Sunk export costs

How they influence on firms' export decisions

and international trade

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Contents

Chapter 1

Introduction

Introduction

Why do countries trade? The traditional economic explanation is the theory of comparative advantage. It focuses on the mutual benefit of trade in *different* products, such as textiles and machinery, between *different* countries, such as Bangladesh and the USA. Today, however, a large share of world trade consists of trade in *similar* products between *similar* countries – like Germany selling cars to Japan, and Japan selling cars to Germany. An explanation for these phenomena has been provided by the new trade theory launched *inter alia* through a seminal article by Paul Krugman (1980). Whereas the traditional focus had been on competitive markets and country differences in technology or factor endowments, the new trade theory models firm behaviour explicitly, and emphasizes imperfect competition, product differentiation, and consumers' valuation of variety.

With the emergence of the new trade theory and later the new economic geography, trade costs came to play a much more central role in economic models than before. According to traditional theory, trade costs have the effect of dampening trade flows and leading to factor price differences between countries. By contrast, the new trade theory sees trade costs as crucial in determining international trade patterns and production structure within countries. Increasing returns and transport costs in manufacturing industries make access to a large home market advantageous, which in turn makes it less profitable for manufacturing firms to be established in small countries. This 'home market effect' (HME) predicts that small countries will have a share of the world's production and exports of manufactured goods that is less than proportional to their share of labour. When trade costs decline, it becomes less costly to serve small countries from abroad, and the advantage of locating in a large country becomes – according to some of the new models – even more evident. As a consequence, reductions in trade costs may lead to de-industrialisation of small countries.

Despite the central role of trade costs in new trade theory, until recently there has been little focus on the different types of trade costs. Trade costs were normally modelled as proportional to the traded volume. This could yield a good representation of trade costs related to transport or tariffs, but is less suited for describing other types of trade costs. For a firm, entering an export market requires some previous knowledge about the market. Product standards, legislation, demand, language, business culture, etc., may differ from the domestic market; and the costs of acquiring knowledge about these differences and adjusting to them may be significant. There may also be costs involved in finding customers and setting up distribution networks. At least some elements of these costs are better described as one-time fixed costs that are independent of the volumes traded, and that accrue only when the firm starts to export: *sunk export costs*. Apart from a few early contributions, the modelling of sunk export costs was absent from the models of new trade theory until the early 2000s, when trade models with heterogeneous firms began to appear.[1]

[1] Many of the models mentioned in this introduction are static models, where there is no distinction between sunk and fixed export costs. Such costs are often referred to differently in different papers. In addition to 'sunk export costs', they are frequently termed 'fixed export costs', 'entry costs' or 'beachhead cost'. For consistency, I will refer to these costs as *sunk export costs*, even if they are termed differently in the paper in question.

In earlier models, all firms had generally been represented as equal. This, together with the failure to include sunk export costs, had several implications which did not fit well with real-life observations. Within an industry, the theory predicted that either all firms would be exporters, or none at all. Adjusted for real transport costs and tariffs, an exporting firm would export all its products to all countries. In economic analysis of trade patterns it was therefore not possible to distinguish effects for exporters from effects for non-exporters.

Although anecdotal evidence clearly contradicted these predictions, few large-scale firm level data sets comparing exporters and non-exporters were available before the mid-1990s. In economics, these patterns were therefore not subjected to systematic analysis. When such data became available for selected countries, it became evident that firms behave very differently from what the models predicted. Gradually, more and more studies revealed the same facts: only a proportion of firms export, and most firms only export a few products to a few countries. (See WTO, 2008; and Bernard *et al*., 2011 for overviews.) Many empirical papers also found indications of sunk export costs. Clearly, the models would have to include mechanisms that could allow for the coexistence of exporters and non-exporters within the same industry. One way of doing this is to model sunk export costs. [2]

With the pioneering article by Melitz (2003) and its subsequent numerous extensions, the new trade theory took a new direction. Melitz included sunk export costs and firm differences in marginal production costs into the Krugman (1980) model. While the previous, homogeneous-firms models predicted that either all firms or no firms would export, the Melitz-type models were able to explain the coexistence of exporters and non-exporters within the same industry as found in firm-level data.

The inclusion of sunk export costs in economic models opened up for analysis of several new questions. It became possible to predict how changes in trade conditions affect measures such as the number of exporters and non-exporters, their average productivity levels, and their average sales in each market. Moreover, various types of trade liberalisation could be analysed, such as reductions in tariffs (analysed by reductions in variable trade costs), versus harmonisation of product standards (analysed by reductions in sunk export costs).

This thesis aims to help explain the role of sunk export costs in international trade transactions, theoretically as well as empirically. It consists of three papers presented in chapters 2, 3 and 4. The papers in chapters 2 and 3 are mainly theoretical. The paper in chapter 2 was published as Medin (2003). The purpose of these papers is to study the effects of trade liberalisation and changes in market sizes. When sunk export costs are present, such changes affect not only trade flows between countries but also firms' export decision and the number of exporters versus non-exporters. The paper in chapter 4 aims at empirically investigating the importance of sunk costs related to exporting a particular product to a particular country. It also investigates whether firms' learning from their own or from other firms' export experience can reduce export costs. The paper is co-authored with Per Botolf Maurseth. The rest of the introduction offer summaries of the main findings from the three

[2] Another possibility is to allow for productivity differences in producing different products between countries, as in e.g. Bernard *et al.* (2003). They demonstrate that sunk export costs are not necessary for creating an equilibrium with the coexistence of exporters and non-exporters.

papers in this thesis and shows how they relate to the existing literature on sunk export costs. I also offer some suggestions for future research.

The nature of sunk export costs

Do firms consider sunk export costs important? And what are the main components of such costs? Firm surveys can provide some answers. Roberts and Tybout (1997b) report that among Colombian exporters, finding customers, gathering information about the foreign market and adjusting products according to foreign standards represent major costs when entering a foreign market. Similar costs are found among Norwegian IT exporters in Melchior (2003) and, although of smaller magnitude, among Norwegian seafood exporters in Medin and Melchior (2002).

While survey evidence indicates that sunk costs are important, it also hints at several learning mechanisms through which these costs can be reduced. Firms may learn about exporting from their own export experience. For example, a Norwegian firm that exports to France may use its knowledge about the French market when entering the German market. Also, if the Norwegian firm exports, say, salmon to France, there may be few additional costs involved in starting to export white fish. Medin and Melchior (2002) find that Norwegian seafood exporters report that different products are often sold to the same customers, and that costs of introducing a new product in a country are much lower if the firm already exports other products to that country. Several firms also report that exporting to one customer in a country considerably facilitates exporting to another customer in the same country, and that exporting to a given country reduces the costs and time of starting to export to another country within the same region. These results may indicate that there are learning effects, although they may also reflect the presence of country specific sunk export costs.

Learning about exporting can also occur through knowledge spillovers from other firms. If many Norwegian firms export salmon, knowledge about salmon export may spill over to potential exporters, facilitating export entry into the salmon market. Similarly, know-how about exporting to a specific destination country may spill over to potential exporters. Indications of such spillovers are found in Medin and Melchior (2002), where exporters report that they obtain useful market information from other exporters when they enter a new market, and that they consider it an advantage if there are other Norwegian exporters present in the new market.

An important aim of economic trade models is to analyse effects from reductions in trade costs. Reductions in trade costs may be related to reductions in transport costs, or to political actions such as the elimination of tariffs or harmonisation of product standards. The inclusion of sunk export costs in economic models is crucial for properly analysing today's trade policies. Tariffs have been reduced or eliminated in many sectors and together with improvements in transport technology this has reduced variable trade costs during the last decades. However, many of today's trade policies cover more comprehensive areas than the traditional political tools of tariffs and quotas. Several of today's bilateral as well as multilateral trade agreements include areas such as competition policy, capital movement, intellectual property rights, investments, product standards, environmental and labour standards, and public procurement. Such deep economic integration is likely to reduce sunk as well as variable trade costs. This kind of policy has become increasingly prevalent in recent decades – early examples being the free trade agreement of the EEC and that between Canada and the USA. The EU and the USA have also been pioneers in advocating this policy in trade negotiations with other countries, and it is an important part of the ongoing negotiations between the two. Furthermore, in recent years such policies have become notable in trade agreements between other countries, especially in Asia – both within ASEAN and between other countries in the region. (See Orefice and Rocha, 2013; and Baldwin, 2011, for discussions on deep economic integration.) In analysing trade liberalisation, it will still be relevant to consider reduction in variable trade costs on some goods for which tariff reductions have been limited, like agricultural products, but trade policy that deals with deep economic integration is probably of more interest in most areas. This underlines the importance of incorporating sunk export costs in models of international trade.

Sunk export costs in theoretical trade models

Until the early 2000s it was common in new trade theory models to assume that firms were homogeneous and faced variable trade costs only. This changed radically with Melitz (2003), who modified the Krugman (1980) model in two important ways.[3] Firstly, he included sunk export costs, thereby allowing the export decision to be separated from the decision to sell in the domestic market. Secondly, he incorporated firm-level differences in marginal production costs, represented by a continuous distribution.[4] In consequence, the model predicts that all operating firms will sell in their domestic market, but only the most productive firms will export. In other words, the model is able to explain the coexistence of exporters and non-exporters within the same industry, as found in firm-level data.

Many papers have offered extensions of the Melitz (2003) model, focusing on country-specific sunk export costs (Chaney, 2008; Akerman and Forslid, 2009); sunk costs of exporting a particular product to a particular country (Arkolakis and Muendler, 2010; Bernard, Redding and Schott, 2011); or sunk costs that vary with firm productivity (Arkolakis, 2010). These models typically predict that the most productive firms will be those that export to many countries, that export many products to the same country, and that pay the highest sunk export costs.

However, it is not necessary to assume that firms have different marginal production costs in order to create an equilibrium where only some of them export. For example, in a model of initially equal firms, Venables (1994) introduces sunk export and shows that firms will become heterogeneous and split into exporters and non-exporters in equilibrium. All firms sell in the domestic market, and some also export.

In chapters 2 and 3 of this thesis, I incorporate sunk export costs into two models of international trade. The aim is to explain how, in the presence of sunk export costs, the relative size of the export market will determine the number of manufacturing firms that

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[3] The Krugman (1980) model introduced the framework of product differentiation, monopolistic competition and CES demand, published in Dixit and Stiglitz (1977), into a trade context.

[4] Also some earlier papers had introduced the idea of firm heterogeneity in trade models building on the Dixit-Stiglitz-Krugman framework. Montagna (2001) and Jean (2002) let firms differ in their marginal costs, and the latter also includes sunk export costs.

export. Rather than focusing on firm differences in marginal production costs as main determinants for their export status, as in the Melitz-type models, these models emphasis the role of export market conditions. I therefore follow Venables (1994) in working with firms that have equal marginal production costs, but, in contrast, I analyse countries of different sizes.

Many new trade theory models, whether dealing with firms with equal or with different marginal costs, predict that the number of manufacturing firms that export will decrease with the relative size of the foreign market. This may seem contra-intuitive, as access to a large foreign market could make exports more profitable and hence lead to an increase in the number of exporting firms. The source of the effect is the HME, which holds that the number of manufacturing firms will be disproportionally lower in small countries. A benchmark HME model with homogeneous firms that is used as point of departure for many other models is presented in Helpman and Krugman (1985, pp. 205–209), from now on referred to as HK 1985. Since this type of model predicts that either all firms will export or no firms will, the HME in the number of manufacturing firms leads directly to an HME in the number of exporters. Consequently, the number of exporters increases with the relative size of the home market and decreases with the relative size of the foreign market. The result may be seen as an undesired side effect of the fact that homogeneous-firms models are not able to separate between exporting and non-exporting firms. However, the effect is also found in the much used Melitz-style extension of HK 1985, where only a proportion of firms export (a model like that is e.g. presented in and Forslid, 2010). In that model, the proportion of firms that export will be independent of country size. This leads to the same negative relationship between the number of manufacturing exporters and the size of the foreign market as found in its homogeneous-firms counterpart.

In the models in chapters 2 and 3, the number of manufacturing exporters is positively related to the size of the foreign market, rather than the home market, thereby creating a ‘foreign market effect’ or a ‘reverse HME’ in the number of manufacturing exporters. In the model in chapter 3, the reverse HME in the number of manufacturing exporters coexists with an HME in the total number of manufacturing firms. Access to a relatively large foreign market is an advantage for the number of manufacturing exporters even though it is a disadvantage for the total number of manufacturing firms.

Both models are extensions of the HK1985 model. I incorporate sunk export costs into that model. However, in order to make possible an equilibrium with the coexistence of exporters and non-exporters, more structure must be added to the model. In the model in chapter 2, I add more structure to the cost side of the economy by assuming that manufacturing production requires a fixed amount of a specific factor not used elsewhere in the economy. This practically restricts entry of firms and causes the total number of manufacturing firms to be proportional to country size. In the model in chapter 3, I add more structure to the demand side of the HK 1985 model. Manufacturing firms are grouped into industries that are country-bounded, and consumers want to differentiate their consumption on different goods within an industry as well as on goods from different industries. Consequently, there is national product differentiation. As opposed to the model in chapter 2, this model allows for free entry of firms within an industry. The number of industries in each country, on the other hand, is exogenously given.

Both models predict that the proportion of firms that export will be larger in small countries than in large ones. In chapter 3, I test this prediction on a cross-country dataset, which, to my knowledge, no other studies have done. Among 116 countries, I find that a doubling of relative home market size leads to a 12.6 per cent decrease in the proportion of firms that export. The results suggest that being a small country is not such a great disadvantage in terms of manufacturing exports as predicted by the benchmark HME models.

