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Fixed costs per shipment ☆

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ABSTRACT

Exporting firms do not only decide how much of their products they ship abroad but also at which frequency. Doing so, they face a trade-off between saving on fixed costs per shipments (by shipping large amounts infrequently) and saving on storage costs (by delivering just in time with small and frequent shipments). The firm's optimal choice defines a mapping from size and frequency of shipments to fixed costs per shipment. We use a unique dataset of Swiss cross-border trade on the transaction level to infer the size and shape of the underlying fixed costs. The inferred fixed costs are specific to each firm–country–product combination. Our results suggest that the fixed costs per shipment of the average Swiss exporter are large, ranging between 0.82% of the export value in our most conservative specification and 5.4%. We document that the imputed fixed costs per shipment correlate negatively with language commonalities, trade agreements and geographic proximity.

1. Introduction

Fixed costs of exporting form a centerpiece of the broad literature following Melitz (2003). These costs divide the set of heterogeneous firms into highly productive exporters and less productive local sellers, generating rich trade patterns on the aggregate and the firm level alike.

Fixed costs of exporting are generally thought to decompose into fixed costs of market entry and per-period fixed costs. These two components of trade costs are equivalent for trade flows in static setups that are usually explored.[1]

In the present paper we introduce and analyze the concept of *fixed costs per shipment*. Such fixed costs accrue by organizing the shipment of each bundle of goods, independent of its size. They comprise the monetary equivalent of the time spent filling in customs forms, organizing trade credit and monitoring and coordinating the actual transportation to the receiver. Exporting firms can, for any given quantity of yearly exports, save on these fixed costs by shipping less often and more at a time. This strategy, however, generates higher storage costs at export destinations. Striking the optimal trade-off between higher fixed costs per shipment and lower storage costs, firms choose the frequency and size of their export shipments as a function of standard parameters of demand, technology, and interest rates.

The key contribution of the current paper is to use a structural model to recover unobserved fixed costs per shipment from observables. In particular, fixed costs per shipment are analyzed in a standard Melitz model. We show that the frequency and size of shipments – in combination with demand elasticities, discount rates and, in a richer setup, physical storage costs – constitute sufficient statistics to quantify the fixed costs per shipment.

In an empirical part, we use transaction-level data from Swiss exporters to quantify fixed costs per shipment according to our theory. The inferred fixed costs per shipment are economically important: according to our most conservative specification, their net present value averages at about 5723 CHF, which translates to 0.82% of the value of shipment. Adopting parameter specifications from the recent literature, average imputed fixed costs per shipment are as high as 5.4% of the shipment value.

We also exploit the country dimension of trade flows to assess the impact of some standard trade barriers on the imputed fixed costs per shipment. Thus, a *common language* is associated with a 57% reduction, the existence of a *trade agreement* with a 41% reduction and finally, the doubling of bilateral *distance* with a 24% increase in fixed costs per shipment. All of these effects are statistically significant independent of the inclusion of determinants of trade flows such as market size and per capita income. Finally, our data allow us to estimate whether the transportation mode correlates with fixed costs per shipment. The analysis suggests that transportation per rail and per ship is associated with high fixed costs per shipment compared to the fixed costs for transactions on the road.

Introducing fixed costs per shipment has a number of novel implications for trade theory. First, trade flows gain an additional margin through which quantities adjust: the traditional intensive margin

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[1] More precisely, in steady state all relevant endogenous variables are unchanged as long as the sum of the net present value of both types of fixed costs is constant.

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(on the firm level) decomposes into frequency and the size of shipments. Our theory predicts that trade volumes generally expand along both margins: the shipment frequency and the value per shipment. An exception to this general rule occurs when fixed costs per shipment drop. In this case, the total trade volume and the number of shipments increase, while the value per shipment decreases.

Second, the concept of fixed costs per shipment smudges the border between fixed costs of exporting and variable costs of exporting because both costs become substitutable: a firm can reduce fixed costs per shipment and increase variable storage costs by shipping goods more or less frequently. In addition and more importantly, a firm's yearly fixed costs per shipments are roughly proportional to its yearly export volume, since larger yearly exports come along with higher frequency. This fact has potentially severe implications for empirical estimates of different components of trade costs. Thus, Das et al. (2007) estimate zero per-period fixed costs of exporting but subsume fixed costs of shipments under variable trade costs.[2] A spurious classification of fixed costs per shipment as part of variable cost is indeed not innocent since extensive margins react differently under fixed and variable costs. For example, if fixed costs per shipment are large, adverse demand shocks may force the least productive exporters out of export markets, while the same exporters would continue to export if trade costs were variable.[3] Also, in the absence of per-period fixed costs, fixed costs per shipment may take the role of the latter, reestablishing the mechanisms in earlier studies like Segura-Cayuela and Vilarrubia (2008) or Irarrazabal and Opromolla (2009), which rely on the existence of per-period fixed costs.[4] Our framework suggests that transition dynamics be analyzed within an adapted setup where the shipment frequency – or, equivalently, the length of a period – is endogenous.

