Multimarket entry in exporting

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Abstract

The expansion of exporters to new markets is an important aspect of international trade. This paper develops a model to explain a firm’s optimal export entry strategy when faced with multiple potential export destinations. The model allows for experience-related reductions in the costs of entry to export markets, which explains productivity-driven heterogeneity in the extent, timing, and order of market entry. The model presents several predictions that are tested and confirmed using Swedish firm-level data. More productive firms employ strategies that involve entering a larger number of markets in the long-term, entering larger markets, and entering markets more quickly. More productive firms tend to enter larger then smaller markets whereas less productive firms enter smaller then larger markets, so the model explains part of the heterogeneity in market entry orders. All firms enter nearer markets earlier. In addition, the model is consistent with empirically observed hierarchies of export markets.

Keywords: export market entry, learning by exporting, fixed costs, heterogeneous firms

JEL classification: D83, F12, F17

1. Introduction

The explanation of the decisions of firms about whether to become exporters and how to establish themselves as exporters is integral to the study of international trade. Aspiring exporters must decide which amongst a wide and diverse selection of markets to export to and when to enter these markets. While much of the research on international trade focuses on the firm’s decision to export, most often at least implicitly to a single potential export market, little attention has been paid to the decisions faced by a firm that has several potential

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export markets, as is the case in reality. This paper proposes an intuitive theoretical model to explain the decisions made by a firm that faces several potential export markets. The model produces expansion patterns that fit with empirical observations, driven by benefits of experience in exporting that decrease the fixed costs of entering further markets. The model offers new insights into the firm’s decision about how to expand exporting across markets, in terms of both the selection of markets and the timing of entry, which enables a better understanding of the process by which firms become exporters.

The recent appearance of datasets that detail the destinations of exports and foreign affiliate sales has facilitated a surge of research into the composition of trade by destination. Central to this research is the study of French firms by Eaton, Kortum, and Kramarz (2004) that detailed the highly-skewed and hierarchical distributions of numbers of export destinations by firm and of firms by market. Further studies have identified a rough hierarchy of export markets in terms of the order of entry, with a positive correlation between the market entry orders of different firms (Eaton, Kortum, and Kramarz, 2008; Lawless, 2009). In addition, a positive correlation has been identified between firm productivity and the number of export destinations (De Loecker, 2007; Eaton, Kortum, and Kramarz, 2008; Lawless, 2009). A small theoretical literature on the hierarchy of markets and the order of entry has also emerged.

Of particular relevance to the current paper is the work of Lawless (2009), who also modelled the export entry strategies of firms facing multiple potential export markets following the heterogeneous firms framework of Melitz (2003). Export markets in her model have idiosyncratic demand and fixed cost parameters that lead to market-level heterogeneity in potential profits for any given firm. A hierarchy of export markets results, with the more productive firms entering a larger number of markets, always a superset of the markets.
entered by less productive firms. Indeed, all firms are predicted to enter export markets in the same order, with more productive firms simply progressing further down the chain. These predictions were upheld using Irish firm-level data. However, the model lacks a mechanism to explain the timing of entry, firms having no incentive to delay entry to any markets beyond the moment of their formation, so the concept of an order of export market entry is arbitrary.

The learning mechanism in the current model generates a time pattern of export market entry and explains diversity in orders of export market entry.

The learning mechanism presented in this paper is related to the mechanism based on uncertainty about demand and production factors in Albornoz, Calvo Pardo, Corcos, and Ornelas (2010). They develop a two-destination model in which a firm may enter the smaller market first in order to gain information about its exporting profitability and then, depending on its realised profitability, either cease to export, continue to export to the smaller market, or export to both markets in the second period. Low-productivity firms do not export and the most productive firms simply enter both markets in the first period. This is a credible explanation for a pattern of exporting in which new exporters are more likely to add new export destinations and to exit from export markets than more established exporters, which they identify in data from Argentinean firms. In contrast, the mechanism presented in the current paper has the advantages of explaining variation in the orders of market entry, of a type that is found to be consistent with data from Swedish firms, and of extending intuitively to any number of potential export destinations. Both models generate export patterns in which more productive firms enter new export markets at a faster rate and export to a larger number of markets in the long-term.

The uncertainty mechanism in Albornoz, Calvo Pardo, Corcos, and Ornelas (2010) is intuitive and complements the learning mechanism presented in this paper. Each mechanism
applies naturally to different aspects of the benefits that experience yields for exporters. For example, when a firm enters a new foreign market it gains experience about the level of demand and this reduces uncertainty about demand in other foreign markets, whereas the experience of adapting products to be compatible with a foreign technology or running an advertising campaign in a new export market would reveal insights into how these processes could be carried out more efficiently, reducing the costs of entering further markets. The uncertainty mechanism more naturally applies to the comparison of new and established exporters, whereas the model presented in this paper yields insight into the speed and order of export market entry. A more complete model would therefore include both mechanisms, a possible extension to the model presented in this paper.

The adaptation process underlying reductions in the fixed costs of entry in the current paper is related to Chaney (2011) and Morales, Sheu, and Zahler (2011). They model the profitability of export markets as depending on prior exports to similar markets, which generates expansion patterns in which firms tend to enter chains of similar markets. These models produce patterns of expansion that vary by firm and are correlated across firms, as observed in data. However, as the variation in entry orders in these models is random at its source, these models do not explain why orders of entry vary to begin with. The introduction of market-specific experience into the model in this paper increases the correlation in market entry orders, but does not affect the main results.

The current paper proposes a theoretical model of export entry that yields insights into the strategic decision of a firm that has several potential export markets. The model is based on the heterogeneous firms framework of Melitz (2003) and developed further by Chaney (2008), in which firms realise their productivity level when they are formed, then decide whether to operate and which foreign markets, if any, to export to. The model introduces a
function for the fixed cost of entry to new export markets that depends on two factors: the size of the market entered, and the firm’s prior experience in setting up new export operations.

The fixed cost of entry is increasing in the size of the market entered, as in Akerman and Forslid (2008). Firms are not able to enter only part of an export market by paying a lower fixed cost, as is the case in Arkolakis (2010), and therefore enter smaller markets to gain experience rather than entering part of a larger market. Allowing entry to part of a market would permit an additional route for the accumulation of experience, but this would be less relevant to the explanation of export expansion patterns. Indeed, as the predictions inferred from the model about export entry patterns are confirmed by the data, the accumulation of experience from entry to small markets at least comprises a significant part of the story. Furthermore, a fixed cost of entry that is increasing in market size for exporters that reach all consumers in the market is consistent with Arkolakis (2010).

Firms are assumed to learn from the experience of exporting, which reduces the fixed costs of entering further markets, consistent with the empirical evidence of Kneller and Pisu (2006, 2007) and Morales, Sheu, and Zahler (2011). This creates incentives concerning the timing and order of entry to export markets, affecting the optimal strategy of the firm. Similar results would obtain using some specifications of a learning effect that instead improved the productivity of the firm. However, it is unclear whether such an effect exists, with evidence of a significant effect in a few specific cases (e.g. Aw, Chung, and Roberts, 2000; Blalock and Gertler, 2004; Damijan and Kostevc, 2006; Van Biesebroeck, 2006; De Loecker, 2007; Greenaway and Kneller, 2007; Aw, Roberts, and Xu, 2008) but not in others (e.g. Clerides, Lach, and Tybout, 1998; Bernard and Jensen, 1999; Arnold and Hussinger, 2005; Fafchamps, El Hamine, and Zeufack, 2008). The benefits of experience in the model are assumed to
accrue through the more intuitive and empirically supported route of decreasing the costs of establishing new export markets. This mechanism involves the firm learning how to adapt its products, run an advertising campaign, and establish a distribution network, all of which could be improved by experience.

The model generates a number of predictions about patterns of export expansion that are confirmed using Swedish firm-level data. The model predicts that more productive firms will enter a larger number of markets, a larger total market size, and enter export markets more quickly. The most novel feature of the model is that it also predicts and provides an intuitive explanation for different orders of export market entry for different firms. Among firms that eventually enter the same export markets, those firms that enter smaller markets first and then larger markets are necessarily less productive than firms that progress from larger to smaller markets. This result arises from the opposing incentives that the firm has to enter larger markets first, to capture higher revenues, or to enter smaller markets first, as the fixed cost reduction from experience is larger in absolute terms for larger markets. For similarly-sized markets the model predicts that all firms, regardless of productivity, enter nearby markets first and then expand to progressively more distant markets. Firms in the model are heterogeneous in terms of their productivity levels but are otherwise identical, so the variation in the strategies employed across firms is driven by variation in firm productivity.

The remainder of the paper is organised as follows: the model is presented in section 2; a discussion of a firm’s optimal strategies is presented in section 3; the hierarchy of export destinations is discussed in section 4; the factors affecting a firm’s choice of an optimal strategy in a scenario with only two potential export markets is detailed in section 5; the data

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3 The model would yield similar results with some alternative dimensions of heterogeneity, such as in the capacities of firms to establish new export destinations or to adapt their products to export.
on Swedish firms are described in section 6; the model is tested using the Swedish data in section 7; the importance of uncertainty is discussed in section 8; and concluding remarks are presented in section 9.

2. Model
The economy in the model is comprised of the firm’s home country and $I$ foreign countries that the firm may choose to export to. There are a large number of other firms operating in the economy, so each individual firm does not consider the effects of its export decisions on price levels or the strategies of other firms. To enter any given export market, the firm must sink an initial fixed cost, which is an increasing function of the market’s size but, due to learning effects, a decreasing function of the number of destinations that the firm already exports to. After entering the market, the firm receives a permanent and constant revenue stream. The firm has full *ex ante* information about the fixed costs of entry and the levels of exporting revenue associated with all potential export markets. As the fixed cost of entry is decreasing in the number of export destinations, the firm is able to benefit in the long-term by entering markets gradually. The model is outlined in detail in this section.