Trade liberalisation in models with sunk export costs.

Do different types of trade liberalisation, such as tariff reductions versus deep economic integration, affect trade differently? While the first type of trade liberalisation is properly analysed by reductions in variable trade costs, the latter is better analysed by considering reductions in sunk export costs as well. This was not possible in homogeneous-firms models, since they considered variable trade costs only. In addition to being better suited for analysing trade liberalisation in the form of deep economic integration, models with sunk export costs have encouraged analysis of the effect of trade liberalisation along two margins: extensive (the number of firms that export) and intensive (average exports per firm). The models generally predict that reductions in sunk as well as variable trade costs will lead to an increase the traded volume, but the two types of liberalisation may differ on their effects along these two margins.

In the models in chapters 2 and 3, reductions in sunk as well as in variable trade costs lead to increased profitability of exports, encouraging more firms to enter the export market. The extensive margin of exports therefore increases.[5] Regarding the intensive margin, however, effects from the two types of trade liberalisation differ. Reductions in sunk costs facilitate entry into export markets. Exporting firms can survive in the export market by selling a smaller amount than before, so the intensive margin is reduced. By contrast, reductions in variable trade costs do not affect the intensive margin. These results are similar to the ones obtained from Melitz-type models (see Lawless, 2010).[6] Reductions in both types of trade costs lead to increased profitability of exporting, and smaller, less productive firms are able to enter into the export market. This increases the extensive margin of exports, just as in the models in chapters 2 and 3. It also tends to reduce the intensive margin. Reductions in variable trade costs have the additional effect of increasing the sales of existing exporters in foreign markets at the expense of sales in the home market. This tends to increase the intensive margin. Consequently, reductions in sunk export costs will lead to a decline in the intensive margin of exports, while reductions in variable trade costs have two opposing effects. Under the widely used assumption of Pareto-distributed marginal production costs, the two effects cancel each other out. To conclude, Melitz type models as well as the models presented in chapters 2 and 3 predict that the intensive margin (average exports per firm) is unaffected by changes in variable trade costs, but declines with reductions in sunk export

[5] The ‘extensive margin of exports’ is defined somewhat differently in chapter 3. Instead of referring to the number of firms that export, it refers to the proportion of firms that export.

[6] The same effects appear also in Venables (1994), but he discusses only the extensive margin.

costs. By contrast, the extensive margin (the number of firms that export) increases with reductions in both types of trade costs.

How is the HME affected by trade liberalisation? In general, when sunk export costs are included in the model, these seem to affect the HME in a similar manner as variable trade costs. In the remainder of this section, I will therefore interpret ‘trade liberalisation’ as reductions in sunk as well as variable trade costs. Some models, like those of HK 1985 and and Forslid (2010), predict that the HME will be reinforced with trade liberalisation. Others predict that it will follow an inverse-U relationship, where the effect will be weakened for very low trade costs (Krugman and Venables, 1990). In the model in chapter 2, there is no HME, and the reverse HME is independent of trade costs. However, in the model in chapter 3, I find that trade liberalisation will reinforce the HME in the total number of manufacturing firms, as well as the reverse HME in the number of manufacturing exporters. The reason for the first result is the same as in other models. When trade costs decline, it will become less costly to serve the small country from abroad. The advantage of access to a large home market for domestic sales will therefore become more prominent, and more and more firms will find it profitable to locate in the large country. The reason for the second result is that the model posits that domestic and foreign goods are imperfect substitutes, so consumers will want to consume some of each. When trade is liberalised, demand for imports increases in both countries, but the increase is greatest in the large country. Consequently, the small country will experience a greater increase in demand from abroad than will the large country; and this will induce more firms to enter into the export market in the small country than in the large. The effect is strong: it more than cancels out the effect of a disproportionally lower number of manufacturing firms in the small country. In other words, the advantage of having access to a large foreign market for manufacturing exports is magnified as trade is liberalised.

Empirical evidence of sunk export costs, learning and spillovers

New opportunities for empirically studying sunk costs as well as learning and spillover effects emerged with the availability of firm level data from the mid-1990s. Typically, studies of these issues treat as the dependent variable the probability that a firm exports; and, in some cases, the value of a firm’s export. Early contributions focus on firms’ exports as such; but, along with more detailed data, recent contributions have often concentrated on a firm’s exports to a particular country, a firm’s export of a particular product, or both.

In the presence of sunk export costs, a firm that exported the previous year would be more likely to export this year than a firm that did not, because the former has already paid the sunk export costs. Firms that enter into the export action must earn enough profits in the foreign market to cover the sunk export costs, unlike the case for continuing exporters. The former therefore require higher profits in the export market than the latter. Consequently, one way to investigate the importance of sunk export costs is to study persistence in firms’ export behaviour. Many studies find evidence of such persistence, using firm-level data. Early examples focusing on global sunk costs (sunk costs related to export as such) include Roberts and Tybout (1997a) on Colombian firms; Campa (2002) on Spanish firms; and Bernard and Jensen (2004) on US firms. Some recent contributions have also found evidence of persistence in country-specific exports. This indicates the presence of country-specific as well as global sunk export costs (see Moxnes, 2010, on Norwegian firms; and Gullstrand, 2011, on Swedish firms).

The paper in chapter 4 is co-authored with Per Botof Maurseth and adds to the literature by including the product dimension into the analysis. We study the export behaviour of Norwegian seafood exporters in a new firm-level data set. The data are particularly interesting because of the high level of detail: 11 years of panel data for all Norwegian seafood exporters, the countries they export to, and the products they export. Norway is one of the world's largest exporters of seafood, with an annual export value of 35.7 billion NOK in 2007 (approx. 7.28 billion USD). The industry is highly internationalized, with exports of a wide range of products to almost 200 countries; some 90 per cent of all Norwegian seafood production is exported.[7] The sector is therefore an interesting case for the study of export activity. We present evidence of persistence in firms' export of a particular product to a particular country, indicating that there are sunk export costs also at the firm-product-country level. The probability of exporting a particular product to a particular country is found to increase by more than 180 per cent, from 3.9 to 11.0 percentage points, if the firm exported the product to the country the previous year.

Can export costs be reduced through learning from own experience, or that of other firms? In chapter 4 we address this question. Theoretical models incorporating learning and spillover effects are still scarce, but there are a few recent contributions. Schmeiser (2012) has developed a model where learning about exporting from other countries reduces the sunk costs of exporting to a given country – a concept she terms 'learning to export'.[8] A model capturing knowledge spillovers from other exporters is presented in Krautheim (2012). An increased number of exporters from country *i* to country *j* reduces the sunk cost of a firm in country *i* exporting to country *j*. We investigate a wide range of learning and spillover effects that may occur within as well as between products and countries.

We study learning from own experience by investigating whether the probability of exporting a particular product to a particular country increased if, in the previous year, the firm (i) exported another product to the same country; (ii) exported the same product to many other countries; or (iii) exported any product to many other countries. Other papers have also studied similar effects (see Gullstrand, 2011, on Swedish firms; Lawless, 2011, on Irish firms; Morales *et al.*, 2011, on Chilean firms; and Castagnino, 2011, on Argentinian firms).

Empirical studies of knowledge spillovers typically focus on the impact of concentrating export activity in the potential exporter's home country. Results from early contributions, which studied implications for whether or not a firm starts to export as such, were mixed (see Clerides *et al.*, 1998; Aitken *et al.*, 1997). Recent contributions that focus on the probability of exporting (a particular product) to a particular country show results more unambiguously in favour of the existence of spillovers. (See Requena Silvente and Castillo Giménez, 2007, on Spanish firms; Koenig, 2009, and Koenig *et al.*, 2010, on French firms; Lawless, 2011, on

[7] Based on information from the Norwegian Seafood Council.
[8] A different, but related concept is 'learning by exporting', discussed in Clerides *et al.* (1998). This concept describes reductions in firms' production rather than export costs due to learning from own export experience. They find little evidence of such effects, and most later contributions are also discouraging, although there are exceptions. Wagner (2007) and Greenaway and Kneller (2008) offer good reviews.

Irish firms; and Fabling et al., 2012, on firms from New Zealand.) In chapter 4, spillover effects are studied by investigating whether the probability that a firm would export a particular product to a particular country increased if, during the previous year, there had been (i) many other Norwegian firms exporting the same product, or (ii) many other Norwegian firms exporting any product, to that country.

Learning and spillover effects may be stronger if the average value of own or other firms' export is higher. As opposed to most other studies on learning and spillovers, we include in the same regression discrete variables on firms' lagged *presence* in markets, capturing the extensive margin, and continuous variables on firms' lagged export *value* to markets, capturing the intensive margin.

Most other studies of learning and spillovers in the firm-country (and possibly product) dimension have focused on entrants – firms that did not export (the product) to the country the previous year. By contrast, in our paper a dynamic model is employed, including entrants as well as continuing exporters (firms that exported the product to the country the previous year). By including interaction variables, we also allow for effects to differ for the two types of firms.[9] Whereas effects for continuing exporters may be interpreted as effects on fixed export costs alone, those for entrants may be interpreted as effects on the combination of fixed and sunk export costs.

Our results indicate that there are learning effects from other products within the same country. Having exported another product to a country in the previous year increases the probability of entering the country with a new product this year by 11.1 per cent and the probability of continuing to export a particular product to the country by 49.6 per cent. Learning effects also seem to be present within product groups across countries. If the firm exported a product to an additional country in the previous year, the probability of starting to export the product to a country this year increases by 1.9 per cent. The probability of continuing to export the product to a country increases by 1.0 per cent. There is no evidence of learning from exporting other products to other countries. Furthermore, we find indications of intra-product spillovers. An additional Norwegian firm exporting a product to a country increases the probability of a firm exporting the same product to the same country by approximately 1 per cent (for entrants as well as for continuing exporters). There is also some evidence of inter-product spillovers, but effects are smaller. Most learning and spillover effects occur through the extensive and not the intensive margin.

Summing up, empirical evidence presented in chapter 4 indicates that there are sunk costs related to exporting a particular product to a particular country. Evidence also suggests that firm-product-country specific export costs can be reduced through various learning and spillover effects, especially within the same product category.

[9] The only other papers I know of that include continuing exporters in addition to entrants are Gullstrand (2011) and Meinen (2012), who focus on country-specific learning, not spillovers. Moreover, these papers do not distinguish between entrants and continuing exporters as we do.

Topics for future research

Recent developments in economic research on international trade have expanded our understanding of the significance of trade costs. We have seen how changes in trade costs may lead to dramatic changes in the composition of trade and in countries' commercial structure. An important contribution from the latest theories is a more sophisticated modelling of trade costs. Up until only a decade ago, it was common to assume that trade costs were proportional to the traded volume. In other words, constant returns to scale in trade transactions were assumed. By contrast, nowadays many researchers aim at modelling increasing returns to scale and externalities in trade transactions.

In its simplest form, increasing returns to scale in trade transactions are modelled by exogenous firm-level sunk export costs, as in the models in chapter 2 and 3 in this thesis. Indeed, this kind of modelling implies that not all firms find it profitable to export, enabling us to explain how changes in trade conditions may affect exporting and non-exporting firms differently – a considerable improvement upon earlier theories. However, several observed trade patterns cannot be explained by this simple representation of trade costs. Although it is still common to use very simplified trade cost functions in models of international trade, some recent papers offer studies of more complex functions.

Empirical evidence presented in chapter 4 in this thesis and elsewhere indicates that sunk export costs may accrue along different dimensions: firm, country, product, the combination of the three, and possibly also along other dimensions. Arkolakis and Muendler (2010) investigate the behaviour of Brazilian firms and find that large firms selling many products, typically export their top products to many countries. Nevertheless, these firms sell a smaller amount of their lowest-selling products than do small exporters. They explain this pattern by a model where firms face product-country specific sunk export costs that may decline with the number of products the firm sells in a country. Studying combinations of different kinds of sunk export costs, and how these affect each other is a pertinent topic for future research.

Evidence presented in chapter 4 in this thesis and elsewhere suggests that there are learning and spillover mechanisms that can affect the magnitude of trade costs. Furthermore, Eaton *et al*. (2008) show that, among Colombian firms, most new exporters are very small, export to only one country, and soon give up exporting. By contrast, those that continue to export often experience a rapid expansion in their export values as well as in the number of countries to which they export. Various models have been suggested for explaining these patterns. A possible explanation is learning. In chapter 4 we assume, like most other empirical studies, that learning and spillover effects are external to the firm – it does not take them into account when deciding upon entering an export market. This might not be an accurate representation of reality. Perhaps firms take into account that learning from own experience and (to a lesser extent) spillovers affect their export costs. In this case, a firm may want to enter an export market even if it expects to earn negative profits there because export experience induces learning and spillover effects that make entry into other markets easier (for example, by reducing uncertainty). In this case, firms' entries across markets are not independent. If firms' learning is particularly strong in the first market they enter, many firms would export a small amount in one market (perhaps without paying the full sunk export costs) in order to test the market and reveal uncertainty about their exporting ability. Mechanisms similar to these are discussed in Albornoz *et al.* (2012).

Another point is that firms may be able to choose between different combinations of trade costs. Let's say firms could choose between selling in a foreign market through a trader (large variable and small sunk costs) instead of setting up a sales office in the export market (large sunk and small variable costs). Firms that are uncertain about their exporting ability would choose the first alternative to test the market, and then perhaps choose the last alternative at a later point when their exporting ability has been revealed. Issues related to this are discussed in Akhmetova and Mitaritonna (2013). Firms may also be able to choose their level of sunk export costs. Arkolakis (2010) suggest that large firms invest more in marketing, thereby being able to reach more consumers.