Finally, by endogenizing the time between either two shipments for a given firm and export market, we raise the question about the adequate definition of exporter-status. A firm that ships products twice a year will report zero exports at least every second quarter. Based on quarterly data, this firm will experience exits and re-entries, while it will be always considered to be an exporter based on a definition using yearly data. That distinction is central for the correct procedure to measure fixed costs of (re-) entry to export markets.[5] Indeed, even when measured on a yearly basis, a large part of firms export discontinuously (see Békés and Muraközy, 2012). Our analysis shows that this pattern is possibly the result of high fixed costs per shipment. Relatedly, one may also analyze the evolution of shipment frequencies when learning reduces fixed costs per shipment in the spirit of Segura-Cayuela and Vilarrubia (2008).[6] Our paper provides a framework to address such questions.

Estimating the size and shape of trade costs has a long tradition. About a decade ago, the continued rise of trade volumes and a secular decline of tariffs and measured transport costs suggested that trade costs had lost their prominent role. Baier and Bergstrand (2001) drew renewed attention to trade barriers, highlighting their role for the rise in post-war trade volumes. Shortly after, Anderson and van Wincoop (2004) put forward that trade costs are still substantial in absolute size and in their economic impact. Recently, Jacks et al. (2008) and Jacks et al. (2008) offer an elegant way to estimate the magnitude of all combined barriers to trade.

The distinction between marginal and fixed costs became paramount with the seminal contribution by Melitz (2003) and the subsequent stampede towards heterogeneous firms. Hummels and Skiba (2004) provide evidence against iceberg type of transportation costs, while Irarrazabal et al. (2011) find them to be large. Das et al. (2007) structurally estimate fixed costs of entry to export markets and report that sunk costs of entry to export markets range between $344,000 and $430,000 U.S. dollars. At the same time, the authors find that annual fixed costs of exporting are close to zero (see also Roberts and Tybout (1997)). Moxnes (2010) shows that sunk costs to export markets vary largely by importer country. Anderson and Yotov (2010) analyze the proportions of trade costs paid by sellers and buyers, showing that the *incidence* of trade costs has important implications for the home bias and the gains from trade. The present paper adds to this line of literature by imputing one specific component of trade costs, namely fixed costs per shipment, from observables of transaction-level trade data.

Several recent studies focus on the economies of scale in transaction technologies. Burstein and Melitz (2011) explore the role of sunk costs, concluding that macroeconomic dynamics "can vary greatly over time depending on those modeling ingredients." Closely related to our paper, Alessandria et al. (2010, 2011) analyze optimal inventory management of importers under stochastic demand with fixed costs of importing and transportation delays. In line with our finding, larger export volumes are predicted to come along with higher shipment frequency. A calibration of their model indicates that fixed costs per shipment amount "to approximately 3.6% of the average value of an import shipment." The difference to our baseline model (which suggests 0.82% tariff equivalent) is largely explained by a different choice of parameters: following Alessandria et al. (2010) and setting annualized storage costs to 35% and demand elasticities at 1.5, we obtain values for fixed costs per shipment of 3.3% of the average value of shipment.[7] Our model thus comes remarkably close to replicating the numbers in Alessandria et al. (2010). In addition, we compare the imputed fixed cost per shipment to direct measures from the *Doing Business* survey of the World Bank. Our results show that, on average, our imputed fixed costs per shipment under realistic assumptions on storage costs are largely consistent with these direct measures. Finally, we show that correcting for biases arising due to potential firm exits from export markets does not significantly alter our findings.

A very recent strand of literature addresses exports on the transactions level directly. Eaton et al. (2007) are among the first to show that the shipment frequency constitutes an important margin along which aggregate trade volumes tend to adjust. Relatedly, Békés and Muraközy (2012) document the prevalence of temporary trade in Hungarian firm-level trade data: less than half of all active firm–product–destination combinations exhibit more than three years of consecutive exporting. The authors explain this observation by a combination of uncertainty about future firm productivity and the firms' choice of sunk- versus per-period fixed costs of exporting.[8] Our model complements this research by predicting sporadic interruptions of yearly trade flows even in absence of per-period fixed costs whenever fixed costs per shipment are large. Analyzing monthly exports of French firms, Békés et al. (2012) show that export volumes expand and contract along the frequency margin parallel to traditional margins. While the authors rely on monthly aggregates, we provide evidence for this pattern based on transaction-level data. On the theory side, we add to this line of research

[2] More precisely, Das et al. (2007) implicitly subsume all trade costs that accrue proportional to trade volumes under market-specific production costs (see Eq. (4) in Das et al. (2007) and the discussion in footnote 6 therein). These costs include the fixed costs per shipment, which are therefore not part of the estimated per-period fixed costs.

[3] Chaney (2005) discusses these hysteresis effects assuming standard per-period fixed costs. Extensive margins are absent or mild when all fixed costs are paid up-front.

[4] Segura-Cayuela and Vilarrubia (2008) study learning about an ex-ante "unknown per-period cost of presence in the foreign market," while Irarrazabal and Opromolla (2009) rely on the concept of per-period fixed costs to study exporters dynamics.

[5] Das et al. (2007) find that firms "tend to continue exporting when their current net profits are negative, thus avoiding the costs of reestablishing themselves in foreign markets when conditions improve."

[6] On the one hand, a reduction of fixed costs per shipment should increase the shipment frequency; on the other hand, forward-looking firms may want to ship frequently right after market entry in an attempt to accelerate the learning process.

[7] When storage costs are large, the substitutability between storage costs and fixed costs per shipment requires large fixed costs per shipment to justify a given frequency of shipments.

[8] See also Deardorff (2001) and Kleinert and Spies (2011) for a model with endogenous choice of transportation technology.