2.1. Consumers
The consumers in the model are assumed to have identical, constant elasticity of substitution preferences of the Dixit and Stiglitz (1977) type, with demand elasticity $\sigma > 1$. Where a continuum of $\Omega$ goods is available in the economy, the utility of a representative individual is

\[
U = \left[ \int_{\omega}^\Omega x_{\omega}^ {\sigma-1} d\omega \right]^{\sigma-1} \sigma. \]

The consumer price of good $\omega$ is denoted $p_{\omega}$ and the income of the individual is denoted $Y$. The demand of the representative consumer for good $\omega$ is therefore

\[
x_{\omega} = \frac{P_{\omega}^\sigma}{P^{1-\sigma}} Y, \quad \text{where} \quad P = \left[ \int_{\omega}^\Omega p_{\omega}^{1-\sigma} d\omega \right]^{1/(1-\sigma)} \]

is an index that reflects the overall level of prices in the market.
2.2. Firms
The firms in this model are assumed to be of the increasing returns to scale, heterogeneous productivity type proposed by Melitz (2003), in which each firm realises its productivity after it is formed. Upon realising its productivity, the firm decides whether to produce and what strategy to employ in entering export markets. There is some fixed cost associated with establishing a firm, which in equilibrium offsets the expected operating profits and ensures that firms in the economy are formed at a positive and finite rate. After formation, the firm realises its idiosyncratic per-unit cost of production, \( a_\omega \), which defines its productivity, \( a_\omega^{1-\sigma} \).

The price of the sole production input is normalised to one, so the firm maximises profits by setting its output price equal to \( p_\omega = a_\omega \sigma / (\sigma - 1) \).

2.3. Export revenues
The firm is faced with \( I \) potential export markets, where market \( i \) has gross domestic product (GDP) \( Y_i \) and an overall level of prices represented by the index \( P_i \). Transport costs are of the iceberg type, with \( \tau_i \) units shipped from the home country for each unit that arrives in country \( i \). For convenience this is converted to the trade freeness parameter \( \phi_i = \tau_i^{1-\sigma} \).

Dropping the subscript \( \omega \), when exporting to market \( i \) the firm with unit cost parameter \( a \) and output price \( p = a \sigma / (\sigma - 1) \) receives the following single-period revenues:

\[
    r(P_i, Y_i) = \phi_i \frac{1/\sigma [(\sigma/(\sigma - 1))]^{-\sigma} a^{1-\sigma}}{P_i^{1-\sigma}} Y_i
\]

This expression may be simplified slightly by defining the ‘size’ of an export destination to be its GDP adjusted for the toughness of competition from other firms, \( s_i = a P_i^{\sigma-1} Y_i \), which reflects the larger demand for the firm’s exports in markets with fewer competitors or in which competitors sell for higher prices. The variable \( s_i \) directly reflects the potential sales.
volume of a new entrant to market $i$ for any given price$^4$. Without loss of generality, parameters can be normalised such that $\alpha = 1/\sigma\left[\sigma/(\sigma - 1)\right]^{1-\sigma}$, which allows (1) to be simplified to the following:

$$r(s_i) = \phi_i a^{1-\sigma} s_i$$  (2)

The fixed costs of exporting are sunk upon entry and the per-unit revenue (2) is strictly positive, so once the firm has entered market $i$ it receives a permanent stream of revenues of $r(s_i)$ in each period from sales to that market. The firm is assumed to have a per-period discount factor $\beta$, so the long-term revenue from export market $i$ discounted back to the period of entry is:

$$R_i = \sum_{t=0}^{\infty} \beta^t r(s_i) = \frac{r(s_i)}{1 - \beta}$$  (3)

Substituting in (2) yields:

$$R_i = \frac{1}{1 - \beta} \phi_i a^{1-\sigma} s_i$$  (4)

2.4. Fixed costs of entry to export markets

A number of studies have found positive plant-level fixed costs associated with entry into new export markets (Bernard and Jensen, 2004; Bernard and Wagner, 2001; Das, Roberts, and Tybout, 2007). However, there is little evidence of ongoing fixed costs associated with continuing to export; indeed, Das, Roberts, and Tybout (2007) found that such ongoing fixed costs were not significantly different from zero. The model design follows this result, with positive fixed costs for entry into a new market but no ongoing fixed cost for continuing to export.

$^4$ The sales volume is not identical for all markets regardless of size, in contrast to the standard constant elasticity of substitution model with uniform fixed costs for all markets. Fixed costs are increasing in market size, which was shown by Akerman and Forslid (2008) to lead to higher per-firm export volumes to larger markets.
export to that market. The fixed cost of entry into export market \( i \) at time \( t \) is represented by the function \( f^X(s_i, n_i) \), where \( s_i \) is the size of the market and \( n_i \) is the number of export destinations that the firm has already entered before the beginning of period \( t \), reflecting the firm’s past experience as an exporter. This section details the minimal set of restrictions on the form of the fixed cost function that are assumed in this paper, based on intuition and empirical evidence.

The fixed cost is assumed to be positive for a destination market of size zero and increasing in the size of the market, as in Akerman and Forslid (2008) and if all consumers in the market were to be reached in Arkolakis (2010). This reflects the higher costs of purchasing advertising and establishing distribution networks to reach a larger number of people. Again the ‘size’ of the market reflects both the GDP and the lack of competition from other firms, as the absence of other firms is assumed to be correlated with the difficulty of exporting to the market. The fixed cost is incurred upon entry and is fully determined by the size of the market, with no option to partially enter the market and incur only part of the entry cost. This assumption is certainly a stylisation of the real world, in which firms often fill individual orders, export to only part of a country, increase the scale of an export operation over time, or vary the level of exports based on the level of success experienced in the market. However, while the possibility of firms entering part of a market would allow another method for firms to accumulate experience, this would complicate the model without adding substantially to the predictions about the orders and timing of entry to new export markets. To reflect

5 This restriction precludes one mechanism for firm exit from export markets, in which a firm that exports to an unprofitable market simply to gain experience in setting up export operations would subsequently exit if the ongoing revenue is negative. However, uncertainty and fluctuations in cost and demand factors over time are likely to be far more important in explaining why firms exit from export markets.

6 The benefits from experience in setting up an export operation are therefore assumed to accrue entirely after a single period.
economies of scale, the fixed cost per unit of size is assumed to be non-increasing in the size of the market:

$$f_s^X > 0 \quad f_s^X \leq f_X^X / s$$

Considering that revenues are linear in market size, economies of scale in the fixed costs imply that larger markets yield higher net profits. Due to discounting, large markets are therefore generally entered earlier than smaller markets, with some irregularity in the order caused by variation in distance and the benefits of experience\(^7\).

The fixed cost of entry to a given market is assumed to be decreasing in the number of destinations already entered, reflecting the benefits of experience, which fits with the empirical findings of Kneller and Pisu (2006, 2007) and Morales, Sheu, and Zahler (2011). The reduction in the fixed cost takes one period to accrue, so the firm does not benefit from entering other markets concurrently. This provides an incentive for the firm to delay entry to a given export market until it has gained experience from other markets\(^8\). As more markets are entered the potential for further such gains is reduced, so the fixed cost is decreasing and convex in the number of export destinations\(^9\):

$$f_n^X < 0 \quad f_{nn}^X > 0$$

Taking the number of markets already entered as the relevant unit of experience implies that the benefits of experience take one period to accrue and then accrue entirely after a single

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\(^7\) This is explained in more detail in appendix 1.

\(^8\) An alternative explanation for delayed entry could be a management constraint on establishing new export markets, whereby the fixed cost of entering an export market would be increasing in the number of other markets entered simultaneously. This, however, would be an equivalent explanation, as the benefits-of-experience mechanism effectively means that it is more costly to enter multiple markets simultaneously.

\(^9\) The assumption that experience reduces the fixed costs of entry is necessary to generate entry patterns in which the firm does not simply enter all profitable markets immediately, which is demonstrated in appendix 1.
period. The most obvious result of this assumption is that no optimal strategy can involve entering consecutive markets more than one period apart\(^{10}\). Even so, the model already has endogenous delays between entry times to consecutive markets, as several markets may be entered simultaneously, and the results arising from a modification in which the benefits of experience accrue over time would not be qualitatively different from those produced here.

The fixed cost that results from experience is assumed to be the same or larger in absolute terms the larger is the export destination, as part of the reduction may depend on the size of the market that is subsequently entered:

\[
\text{f}^X_{sn} \leq 0
\]

This could be due, for instance, to improvements in the process of adapting a product that reduce the cost of producing each unit that is exported. Absolute savings that are increasing in the size of the market create an incentive for firms to delay entry into larger rather than smaller markets, driving the predictions about firms entering markets in different orders\(^{11}\).

The fixed cost of entering a new export market may be increasing in distance, as distance is correlated with several factors that influence the cost of setting up an export operation. For instance, differences in regulations, culture, and product characteristics tend to increase with distance, factors that affect the costs of satisfying legal requirements, advertising, and adapting products. However, as the conclusions of the model would not be qualitatively different were distance to be included as a factor in the fixed cost function, it is excluded in the interests of simplicity.

\(^{10}\) A formal explanation of this is given in appendix 1.

\(^{11}\) The justification for this is explained in detail in appendix 1.
2.5. Long-term profits

As there is no uncertainty in the model, it is never optimal to drop out of an export market once it has been entered, as the revenue in each period must be positive for the firm to enter in the first place. The optimal policy function can therefore be expressed as a vector $E$ of integer values representing the period in which each particular market is entered. That is, the firm is defined to enter market $i$ in period $E_i$, where by convention period zero is the initial period and $E_i = \infty$ if the firm does not enter market $i$ at all. The discounted payoff of the strategy represented by $E$ is therefore:

$$
\Pi = \sum_{i=1}^{m} \beta^{E_i} R_i - \sum_{i=1}^{m} \beta^{E_i} f^X(s_i, n_{E_i})
$$

Substituting in the expression for single-period revenue (4), this simplifies to:

$$
\Pi = \frac{1}{1-\beta} \alpha^{1-\sigma} \sum_{i=1}^{m} \beta^{E_i} \phi s_i - \sum_{i=1}^{m} \beta^{E_i} f^X(s_i, n_{E_i})
$$

Following Chaney (2008) the stock of potential firms in each country is assumed to be restricted, so that free entry does not drive the expected profits of firms to zero. Rather, these profits are distributed around consumers in the firm’s home country in the form of dividends.

3. Optimal export entry strategy

Taking into account the potential revenues from exporting to each destination and the function of fixed costs of entry, the firm devises its optimal strategy for which markets to enter and when to enter these markets. The solution to this optimisation problem is a vector of export market entry times $E$, which maximises the payoff given by (6).