The study of trade cost functions incorporating elements like those mentioned above (sunk export costs along different dimensions, endogenous sunk export costs, or internal learning effects) is still in its infancy. Nevertheless, the literature centred around this is growing. Theoretical as well as empirical studies of these issues should be an important part of future research.

Inclusion of sunk export costs in trade models have enabled us to analyse how changes in trade costs and market size affect exporters and non-exporters differently. In chapters 2 and 3, I argue that an increase in the relative size of the foreign market should lead to a more than proportional increase in the number of exporters in a small country. This is what I refer to as the reverse HME in exports. A weakness about the models in chapters 2 and 3 is that the result hinges on strong assumptions: the assumption of restricted firm entry in chapter 2 and national product differentiation in chapter 3. In chapter 3, I partly relax the assumption of restricted firm entry by allowing for free entry of firms within an industry, but not free entry of industries. This allows for an HME in the number of firms to coexist with the reverse HME in the number of exporters. Since the results hinge on quite strong assumptions, a topic for future research would be to investigate these mechanisms in a more general model.

As mentioned in the beginning of this introduction, the fact that firm-level data became available in the mid-1990s encouraged empirical studies of firms' export dynamics. These studies, in turn, served as a source of inspiration for many new theoretical models that looked at firms' entries into export markets. Still, today's empirical evidence of the presence and nature of sunk costs builds mostly on data for individual countries, or a small number of countries. An exception is the empirical analysis in chapter 3, where I, in a large cross-country dataset, present evidence of a negative relationship between the proportion of firms that export and the relative home-market size – a pattern we could observe in the presence of sunk export costs.

However, the data used for this analysis have their clear limitations. The dataset includes developing countries only, and we are not able to compare the actual number of exporters and non-exporters between different countries, only the proportion of firms that export. Moreover, the results from the empirical analysis in chapter 3 do not necessarily imply that there is a reverse HME in exports, as predicted by the models. There could very well be a situation where there is an advantage in manufacturing exports of access to a large foreign market, but this advantage is not strong enough to cancel out the HME. In that case, we would also observe higher proportions of manufacturing firms in small countries. Nevertheless, the number of firms that export would be less than proportional to country size for the small country, i.e. there would not be a reverse HME in manufacturing exports. With access to better data, we would be able to directly test the coexistence of a reverse HME in the number of manufacturing exporters and an HME in the number of manufacturing firms.

Such data would also open up many new possibilities for studying the nature of sunk export costs. For example, we would be able to investigate the importance of home-country characteristics for sunk export costs as well as for the intensive and the extensive margins of exports. Future research should therefore focus on obtaining comparable data on the number of firms and exporters for a large number of countries. Studying such data would also hopefully inspire many new theoretical contributions that would in turn further improve our understanding of the role of trade costs.

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Chapter 2

Firms’ export decisions – fixed trade costs and the size of the export market

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Firms' export decisions—fixe trade costs and the size of the export market

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Abstract

This article presents a model of international trade under monopolistic competition. In the increasing returns sector firm face fixed in addition to variable, trade costs, and both exporters and non-exporters may coexist. Exporters benefi from access to large foreign markets, thus a small country has a higher share of exporting firm than a large one. In contrast to standard models, the increasing returns sector will be more open in a small country than in a large one, and a small country may be a net exporter of such commodities, despite the disadvantage of a smaller home market.

Keywords: Monopolistic competition; Product differentiation; Home market effect; Fixed trade costs

JEL classificatio : F12; F15

1. Introduction

Standard new trade theory predicts that the profitabilit of increasing returns to scale production depends positively on the size of the domestic market. A country with a large domestic market for a certain good will have a share of the world's production of that good that is more than proportional to the size of the domestic market. This effect was firs identifie by Krugman (1980) and is often called the

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home market effect. It is widely recognized in the new theory of international trade and economic geography (see Helpman and Krugman, 1985; and Fujita et al., 1999 for overviews). It is common for most models belonging to these traditions to assume that firm are symmetric so either all firm or no firm are exporters. A firm' decision to export is linked to its decision to produce, hence the home market effect5 applies to export as well as production. Consequently, a country with a large home market also has a larger than proportional share of the world's *export* of increasing returns to scale goods. In Helpman and Krugman (1985) the home market effect increases with trade liberalization. As trade costs decline, increasing returns to scale production becomes less profitabl in the country with the small home market, and below a certain level of trade costs, it gets deindustrialized.

While it seems reasonable that a large home market should be beneficia for increasing returns to scale *production*, it seems less obvious that it should be beneficia also for *export*. Trade theory based on constant returns and comparative advantage, predicts countries to be net importers of goods for which they have large domestic demand, and empirical evidence on the home market effect is ambiguous (see e.g. Head and Ries, 2001). In general we should expect a large foreign market to create large demand for imports, and hence give large export from relatively small markets. In the new trade theory models, however, the opposite is true: while a country's export of increasing returns goods is positively related to its domestic market size it is in fact negatively related to the size of the foreign market.

Since standard new trade theory predicts either all firm or no firm to be exporters, changes in trade costs cannot affect the share of firm that export, but only each firm' export volume. In the real world, however, we observe that both exporters and non-exporters coexist within the same industry. One reason for this might be that there are fixe costs related to exporting, which can make it profitabl for only a subset of firm to export. Both non-tariff trade barriers and other costs related to market research, the establishment of foreign distribution networks and foreign contacts, or adaption of foreign standards are examples of export costs with a fixe element. While empiric evidence confirm the importance of such costs (see e.g. Bernard and Wagner, 2001; or Roberts and Tybout, 1997), they are rarely considered in theoretical contributions. One exception is Venables (1994), who presents a model with fixe export costs, and both exporting and non-exporting firms He shows that trade liberalization leads to an increase in the share of exporting firms rather than an increase in each firm' export. Trabold (1998) find empirical evidence for these results, investigating the effects of the southern enlargement of the EEC in 1986. Another exception is Jean (2002), who presents a model with fixe export costs and productivity differences, and shows that exporters will be more efficien than non-exporters. This is also supported by empirical analyses (see e.g. Bernard and Jensen, 1999).

In this article I argue that the size of the export market should affect the share of firm that export in increasing returns to scale sectors. The argument is twofold:

firstly I argue that there are fixe costs related to export so only a subset of firm fin it profitabl to export. Secondly, I argue that even if economies of scale make the size of the home market important for production, it should be the size of the *foreign* market that matters for export. I present a model that has large structural similarities with the home market effect model (presented in Helpman and Krugman, 1985, pp. 205–209), yet it yields very different predictions. For example, a small country will have a higher share of exporting firm than a large one, thus the increasing returns to scale sector in a small country should be more open than in a large one. In most cases a small country will be a net exporter of increasing returns to scale goods. This contrasts the new trade theory models where increasing returns to scale sectors are predicted to be of the same openness in a small and large countries and a large country is a net exporter of increasing returns to scale goods.

2. Foreign market size effects and the share of firms that export

The point of departure for the model is the standard home market effect model of international trade under monopolistic competition with Dixit and Stiglitz (1977) preferences, iceberg trade costs, a constant returns to scale agricultural sector and an increasing returns to scale manufacturing sector (see Helpman and Krugman, 1985, pp. 205–209). My model differs from the home market effect model in two ways.

Firstly, in line with Venables (1994) and Jean (2002) I assume that firm in the manufacturing sector face fixe export costs in addition to fixe production costs. This modelling of trade costs separates the firm' export decision from its production decision: the fir may choose to supply both foreign and domestic markets, or just the latter. Exporting yields higher fixe costs but also higher sales.[1] Since the firm' decision to export is independent of its decision to produce, the benefi of a large home market in increasing returns to scale production does not necessarily translate over to export. Thus the dependency between the home market size and export found in the home market effect model is broken as long as some firm are non-exporters. If, on the other hand, all firm export, the fixe export cost is just an increment to fixe production costs. All manufacturing firm fin it profitabl to export, so a fir that wants to start exporting also has to start production. Profitabilit of export will therefore be dependent on the size of the home market insofar as production is so.

Secondly, I assume that fixe costs in manufacturing firm use a specifi factor

[1]This feature yields some similarity with certain models of horizontal FDI, where firm can chose between supplying the foreign market through exporting, which involves variable trade costs, but low fixe costs; or through establishing a subsidiary, which involves no variable trade costs, but higher fixe costs (see Markusen and Venables, 2000).

which is not used elsewhere in the economy. Fixed production costs thus use a different factor than fixe export costs and this assumption yields a foreign market effect in export. This is because the number of manufacturing firm is uniquely determined by the supply of the specifi factor, so the number of domestically produced varieties of the manufactured good cannot increase. Consumers can thus not get access to new domestica lly produced varieties. The number of exporting firms however, can vary, so consumers can get access to new varieties by importing. The larger demand in the large country is hence directed toward the small country's products as well as domestic products. Small-country firm now face larger demand from abroad than large-country firms and, as we shall see, this results in a higher number of exporting firm in the small country.[2]

As pointed out by Venables (1994), fixe export costs alone are not sufficien to generate an equilibrium where exporting and non-exporting firm coexist within the standard home market effect model. The reason for this is that entry conditions of foreign and domestic firm depend on each other. Firstly the number of firm selling in a given market affects the demand curve faced by foreign and domestic firm in the same way via the price index and, secondly, costs are independent of the number of firms The entry conditions of foreign and domestic firm are therefore symmetric and we cannot determine both the number of firm in each market and the share of these that export. There are different ways of breaking this dependency and Venables (1994) chooses to modify the demand side by introducing an Armington assumption. In this article, on the other hand, I modify the cost side. The assumption of a specifi factor used in manufacturing production assures that costs of entry of domestic firm are affected by the number of domestic firm via the price of the specifi factor. If more domestic firm try to establish, demand for the specifi factor and hence its price will increase. This leads to an increase in the fixe production costs, and the profitabilit of entry of domestic firm declines. Foreign firms however, do not use the specifi factor when entering the domestic market, thus their entry cost is exogenous. Hence the number of domestic firm affects entry conditions of foreign and domestic firm differently. Since these entry conditions are no longer symmetric, we can use them to determine both the price of the specifi factor and the share of firm that export in each country.[3]

Summing up, the assumption of fixe export costs disconnects each firm' export decision from its production decision. The assumption of a specifi factor

[2]The assumption of a specifi factor used in fixe production costs is also applied by Forslid (1999) and Ottaviano (2001) in agglomeration models, and it is indirectly used in Smith and Venables (1991) in a model of regional integration. However, these models do not differ between fixe production and export costs and there is no foreign market size effect in export.

[3]Note that in contrast to the standard home market effect model we do not need the entry conditions to determine the number of manufacturing firms as this is given by the endowment of the specifi factor. Instead we use them to determine the price of the specifi factor.

used in a fixe amount in manufacturing production serves two purposes. Firstly, it makes a country’s imports sensitive to its market size and hence links each firm’ profitabilit of export to the size of the foreign market. Secondly, it assures that the number of firm selling in a given market affects entry of domestic and foreign firm differently. Together with the fixe export costs assumption, this permits an equilibrium with both exporting and non-exporting firms removes the home market effect in export, and creates a foreign market effect instead. Both assumptions are thus necessary in order to analyze how the foreign market size affects the share of exporting firms

Unlike the present article, the focus in the Venables (1994) article is not market size effects in export. The countries are of equal sizes, and there is only one factor of production. It turns out, however, that the Armington assumption applied in that article, also creates a foreign market effect in export when used in a model with asymmetric countries. In Appendix A sketch a model where different country sizes are considered within the Venables (1994) framework and which yields similar predictions to those in the present article.

3. The model

There are two countries: home (h) and foreign (f), endowed with two factors of production: labor (L_i) and capital (K_i), $i = h, f$.

Labor is used in a homogeneous, constant returns to scale agricultural sector. Constant labor supply and free trade in agricultures assures that the wages are equalized between the two countries, and we choose units so that the wage and price of agricultures equal 1.

Labor is also used in constant marginal costs in manufacturing production (c) and fixe cost in export of manufactures (G; $G \geq 0$). We may think of G as a fixe amount of working hours needed in order to acquire necessary information about exporting conditions or to establish a foreign customer relationship. In addition, exporters of manufactures face iceberg trading costs, which implies that only $1/t$ unit of an exported good arrives to its destination; $t \geq 1$ and $t = 1$ implies no variable trade costs. The manufacturing sector consists of many symmetric firm each producing a unique variety of the differentiated manufactured good. Each fir need a fixe amount of capital (F; $F > 0$) which can be thought of as physical or human capital. Capital is not used elsewhere in the economy, and this may reflec the idea that manufacturing production needs special production equipment, R&D or management services. Fixed production costs are thus given by $v_i F$, where v_i is the price of capital in country i.

