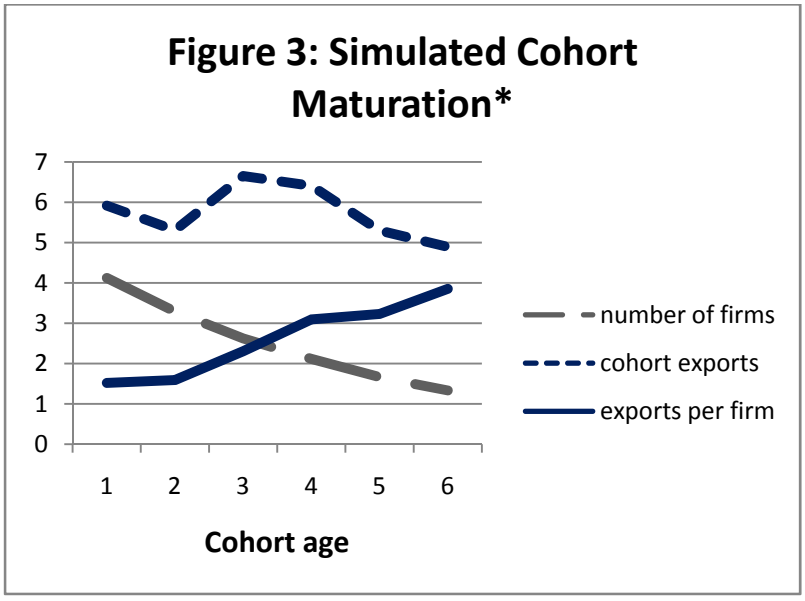
$$V(\bar{z}_j^n, \sigma_j^n, \varphi_{jt}, e_t) = \max_\lambda \Big\{ -c(\lambda) + \lambda \cdot \tilde{\pi}(\bar{z}_j^n, \sigma_j^n, \varphi_{jt}, e_t) + \frac{1-\lambda}{1+r} \int_{\varphi'} \int_{e'} V(\bar{z}_j^n, \sigma_j^n, \varphi_{jt}, e_t)\, dG(\varphi', e' \mid \varphi_{jt}, e_t) + \frac{\lambda}{1+r} \int_{z^{n+1}} \int_{\varphi'} \int_{e'} V(\bar{z}_j^{n+1}, \sigma_j^{n+1}, \varphi_{jt}, e_t)\, dG(\varphi', e' \mid \varphi_{jt}, e_t) d\Phi(\bar{z}'^{n+1} \mid \bar{z}^n) \Big\}$$

Here G( ) and $\Phi()$ are transition densities, and the latter reflects Bayesian updating. Combined with realizations on the exchange rate, productivity levels, and buyer-specific demand shocks, the optimal search rule implies exporting patterns for each potential seller.

The Eaton et al model explains the prevalence of tiny, short-term exporters as a consequence of low costs for low-level search. Such costs imply that lots of Colombian firms maintain a mild interest in the U.S. market and experience occasional matches. These matches typically result in small orders, hence they typically discourage sellers from intensifying their search efforts. To the contrary, since they are early signals they receive heavy weight, and they often discourage further search altogether. Consonant with the stylized facts reviewed above, the Eaton e al model also implies that a handful of the new matches will result in non-trivial orders, and that the sellers who are fortunate enough to encounter one of these relationships will tend to exhibit rapid subsequent export growth as they intensify their search for clientele. Eventually,

[5] The expected profit stream $\tilde{\pi}(\bar{z}_j^n, \sigma_j^n, e_t, \varphi_{jt})$ is related to single period export profits by the match separation hazard, the Markov processes for exogenous state variables, and the Bayesian updating rule.

however, their client base becomes so large that their search intensity is just sufficient to replace the clients who are separating.



*Based on Eaton et al (2009)

Eaton et al calibrate a prototype version of their model in order to examine these implications numerically. They find they can crudely replicate the patterns documented in figure 2, except for the extraordinarily high exit rate among first-year exporters (figure 3). (This limitation is easily rectified by allowing the match separation rate to depend upon the number of period that the match has endured.) Their model also generates hysteresis effects and state dependence in trade flows, since exporters do not forget what they have learned about their product's appeal once they have generated a match history. For example, since search and learning should intensify during periods of favorable exchange rates, and since learning is irreversible, temporary devaluations can trigger permanent increases in export volumes.

Directions

The recent shift of focus toward micro dynamics of business relationships opens up a number of new directions for research. In addition to econometrically estimating the model mentioned above, Jonathan Eaton, Marcela Eslava, Maurice Kugler, C.J. Krizan and I are planning to pursue several related exercises. First we hope to generalize our model so that potential exporters learn about their product's appeal not just from their experiences in the destination market, but from their experiences in their home market and in other countries they have exported to. Similarly, we hope to incorporate learning from the experiences of other exporters in similar industries. This will open the possibility that a few pioneer exporters might create demonstration effects, and thus induce industry-specific export surges similar to those described by Hausmann and Rodrik (2003) and Hausmann et al (2007). It will also help us to understand contagion effects that induce exports who experience success in some markets to begin exporting to other countries with similar demand features.[6]

A second issue we are pursuing is the question of which type of buyer tends to match with which type of seller, and once matched, which types of buyer-seller pairs tend to flourish. To this end we are merging plant-level information on Colombian exporters and on U.S. importers from annual industrial surveys with the trade shipments data. Then we are borrowing techniques from the marriage literature to characterize the assortative sorting process. (One challenge here is that the marriage literature generally presumes monogamy, whereas buyers and sellers are often polygamous.) If successful, this exercise will shed light on the way business relationships are formed in general, and could conceivably identify promising exporting opportunities for particular types of firms that have not yet been exploited.

[6] Eaton et al (2008) document "geographic expansion paths" that Colombian firms tend to follow as they add new countries to their portfolio of export destinations.

Third, to confirm the ideas behind the model, and to learn more about the way that managers think about building exporting relationships, interviews with potential exporters, exporters and importers should prove valuable.

Others are also starting projects based on shipments data. Blum et al (2009) have used shipments data between Chile and Colombia to determine which exporters use intermediaries, and which ship directly to their final buyers abroad. They find, inter alia, that "in virtually every Chilean exporter-Colombian importer pair, at least one of the parties is a large international trader." They go on to develop a theoretical model that explains firms' choices of intermediation technology, emphasizing the importance of the volume of the shipment as a determinant. Large sellers do not need to use intermediaries; rather, buyers find them. But small sellers do best to use trading firms to achieve visibility.

Finally, Drozd and Nosal (2009) develop a dynamic general equilibrium model in which exporters invest in building customer relationships abroad. Once a match is made, the terms of the sale are determined by a bargaining game, so different prices emerge for the same product in different countries or at different points in time. Among other things, the model provides a new interpretation for observed patterns of pricing to market.

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