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12 With a positive ongoing fixed cost of exporting this may not hold true, even in the absence of uncertainty, as the firm could enter a market to benefit from that experience even if revenue from exporting to that market is less than the ongoing fixed cost. In such a case the firm would not continue exporting to the market once it had benefited from the experience of establishing the export operation.
3.1. Productivity ordering of firms

A relationship between the productivity levels of firms and the characteristics of the strategies that they would optimally employ may be inferred from the expression for the strategy payoff in (6). To see this, observe that the first term in (6), the sum of discounted revenue streams, is positive and linear in the firm’s productivity factor \( a^{1-\sigma} \). The multiplier on the productivity level is proportional to the term \( A = \sum_{i=1}^{m} \beta_{E_i} \phi_{s_i} \), which combines the number of markets entered, the sizes of those markets, and the timing of entry into a single variable. The term \( A \) is henceforth referred to as the ‘aggressiveness’ of the strategy characterised by \( E \). The second term in (6), which combines the discounted fixed costs of entry, is independent of the firm’s productivity level. The discounted payoff of a given strategy is therefore an increasing, linear function of the firm’s productivity, with the gradient of the function determined by the aggressiveness of the strategy. This is illustrated in Figure 1 for three hypothetical strategies, for which \( A^{(3)} > A^{(2)} > A^{(1)} \).
Figure 1. Strategy payoffs as functions of firm productivity levels.

The payoffs from any given pair of strategies may intersect at most once across the spectrum of productivity levels, with the more aggressive strategy yielding a higher payoff for all productivity levels above this threshold and vice versa, as shown in Figure 1. As this applies for any pair of strategies, There is a positive and monotonic relationship between the aggressiveness of the strategies and the productivity levels of the firms that optimally employ them, though it should be kept in mind that some potential strategies may not be optimal for any firms to employ and therefore do not appear in the productivity ordering, as is the case with strategy 2 in Figure 1. Holding all else constant, each of the following implies a more aggressive strategy, which may therefore only be optimally employed by a more productive firm:

1. Entering an additional market;

2. Exporting to a larger market instead of a smaller market;
3. Entering any given market earlier.

If the assumption about holding the other factors constant were to be loosened, then it would be possible for a strategy to be more aggressive than another and thus be employed by more productive firms despite being less aggressive in terms of one or even two of the above factors, if there was a more-than-compensating difference in the remaining factor or factors. Therefore, while the productivity of the firms optimally employing a strategy is generally increasing in each of the above factors, the ordering of firm productivities in terms of any one factor is not strict. With this in mind, the overall relationships are expressed in the following proposition.

**Proposition 1.** *When firms employ optimal strategies, more productive firms:*

1. *Enter a larger number of markets in the long-term;*

2. *Enter a larger total market size in the long-term;*

3. *Enter markets more quickly.*

*Holding the other two factors constant. Each factor is generally, if not monotonically, increasing across the full range of firm productivity levels.*

**Proof.** *See appendix 2.*

The prediction that more productive firms enter a larger number of markets in the long-term is not surprising, and fits with existing empirical evidence (De Loecker, 2007; Eaton, Kortum, and Kramarz, 2008; Lawless, 2009). The intuition is that a more productive firm generates more revenue from each export market and is therefore able to cover the fixed costs of entry to a larger number of markets, which fits with the mechanism in Lawless (2009). As the advantage in revenue from higher productivity is increasing in the size of the export
market, a more productive firm is also able to cover the fixed costs of entry into larger markets. In combination these two points motivate the prediction that a more productive firm exports to a set of markets with a larger total size.

The model also predicts that more productive firms will enter markets more rapidly, with the most productive firms entering many markets immediately. The benefit of delaying entry to a further export market at any point in time is that if the firm delays entry until it gains experience from the other markets, then the fixed cost it faces of entering the market will be reduced. However, this benefit is offset by a period of foregone revenue. The fixed costs do not depend on the firm’s productivity, while revenue is directly related to productivity, so the more productive firms have less incentive to delay export market entry and therefore enter export markets more rapidly\(^\mathrm{13}\).

Furthermore, the model represents the contrasting incentives that the firm has either to enter smaller markets first, in order to gain exporting experience at a relatively low cost, or to enter larger markets first, in order to receive more revenue in the near-term, and is therefore able to generate either type of pattern. In fact, it is possible that some firms may enter unprofitable markets, simply in order to gain experience that makes it more profitable to export elsewhere\(^\mathrm{14}\). The relationship between firm productivity and the optimal order of markets entered by size is summarised in the following proposition.

**Proposition 2.** *When firms employ optimal strategies, firms that enter the larger of two markets first and then the smaller market are necessarily more productive than firms that*

\(^{13}\) This result also holds under the alternative explanation that delaying entry into some export markets is the result of a management constraint, whereby establishing several new export markets simultaneously puts a strain on the firm’s resources. More productive firms would enter markets more rapidly as they earn more revenue, which offsets the additional costs from entering markets simultaneously.

\(^{14}\) As the fixed cost of exporting has been sunk, the firms would continue to export to these markets.
enter the same markets in the opposite order, holding all other aspects of the strategies constant.

Proof. See appendix 2.

Proposition 2 reflects the fact that for a more productive firm, the revenues from each market are higher, which implies a greater incentive to enter larger markets sooner in order to maximise discounted long-term revenues. On the other hand, a less productive firm earns less revenue from each market and therefore the fixed costs of entry are relatively important, so the firm has a greater incentive to enter the smaller markets first, as the absolute decreases in the fixed costs of entry are larger for larger markets.

The pattern outlined in proposition 2 extends to any subset of exporting strategies. Amongst firms that eventually enter the same set of markets, this produces an overall ordering in which more productive firms tend to export to larger markets earlier and less productive firms do the opposite. A pattern of market entry that progresses from smaller to larger markets is related to the theory of Rauch and Watson (2003) that less productive exporters would begin by exporting small volumes, which could correspond either to exporting progressively larger amounts to the same markets, entering progressively larger export markets, or some combination of both.

One implication of proposition 2 is that firms with different productivity levels, but which are otherwise identical, may optimally enter export markets in different orders, so heterogeneity in productivity levels is sufficient to explain diversity in orders of export market entry. The model therefore presents an alternative theoretical explanation for the heterogeneity in orders of export market entry observed for French firms in Eaton, Kortum, and Kramarz (2008) and for Irish firms by Lawless (2009) that is not based on firm-specific heterogeneity in demand or in the fixed costs of entry.
3.2. Distance to export destinations and the optimal order of entry
It is possible to infer a prediction about the order of market entry from the model, which is the subject of the following proposition.

**Proposition 3.** *When firms employ optimal strategies, all firms enter a nearer market no later than a more distant market of the same size.*

**Proof.** *See appendix 2.*

The prediction that firms will enter a nearer market before a more distant market is a simple product of discounting: if one market yields a larger net profit, the firm benefits by entering that market earlier. Proposition 3 is not surprising considering how much of the variation in trade volumes is explained by the gravity model of trade, in which the two principal factors are market size and distance (Anderson and van Wincoop, 2004). The prediction here is related: not only do firms export more to nearer or otherwise more accessible markets, but they also enter these markets earlier. As with the gravity model, the sizes of markets and other factors not made explicit in the current model also play a role, but in general firms are predicted to begin by exporting to neighbouring countries and then expand to progressively more distant markets.

As outlined in the discussion of proposition 2, the order in which markets of different sizes are entered by different firms is not uniform, but varies depending on firm productivity. It is therefore not possible to predict an ordering of markets based solely on their sizes. However, in general the model predicts that larger markets will yield higher net profits, which is consistent with firms generally entering larger markets earlier.

4. Export destination hierarchy
Export markets have been shown in French data by Eaton, Kortum, and Kramarz (2004) to follow a hierarchy, even within individual sectors, with a few markets being exported to by
many firms while many markets are exported to by only a few firms. The data from Swedish manufacturing firms show a similar hierarchical pattern, as detailed below. The model presented here generates such a hierarchy. It was noted in Proposition 1 that more productive firms enter a larger number of markets, so there is heterogeneity in the numbers of export markets per firm. To demonstrate a hierarchy of export markets, it is necessary to show that there is heterogeneity in the numbers of firms per export market.

The variation in market sizes and transport costs generates heterogeneity in the profitability of different markets for any given firm. In combination with productivity heterogeneity, this leads naturally to a hierarchy of markets, with many firms entering markets with low fixed costs of entry or transport costs, for example, whereas only high-productivity firms enter more markets where these costs are higher. The situation here is slightly more nuanced due to the reductions in the fixed costs of entry that result from experience. For instance, some markets may be optimal for firms with particular productivity levels to enter simply to gain experience that reduces the fixed costs of entering further markets. However, this does not prevent a hierarchy of markets from emerging, as even if some markets are entered to gain experience, the remaining markets retain the same order in terms of their profitability. So the broader ordering of markets driven by potential revenues and costs is retained, but with an unusually large number of firms exporting to some relatively small and low-cost markets that are used to gain experience.

Furthermore, in the long-term there is always an overlap between the sets of markets entered in the optimal strategies of any given pair of firms. The overlap in export destinations arises because if it is profitable for one firm to export to a given set of markets, then another firm with at least the same level of productivity would also find it profitable to export to that same set of markets. This finding holds despite productivity differences and would hold even if
adaptation were country-specific, so that firms could adapt their products in different
directions, as in Morales, Sheu, and Zahler (2011). Though there may be a tendency for
firms that adapt their products to one country with a certain technological requirement,
language, or taste subsequently to export to other similar countries, the argument that if one
of these sets of markets is profitable for one firm then it must also be profitable for a more
productive firm still holds. The situation would be different, of course, if firms were
somehow heterogeneous in their capacity to adapt their products to different markets, or if
transport costs were heterogeneous across combinations of firm and market.

5. Two-market example
In order to understand the factors that affect the firm’s decision, it is useful to analyse in
detail a scenario in which there are only two potential export destinations. Though simple,
this case contains basic forms of the most important characteristics of market entry patterns
and the trade-offs involved in choosing different strategies. It can therefore aid in illustrating
the intuition behind the model and the factors affecting the choice of strategy.

The two potential markets are defined to be a smaller market of size $s_1$ and a larger market of
size $s_2$. In this restricted example it is convenient to loosen the assumption of concavity of
$f^X(s_i,n_i)$, so that it is simply required to be increasing in $s_i$. Due to discounting and the
fact that the benefits of exporting experience are fully realised after one period, it is never
optimal for the firm to wait before entering the first market, nor to wait more than one period
before entering the other market. Therefore, the optimal strategy must be one of six possible
alternatives: (1) enter neither market; (2) enter market 1 in the first period but do not enter
market 2; (3) enter market 2 in the first period but do not enter market 1; (4) enter market 1 in
the first period and then market 2 in the second; (5) enter market 2 in the first period and then
market 1 in the second; or (6) enter both markets immediately. The timing of exports associated with these six strategies is represented by Figure 2.