Preferences in both countries are equal and of the Dixit and Stiglitz (1977) type. Utility is a Cobb–Douglas aggregate of the agricultural good and the aggregate of manufactures. The budget share for manufactures equals μ. Further, sub-utility of manufactures is a CES aggregate of all manufactured varieties. The elasticity of substitution equals the elasticity of demand and is denoted ε. In country i, demand for a domestic and foreign product variety respectively is now given by (see Helpman and Krugman, 1985, pp. 117–119):

$$d_{ii} = \frac{\mu y_i p^{-\varepsilon}}{\left(p^{1-\varepsilon} n_i + (pt)^{1-\varepsilon} s_j n_j\right)} \quad d_{ji} = \frac{t \mu y_i (tp)^{-\varepsilon}}{\left(p^{1-\varepsilon} n_i + (pt)^{1-\varepsilon} s_j n_j\right)} \tag{1}$$

where p is the price of a manufactured variety, n_i, n_j is the number of manufacturing firms s_i, s_j is the share of these that export, and y_i, y_j is income in country i and j respectively.

p is equal across firm and countries because the manufacturing sector consists of monopolistically competitive firm that produce symmetric varieties and face the same technology and demand. Equalization of marginal revenue and marginal cost gives:

$$p - c = \frac{c}{\varepsilon - 1} \tag{2}$$

There are four possible kinds of firms exporters (e) and non-exporters (ne) in both countries. The sales volume in market j of a fir   from country i is z_{ij}. Using (2), the profit (π) corresponding to the four kinds of firm are given by:

$$\pi_h^{ne} = \frac{c}{(\varepsilon - 1)} z_{hh} - v_h F \tag{3}$$

$$\pi_h^{e} = \frac{c}{(\varepsilon - 1)} \left(z_{hh} + z_{hf}\right) - (v_h F + G) \tag{4}$$

$$\pi_f^{ne} = \frac{c}{(\varepsilon - 1)} z_{ff} - v_f F \tag{5}$$

$$\pi_f^{e} = \frac{c}{(\varepsilon - 1)} \left(z_{ff} + z_{fh}\right) - (v_f F + G) \tag{6}$$

All firm in a given country face the same domestic demand independently of whether or not they export (since products are symmetric), but exporters also face demand from abroad. This tends to give a high number of exporters. On the other hand, exporters face higher overall fixe costs because they have to pay a fixe export cost in addition to the fixe production cost, and this tends to give a low number of exporters. Whether all firms some firm or no firm export depends on the relative importance of these two mechanisms.[4]

There is free entry and exit, so firm will enter the different markets until their profit equal zero. This determines the equilibrium sales of each kind of firm The endogenous variables are then determined by setting sales equal to demand.

If there are non-exporters and exporters in both countries the model consists of Eqs. (3)–(6) and the endogenous variables s_h, s_f, v_h, v_f are determined by setting these equations equal to zero and insert for demand. In this case both types of trade costs must be high enough to assure that not all firm fin it profitabl to export. As we shall see from Eq. (17) below, we can derive a lower limit of G that gives non-exporters and exporters in both countries:

$$G^* = \frac{\gamma\mu}{\left(1 + \gamma \frac{t^{\varepsilon-1}(\varepsilon-\mu)}{\varepsilon}\right)\varepsilon} \frac{L_h F}{K_h} \tag{7}$$

where γ is the ratio of the size of the foreign to the home country in terms of factor endowments (see Eq. (13) below). If G is smaller than G^*, all firm can sell enough in the foreign market to cover G.[5] Further, $G^* > 0$, thus fixe trade costs must be strictly positive if there shall be non-exporters. However, there may be non-exporters even if there are no variable trade costs (since G^* is define even if $t = 1$). Variable and fixe trade costs have similar effects on the export decision, so if all firm export and t increases, G must decrease in order to assure that all firm still fin it profitabl to export (thus G^* decreases with t). If all firm export, not all Eqs. (3)–(5) are valid. A short presentation of this case is given in Section 3.2. The main focus, however, will be on the case where there are non-exporters in both countries.

31. Non-exporting f rms in both countries

By setting (3) and (5) equal to zero, we fin equilibrium domestic sales in country i:

$$z_{ii} = \frac{(\varepsilon - 1)v_i F}{c} \tag{8}$$

[4]In the case where both exporters and non-exporters coexist, we cannot say anything about which firm will become exporters, since all varieties are symmetric. Some firm simply do not fin it profitabl to export because foreign demand is not sufficientl high to assure that all firm can export enough to cover the fixe export costs. Note, however, that this indeterminacy of which firm become exporters is not conceptually different from the indeterminacy in the home market effect model of which goods are produced in which country.

[5]As shown below, this is the case for the small country. For the large country, G must be even lower in order to assure that all firm fin it profitabl to export.

Setting (4) and (6) equal to zero and using (8) we fin equilibrium export from country j to country i:

$$z_{ji} = \frac{(\varepsilon - 1)G}{c} \tag{9}$$

Eqs. (8) and (9) show that sales in the home market are determined by fixe production costs, while export is determined by fixe trade costs. We can use the two to derive the ratio of sales of an imported variety to a domestically produced variety in country i:

$$\frac{z_{ji}}{z_{ii}} = \frac{G}{v_i F} \tag{10}$$

Correspondingly, we can derive the ratio of demand for an imported variety to a domestically produced variety in country i from (1):

$$\frac{d_{ji}}{d_{ii}} = t^{1-\varepsilon} \tag{11}$$

Now, setting sales equal to demand we can derive the capital price in each country:

$$v_i = t^{\varepsilon - 1} \frac{G}{F} \tag{12}$$

which is equalized in the two countries as long as there are both non-exporters and exporters both places.[6] This is because the decision to export is independent of the decision to produce, and capital is only used in production. Differences in foreign demand will thus not give a different capital price in the two countries. We also see that increased trade costs increase the price of capital. This is because increased trade costs increase demand for domestic manufactures relative to demand for imports. Demand for capital, which is used intensively in manufacturing production for the domestic market, must then increase and so must its price.

The above result is independent of how we model the supply of capital to the manufacturing sector. In order to determine the number of exporting firms however, we must look at factor endowments. The easiest way to model this is to assume that the endowment of capital in country i is given exogenously, and that relative factor endowments are equal, so that

$$\frac{K_f}{K_h} = \frac{L_f}{L_h} = \gamma \tag{13}$$

The foreign country is assumed to be the largest, thus $\gamma > 1$. The number of

[6]Remember that when there are exporters and non-exporters in both countries, G is strictly positive, thus there is a lower limit to the capital price.

manufacturing firm will now be uniquely determined by the endowment of capital and the fixe requirement of this factor in the manufacturing production:

$$n_i = \frac{K_i}{F} \tag{14}$$

The relative number of firm must be equal to the relative country size:[7]

$$\frac{n_f}{n_h} = \gamma \tag{15}$$

Total income in country i consists of returns to capital and labor.

$$y_i = v_i K_i + L_i \tag{16}$$

Using (12), we can see from (8) that each firm' domestic sales will be equal in the two countries. Since sales equal demand in equilibrium, by using (8) and (1), we get:

$$\frac{(\varepsilon - 1) v_h F}{c} = \frac{\mu y_h p^{-\varepsilon}}{\left(p^{1-\varepsilon} n_h + (pt)^{1-\varepsilon} s_f n_f\right)} = \frac{\mu y_f p^{-\varepsilon}}{\left(p^{1-\varepsilon} n_f + (pt)^{1-\varepsilon} s_h n_h\right)}$$

To fin the share of firm that export, we insert for (12), (13), (14) and (16) in the above equations. After some rearrangement, this yields:

$$s_h = \gamma \left(\frac{\mu}{\varepsilon} \frac{L_h}{G} \frac{F}{K_h} - \frac{t^{\varepsilon - 1}(\varepsilon - \mu)}{\varepsilon} \right) \tag{17}$$

$$s_f = \frac{1}{\gamma} \left(\frac{\mu}{\varepsilon} \frac{L_h}{G} \frac{F}{K_h} - \frac{t^{\varepsilon - 1}(\varepsilon - \mu)}{\varepsilon} \right) \tag{18}$$

$$\frac{\mathrm{d}s_i}{\mathrm{d}t} < 0 \quad \frac{\mathrm{d}s_i}{\mathrm{d}G} < 0$$

From (17) and (18) we see that the relative share of firm that export must be:

$$\frac{s_f}{s_h} = \frac{1}{\gamma^2} < 1 \tag{19}$$

From (19) we see that the share of firm that export is much higher in the small country than in the large one, thus the manufacturing sector here is more open.

As an indicator of net trade in manufactures we shall use the relative export share (E), which shows total export of manufactures in the foreign country divided

[7]This follows directly from the assumption of exogenous capital supply to the manufacturing sector. However, the same result may arise with an endogenous capital supply to the manufacturing sector. A note that illustrates one such case is available from the author upon request.

by total export of manufactures in the home country. Using (19) together with (9) and (15), we get:

$$E = \frac{ps_f n_f z_{fh}}{ps_h n_h z_{hf}} = \frac{1}{\gamma} < 1 \tag{20}$$

Note that E is the ratio of the value of export of manufactures in the foreign versus the home country, thus we have not corrected for country sizes. From (20) we see that the small country is a net exporter of manufactured goods. In fact, export of manufactures is proportional to the size of the foreign market, while the domestic market size plays no role. There is a foreign market size effect in export. The high share of firm that export in the small country more than cancels out the effect of a lower number of manufacturing firm (see Eqs. (15) and (19)). Larger demand in the large country is directed towards small-country products as well as domestic products because increased demand for manufactures cannot result in an increase in the number of domestically produced varieties (since n_i is given directly by factor endowments). Consumers value variety and prefer access to new varieties instead of consuming more of the domestic ones, and the only way of achieving this is by importing. Small-country firm thus face larger demand from abroad than large-country firms Since the decision to export is independent of the decision to produce, this assures that more small-country firm can export enough to cover the fixe trade costs.

We see that while the standard home market effect model predicts the large country to be a net exporter of manufactures, this model predicts the small country to be so. Further, the standard model predicts the manufacturing sector in each country to be of the same openness (because the export volume of each fir is equal, and all firm export), while this model predicts the manufacturing sector in the small country to be more open than in the large one.

Eq. (20) also shows that the net trade ratio in manufactures is independent of the level of trading costs. The reason for this is again that the export decision is separated from the production decision, so changes in trade costs affect demand for imports proportionally in the two countries. Looking at (17) and (18), we can also see that the share of exporting firm decreases with fixe and variable trade costs. This is consistent with Venables (1994) and the model thus offers an alternative explanation for the predictions from that model, and for the finding of Trabold (1998).

32. All f rms export in either one or both countries

We know that the share of firm that export will be highest in the small country, thus s_i will equal 1 at higher trade costs in the small country than in the large country. Setting $s_h = 1$ in (17) we can derive (7), which shows the maximum level of trade costs allowed if all firm shall export in the small country. Eq. (3) must now be dropped from the model, and $s_h = 1$ must be inserted in demand. In Appendix A it is shown that the relative export share now equals:

$$E^* = \frac{1}{\gamma} + t^{\varepsilon-1}\frac{\varepsilon-\mu}{\varepsilon} + \frac{1}{\varepsilon}\mu - \frac{1}{\gamma}\frac{G}{F}\frac{K_h}{L_h}\frac{\left[t^{\varepsilon-1}(\varepsilon-\mu)+\mu\right]\left[t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon\right]}{\varepsilon\mu} \tag{21}$$

$$\frac{\mathrm{d}E^*}{\mathrm{d}G} < 0$$

If trade costs are further reduced, all firm may start to export also in the large country. In this case we must drop both (3) and (5) and insert $s_h = s_f = 1$ in demand. In Appendix A it is shown that the relative export share now equals:

$$E^{**} = \frac{1}{\gamma}\frac{t^{\varepsilon-1}\left(1-\frac{\mu}{\varepsilon}\right)+\frac{\mu}{\varepsilon}+\frac{1}{\gamma}}{t^{\varepsilon-1}\left(1-\frac{\mu}{\varepsilon}\right)+\frac{\mu}{\varepsilon}+\gamma} \tag{22}$$

$$\gamma \geq E^{**} \geq 1 \quad \frac{\mathrm{d}E^{**}}{\mathrm{d}t} > 0 \quad \frac{\mathrm{d}E^{**}}{\mathrm{d}G} = 0$$

In contrast to the case where there are exporters and non-exporters in both countries (21) and (22) show that the relative export share now depends on trade costs. G only affects E^*, where a higher G results in a decline in the large country's market share. t affects both E^* and E^{**}. While $E_t^{**\prime}$ is always positive, $E_t^{*\prime}$ may be both positive and negative. However, since E is smaller than E^{**}, we know that $E_t^{*\prime}$ must be negative for at least for some ranges of t. In most numerical examples $E_t^{*\prime}$ is negative for all ranges of variable trade costs where E^* is valid.

In Figs. 1 and 2 I have assumed that the foreign country is twice the size of the home country, thus for relatively high variable trade costs, when there are non-exporters in both countries, $E = 1/2$. For intermediate variable trade costs, all firm in the small country export and the production decision and the export decision become dependent. Increased foreign demand due to trade liberalization can no longer result in an increase in the number of exporters only increased export volume in each firm Thus large-country consumers cannot get access to new varieties by importing. However, in the large country there are still some non-exporting firms so small-country consumers can get access to new varieties if trade is liberalized. Consequently, in the small country trade liberalization leads to an increase in each firm' export, z_{hf}, while the number of exporters, n_h, is constant, but in the large country each firm' export, z_{fh}, is constant while the number of exporters $s_f n_f$ increases. Because consumers value variety, growth in large-country consumers' demand for small-country products is now dampened.

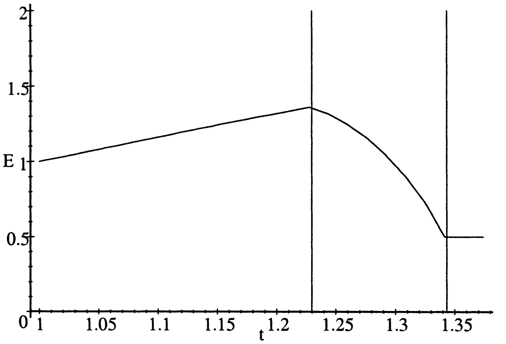

Fig. 1. Trade liberalization and the net trade pattern.