Figure 2. Timing of market entry for all six potentially optimal strategies in the 2-destination case.
The dots in Figure 2 represent potential export markets, for each strategy and point in time, the smaller market denoted \( m_1 \) and the larger market \( m_2 \). Time is discrete, with the first period is at \( t = 0 \). A filled dot indicates that the firm exports to the market, an unfilled dot that the firm does not export to the market. As stated above, it is never optimal for a firm to exit export markets that it has entered, so the same combination of markets is exported to for all periods after \( t = 1 \), for each strategy. The solid lines indicate continued exporting to a market. The discounted profits of these six strategies are:

\[
\Pi^1 = 0 \\
\Pi^2 = \frac{\phi a^{1-\sigma} s_1}{1 - \beta} - f^x(s_1, 0) \\
\Pi^3 = \frac{\phi a^{1-\sigma} s_2}{1 - \beta} - f^x(s_2, 0) \\
\Pi^4 = \frac{\phi a^{1-\sigma}}{1 - \beta} \left[ s_1 + \beta s_2 \right] - f^x(s_1, 0) - \beta f^x(s_2, 1) \\
\Pi^5 = \frac{\phi a^{1-\sigma}}{1 - \beta} \left[ \beta s_1 + s_2 \right] - \beta f^x(s_1, 1) - f^x(s_2, 0) \\
\Pi^6 = \frac{\phi a^{1-\sigma}}{1 - \beta} \left[ s_1 + s_2 \right] - f^x(s_1, 0) - f^x(s_2, 0)
\]

As discussed above, only one of the strategies with long-term entry into a single market may be optimal for some nonempty set of productivity levels. For simplicity, but without leaving out too much in the way of intuition, the discussion here is limited to the scenario in which no firm optimally enters only the larger market (strategy 3). This narrows the scope to a maximum of five optimal strategies, which are ordered 1, 2, 4, 5, 6 in increasing levels of aggressiveness and therefore the productivity levels of the firms that optimally employ these strategies. A qualitative representation of the strategy payoffs in such a scenario is given in Figure 3. The gray lines represent the strategy payoffs, the black line represents the upper envelope of these representing the maximum of these for any given productivity level, and the dotted lines represent the productivity thresholds. Higher productivity firms earn higher
profits from any given export market, so the strategy payoffs are all upward-sloping for all strategies that involve exporting. More aggressive strategies have more steeply-sloped payoffs, so more aggressive strategies are naturally employed by higher productivity firms. Strategy 3 yields a lower payoff than at least one other strategy for all potential levels of productivity and is therefore not optimally employed by any firms.

Figure 3. Strategy payoffs by productivity level in a 2-destination case in which strategies 1, 2, 4, 5, and 6 are optimal for firms at different points of the productivity spectrum.
To clarify the intuition behind the model, it is useful to interpret the threshold levels of productivity for each strategy in this scenario. At each of these thresholds, the more aggressive strategy involves a level of productivity above the given threshold, the less aggressive strategy employed by firms with productivity below the given threshold, in line with the findings above. To begin with, strategy 2 is preferred to strategy 1 if \( \Pi^2 > \Pi^1 \), or:

\[
\frac{\phi \alpha^{1-\sigma} s_1}{1-\beta} > f^X(s_1,0)
\]

The choice in this case is between exporting only to the small market and not exporting at all. Generally, exporting to the small market is preferred to not exporting if transport costs are low, productivity is high, the size of the market is large (in terms of its effect on revenue rather than fixed costs), discounting is slight, and the fixed cost of entering the small market with no experience is low. Similarly, strategy 4 is preferred to strategy 2 if \( \Pi^4 > \Pi^2 \), or:

\[
\frac{\phi \alpha^{1-\sigma} s_2}{1-\beta} > f^X(s_2,1)
\]

The choice here involves a comparison of the discounted profits from entering the smaller market and then the larger market with those from entering the smaller market alone. This reduces to determining if positive profits are yielded from entry into the larger market once the smaller market has already been entered. This is similar to the previous case, but now the size of the larger market and the fixed costs of entering that market second are pivotal.

Moving on to the two strategies where one market is entered in the first period and then the other market is entered in the second period, strategy 5 is preferred to strategy 4 if \( \Pi^5 > \Pi^4 \), or:

\[
\phi \alpha^{1-\sigma} [s_2 - s_1] > f^X(s_2,0) - \beta f^X(s_2,1) - f^X(s_1,0) + \beta f^X(s_1,1)
\]
The relative profits from these two strategies depend upon the relative revenues gained in the first period, as both strategies involve exports to both markets from the second period on, and the reductions in the levels of the fixed costs of entry. The left hand side of the above inequality represents the difference between one period of revenue from the larger market and one period of revenue from the smaller market, while the right hand side represents the difference in discounted fixed cost reductions. For firms above the productivity threshold, the revenue difference exceeds the fixed cost difference, so that the larger market is entered first. If the reduction in fixed entry costs with experience were not to depend on the size of the market, then the right hand side of the above inequality would be equal to zero and it would never be optimal to enter the smaller market first. Finally, strategy 6 is preferred to strategy 5 if $\Pi^6 > \Pi^5$, or:

$$\phi \alpha^{1-\sigma} \sigma_1 > J^x(s_1,0) - \beta J^x(s_1,1)$$

Here the comparison is between the strategy of entering both markets immediately and that of entering the larger market and then the smaller market. The left hand side of the above inequality represents the revenues received in one period of exporting to the smaller market, while the right hand side represents the discounted benefit of reducing the fixed cost of entry into the smaller market by deferring entry until after the larger market has been entered. The absolute reduction in this fixed entry cost for the smaller market should be relatively small and discounting relatively light for immediate entry into both markets to be optimal, as each would imply a lower benefit from staggering entry.

6. Data

The data used in this paper are a panel of Swedish firm-level data supplied by Statistics Sweden (Statistiska centralbyrån) for all years from 1997 to 2007. The data include information on firm characteristics (wages, numbers of employees, investments, inputs, locations of plants and headquarters, and so on) and the amount of exports for each firm in
each year by destination country. Data on the GDP levels of each country are from the CIA World Factbook. Data on the distances of countries from Sweden are the distance between the principal cities from the CEPII (Centre d'Etudes Prospectives et d'Informations Internationales) database.

The sample is restricted to manufacturing firms, in the interests of both internal consistency and consistency with the model, and to firms with at least ten employees. Two different types of analysis are conducted in the empirical section of this paper, one that requires a sample of mature firms and one that requires a sample of new firms with information on the age and periods of entry to new export destinations. The sample of mature firms used is a cross-section of the data for 2007 for firms that are in at least their fifth year of operation. New firms are identified as firms that are absent from the first year of the panel (1997) but appear thereafter, with the condition that they have no more than 50 employees in their first year of operation to control for classification errors of established firms. Only manufacturing industries for which there were at least 50 Swedish firms operating in 2007 are included in the sample. Table 1 outlines the numbers of firms and exporters in each sample, with the total numbers of firms and exporters in 2007 included as a reference.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of firms</td>
<td>4,186</td>
<td>4,775</td>
<td>5,751</td>
</tr>
<tr>
<td>Number of exporters</td>
<td>3,333</td>
<td>3,353</td>
<td>4,201</td>
</tr>
</tbody>
</table>

Table 1. Numbers of firms and exporters in the two samples of Swedish firms.

To give an impression of the countries that Swedish manufacturing firms most commonly export to, Table 2 displays rankings of the most popular destinations for Swedish exports in 2007, in terms of both the number of Swedish exporters and the value of exports.
### Table 2. Rankings of the 20 most popular export destinations for Swedish manufacturing firms in 2007 by the number of Swedish exporters (left) and by the value of Swedish exports (right).

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Number of Swedish exporters</th>
<th>Rank</th>
<th>Country</th>
<th>Value of Swedish exports (billions of SEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Norway</td>
<td>3,609</td>
<td>1</td>
<td>Germany</td>
<td>83.40</td>
</tr>
<tr>
<td>2</td>
<td>Finland</td>
<td>1,942</td>
<td>2</td>
<td>United States of America</td>
<td>66.14</td>
</tr>
<tr>
<td>3</td>
<td>Denmark</td>
<td>1,837</td>
<td>3</td>
<td>United Kingdom</td>
<td>56.44</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>1,833</td>
<td>4</td>
<td>Norway</td>
<td>42.82</td>
</tr>
<tr>
<td>5</td>
<td>United States of America</td>
<td>1,761</td>
<td>5</td>
<td>Belgium</td>
<td>40.25</td>
</tr>
<tr>
<td>6</td>
<td>United Kingdom</td>
<td>1,612</td>
<td>6</td>
<td>France</td>
<td>39.31</td>
</tr>
<tr>
<td>7</td>
<td>Netherlands</td>
<td>1,443</td>
<td>7</td>
<td>Netherlands</td>
<td>38.65</td>
</tr>
<tr>
<td>8</td>
<td>Switzerland</td>
<td>1,442</td>
<td>8</td>
<td>Denmark</td>
<td>28.89</td>
</tr>
<tr>
<td>9</td>
<td>France</td>
<td>1,387</td>
<td>9</td>
<td>Italy</td>
<td>28.37</td>
</tr>
<tr>
<td>10</td>
<td>Poland</td>
<td>1,303</td>
<td>10</td>
<td>Finland</td>
<td>26.66</td>
</tr>
<tr>
<td>11</td>
<td>Belgium</td>
<td>1,229</td>
<td>11</td>
<td>Spain</td>
<td>23.97</td>
</tr>
<tr>
<td>12</td>
<td>Italy</td>
<td>1,186</td>
<td>12</td>
<td>Russian Federation</td>
<td>16.85</td>
</tr>
<tr>
<td>13</td>
<td>Spain</td>
<td>1,154</td>
<td>13</td>
<td>China</td>
<td>16.45</td>
</tr>
<tr>
<td>14</td>
<td>China</td>
<td>1,050</td>
<td>14</td>
<td>Poland</td>
<td>15.34</td>
</tr>
<tr>
<td>15</td>
<td>Estonia</td>
<td>998</td>
<td>15</td>
<td>Australia</td>
<td>11.06</td>
</tr>
<tr>
<td>16</td>
<td>Austria</td>
<td>969</td>
<td>16</td>
<td>Japan</td>
<td>10.83</td>
</tr>
<tr>
<td>17</td>
<td>Australia</td>
<td>872</td>
<td>17</td>
<td>India</td>
<td>8.54</td>
</tr>
<tr>
<td>18</td>
<td>Czech Republic</td>
<td>848</td>
<td>18</td>
<td>Canada</td>
<td>8.49</td>
</tr>
<tr>
<td>19</td>
<td>Japan</td>
<td>845</td>
<td>19</td>
<td>Austria</td>
<td>8.44</td>
</tr>
<tr>
<td>20</td>
<td>Iceland</td>
<td>843</td>
<td>20</td>
<td>Switzerland</td>
<td>7.74</td>
</tr>
</tbody>
</table>

The rankings in Table 2 confirm the importance of market size and the distance from Sweden in determining the popularity of an export destination, consistent with a gravity model. The most popular markets tend to be either relatively large (e.g. USA, Japan, and China), relatively close to Sweden (e.g. Norway, Finland, and Denmark), or both (e.g. Germany, France, and the United Kingdom). The most popular destination in terms of the number of exporters is Norway, which shares a long land border with Sweden and is no further than a few hundred kilometres by land from any point in Sweden. The most popular destination in terms of the value of exports is Germany, another neighbour of Sweden that nine times the GDP of Norway, closely followed by the USA, a distant but far larger market. The popularity of export destinations in terms of the number of Swedish firms and the value of Swedish exports are plotted in Figure 4 and Figure 5.
Figure 4 and Figure 5 show that the distribution of Swedish exports by destination is highly skewed, in terms of both the number of exporters and the value of exports. Both distributions
are close to linear on a log scale, resembling Pareto distributions, with the exception of the 20 most popular and 40 least popular destinations in terms of the value of Swedish exports. There is a relatively steep gradient at each end of the distribution in Figure 5, indicating that the most popular destinations receive more exports than a Pareto distribution would predict, while the least popular destinations receive less. In terms of the number of exporters, the most popular market, Norway, is a particular outlier, lying far above the trend line suggested by the rest of the distribution.

7. Results
The predictions made in propositions 1 and 2 relate to firm productivity, so to test these predictions it is necessary to produce estimates of the productivity levels of all firms. This is done using the method proposed by Levinsohn and Petrin (2003), in which intermediate inputs are used to solve the endogeneity problem associated with firms increasing inputs in response to positive productivity shocks. The method is applied using value added as the measure of firm output.

7.1. Proposition 1
Proposition 1 is comprised of three parallel predictions about the export strategies optimally employed by firms of different productivity levels. As these predictions concern how different aspects of the export strategy are determined by firm productivity, it makes sense to test each of the three predictions separately. The first of these concerns the number of export markets entered by an exporting firm in the long-term, which is predicted to be increasing in the productivity of the firm. As firms are constantly varying their exporting activity, the definition of the ‘long-term’ is necessarily imperfect. The approach used here is to take a cross-section of firms in 2007 and to include only those firms that have been in operation for at least five years. There is a trade-off between setting a high age threshold, which excludes nascent exporters that are less settled in their exporting patterns, and setting a low age
threshold, which increases the number of firms in the data. However, the results are robust to changes in both the minimum age of firms and the year. The prediction is tested for each industry assuming the following underlying process:

\[ N_{\omega,2007} = \alpha_{j,2007} + \beta_{j,2007} z_{\omega,2007} + \epsilon_{\omega,2007} \]  

(7)

where \( N_{\omega,2007} \) is the number of markets that firm \( \omega \) (in industry \( j \)) exports to in 2007, \( \alpha_{j,2007} \) is the intercept for industry \( j \), \( \beta_{j,2007} \) is the coefficient on productivity for industry \( j \), \( z_{\omega,2007} \) is the (log) productivity of the firm as measured in 2007, and \( \epsilon_{\omega,2007} \) is the error term. The prediction is also tested for all industries with and without fixed effects assuming the following underlying process:

\[ N_{\omega,2007} = \alpha_{2007} + \beta_{2007} z_{\omega,2007} + \gamma_{j,2007} + \epsilon_{\omega,2007} \]  

(8)

where \( \alpha_{2007} \) is the overall intercept, \( \beta_{2007} \) is the overall coefficient on productivity, \( \gamma_{j,2007} \) is the fixed effect for industry \( j \), and all other variables have the same definitions as in (7).

These equations are estimated using ordered logistic models, which imposes a monotonically relationship between firm productivity and the number of export destinations but allows the ranges of productivity levels associated with each number of export destinations to be of different sizes. The numbers of export destinations are grouped into multiples of five, the first category being non-exporters, the second category those firms that export to a maximum of five markets, and so on. Table 3 displays the productivity coefficients from the regressions run on (7) for each manufacturing industry and on (8) with and without industry fixed effects.
<table>
<thead>
<tr>
<th>Industry</th>
<th>Productivity</th>
<th>Number of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>2.015***</td>
<td>367</td>
</tr>
<tr>
<td></td>
<td>(7.73)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>0.646</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>(1.55)</td>
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</tr>
<tr>
<td>22</td>
<td>0.288</td>
<td>374</td>
</tr>
<tr>
<td></td>
<td>(0.91)</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>1.019***</td>
<td>141</td>
</tr>
<tr>
<td></td>
<td>(2.83)</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.266***</td>
<td>274</td>
</tr>
<tr>
<td></td>
<td>(3.40)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>1.371***</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>(2.73)</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>2.763***</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>(6.15)</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>1.931***</td>
<td>1,047</td>
</tr>
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<td></td>
<td>(8.56)</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>2.883***</td>
<td>691</td>
</tr>
<tr>
<td></td>
<td>(10.68)</td>
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</tr>
<tr>
<td>31</td>
<td>2.922***</td>
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<tr>
<td></td>
<td>(5.84)</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>3.687***</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>(5.25)</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>0.355</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>1.765***</td>
<td>193</td>
</tr>
<tr>
<td></td>
<td>(3.46)</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>0.848**</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>(2.10)</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>3.410***</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>(7.60)</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>-0.003</td>
<td>4,186</td>
</tr>
<tr>
<td></td>
<td>(-0.08)</td>
<td></td>
</tr>
<tr>
<td>All with</td>
<td>1.751***</td>
<td>4,186</td>
</tr>
<tr>
<td>fixed effects</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(18.90)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** $t$-statistics in parentheses
* significant at 10% level
** significant at 5% level
*** significant at 1% level

Table 3. Productivity coefficients from ordered logistic regressions of numbers of export destinations by industry.

The results displayed in Table 3 confirm the prediction that more productive firms export to a larger number of markets. All manufacturing industries exhibit a positive effect of firm productivity on the number of export destinations and for a majority of industries this effect is significant at the 1% level. Nevertheless, the productivity coefficient for all industries is only positive if fixed effects are included, which suggests cross-industry differences that
necessitate the inclusion of fixed effects in the regressions run below on firms in all industries.

The second prediction in proposition 1 concerns the total size of the markets exported to, which is predicted to be increasing in the productivity of the firm. Again this prediction concerns long-term exporting patterns, so only firms that have been operating for at least 5 years in 2007 are included in the sample. As the purpose is to identify the variation amongst exporters rather than the difference between exporters and non-exporters, only firms that export are included. This is tested assuming the following underlying process:

\[ S_{\omega,2007} = \alpha_{j,2007} + \beta_{j,2007} z_{\omega,2007} + \varepsilon_{\omega,2007} \]  

(9)

where \( S_{\omega,2007} \) is the log of the sum of the GDP levels of all countries that firm \( \omega \) (in industry \( j \)) exports to in 2007, \( \alpha_{j,2007} \) is the intercept for industry \( j \), \( \beta_{j,2007} \) is the coefficient on productivity for industry \( j \), \( z_{\omega,2007} \) is the (log) productivity of the firm as measured in 2007, and \( \varepsilon_{\omega,2007} \) is the error term. The prediction is also tested for all industries with and without fixed effects assuming the following underlying process:

\[ S_{\omega,2007} = \alpha_{2007} + \beta_{2007} z_{\omega,2007} + \gamma_{j,2007} + \varepsilon_{\omega,2007} \]  

(10)

where \( \alpha_{2007} \) is the overall intercept, \( \beta_{2007} \) is the overall coefficient on productivity, \( \gamma_{j,2007} \) is the fixed effect for industry \( j \), and all other variables have the same definitions as in (9).

These equations are estimated using ordinary least squares. Table 4 displays the productivity coefficients from the regressions run on (9) for each manufacturing industry and on (10) with and without industry fixed effects.
<table>
<thead>
<tr>
<th>Industry</th>
<th>Productivity</th>
<th>Number of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1.654***</td>
<td>289</td>
</tr>
<tr>
<td></td>
<td>(7.55)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>0.479</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>(1.27)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>0.875**</td>
<td>249</td>
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<td></td>
<td>(2.04)</td>
<td></td>
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<tr>
<td>24</td>
<td>0.638**</td>
<td>137</td>
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<tr>
<td></td>
<td>(2.41)</td>
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</tr>
<tr>
<td>25</td>
<td>0.743**</td>
<td>257</td>
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<td></td>
<td>(2.47)</td>
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<tr>
<td>26</td>
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<td></td>
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<tr>
<td>27</td>
<td>1.460***</td>
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<td></td>
<td>(5.17)</td>
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<tr>
<td>28</td>
<td>1.256***</td>
<td>700</td>
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<tr>
<td></td>
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<tr>
<td>29</td>
<td>1.464***</td>
<td>581</td>
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<tr>
<td>31</td>
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<td>158</td>
</tr>
<tr>
<td></td>
<td>(4.89)</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>1.540***</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>(3.62)</td>
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<tr>
<td>33</td>
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<tr>
<td></td>
<td>(0.49)</td>
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</tr>
<tr>
<td>34</td>
<td>0.923*</td>
<td>166</td>
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<tr>
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<td>(0.88)</td>
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<tr>
<td>36</td>
<td>2.476***</td>
<td>196</td>
</tr>
<tr>
<td></td>
<td>(6.49)</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>-0.054</td>
<td>3,333</td>
</tr>
<tr>
<td></td>
<td>(-1.46)</td>
<td></td>
</tr>
<tr>
<td>All with fixed effects</td>
<td>1.118***</td>
<td>3,333</td>
</tr>
<tr>
<td></td>
<td>(13.86)</td>
<td></td>
</tr>
</tbody>
</table>

Note: t-statistics in parentheses
* significant at 10% level
** significant at 5% level
*** significant at 1% level

Table 4. Productivity coefficients on the (log value of) total GDP of export destinations for mature manufacturing exporters.