The small country face the disadvantage of a small home market, and we experience an increase in the large country's share of the world's export of manufactures.

From (22) we see that when all firm export in both countries, the large country benefi from a relatively large home market and is a net exporter of manufactures. Note, however, that the export share will always be lower than proportional to the relative country sizes. We also see that E declines as t is reduced. This is because neither country can now provide new varieties, and the advantage for large-country firm disappears. Consumers switch their demand towards imports as trade is liberalized, and this has a larger impact on each fir in the small country because overall demand is higher in the large country. When variable trade costs equal zero ($t = 1$), both countries will have an equal share of the world's export of manufactures, but the export volume of each fir is twice as high in the small as in the large country.

Increased fixe trade costs only affect the case where $s_h = 1$ and $s_f < 1$. Increased G implies lower profitabilit from exporting, thus a lower t is required

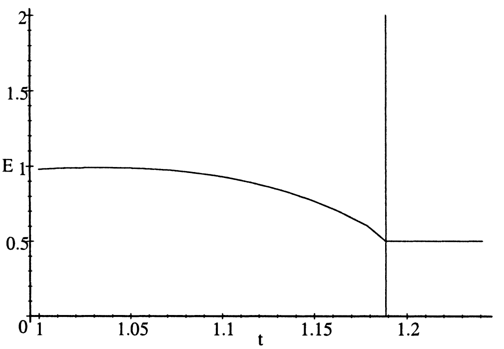

Fig. 2. Higher entry costs: the large country never becomes a net exporter.

in order for both s_h and s_f to reach 1. If variable trade costs are sufficientl high, s_f never equals 1 and the large country may never become a net exporter of manufactures. This case is shown in Fig. 2.

The analysis above has concentrated on the case where no country specializes in manufacturing production, thus factor prices are equalized. This is likely to be the case if μ is not too high or countries are not too different in size. If this is not the case, the small country might specialize in the production of manufactures, and this may lead to increased wages and prices in that country. However, in contrast to the standard model, both countries will always have some manufacturing production, so the small country will never get deindustrialized.

Some may argue that this foreign market size in export is too strong in the model presented above. The role of the domestic market size in export should not be completely ignored, and very small countries should not be net exporters of manufactures. There are several ways of modifying this result, and one possibility is to let fixe export costs increase with the size of the foreign market (Medin and Melchior, 2002 fin empirical evidence for this assumption). However, I prefer to present the simple model here in order to concentrate on the main point, namely that exporting firm benefi from a large export market and that increasing returns to scale sectors in small countries are more open than in large ones.

4. Conclusion

The aim of this article has been to give a theoretical background for explaining how the size of export markets affects the share of exporting firm in increasing returns to scale sectors.

I have argued that, in contrast to what is predicted in the standard new trade theory, the size of the foreign market should matter for profitabilit of export. Further, I have argued that there are fixe costs of exporting. This is supported by empirical analysis yet poorly analyzed in theoretical models. Such costs may make it profitabl for only a share of firm to export, and both each firm' export and the share of firm that export can vary with trade costs.

The model presented in this article has large structural similarities with standard new trade models, yet it yields predictions that differ sharply: small countries are predicted to have a higher share of exporting firm in the increasing returns to scale sector than large ones, hence this sector is more open in small countries. Further, as long as there are non-exporting firm in both countries, small countries are predicted to be net exporters of increasing returns to scale goods, because export of these goods then only depends on the foreign market size. In contrast to the standard theory, small countries can never get deindustrialized thus they have no reason to fear trade liberalization.

The model shows that reduced fixe export costs have similar effects to reduced variable costs. Trade policy has traditionally concentrated on reducing variable trade costs such as tariffs, and as a consequence these have declined considerably in many areas. There may therefore be little additional gains from further tariff reductions. In contrast, informal barriers to trade such as costs of gathering market information, establishing contact with customers or adjustment to national standards and legislation may still be considerable. Reducing these barriers however, will require a policy that explicitly aims at overcoming entry barriers in foreign markets. An example is the establishment of export promotion agencies that provide information about foreign markets and potential customers. Another example is international harmonization of standards.

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Appendix A

All frms export in the small country

The price of capital is no longer equalized in the two countries. In order to solve for the endogenous variables, we must insert for $s_h = 1$ in (1), and further insert (1) in (4), (5) and (6). Setting these equations equal to zero and rearranging, we now get:

$$v_f = t^{\varepsilon-1}\gamma\mu \frac{L_h}{K_h} \frac{1}{[t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon]}$$

$$v_h = \gamma\mu \frac{L_h}{K_h} \frac{1}{[t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon]} + \frac{G(t^{\varepsilon-1}-1)}{F}$$

$$s_f = \frac{1}{\gamma}\left(\frac{F}{G}\frac{\mu}{\varepsilon}\frac{L_h}{K_h}\frac{[\gamma(\varepsilon-\mu)t^{\varepsilon-1}+\varepsilon+\mu]}{[t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon]} - \frac{t^{\varepsilon-1}(\varepsilon-\mu)+\mu}{\varepsilon}\right)$$

z_{ff} is still equal to (8), but in order to fin z_{hf}, we must set sales equal to demand in (11) and then insert for (8):

$$z_{hf} = t^{1-\varepsilon} z_{ff} = t^{1-\varepsilon} \frac{(\varepsilon-1)v_f F}{c}$$

The relative export share can then be expressed as:

$$E^* = \frac{ps_f n_f z_{fh}}{pn_h z_{hf}} = \gamma t^{\varepsilon-1}\,\frac{s_f}{v_f}\,\frac{G}{F}$$

Inserting for v_f and s_f gives:

$$E^* = \frac{1}{\gamma} + t^{\varepsilon-1}\,\frac{\varepsilon-\mu}{\varepsilon} + \frac{1}{\varepsilon}\,\mu - \frac{1}{\gamma}\,\frac{G}{F}\,\frac{K_h}{L_h}\,\frac{\left[t^{\varepsilon-1}(\varepsilon-\mu)+\mu\right]\left[t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon\right]}{\varepsilon\mu}$$

$$\frac{\mathrm{d}E^*}{\mathrm{d}G} < 0$$

All firms export in both countries

Now we have that $s_h = s_f = 1$. Inserting for this and (13), (14) and (16) in (1), demand for imports in the home and foreign country respectively is now given by:

$$d_{fh} = \frac{(v_h K_h + L_h)t^{1-\varepsilon}}{\frac{K_h}{F} + \gamma\,\frac{K_h}{F}\,t^{1-\varepsilon}} \quad \text{and} \quad d_{hf} = \gamma\,\frac{(v_f K_h + L_h)t^{1-\varepsilon}}{\gamma\,\frac{K_h}{F} + \frac{K_h}{F}\,t^{1-\varepsilon}}$$

Setting demand equal to sales and using (15), the relative export share can now be expressed as:

$$E^{**} = \frac{pn_f z_{fh}}{pn_h z_{hf}} = \frac{(v_h K_h + L_h)}{(v_f K_h + L_h)}\,\frac{(\gamma + t^{1-\varepsilon})}{(1+\gamma t^{1-\varepsilon})}$$

Further, inserting for demand in (4) and (6) and setting these two equations equal to zero we can derive the following expression

$$\frac{(v_h K_h + L_h)}{(v_f K_h + L_h)} = \frac{\left(1 - \gamma\,\frac{\mu}{\varepsilon}\,\frac{1-t^{1-\varepsilon}}{\gamma + t^{1-\varepsilon}}\right)}{\left(1 - \frac{\mu}{\varepsilon}\,\frac{1-t^{1-\varepsilon}}{1+\gamma t^{1-\varepsilon}}\right)}$$

which can be inserted in the expression for E^{**}. The relative export share will then be given by:

$$E^{**}=\frac{1}{\gamma}\frac{t^{\varepsilon-1}\left(1-\frac{\mu}{\varepsilon}\right)+\frac{\mu}{\varepsilon}+\frac{1}{\gamma}}{t^{\varepsilon-1}\left(1-\frac{\mu}{\varepsilon}\right)+\frac{\mu}{\varepsilon}+\gamma}$$

$$\gamma\geq E^{**}\geq 1 \quad \frac{\mathrm{d}E^{**}}{\mathrm{d}t}>0 \quad \frac{\mathrm{d}E^{**}}{\mathrm{d}G}=0$$

An alternative model: the armington approach

In Venables (1994) there is only one factor of production, but sub-utility for manufactures is a two-level CES aggregate of: (1) foreign and domestically produced manufactures, and (2) different varieties of the manufactured good. Extending the Venables model to countries of different sizes, we will get a foreign market effect in export, just as in the model presented in this article. However, this is a result of the fact that foreign and domestically produced manufactures are imperfect substitutes. Since consumers want to consume some of each, large absolute demand in the large country must be directed towards imports as well as domestic varieties. This links profitabilit of export to the size of the foreign market. Further, there are fixe export costs, which separate the decision to export from the decision to produce and assure that non-exporters and exporters may coexist.

The predictions about the share of firm that export and the relative export share are identical to the predictions from the model presented here when there are both exporters and non-exporters in the two countries. When all firm export in either one or both countries, predictions are somewhat different. The number of manufacturing firm is endogenous, and when all firm export in the small country a new exporter can be established by establishing a new firm Increased foreign demand due to reduced variable trade costs now makes the number of manufacturing firm grow in the small country, and we get a smaller decline in the manufacturing sector than in the present model. When all firm export in both countries, we approach a situation where $E^{**}=\frac{1}{2}$ when variable trade costs decline. This is because of constant elasticity of substitution between the aggregates of foreign and domestically produced manufactures, so for equal prices on foreign and domestic products, consumers want to consume an equal amount of the two aggregates. Hence the number of manufacturing firm is equal in the two countries. However, twice as many consumers in the large country makes export of each fir twice as high in the small than in the large country.

A note with the full model and discussion is available from the author upon request.

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Chapter 3

The reverse home market effect in exports: A cross-country study of the extensive margin of exports

The reverse home market effect in exports:

A cross-country study of the extensive margin of exports

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Abstract

This paper presents a simple trade model with results that contradict those from home market effect models in two ways. Firstly, a home market effect in manufacturing domestic sales is found to co-exist with a reversed home market effect in manufacturing exports. While small countries have a disadvantage in manufacturing domestic sales given their access to small domestic markets, they have an advantage in manufacturing exports given their access to large export markets. Secondly, initially equal firms split into exporters and non-exporters in equilibrium; and market conditions, rather than firm-level differences in marginal costs, are the main determinants of the number of manufacturing firms that export. In consequence of these two results, for a small country the number of manufacturing of firms that export is higher than proportional to country size. The extensive margin of exports, defined as the proportion of firms that export, decreases with relative size of the home market. Empirical support for the latter prediction is found in a cross-sectional dataset on firm level exports for 116 countries.

Keywords: reverse home market effect, monopolistic competition, national product differentiation, fixed export costs, firm-level data, fractional logit

JEL classification: F12, F13, F14

1 Introduction

Will trade liberalisation lead to deindustrialisation of small countries? A well-known result from new trade theory models is the home market effect (HME), first introduced formally by Krugman (1980). The argument is as follows: Increasing returns and transport costs in manufacturing industries make access to a large home market advantageous. It is therefore less profitable for manufacturing firms to be established in small countries. In consequence, small countries may offer lower wages, or have a share of the world's production and exports of manufactured goods that is less than proportional to their share of labour. Some authors predict that the effect will be reinforced by trade liberalisation (Helpman and Krugman 1985, pp. 205–209, henceforth: HK 1985), while others predict that the effect will follow an inverse U relationship, where it is weakened for very low trade costs (Krugman and Venables, 1990). This has led to concern as to whether small countries are likely to have lower income per capita or become deindustrialised.

However, several studies show that small countries in general do not have lower GDP per capita than large ones. (See e.g. Easterly and Kraay, 2000; Rose, 2006.)[10] Moreover, in several small countries, manufactured goods account for a large proportion of their total exports. Examples include many prosperous countries, among them Singapore, Finland and Luxembourg, but also less developed countries. Eastern European countries, like the Slovak Republic and Estonia, and other emerging markets, like Mauritius and Namibia, have experienced growth in GDP per capita, and the proportion of manufactured goods in their total exports is relatively high. This may indicate that being a small country is not as great a disadvantage as indicated by the literature on the HME.

A weakness of HME models is that lower profitability of manufacturing *domestic sales* in small countries often induces lower profitability of manufacturing *exports*. In other words, the

[10] Furthermore, Ramondo and Rodríguez-Clare (2010) and Ramondo, Rodríguez-Clare and Saborío-Rodríguez (2012) discuss the issue of small countries being much richer than predicted by models of idea-based growth.

HME applies to manufacturing exports as well as to manufacturing domestic sales. However, relatively small countries may have access to relatively large export markets, and this could make exports more profitable in small countries than in large ones. Generally, this mechanism is present in models with constant returns to scale, but in the HME models it is normally completely dominated by the benefit of access to a large home market. This might not be a good description of real life. Even if a relatively small home market is a disadvantage for manufacturing domestic sales, it can be an advantage for manufacturing exports. This could yield a reverse HME in exports, where small countries have a more than proportional share of the world's export of manufactured goods. The first aim of this paper is to show how an HME in manufacturing domestic sales may coexist with a reverse HME in manufacturing exports in a simple model of international trade. To my knowledge, no other authors have discussed this dichotomy.