The results displayed in Table 4 confirm the prediction that more productive firms export to markets with a larger aggregate size. A majority of manufacturing industries exhibit a positive and significant effect of firm productivity on the total GDP of the export destinations of each firm. As was the case with the number of export destinations in Table 3, the productivity coefficient for firms in all manufacturing industries is only positive if fixed effects are included, which endorses the inclusion of industry fixed effects.
The third prediction in proposition 1 is that firms with higher productivity levels will enter export markets more quickly. That is, from the time the firm is founded, a more productive firm will begin exporting sooner and then add new export markets at a higher rate than a less productive firm, all else being equal. This relationship is tested by regressing the delay between the formation of the firm and entry to the first export market, as well as the delay before entry to each subsequent export market, on firm productivity. To ensure that the delay between formation of the firm and entry to the first export market is measured accurately and that past exporting activity of the firms is not being ignored, only firms that are formed during the period of the data are included in the sample. The regression is run assuming the following underlying process:

\[ E_{i \bar{\rho}_{n} = n} - E_{i \bar{\rho}_{n} = n-1} = \exp\left( \alpha_n + \beta_n z_{\omega} + \gamma_{n,j} + \epsilon_{\omega,n} \right) \]  

(11)

where \( \bar{n}_{\omega} \) denotes the \( n \)th export market that firm \( \omega \) (in industry \( j \)) enters, so that \( E_{i \bar{\rho}_{n} = n} \) is the year of operation for firm \( \omega \) in which it enters its \( n \)th export market (market \( i \)), \( \alpha_n \) is the intercept for entry to the \( n \)th export market, \( \beta_n \) is the coefficient on productivity, \( z_{\omega} \) is the (log) productivity of the firm as measured in its first year of operation, \( \gamma_{n,j} \) is the fixed effect for industry \( j \), and \( \epsilon_{\omega,n} \) is the error term. By definition \( E_{i \bar{\rho}_{n} = 0} \) is the period of formation of firm \( \omega \), so the delay before entry to the first export market is measured from the time at which the firm is formed. Equation (11) is estimated using a Poisson model, as the delays are constrained to be nonnegative and their distribution in the data resembles an exponential distribution. The productivity coefficients are displayed in Table 5 and are given separately for the delay before commencement of exporting, the delay between entry times to each successive pair of markets, and the combination of these.
Table 5. Productivity coefficients for the delay before entry to nth market by firm productivity levels.

The productivity coefficients displayed in Table 5 are negative and significant, confirming the prediction that more productive firms should enter new export markets more quickly. More productive firms begin exporting sooner, and then go on to add further markets more quickly.

7.2. Proposition 2

Proposition 2 predicts that more productive firms enter a larger market then a smaller market whereas less productive firms will enter the same markets in the opposite order, when all other aspects of the two firms’ export entry strategies are the same. This prediction is less straightforward to test empirically than those in proposition 1, due mostly to the difficulty in isolating strategies that are comparable in all aspects other than entry times to two markets. If the sample is restricted to firms that employ strategies that are identical except from the entry times to two particular markets, then only a small number of firms remains, because of the large number of potential markets and unobservable heterogeneity across firms. To obtain a larger sample, more variation between strategies must be allowed.

The approach used here is to focus on exports to one or more ‘small’ countries and to one particular ‘large’ market. The relative entry times to the ‘small’ and ‘large’ markets are estimated as a function of firm productivity, for firms that eventually enter both types of market. This approach excludes firms that attempt to export to a ‘trial market’ but are
unsuccessful and subsequently cease to export, which would be a manifestation of the uncertainty mechanism explained above. Also excluded are many of the firms that simply fill occasional orders but do not establish themselves as exporters in either type of market.

The most obvious large market in the world is the United States of America (US), easily the largest market in the world and a potentially lucrative export destination for successful firms. The US has the added advantages for the current exercise of being a relatively popular export destination for Swedish firms, permitting a larger sample size, and of having a culture and level of development similar to those of European countries, implying relatively little heterogeneity in aspects other than size between the US and the neighbouring markets observed here\textsuperscript{15}. The small, neighbouring countries are comprised of Norway, Denmark, and Finland (henceforth the ‘neighbouring’ markets). Each of these countries would serve as an appropriate market for Swedish firms to gain experience in exporting, due to their proximity to Sweden and relatively small sizes. Germany and Poland are excluded because they are substantially larger, while Estonia, Latvia, and Lithuania are excluded because these countries acceded to the European Union during the period of the data, implying that exports to these markets may not be consistent over time\textsuperscript{16}.

Once again it is necessary to restrict the sample to new firms, to ensure that we are capturing entry times to new export markets. The sample is further restricted to firms that enter the US market during the period of the data. The regressions are repeated with and without a restriction on eventually entering at least one neighbouring market, in order to get a more

\textsuperscript{15} The same qualitative results emerge if certain other ‘large’ markets were to be used, such as the United Kingdom, France, or Italy. The productivity coefficients for Japan and Russia are not significant, though this may be due to the relatively small sample sizes.

\textsuperscript{16} The inclusion of Germany and Poland would not qualitatively affect the results, nor would the inclusion of Estonia, Latvia, and Lithuania.
thorough impression of the data. The proportion of firms that enter at least one of the neighbouring markets before entering the US is assumed to fit the logistic function

\[ I_{\omega}^{(t, c_{t+5})} = \frac{e^\nu}{1 + e^\nu} \]

with the following underlying process:

\[ \nu = \alpha + \beta_{\text{prod}} z_{\omega} + \gamma_j + \epsilon_{\omega} \]  

(12)

where \( I_{\omega}^{(t, c_{t+5})} \) is an indicator variable for firm \( \omega \) (in industry \( j \)) entering at least one of the neighbouring markets before entering the US market, \( \alpha \) is the intercept, \( \beta_{\text{prod}} \) is the coefficient on productivity, \( z_{\omega} \) is the (log) productivity of firm \( \omega \) as measured in its first year of operation, and \( \epsilon_{\omega} \) is the error term. Equation (12) is estimated using a logistic model, for an unrestricted sample and for a sample of firms that eventually enter at least one neighbouring market. The productivity coefficients are shown in Table 6.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>-0.291**</td>
<td>-0.365***</td>
</tr>
<tr>
<td></td>
<td>(-2.33)</td>
<td>(-2.74)</td>
</tr>
<tr>
<td>Minimum number of</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>neighbouring markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of</td>
<td>1,417</td>
<td>1,299</td>
</tr>
<tr>
<td>observations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: \( t \)-statistics in parentheses
* significant at 10% level
** significant at 5% level
*** significant at 1% level

Table 6. Productivity coefficients for entry to at least one neighbouring market (Norway, Denmark, or Finland) before entry to the US.

Table 6 confirms the prediction made in proposition 2, at least for these markets. When we observe firms that export to at least one neighbouring market and to the US, the firms that enter their first neighbouring market before beginning to export to the US are significantly less productive. This is consistent with lower-productivity firms gaining experience by exporting to a smaller market, in which mistakes in setting up the operations would be less costly, before expanding to export to a larger market. Without the sample restricted to firms that eventually export to at least one neighbouring country the effect is smaller and less
significant, reflecting the lower productivity of firms that export to the US but not to any neighbouring countries. This could be due to smaller, less productive exporters that fill occasional orders.

It is also possible to estimate the coefficients on the numbers of neighbouring markets entered before entry to the US, which is done assuming the following underlying process:

\[ N_{\omega} = \alpha + \beta_{\text{prod}} z_{\omega} + \gamma_{j} + \epsilon_{\omega} \]  

(13)

where \( N_{\omega} \) is the number of neighbouring markets that firm \( \omega \) (in industry \( j \)) enters before entering the US market, \( \alpha \) is the intercept, \( \beta_{\text{prod}} \) is the coefficient on productivity, \( z_{\omega} \) is the (log) productivity of firm \( \omega \) as measured in its first year of operation, and \( \epsilon_{\omega} \) is the error term. Equation (13) is estimated using an ordered logistic model, for an unrestricted sample and for samples of firms that eventually enter at least one, two, and three neighbouring markets. Table 7 displays the productivity coefficients from these regressions.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
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<tbody>
<tr>
<td>Productivity</td>
<td>-0.243**</td>
<td>-0.298**</td>
<td>-0.432***</td>
<td>-0.394**</td>
</tr>
<tr>
<td></td>
<td>(-2.02)</td>
<td>(-2.38)</td>
<td>(-2.96)</td>
<td>(-2.01)</td>
</tr>
<tr>
<td>Minimum number of</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>neighbouring markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,417</td>
<td>1,299</td>
<td>902</td>
<td>691</td>
</tr>
</tbody>
</table>

Note: \( t \)-statistics in parentheses
* significant at 10% level
** significant at 5% level
*** significant at 1% level

Table 7. Productivity coefficients for the number of neighbouring markets (Norway, Denmark, or Finland) before entry to the US.

The productivity coefficients in Table 7 are negative and significant for all samples. The negative productivity coefficients mean that less productive firms enter a larger number of neighbouring markets before beginning to export to the US, which confirms the prediction made in proposition 2.
The results in Table 6 and Table 7 are potentially sensitive to the choice of the ‘large’ and ‘small’ markets, in particular because many markets have insufficiently many Swedish manufacturing exporters for significant results to obtain. For instance, if Japan, China, or Russia were to be substituted for the US as the ‘large’ market, the productivity coefficients would not be significantly different from zero. On the other hand, the productivity coefficients would be negative and significant if Germany, France, Italy, or the United Kingdom were used as the ‘large’ market.

It would be reasonable to suspect that the results displayed above for the neighbouring countries and the US may be driven by the geographical or cultural proximity of the neighbouring countries to Sweden, rather than by their small size in comparison to the US. To address this point, the above analysis is repeated using the US as the ‘large’ market but using Canada as the ‘small’ market. Canada is far smaller than the US in terms of GDP, but the two countries have very similar cultures and are practically equidistant from Sweden. Equation (12) is once again estimated using a logistic model, using a sample of all firms that eventually export to the US and a sample of firms that eventually export to both the US and Canada. The productivity coefficients from these regressions are shown in Table 8.

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>-0.500** (-2.01)</td>
</tr>
<tr>
<td>Only firms eventually exporting to Canada</td>
<td>No</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,380</td>
</tr>
</tbody>
</table>

Note: *-statistics in parentheses
* significant at 10% level
** significant at 5% level
*** significant at 1% level

Table 8. Productivity coefficients for entry to Canada before entry to the US.

The productivity coefficients displayed in Table 8 are negative and significant for both specifications of the model, reflecting a greater propensity for lower-productivity firms to
enter the smaller market (Canada) before entering the larger market (the US). Again, these results support the prediction made in proposition 2. In keeping with the results displayed in Table 6 for neighbouring markets and the US, the productivity coefficient is larger in magnitude and has a higher level of significance when the sample is restricted to firms that eventually enter the smaller market. This reflects the relatively low productivity of firms that enter to the US but not to Canada.