Why do some firms become exporters while others do not? What factors determine the number of firms that export? The literature has generally focused on firm differences in answering these questions. After the pioneering article of Melitz (2003) it has become common to include fixed export costs and firm differences in marginal production costs in trade models. This ensures that only the most productive firms will find it profitable to export. However, not only firm differences, but also the relative size of the foreign market may be important for firms' export decisions. If the home market is small and the foreign market is large, many firms may find it profitable to export, whereas a relatively small foreign market may have room for only a few exporters. A weakness of HME models, whether dealing with homogeneous or heterogeneous firms, is that they often predict that the number of manufacturing exporters will increase with relative size of the home market due to the HME. In other words, it decreases with the relative size of the foreign market. The HK 1985 model is a benchmark HME model which is used as point of departure for many other models. There are no fixed export costs and firms are homogeneous, thus the model predicts that either all firms will export or no firms will. Consequently, the HME in the total number of manufacturing firms leads directly to an HME in the number of exporters. The result may be seen as an undesired side effect of the fact that homogeneous-firms models are not able to separate between exporting and non-exporting firms. However, the effect is also found in the much used Melitz-style extension of HK 1985, where only a proportion of firms export (a model like that is e.g. presented in Baldwin and Forslid, 2010). In that model, the extensive margin of exports, defined as the proportion of firms that export, will be independent of country size.[11] This leads to the same negative relationship between the number of manufacturing exporters and the size of the foreign market as found in its homogeneous-firms counterpart.

The second aim of this paper is to show how export market conditions, rather than firm differences in marginal costs, can be the main determinants of the number of exporters. It is not surprising that different firms behave differently as in Melitz-type models. In the model presented here, however, I show that even firms that are initially equal may behave differently in equilibrium and become heterogeneous with respect to export status. The model yields an equilibrium where the total number of manufacturing *firms* in a small country relative to that in a large country is less than proportional to relative country size, due to the HME. At the same time, the relative number of manufacturing *exporters* is more than proportional, due to the reverse HME. As a consequence, the extensive margin of exports, defined as the proportion of firms that export, will be higher in small countries than in large ones.

The third aim of this paper is to present empirical evidence of larger extensive margins of exports in small countries than in large countries – which we would observe in the presence of a reverse HME in exports. Very little evidence exists on this point. To my knowledge only

[11] Note that this definition of the extensive margin of export differs somewhat from other papers. Normally, it refers to the number of firms that export, but in this paper it refers to the proportion of firms that export.

one study has dealt with this issue, and then only briefly, without econometric testing. The International Study Group on Exports and Productivity (2008) compares firm level data on exporters and non-exporters between 14 countries, and finds that the extensive margin of exports is 'loosely decreasing in the size of the domestic markets' (p. 5). In this paper, I use firm level data for manufacturing exports for 116 developing countries from the Enterprise Surveys dataset. Results show that, for the average country, a doubling of relative home market size is associated with a 12.3% decrease in the extensive margin of exports.

The paper is organised as follows: Section 2 gives an overview of related literature, Section 3 presents the theoretical model, Section 4 presents the empirical evidence, and Section 5 offers some conclusions.

2 Related literature

Traditional trade models, characterized by constant returns to scale (CRS) and comparative advantage, generally predict that countries are net exporters of goods for which they have low domestic demand (Davis and Weinstein, 1999). Krugman (1980), on the other hand, showed that under increasing returns to scale (IRS) and trade costs there will be an HME, which manifests itself in two ways. In a country with relatively low domestic demand for an IRS good, it will result in a lower-than-proportional share of the world's *production* as well as *exports* of this good. Consequently, in contrast to the case for CRS goods, countries will be net importers of IRS goods for which they have low domestic demand. The HME has been shown to be robust to several different model specifications (for an overview, see Felbermayr and Jung, 2012).

The benchmark model of two countries, two sectors, and one factor, presented in HK 1985, will serve as the basis for the discussion in the present paper. This model posits one traditional good CRS sector with perfect competition and no trade costs, and one IRS manufacturing sector with monopolistic competition and trade costs. As long as there is some production of the traditional good in both countries, wages will equalise. In this case, the HME will result in the relative number of manufacturing firms in the small country being less than proportional to relative country size. Whereas firms are homogeneous and face variable export costs only in the HK 1985 model, the effect also arises in the corresponding Melitz-type model with fixed export costs and firm-level differences in marginal costs (see e.g. Baldwin and Forslid, 2010 for a model like that). These models are frequently used as point of departures for other models. A weakness of both models is that the less-than-proportional number of manufacturing firms in the small country induces a less-than-proportional number of manufacturing exporters. Consequently, the relative number of manufacturing exporters increases with relative size of the home market and hence decreases with the relative size of the export market. The reason is that, in the case of the homogeneous firms model, either all firms or no firms export; and, in the case of the Melitz-type model, that the extensive margin of exports (defined as the proportion of firms that export) is independent of country size. In both models, average sales per firm in the domestic market are equal in the two countries, as are average exports. Consequently, the HME applies to a country's production and exports as well as to its number of firms and exporters.

Several empirical studies have attempted to find evidence of the HME. Some has focused on the production side, others on the export side, of the HME hypothesis. Some studies also take into account that there may be 'home-bias' in demand (consumers may have stronger preferences for domestically produced goods than for foreign produced goods). In a survey of early contributions, Head and Mayer (2004) conclude that the evidence is mixed: 'One can see some support for HMEs in some industries in some specifications. However reverse HMEs (coefficients on demand of less than one or on home biased demand of less than zero) are more frequent.' (p. 2642). Conclusions from more recent contributions are also ambiguous. For example, Crozet and Trionfetti (2008) study the relationship between production shares and demand shares. They find some evidence of HMEs, but the economic significance is small. On average, the HME influences specialization in only about 12.5% of the 25 countries under study, and in these countries it influences specialization in 62% of the manufacturing activity. Hanson and Xiang (2004) focus on the relationship between export shares and GDP. They present a model of multiple countries and industries and show that industries with high transport costs and more differentiated products will concentrate in large countries due to the HME. They find strong empirical support for this pattern. However, their results have been questioned by Pham, Lovely and Mitra (2009), who apply different methodological procedures on the same data and find little evidence of a HME.

Also several theoretical contributions have shown that the HME does not necessarily arise in models where production is characterized by IRS. A reverse HME in exports typically occurs if entry is restricted. For example, Medin (2003) introduces a specific factor in fixed production costs, into the HK 1985 model (together with fixed export costs). In practice this means that entry is restricted by the endowment of the specific factor and that the relative number of manufacturing firms becomes proportional to relative country size. The number of exporters, however, becomes negatively related to relative home market size. Similarly, a reverse HME in export values arises when there is only one firm in each country. This is shown in the model with Cournot competition and homogeneous goods in Feenstra, Markusen and Rose (2001).

Modifications of the cost side of the HK 1985 model can affect the HME. Davis (1998) shows that the HME may disappear if the CRS sector is subject to sufficiently high transport costs. Further, Okubo and Rebeyrol (2006) show that higher fixed production costs in the large country can produce a reverse HME with respect to the number of manufacturing firms and exporters.

Also demand-side modifications of the HK 1985 model may cause a reverse HME. In Yu (2005) manufactured and traditional goods enter the utility function as CES aggregates rather than Cobb-Douglas aggregates. If the elasticity of substitution between manufactured and traditional goods is lower than one, consumers' expenditure share for manufactured goods in the small country is higher than in the large country. This makes it more profitable to establish a manufacturing firm in the small country, and a reverse HME in the number of manufacturing firms and exporters will arise. In a Cournot competition model with linear demand, Head, Mayer and Rise (2002) show that a reverse HME in the number of manufacturing firms and exporters may emerge when products are differentiated by nations rather than firms, as long as products are sufficiently differentiated.

3 Theory

None of the above-mentioned models distinguishes the HME in the number of manufacturing firms from the reverse HME in the number of manufacturing exporters. By contrast, the model presented here allows for these two effects to coexist. For analysis of exports of manufacturing goods in a small country, it merges the notion of disadvantage of a small home market, predicted by the HME literature, with the notion of benefit of a large foreign market, predicted by traditional trade models. To my knowledge no other articles have discussed this dichotomy.

I follow Venables (1994) in introducing fixed export costs, national product differentiation, and a two-level nested CES subutility function for manufactured goods into the HK 1985 model. This allows a firm's export decision to be separated from its decision to sell on the domestic market. As a consequence, initially equal firms divide into exporters and non-exporters in equilibrium and hence become heterogeneous with respect to export status.[12] As

[12] Medin (2003) presents another model with the same feature. Both models introduce fixed export costs into the HK 1985 model. However, in order to render possible an equilibrium with the coexistence of exporters and non-exporters, more structure has to be added to the HK 1985 model. In Medin (2003) more structure is added to the

opposed to Venables (1994), the present model considers countries of different sizes, with multiple manufacturing industries within each country. As in HK 1985, trade costs and IRS in production of manufactured goods lead to a lower than proportional number of manufacturing firms in the small country. However, this HME in the number of firms does not induce an HME in the number of exporters. Due to national product differentiation, large demand in the large country is directed towards foreign as well as domestic manufactured goods. Since the export decision is separated from the decision to sell in the domestic market, this allows a larger-than-proportional number of manufacturing exporters in the small country. The model serves as an illustration of the highly polar case where demand-side conditions create a reverse HME in the number of exporters, but, at the same time, IRS create an HME in the total number of firms. As a consequence of the reverse HME in exports, the extensive margin of exports (defined as the proportion of firms that exports) is larger in small countries.

3.1 Setup of the model

There are two countries, home and foreign, indexed by $i, j = h, f$, where h is smaller than f. Labour l, is the only input, and it is supplied inelastically. There are two economic sectors in each country. The first sector produces a traditional good with CRS and zero export costs, and this ensures that wages are equalised between the two countries. As is customary, I normalise the wage to 1. The only income is wage; thus total income, y, equals l. The other sector consists of many manufacturing firms, each producing a unique variety, indexed by ω. $\omega \in \Omega$, where Ω is the set of all potentially available goods. Firms have constant marginal

cost side, while in the present model more structure is added to the demand side. In an appendix in Medin (2003) a model similar to the present model (albeit with only one manufacturing industry in each country) is outlined, but the full model is not written out. Also Yeaple (2005) presents a model of initially equal firms where exporters and non-exporters coexist. In that model, labour is heterogeneous, and firms become different with respect to choice of production technology, type of labour employed and export status. None of these models describe the coexistence of a home market effect in the number of manufacturing firms and a reverse home market effect in the number of manufacturing exporters. In Medin (2003) the number of manufacturing firms is proportional to country size; the two other models consider countries of equal size.

production costs φ. In addition, they have to pay a fixed cost to enter the domestic market, F, and a fixed export costs, G.[13] There are also variable iceberg export costs ($\tau > 1$). As the present article studies market size asymmetries rather than firm asymmetries, I disregard the modelling of firm differences in marginal production costs that is now common in trade models (see Melitz, 2003). Consequently, I assume that φ, as well as F and G are equal for all firms, independently of country of origin, so that all firms are symmetric. Manufacturing firms are grouped into industries that are country-bounded, and there is an exogenous number of m symmetric industries within a country.[14]

Preferences are represented by a three-level utility function. The first level is a Cobb-Douglas aggregate of traditional and manufactured goods, with expenditure share of manufactured goods equal to μ. In the following analysis, I assume that μ is sufficiently small to ensure that both countries produce the traditional good, so that wages will be equalised (see Appendix 3 for details). Subutility for manufactured goods is a two-level nested CES aggregate. The lower level is a CES aggregate over varieties belonging to the same industry, with elasticity of substitution equal to ε. This approach allows us to treat all varieties from the same industry as an aggregated composite industry good. The upper level is a CES aggregate over composite industry goods for which the elasticity of substitution is equal to η. Since industries are country-bounded, this implies that consumers will want to differentiate their consumption between foreign and domestically produced goods, as well as between varieties from the same

[13] Note that F is interpreted as a domestic market entry cost, not a fixed production cost. This is in line with interpretation in several recent contributions, including Baldwin and Forslid (2010) and Felbermayr and Jung (2012). Mathematically, the model would look the same if F were interpreted as fixed production costs, as long as the proportion of firms that export is lower than 1 in both countries (see below).

[14] Such national product differentiation could reflect Ricardian comparative advantages, or comparative institutional advantages. It could also reflect the existence of immobile country-specific factors. The model does not have enough structure to let both the number of industries and the number of firms be endogenous.

country. It is reasonable to expect varieties within the same industry to be more substitutable than varieties between industries, thus I assume that $\varepsilon > \eta > 1$.[15]

I assume that m is lower in the small country. This seems reasonable, as large countries may have access to a wider range of inputs (e.g. natural resources) or may have a greater variety of preferences. There may also be economies of scale and the industry level which make room for more industries in large countries. The assumption is supported by empirical evidence. For example, Parteka and Tamberi (2013) investigate several measures of export diversification in manufacturing industries for 60 countries over 20 years. They find a positive relationship between country size (measured in either population size or GDP) and export diversification indices. In particular, I assume that the relative number of industries is proportional to the relative country size, i.e. $Y = M < 1$, where $M = m_h / m_f$ and $Y = y_h / y_f$. For the sake of comparison, I will also consider the case where $M = 1$. Nevertheless, this case appears less realistic, as it contradicts the empirical evidence mentioned above; and it makes the demand effect from the large country towards small-country products unreasonably large.[16] The results from the preceding analysis will hold also when $Y < M < 1$. However, the size of M may affect the range of expenditure share of manufactured goods (μ) that renders possible an equilibrium with non-specialisation in both countries (see Appendix 3 for details). Further, it may affect the ranges of Y, G and τ that render possible an equilibrium with proportions of firms that export below 1 in both countries (see Appendix 4 for details). Since all industries within a country are symmetric, the number of firms in an industry in country i (n_i) and the proportion

[15] Similar nested CES functions are frequently used in multiproduct firm models to distinguish varieties produced by the same firm from varieties produced by different firms. See Allanson and Montagna (2005), Arkolakis and Muendler (2010), and Bernard, Redding and Schott (2011). Venables (1994) and Jorgensen and Schroder (2006) use it to separate domestically-produced varieties from foreign-produced ones, as here.