Beyond confirming the prediction made in proposition 2, these results suggest the existence of a learning effect in setting up new export operations. Among firms that export to a pair of markets, lower productivity firms are found to be more likely to export to the smaller market first and then to the larger market. In the absence of a benefit that accrues from exporting and applies when further export markets are entered, this pattern is difficult to explain. Similarly, these results support the fixed cost function being of a form in which the experience-induced reduction is increasing in the size of the market subsequently entered. Such a form is also necessary to generate the pattern in which less productive firms have a higher propensity to enter the smaller market first. In other words, the savings in running an advertising campaign, for example, would not simply be reduced by a fixed absolute amount: the reduction would be larger the more consumers there are. This fits with intuition, as experience may allow the firm to learn which of a selection of advertisements are most effective, and the savings from dropping a less effective advertisement will be larger if the firm is required to purchase advertising from more or higher-circulation media outlets.

Furthermore, by demonstrating that some of the variation in export entry orders is due to firm productivity, these results explain part of the heterogeneity in market entry orders. If the same phenomenon of learning effects applies also to French and Irish firms, then this
mechanism could explain part of the variation in export entry orders observed by Eaton, Kortum, and Kramarz (2008) and Lawless (2009).

It could be argued that the country is not the relevant unit of observation for analysing such effects, as entering a smaller market would be equivalent to entering a part of a larger market that is equivalent in size to the smaller market. However, this explanation is rejected by these results: if it were true, then once again there would be no reason for lower productivity firms to begin exporting to a small market rather than to part of the larger market.

7.3. Proposition 3
Proposition 3 predicts that nearer markets to Sweden will be entered no later than more distant markets. To test this proposition, the ranks of the markets in the export entry orders of firms are regressed on the distances to the markets. The order of entry to new export markets by each firm is observed and each of these is assigned a rank \( r_{\omega,i} \), where \( r_{\omega,i} = 1 \) if country \( i \) is the first export market entered by firm \( \omega \), \( r_{\omega,i} = 2 \) if country \( i \) is the second export market entered by firm \( \omega \), and so on. In order to capture the full history of each firm so that it can be identified in the order of entry to new export markets, the sample of firms that began operating after the first year of the data (1997) is used. The following underlying process is assumed with the distance and GDP variables in logs:

\[
\begin{align*}
    r_{\omega,i} &= \alpha + \beta_{dist} dist_i + \beta_{GDP} GDP_i + \beta_{dist \cdot GDP} (dist_i \cdot GDP_i) + \epsilon_{\omega,i} \\
    i = 1, \ldots, \text{N} \\
\end{align*}
\]

where \( r_{\omega,i} \) is the rank of market \( i \) in the order of export markets that firm \( \omega \) exports to, \( \alpha \) is the intercept, \( \beta_{dist} \) is the coefficient on the distance from Sweden to country \( i \), \( \beta_{GDP} \) is the coefficient on the GDP of market \( i \), \( \beta_{dist \cdot GDP} \) is the coefficient on the interaction term of the distance to and the GDP of market \( i \), and \( \epsilon_{\omega,i} \) is the error term. The results of this regression are shown in Table 9.
The results in Table 9 strongly support the prediction made in proposition 3. The coefficient on distance is positive in the position of the firm in the order of entry and is highly significant for all specifications of the model. Whether or not destination GDP is controlled for or the interaction term is included, the coefficient on distance is positive and highly significant.

8. **Uncertainty**

Entry into new export markets is naturally associated with a measure of uncertainty. This is reflected in the prevalence of short-term exporters (Besedeš and Prusa, 2006; Eaton, Eslava, Krizan, Kugler, and Tybout, 2010). Therefore, though the model presented in this paper explains several aspects of export market expansion, as perfect information is assumed it does not represent a comprehensive representation of the problem. It would be possible to expand the present model to include an aspect of uncertainty about stochastic demand and production factors, which would complicate the model but may yield some additional predictions. Such a model would not, however, produce any predictions beyond those contained in either the current paper or the uncertainty-based model of Albornoz, Calvo Pardo, Corcos, and Ornelas (2010). Moreover, the predictions outlined above would all continue to hold. Nevertheless, the following is a short discussion of how the model and its predictions would be influenced by the treatment of uncertainty.
Allowing for uncertainty about the cost and demand factors associated with exporting to a given market would yield further predictions about firms’ optimal exporting behaviour. Foremost amongst these in terms of the empirical validity of the model would be the explanation of firm exit from export markets. In a case with ongoing fixed costs of exporting, a change in parameter values that decreased the firm’s revenue or increased its costs from a given export market could reduce its current and expected future profits from that market below zero, leading the firm to exit the market. The firms that exit from a given market would naturally be those with relatively low productivity levels, as these firms would be nearest the threshold level for exporting profitably. The markets exited by a firm would be those from which it gains relatively low profits.

Furthermore, as in Albornoz, Calvo Pardo, Corcos, and Ornelas (2010), firms with uncertainty about their export performance may trial export markets in order to evaluate their potential success as exporters. This would provide an additional incentive for firms to begin by entering smaller markets, altering somewhat the hierarchy of markets in terms of the order of entry. The use of trial markets to realise exporting profitability would also lead to firms exiting from export markets, as firms that realise a low exporting productivity, and even some firms that realise a sufficiently high exporting profitability to expand to new markets, may subsequently exit from the trial market.

9. Conclusion
Experience in exporting has been shown to reduce the costs of entering further export markets. By integrating this observation into an otherwise standard trade model, this paper offers a simple framework for understanding the strategic decision made by a firm that is planning to begin exporting and has several potential export markets. The model generates a diversity of export expansion strategies through a simple and intuitive mechanism based on the costs of entry to new export markets.
The model produces novel and intuitive predictions about the relationships between firm characteristics and the type of exporting pattern employed. Particularly, more productive firms are predicted to enter a larger number of markets and a larger total market size, to enter new export markets at a faster rate, and to enter larger markets then smaller markets rather then the reverse. Firms enter nearer markets first and then expand to progressively more distant markets. These predictions are tested and confirmed using a panel of firm-level data on Swedish manufacturing firms for the period from 1997 to 2007.

On the whole, the learning mechanism in which the fixed cost of entering an export market is reduced by experience at setting up export operations is powerful in explaining the export expansion patterns of Swedish firms. In particular, the model offers an intuitive explanation for the timing of entry to export markets and for the orders of market entry. The predictions concerning both of these aspects of entry strategies are consistent with the data from Swedish manufacturing firms. Importantly, the effect of productivity on the order of entry found in the empirical tests for proposition 2 suggests that the learning effect is relevant. If firms did not gain from the experience of exporting, then there would be no incentive for lower productivity firms to begin by exporting to smaller markets and progress to larger markets whereas higher productivity firms expand to these markets in the opposite order. Furthermore, this mechanism explains part of the variation in export entry orders in the Swedish data and may also explain part of the variation observed in French data by Eaton, Kortum, and Kramarz (2008) and in Irish data by Lawless (2009).

The theoretical results presented in this paper do not require productivity improvements from exporting or uncertainty about costs or demand levels. Rather, it is sufficient that the experience of setting up an export operation allows firms to become better at setting up further export operations in the future.
References


Appendix 1

This appendix outlines some of the implications that the shape of the fixed cost of entry function $f^X(s_i,n_i)$ has on the set of potentially optimal strategies. To begin with, the net profit from market $i$ within the strategy characterised by $E$ is separated from the strategy payoff (6):

$$\pi_i = \beta E \left[ \frac{1}{1-\beta} \phi_i a^{1-\sigma} s_i - f^X(s_i,n_i) \right]_{E_i}$$

(15)

Equation (15) is the net profit that the firm gains from market $i$. This should, however, be interpreted with care, as the contribution that exporting to market $i$ makes to the aggregate net profit of the firm would rightfully include part of the reduction in the fixed costs of entering further markets.

Shape of the fixed cost function and the optimal timing of export market entry

The partial derivative of (15) in terms of the period of entry $E_i$ is:

$$\frac{\partial \pi_i}{\partial E_i} = \ln(\beta) \pi_i + \beta E \left[ - \frac{df^X(s_i,n_i)}{dn_i} \right]_{n_i=E_i}$$

(16)

From (16) at least two implications for the types of strategies that may be optimal depending on the shape of $f^X(s_i,n_i)$ in terms of $n_i$ are apparent. Firstly, without the assumption of reduced fixed costs of entering further export markets there would be no incentive to delay entry to any markets past the initial period. This assumption would be expressed formally as $df^X(s_i,n_i)/dn_i = 0$. When this is substituted into (16) the expression simplifies to $\partial \pi_i / \partial E_i = \ln(\beta) \pi_i$, which is strictly negative for $\pi_i > 0$. That is, for any potentially profitable market, the net profit would be strictly decreasing in the delay before the market is
entered, so all optimal strategies would involve entering some set of markets in the initial period and none thereafter.

Secondly, if the number of markets already entered does not increase with a lengthening of the delay before entry to market \( i \), so \( \frac{dn_i}{dE_i} = 0 \), then (16) once again simplifies to 
\[
\frac{\partial \pi_i}{\partial E_i} = \ln(\beta)\pi_i \text{, and the net profit from any potentially profitable market is strictly decreasing in the delay before entry. As a result it is never optimal for a firm to delay entry to market } i \text{ unless this implies that more markets will have been entered before entry to market } i \text{, as the firm only benefits from the delay if it becomes more experienced in setting up export operations in the meantime. Therefore, no optimal strategy involves a delay of more than one period between entry times to consecutive markets, though this conclusion would not hold if the benefits of experience were to accrue over several periods.}
\]

**Shape of the fixed cost function and optimal export market sizes**
Dividing expression (15) by the market size \( s_i \) yields:
\[
\frac{\pi_i}{s_i} = \beta_{E_i} \left[ \frac{1}{1 - \beta} \phi_i a^{1-\sigma} - \frac{f^X(s_i, n_i)}{s_i} \right] \quad (17)
\]
While the partial derivative of (15) in terms of market size \( s_i \) is:
\[
\frac{\partial \pi_i}{\partial s_i} = \beta_{E_i} \left[ \frac{1}{1 - \beta} \phi_i a^{1-\sigma} - \frac{df^X(s_i, n_i)}{ds_i} \right] \quad (18)
\]
Combining (17) and (18) yields:
\[
\frac{\partial \pi_i}{\partial s_i} - \frac{\pi_i}{s_i} = \beta_{E_i} \left[ \frac{f^X(s_i, n_i)}{s_i} - \frac{df^X(s_i, n_i)}{ds_i} \right] \quad (19)
\]
Due to the condition that the fixed cost function exhibit nonnegative economies of scale, \( f^X_s \leq f^X / s \), the right hand side of (19) must be positive. It follows that across the range of market sizes \( s_j \) for which net profit \( \pi_j \) is positive, \( \partial \pi_j / \partial s_j \) is positive and so net profit is increasing in market size. Therefore, if there are any profitable markets, then the most profitable market is the largest one. This is because revenue is proportional to market size while the fixed cost is either proportional to or a decreasing proportion of market size. Under the minimal restrictions on the fixed cost function outlined above, the optimal strategy must involve exports to the largest available market and, although some smaller markets may be entered in order to reduce the cost of entering subsequent markets, the optimal strategies of firms involve exports to relatively large markets.

**Shape of the fixed cost function and optimal export market order**

Consider a strategy that involves entering markets \( i \) and \( j \), with market \( i \) entered in period \( t \) and market \( j \) entered in some later period \( T > t \). Consider also a strategy in which the same markets are entered in the same two periods, but in the opposite order, so market \( j \) is entered in period \( t \) and market \( i \) is entered in period \( T \). The strategies may involve entering other markets, but the set of markets besides \( i \) and \( j \) and the periods of entry to these markets are identical in the two strategies. This implies that \( n_i \) and \( n_T \) are the same for the two strategies. Markets \( i \) and \( j \) are assumed to be equidistant in terms of transport costs, so \( \phi_i = \phi_j \). The difference in payoffs between these two strategies can be found from (15):

\[
\left[ \pi_i^{(E_{i=t})} + \pi_j^{(E_{j=t})} \right] - \left[ \pi_i^{(E_{i=T})} + \pi_j^{(E_{j=T})} \right] \\
= \left( \beta^T - \beta^t \right) \left[ 1 - \beta \right] \phi_i a^{1-\sigma} \left[ s_i - s_j \right] \\
- \beta^t \left[ f^X (s_i, n_t) - f^X (s_j, n_t) \right] \\
+ \beta^T \left[ f^X (s_i, n_T) - f^X (s_j, n_T) \right] \\
= (20)
\]
The first term in (20) is strictly positive. The relative sizes of the second and third terms depend on the shape of the fixed cost function. If experience decreases the fixed cost of markets of all sizes by the same amount, formally \( f_{sn}^X = 0 \), then \( f^X(s_i, n) - f^X(s_j, n) \) is invariant in \( n \) and so (20) can be reduced to:

\[
\left[ \pi_i^{(E_i=t)} + \pi_j^{(E_j=t)} \right] - \left[ \pi_i^{(E_i=t)} + \pi_j^{(E_j=t)} \right] = \left( \beta^t - \beta^T \right) \left[ \frac{1}{1-\beta^t} a^{1-\sigma} [s_i - s_j] - \left[ f^X(s_i, n) - f^X(s_j, n) \right] \right] \quad \forall n
\]  

(21)

Substituting in the net profits from entering markets \( i \) and \( j \) in period \( t \) from (15) allows the reduction of (21) to:

\[
\left[ \pi_i^{(E_i=t)} + \pi_j^{(E_j=t)} \right] - \left[ \pi_i^{(E_i=t)} + \pi_j^{(E_j=t)} \right] = \left( \beta^t - \beta^T \right) \left[ \frac{1}{\beta^t} \right] \left[ \pi_i^{(E_i=t)} - \pi_j^{(E_j=t)} \right]
\]

(22)

As \( \left( \beta^t - \beta^T \right) / \beta^t > 0 \), the sign of the right hand side of (22) is the same as the difference between the net profits from market \( i \) and those from market \( j \). That is, the more profitable of the two strategies is the one that involves earlier entry to the market that yields the higher net profit. The same reasoning applies to any pair of markets, resulting in an ordering of markets in all optimal strategies with the market that yields the highest net profit entered first, then further markets entered in descending order of the net profits that they yield. This would apply even if the assumption about the markets being equidistant were to be loosened. Each firm continues to enter new markets until no markets remain that would yield a positive net profit. As net profits are increasing in firm productivity, more productive firms enter a larger number of markets. This scenario matches the predictions of Lawless (2009). The corollary is that a negative cross-derivative on the fixed cost function, \( f_{sn}^X < 0 \), is required for it to be optimal for different firms to enter markets in different orders.
Appendix 2

Proof of proposition 1

From (6), the payoff from any given export market entry strategy is a linear and increasing function of productivity, with the gradient of the function given by the aggressiveness term $A = \sum_{i=1}^{m} \beta^E \phi_i s_i$. For any given pair of strategies, there must either be one strategy that yields a higher level of revenue for all potential levels of productivity, or a unique productivity threshold at which the strategy payoffs intersect. In the case of a threshold, the more aggressive strategy would yield a higher payoff for any productivity level above this point, as its payoff function has a steeper gradient, while the less aggressive strategy would yield a higher payoff for any productivity level below this point. So for any pair of strategies, the more aggressive strategy is optimally employed by more productive firms. It is not necessarily the case that any given strategy is optimally employed by some firms, as there may simply be other strategies that yield a higher payoff for all possible productivity levels.

Then, the value of the aggressiveness term $A = \sum_{i=1}^{m} \beta^E \phi_i s_i$ clearly increases with the following isolated changes to the strategy:

1. Adding an additional market $i$ of positive size entered some finite length of time in the future to the strategy, which increases the aggressiveness term by $\beta^E \phi_i s_i > 0$;

2. Replacing a smaller market $i$ with a larger market $j$ that is equally distant in terms of transport costs, so $\phi_j = \phi_i$, and entering it in the same period $E_j = E_i$, which increases the aggressiveness term by $\beta^E \phi_i [s_j - s_i] > 0$;

3. Entering any market $i$ earlier, so that the period of entry is instead $E_i^1 < E_i^0$. If market $i$ is nonzero in size, the aggressiveness term increases by $[\beta^E - \beta^E] \phi_i s_i > 0$. 

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At the two limits of the aggressiveness measure, the least aggressive strategy involves not entering any markets, while the most aggressive strategy involves entering all markets immediately. These two possibilities represent the minimum and maximum, respectively, of all three factors. Between these two endpoints, there must therefore be an overall trend of increasing numbers and total size of export destinations, and of the earliness of market entry. As explained above, it is possible that a strategy is more aggressive than another despite being less so in terms of a single factor or even two factors, but that this requires the difference in the remaining factor or factors to be relatively large, so that an ordering of potential strategies from the least to most aggressive would have a prevailing increase in the aggressiveness of each factor.

**Proof of proposition 2**

Consider two potential export destinations, $i$ and $j$, of which market $j$ is the larger, so that $s_j > s_i$. Consider two strategies that involve entering markets $i$ and $j$ in opposite orders but are otherwise identical in terms of the markets entered and the timing of entry. Suppose that strategy $a$ involves entering the larger market first and strategy $b$ involves entering the smaller market first, so that $E^a_j = E^b_j < E^a_i = E^b_i$. The difference between the combined net profits from the two markets under the two strategies is:

$$\pi^a_{i,j} - \pi^b_{i,j} = \frac{1}{1-\beta} \alpha^{1-\alpha} \left[ \beta^{E^a_j} - \beta^{E^b_j} \right] \left[ \phi_j s_j - \phi_i s_i \right] - \Omega$$

where

$$\Omega \equiv \left[ \beta^{E^a_j} \left[ f^X (s_j, n_{E^a_j}) - f^X (s_i, n_{E^a_i}) \right] - \beta^{E^b_j} \left[ f^X (s_j, n_{E^b_j}) - f^X (s_i, n_{E^b_i}) \right] \right]$$

The term defining the difference between the fixed costs of entry in (23), denoted $\Omega$, is strictly positive as $\beta^{E^a_j} > \beta^{E^b_j}$ and $f^X (s, n_{E^a_j}) > f^X (s, n_{E^b_j}) > f^X (s, n_{E^a_i})$. The intuition is that: (1) the condition $f^X \leq 0$ implies that the discount from experience is weakly larger when the small market is entered first; and (2) when discounting is applied, the
strategy in which the large market is entered last is discounted more heavily in the aggregate.

From here it is easiest to consider two cases separately. In the first case \( \phi_j s_j \leq \phi_i s_i \), which makes it straightforward to sign (23):

\[
\pi^{a}_{i,j} - \pi^{b}_{i,j} = \frac{1}{1 - \beta} a^{1-\sigma} \left[ \beta^{E_i} - \beta^{E_j} \right] \left[ \phi_j s_j - \phi_i s_i \right] - \Omega < 0
\]

(24)

The difference between the strategy payoffs is strictly negative for all productivity levels, so for this pair of markets strategy \( a \) is not optimal for any firms. Therefore, all firms enter these two markets in the same order: the smaller, nearer market and then the larger, more distant market. In the second case \( \phi_j s_j > \phi_i s_i \), so the components of (23) can be signed as:

\[
\pi^{a}_{i,j} - \pi^{b}_{i,j} = \frac{1}{1 - \beta} a^{1-\sigma} \left[ \beta^{E_i} - \beta^{E_j} \right] \left[ \phi_j s_j - \phi_i s_i \right] - \Omega > 0
\]

(25)

The multiplier on \( a^{1-\sigma} \) in (25) is strictly positive, so in this case strategy \( a \) has a higher value of the aggressiveness term \( A = \sum_{i=1}^{m} \beta^E \phi_i s_i \). As explained in the proof to proposition 1, this implies that such a strategy is optimally employed by more productive firms. Therefore, in this case firms below a certain productivity threshold enter the smaller market then the larger market, while firms above the threshold enter the larger market then the smaller market.

**Proof of proposition 3**

Suppose that there is a monotonically increasing relationship between distance and the cost of transporting goods. The partial derivative of the net profit from market \( i \) (15) in terms of the transport cost parameter \( \phi_i \) is:

\[
\frac{\partial \pi_i}{\partial \phi_i} = \beta^E \left[ \frac{1}{1 - \beta} a^{1-\sigma} s_i \right]
\]

(26)
The right hand side of (26) is strictly positive. As a higher value of $\phi_i$ represents lower transport costs, the net profit from an export market is strictly decreasing in the distance to the market. All else equal, due to discounting it is optimal to enter the market that yields the higher net profit in an earlier period, so among markets of a given size it is optimal to enter a nearer market earlier than a more distant market.