[16] For $M = 1$, an equal number of foreign and domestic composite industry goods would enter the utility function, regardless of how small the smallest country were. If the large country were 100 times larger than the small and there were no export costs, foreign demand towards small-country manufactured goods would be 100 times higher than foreign demand towards large-country manufactured goods.

of these that sell in country *j*, (s_{ij}) will be equal across all industries within the country. Firms are monopolistically competitive, so the producer price for a single variety is a constant mark-up over marginal costs and is equal for all firms, independent of country and industry of origin:

(1) $$p = \varphi \frac{\varepsilon}{\varepsilon - 1}$$

Using (1), we can characterise demand by the following expressions (see Appendix 1 for deduction).[17]

For a firm from country *j*, demand from country *i* is given by:

(2) $$c_{ji} = \mu Y_i Q_i^{\eta-1} P_{ji}^{\varepsilon-\eta} \tau_{ji}^{1-\varepsilon} p^{-\varepsilon}$$

Price index for manufactured goods in country *i*:

(3) $$Q_i = \left(m_i P_{ii}^{1-\eta} + m_j P_{ji}^{1-\eta} \right)^{\frac{1}{1-\eta}}$$

Price index in country *i* for a composite industry good produced in country *j*:

(4) $$P_{ji} = (s_{ji} n_j)^{\frac{1}{1-\varepsilon}} \tau_{ji} p$$

Since there are four possible combinations of *h* and *f*, (2) and (4) represent four equations each, while (3) represents two equations, one for each country.

I assume symmetric variable export costs, thus $\tau_{ij} = \tau_{ji} = \tau$, $i \neq j$. There are no domestic trade cost, thus $\tau_{ii} = \tau_{jj} = 1$. The s_{ij} denote proportion of firms from country *i* that sell in country *j*. Either all firms sell in their domestic market and only some of them export (i.e.

[17] Since firms and industries are symmetric, we can disregard indexing them. It is sufficient to characterize a firm and an industry by country of origin.

$s_{ii} = 1$ and $s_{ij} < 1$); or all firms export and only some sell in their domestic markets (i.e. $s_{ii} < 1$ and $s_{ij} = 1$).[18] The relationship between export costs and market size determines which of the s_{ij} will equal one, and in the following I assume that these are related in a way that ensures that $s_{ii} = 1$ and $s_{ij} < 1$.[19] This is reasonable, as empirical evidence generally shows that only a fraction of firms export, and very few firms that export do not sell also in their domestic markets. For example, in a representative sample of firms from developing countries from the Enterprise Survey dataset, some 21.5% of them exported some of their output, whereas only 1.5% exported all their output (see section 4.1. in the present paper for details about the dataset). WTO (2008) and Bernard *et al*. (2011) present surveys of empirical evidence on firm level exports.

In equilibrium there are two types of firms in each country: non-exporters and exporters (the latter also sell in their domestic market). Since there are constant marginal production costs and separate fixed costs of entry in the domestic market and the export market, a firm's profits in the two markets can be analysed separately. These are given by:

(5) $\pi_{ii} = (p - \varphi) z_{ii} - F$

(6) $\pi_{ij} = (p - \varphi) z_{ij} - G$

z_{ii} and z_{ij} represent the sales of a firm from country *i* in the domestic market and export market respectively; together, they amount to the firm's total output, Z_i. There is free entry of firms in both markets; thus, profits in each market must equal zero. Inserting (1) in (5) and (6) and setting profits equal to 0 yields two separate free entry conditions, one for firms selling in

[18] Also possible is a situation where all firms export in *h*, while only a fraction exports in *f*: i.e. $s_{ij} = s_{jj} = 1$ and $s_{ii} < 1$, $s_{ji} < 1$. See Appendix 4 for details.
[19] Criteria for this to happen are discussed in Appendix 4. Also see Felbermayr and Jung (2012) for a similar discussion in a model with firms with different marginal costs.

the domestic market only, and one additional condition for firms that also export. In equilibrium there will be a total number of n_i firms, but only a subset $s_{ij}n_i$ of these will export. Hence, z_{ii} is positive for all firms, while z_{ij} is positive only for exporters.[20] By rearranging, we can solve for a firm's sales in its domestic and foreign market respectively:

$$(7)\quad z_{ii} = \frac{\varepsilon - 1}{\varphi} F$$

$$(8)\quad z_{ij} = \frac{\varepsilon - 1}{\varphi} G$$

(7) shows that all firms sell the same amount in their domestic market, independent of country of origin. Similarly, (8) shows that all exporters sell the same amount in their export market. (1), (3) and (4) in (2) yield four demand functions (for domestically and foreign produced varieties in the two countries); and (7) and (8) represent four supply functions (for domestic sales and exports in the two countries). By setting supply equal to demand, we can solve for the four endogenous variables: s_{ij} and n_i . See Appendix 2 for deduction of the equilibrium.

The present model differs from Melitz-type models in the mechanisms that create coexistence of exporters and non-exporters. In Melitz-type models some firms start exporting because they are different from others. The main determinant of whether or not a firm exports is its productivity. By contrast, in the present model, all firms are initially equal, but we get an equilibrium where firms become different with respect to export status. It is not possible *a priori* to tell which firms will become exporters and which will not.[21] The export market is simply not large enough to include all firms. It is not my intention to claim that firms do not

[20] Note that the definition of a 'firm' is that it produces a unique variety ω. An alternative interpretation of the model is that exporters and non-exporters are different firms that produce different unique varieties.

[21] Examples of other models that have the same feature are Venables (1994), Medin (2003) and Yeaple (2005). Conceptually this is not different from the fact that in the Dixit-Stiglitz model there is a potential number of Ω firms in the economy, but the market is not big enough for all of them; thus, in equilibrium, only a subset actually produce.

differ in their marginal production costs, but in this paper I have chosen to work with initially equal firms because I wish to focus on export market conditions, rather than firm differences in marginal production costs, as determinants of firms' export status. All firms face demand from the domestic market, but exporters face demand from abroad as well. This tends to increase the number of exporters. On the other hand, exporters face fixed and variable export costs, and this tends to reduce the number of exporters. The extensive margin of exports, s_{ij} , depends on the relative importance of these mechanisms.

3.2 The HME in the number of firms

The number of firms within an industry located in the home country relative to the number of firms within an industry located in the foreign country is given by:

(9) $$N = YM^{-1}\frac{1+Mt^{\beta}T^{\beta}}{1+M^{-1}t^{\beta}T^{\beta}} \qquad t=\tau^{1-\varepsilon}\leq 1 \qquad T=\frac{F}{G}\leq 1 \qquad \beta=\frac{\eta-1}{\varepsilon-\eta}>0$$

$$N=\frac{n_h}{n_f} \qquad Y\leq N<1 \qquad \frac{\partial N}{\partial Y}>0 \qquad \frac{\partial N}{\partial T}\leq 0 \qquad \frac{\partial N}{\partial t}\leq 0$$

$t^{\beta}T^{\beta}$ is an aggregate of variable export costs and domestic market entry costs relative to fixed export costs. It is a measure of openness. It is reasonable to assume that firms face higher fixed export costs than domestic market entry costs, as costs related to conducting market analyses, setting up distribution networks, acquiring information about laws, rules and business cultures, etc. are likely to be higher in a less familiar market. I therefore focus on the case where fixed export costs are higher than domestic market entry costs ($G>F$). This ensures that $t^{\beta}T^{\beta}<1$.[22] $t^{\beta}T^{\beta}=1$ implies no variable export costs ($t=1$) and fixed export

[22] See Melitz (2003), Baldwin and Forslid (2010) or Felbermayr and Jung (2012) for a similar measure. Note that $t^{\beta}T^{\beta}<1$ is a necessary but not sufficient condition for the existence of non-exporters in both countries. See Appendix 4 for details.

costs equal to entry costs in the domestic markets ($T = 1$). The expression is equal to 0 if either variable or fixed export costs are infinitely high.

N lies between Y and 1, so the number of firms within an industry will be lower in the small country. For the small country, the relative number of all firms is given by MN. For $M = Y$, this is less than proportional to Y. In other words, the small country has a less-than-proportional share of manufacturing firms, and the model therefore produces an HME. Since all firms sell the same amount in their domestic markets, independent of country of origin (see Equation 7), the HME applies to the number of manufacturing firms as well as to total domestic sales. For M=1, $MN = Y$, and there is no HME.

The results for $M = Y$ are in line with the HK 1985 model and its Melitz-style extension (Baldwin and Forslid, 2010). The mechanism behind the HME is similar as in those models: A firm in the small country faces relatively lower demand from the home market than a firm in the large country. If the number of firms were proportional to country size, a firm in the small country would therefore have to export more and hence pay transport costs on a larger share of its total sales than would a firm in the large country. In other words, locating in the small country is less profitable. In equilibrium, the number of firms in the small country therefore becomes less-than-proportional to country size. Trade liberalisation magnifies the HME. When export costs decline, it becomes less costly to serve the small country from abroad. The advantage of access to a large home market for domestic sales therefore becomes more prominent, and more and more firms will find it profitable to locate in the large country. In contrast to the above-mentioned models, however, the present model always yields some manufacturing production in the small country, because consumers will want to diversify their consumption between foreign and domestic composite industry goods. Hence, in the present model, the HME is dampened as compared to those models for high degree of openness.

3.3 The reverse HME in the number of exporters

The relative extensive margin of exports, defined as the relative proportion of firms that export, in *h* versus *f* is given by:

(10) $$S = N^{-2} = Y^{-2} M^{2} \left(\frac{1 + M^{-1} t^{\beta} T^{\beta}}{1 + M t^{\beta} T^{\beta}} \right)^{2}$$

$$S = \frac{s_{hf}}{s_{fh}} \qquad \frac{\partial S}{\partial Y} < 0 \qquad 1 < S \leq Y^{-2} \quad \frac{\partial S}{\partial T} \geq 0 \qquad \frac{\partial S}{\partial t} \geq 0$$

S lies between 1 and Y^{-2}, thus the extensive margin of exports is larger in the small country. The reason is that demand for any composite industry good will be higher in the large country, since there are more consumers there. Consequently, manufacturing firms within an industry in the small country face higher demand from abroad than the case in the large country, and manufacturing exports becomes more profitable in the small country.

From (10) we see that the relative number of exporters within an industry in *h* versus *f*, SN, is equal to N^{-1}, thus the relative number of all exporters is given by:

(11) $$MSN = MN^{-1} = Y^{-1} M^{2} \frac{1 + M^{-1} t^{\beta} T^{\beta}}{1 + M t^{\beta} T^{\beta}}$$

$$Y < MSN \leq Y^{-1} \qquad \frac{\partial MSN}{\partial t} \geq 0 \quad \frac{\partial MSN}{\partial T} \geq 0$$

For the small country, the relative number of all exporters is more than proportional to relative country size (both for $M=Y$ and for $M=1$), even though the relative number of firms is less than proportional to country size (due to the HME). The reason is that the larger relative extensive margin of exports in the small country more than outweighs the less than proportional relative number of firms. I will call this result the ‘reverse HME’ in exports. The result contradicts the HK 1985 model and its Melitz-style extension (Baldwin and Forslid, 2010). A higher M reinforces the reverse HME in exports, and is strongest for $M=1$.

The extensive margin of exports in the home country is given by:

(12) $$s_{hf} = N^{-1}t^{\beta}T^{\beta+1} = Y^{-1}M\frac{1+M^{-1}t^{\beta}T^{\beta}}{1+Mt^{\beta}T^{\beta}}t^{\beta}T^{\beta+1}$$

$$\frac{\partial s_{hf}}{\partial Y} < 0 \qquad \frac{\partial s_{hf}}{\partial T} > 0 \qquad \frac{\partial s_{hf}}{\partial t} > 0$$

Both for $M=Y$ and $M=1$, the derivative with respect to relative home market size is negative. In other words, an increase in relative home market size leads to a decrease in the extensive margin of exports. This would also hold true if *h* were the largest country (then Y would be larger than 1, and the sign of the derivative would be the same). This is a key result from the model and will be tested empirically in Section 4.[23]

3.3.1 Export shares and specialisation

Since all firms export the same amount, independent of country of origin (see Equation 8), the reverse HME applies to the number of exporters as well as to the country's total export value. If $M=Y$, $MSN< 1$, the large country will be a net exporter of manufactured goods. If M increases, the reverse HME in exports is reinforced, and the small country will gain a growing share of the world trade in manufactured goods. This is because a greater number of manufacturing industries in the small country will mean greater demand from abroad for small-country manufactured goods. On the other extreme where $M=1$, $MSN= Y^{-1}$. There is

[23] Some other models may produce similar results. For example, Felbermayr and Jung (2012) have developed a Melitz-type model with asymmetric countries and no CRS sector. For the small country, the relative mass of firms is less than proportional to relative country size, so there is a home market effect with respect to the number of firms. As in the present model, the proportion of firms that export is larger in the small country. Nevertheless, the size of the relative mass of exporting firms is uncertain; thus, we cannot know whether there is a reverse home market effect in the number of exporters. Also Medin (2003) predicts that the extensive margin of exports will be larger in small countries, but there is no HME in that model.

no HME in domestic sales ($MN=Y$) and the small country will be a net exporter of manufactured goods. For intermediate values of M, trade in manufactured goods may be balanced.

Since industries are country-bounded, there is no direct competition with foreign firms within an industry. Competition is only indirect and via the demand share for the whole industry. Further, within an industry there is only one-way trade. There is, however two-way trade in manufactured goods, across industries.

Unlike in the HK 1985 model, the small country will never become deindustrialised, as consumers in both countries want to consume domestic as well as foreign manufactured goods. Nevertheless, if consumers' expenditure share for manufactured goods exceeds a critical value, μ^*, one of the countries may specialise in manufacturing production. In that case, wages will no longer be equalised, but will increase in the country that specialises. If $M=Y$, the large country may specialise; and if $M=1$, it is the small country that may specialise. Specialisation is most likely to occur when the countries differ considerably in size. Furthermore, in the case where $M=1$, specialisation is most likely to occur for low export costs; but in the case where $M=Y$, specialisation is most likely to occur for intermediate values of export costs (see Appendix 3 for details).

3.3.2 Effects of trade liberalization

The number of firms that export in country *i* equals (see Appendix 2 for derivation):

$$(13)\quad m_i s_{ij} n_i = \frac{\mu y_j}{\varepsilon F} \frac{\frac{m_i}{m_j} t^{\beta} T^{\beta+1}}{1+\frac{m_i}{m_j} t^{\beta} T^{\beta}} \qquad \frac{\partial m_i s_{ij} n_i}{\partial t} > 0 \qquad \frac{\partial m_i s_{ij} n_i}{\partial T} > 0$$

Both for $\frac{m_i}{m_j} = \frac{y_i}{y_j}$ and $\frac{m_i}{m_j} = 1$, the derivatives with respect to T and t are positive. Hence increased openness, whether through reduced variable or fixed export cost, increases the number of firms that export. As compared to increased *t*, trade liberalisation through increased *T* has an additional positive effect. The reason is that increased *T* also leads to a reduction of the intensive margin of exports (each firm's export volume), given by z_{ij} in (8). With lower fixed export costs, an exporting firm will break even in the export market selling a smaller amount than before. This allows for more exporters. Reduced variable export costs, on the other hand does not affect the intensive margin of exports. Empirical evidence in Lawless (2010) suggest that the intensive margin of exports is negatively related to fixed export costs and independent of variable export costs, just as predicted in the present model. She shows that this result will arise in a Melitz-type model under the assumption of Pareto distributed marginal production costs. Nevertheless, the present model shows that the result will also arise in models where firms have equal marginal production costs.[24]

From (11) we know that there will be a reverse HME in exports. Examining the derivatives of MSN with respect to t and T shows that effect is magnified by trade liberalisation when $M=Y$.[25] As trade is liberalised (whether through reductions in *t* or *T*), both countries experience a decrease in the expenditure share for a domestic composite industry good and an increase in the expenditure share for a foreign composite industry good (since imports become relatively cheaper). However, the changes are not symmetric. The number of domestic industries is lower in the small country, so the decrease in the expenditure shares for the few domestic composite industry goods must be spread over the increase in the expenditure shares for the many foreign composite industry goods. Therefore, the expenditure share for a given

[24] The result also arises in other models with fixed export costs and initially equal firms, such as Medin (2003) and Venables (1994), but it is not discussed in those articles.

[25] For $M=1$ there is no effect on MSN from trade liberalization.

foreign composite industry good increases less in the small country than in the large. Consequently, the increased demand from abroad will be larger for a small-country industry than for a large-country industry. This yields a greater increase in the number of exporters in the small country than in the large one.

4 Empirical evidence

Equation (12) shows that the extensive margin of exports, defined as the proportion of firms that export, s_{hf} , is a function of the relative home market size, Y. In the presence of a reverse HME in exports, we should expect the extensive margin of exports to decrease with relative home market size.[26] Let us now test this prediction.

4.1 Data and regression variables

4.1.1 The extensive margin of exports and the relative home market size

Empirical analysis on firm level export data has been a fast-growing field in international economics.[27] Unfortunately, firm level data that compare exporters and non-exporters are available only for selected countries, and studies are often not comparable between countries – with a few exceptions. The International Study Group on Exports and Productivity (2008) has compared firm level data on exporters and non-exporters for 14 countries. It finds that the extensive margin of exports is 'loosely decreasing in the size of the domestic markets' (p. 5). To my knowledge this is the only empirical study to deal with the relationship between the extensive margin of exports and country size. As this was not a major issue for the Study Group, it is done very briefly without econometrically testing the relationship.[28] There are no good datasets that include comparable data for most countries in the world, and this is therefore a difficult task. Even so, in this section I attempt to present first evidence on the

[26] Note that this is true both when the home market is small (Y<1) and when it is large (Y>1).
[27] Examples include Roberts and Tybout (1997) on Colombian firms; Bernard and Jensen (2004) on US firms; Eaton, Kortum and Kramarz (2004) on French firms; Lawless (2009) on Irish firms; Wagner (2001) on German firms; Moxnes (2010) on Norwegian firms; and several others.
[28] As the dataset covers only 14 countries, it is difficult to use it for drawing inferences.

importance of relative country size for the extensive margin of exports, using firm level data from the Enterprise Surveys dataset. This dataset is currently the best available, but has its limitations, as it covers only developing countries. Thus, 'Asia/Oceania' does not include developed countries such as Japan and South Korea, or indeed China and India; and 'Europe' does not include any Western European countries. However, most countries in Africa and Latin America are included. Moreover, the data cover a large number of countries – 119 in total – and can be used to construct comparable unbiased estimates of the extensive margins of exports in these countries.

The data are based on surveys among a representative sample of all firms in the non-agricultural formal private economy in each country, and were collected between 2006 and 2011. The data are mainly cross-sectional, but some countries appear in different years than others. In addition, a few countries appear in more than one year, in which case I use the most recent observations. Most observations are from 2009 and 2010. The survey is stratified by business sector, location and firm size; and the population of firms that form the basis of the sample is consistently defined in all countries. The same methodology and the same core questionnaire are applied in all countries, making data comparable across countries. See Enterprise Surveys (2012) for further details.

In the present study, I include manufacturing firms only, which are drawn from the entire manufacturing sector in the countries in question. The data contain firm level information about the proportion of output exported.[29] I define a firm as being an exporter if it exports at least 20% of its output. The reason for this is that firms that export a very small amount may be testing the export market for the first time or may be exporting by coincidence, and most of them will probably not survive in the market (see Eaton *et al*., 2008). It is not likely that these firms have paid the full fixed export cost, *G*. In Appendix 5, I show that results are robust

[29] If this information is missing, the observation is deleted from the sample

against defining as 'exporters' firms that export any amount. Using this information, I construct an estimate of the proportion of manufacturing firms that export in each country, i.e. the extensive margin of exports. The estimate is calculated using sampling weights and is hence unbiased. This is the dependent variable. It corresponds to s_{hf} in Equation (12) and is called *extensive margin of exports*. The main explanatory variable of interest here is the home country's GDP in per cent of the rest of the world's GDP (including countries not in the sample). It corresponds to Y in Equation (12) and is called *relative home market size*.[30]

Table 1 presents these two variables for the whole sample, as well as for four regional subsamples. Due to missing explanatory variables for three countries, the table and the regression analyses include only 116 countries.[31] As shown in the first column of Table 1, the extensive margin of exports is small, with an average of 0.14. For three countries in the sample (Iraq, Liberia and Vanuatu) the estimated extensive margin of exports indicates no exporting firms in the manufacturing sector. Also the relative home market size is small: on average, home market GDP constitutes only 0.12 per cent of the rest of the world's GDP. The median is much smaller than the mean (only 0.02), indicating that there are many small countries in the sample. Investigating the variables at the regional level shows that Europe has a much higher average extensive margin of exports (0.27) than the other regions.

[30] GDP is measured in constant (year 2000) US dollars and the data are taken from the World Development Indicators. I lack data for Barbados for 2010, and use figures for 2009 instead.

[31] I lack GDP data for Afghanistan, and distance for Kosovo and Montenegro.

Table 1. Extensive margin of exports and relative home market size in 116 countries from the Enterprise Surveys dataset

Group of countries	All		Europe		Asia/Oceania		America		Africa	
Variable	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size
Min	0.000	0.001	0.085	0.005	0.000	0.001	0.001	0.001	0.000	0.001
Median	0.116	0.018	0.248	0.063	0.083	0.014	0.139	0.030	0.073	0.011
Mean	0.137	0.120	0.267	0.187	0.121	0.081	0.125	0.224	0.092	0.029
Max	0.543	2.231	0.543	1.027	0.435	0.665	0.296	2.231	0.260	0.454
No of observations	116	116	20	20	25	25	31	31	40	40

Note: Extensive margin of exports = estimate of the proportion of manufacturing firms that export in each country. An exporter is defined as a firm that exports at least 20% of its total output. Relative home market size= home country GDP in per cent of the rest of the world's GDP in constant year 2000 US dollars.

4.1.2 Export costs

According to Equation (12), not only relative home market size, but also export costs, can affect the extensive margin of exports. Reductions in either fixed or variable export costs are predicted to increase the extensive margin of exports. Distance is commonly used as a proxy for export costs. Variable export costs may increase with distance due to higher transportation costs, while fixed export costs may increase with distance due to factors such as greater legal and cultural disparities. In addition, Krautheim (2012) shows that in the presence of exporting spillovers, fixed export costs increase with distance. Consequently, I expect more remote countries to have a lower extensive margin of exports. While the model in Section 3 is a two-country model, the data used for regression analyses include many countries, so a variable that corresponds to τ and G (which are embedded in t and T respectively in Equation 12) should reflect a country's distance to the rest of the world. I therefore calculate the variable *remoteness***,** which is an output-weighted average of country i's distance to the rest of the world, where weights are equal to the proportion of country j's GDP to the rest of the world's GDP. This is a commonly used measure of average distance (Melitz, 2006).

$$remoteness_i = \sum_{j=1}^{n} x_j d_{ij} \qquad x_j = \frac{GDP_j}{GDP_w - GDP_i} \qquad i \neq j$$

d_{ij} is distance from country *i* to country *j*, where $d_{ii} = 0$, and GDP_w equals world *GDP*. In the regression analysis I use remoteness to control for both fixed and variable export costs.

Data for distance between pairs of countries is provided by the CEPII database *dist_cepii* (Mayer and Zignago, 2011). I use the great circle distance measured in kilometres between largest cities (the *dist* variable).

4.1.3 Other control variables

Equation (12) predicts that only the relative home market size and export costs will affect the extensive margin of export (recall that M is equal to either Y or unity). However, a simplifying, albeit unrealistic, assumption behind the model presented in Section 3 is that cost functions are equal across all firms independent of country of origin: hence, all firms are equally productive. However, exporters are known to be more productive than non-exporters, and evidence indicates that more productive firms self-select into exporting (see Wagner, 2007). If technology levels differ between firms or countries and are correlated with GDP, we may therefore get biased estimates for the coefficient for relative home market size. To correct for differences in technology levels, I include *GDP per capita*, *GDP per capita* squared, and *average firm size*.

Less developed countries often have access to a generally lower level of technology than more developed ones. This may reduce the competitiveness of manufacturing firms and lead to a lower extensive margin of exports. For highly developed countries, on the other hand, the relationship may be reversed. These countries are characterised by a shift in employment from manufacturing to service industries (Syrquin, 1988). There are many possible explanations for this (Rowthorn and Ramaswamy, 1999). One is that the high cost of labour reduces competitiveness in manufacturing industries, leading them to relocate to less-developed countries. In this case we could expect an inverse U relationship between level of development and the extensive margin of exports. Alternatively, the relationship might be unambiguously positive. For example, higher productivity growth in manufacturing industries than in services or declining income elasticity of demand for manufactured goods can lead to reduction in manufacturing employment, but not as a consequence of lower competitiveness. To correct for level of development, I include *GDP per capita* in the analysis. I also include *GDP per capita squared* to test for a possible inverse U relationship. Data are taken from the World Development Indicators and are measured in constant (year 2000) 1000 US dollars. [32]

Even if countries have access to the same overall level of technology, firms within the same country may differ in productivity. Differences in economic conditions between countries may then lead to differences in average productivity levels. For example, Melitz and Ottaviano (2008) predict that firms in large countries will have higher average productivity levels because tougher competition will force the least productive firms out of the market. Felbermayr and Jung (2012), on the other hand, predict the opposite, on the grounds that high demand in large countries makes room for less productive firms. I do not have data for firm productivity, but firm size can be used as a proxy. The Enterprise Survey data contains information about whether a firm is small (<20 employees), medium-sized (20 - 99 employees), or large (> 100 employees). Assigning to these categories values of 1, 2 and 3, I construct the variable *average firm size*, which indicates the average firm size in the country (I include only firms for which I have information about export status). Since the variable does not measure the actual average number of employees, we should not pay attention to the size of its coefficient, on the sign.

[32] The World Development Indicators database lacks GDP and GDP/cap data for Barbados for 2010, so I use figures for 2009 instead.

4.2 Results

In the empirical analyses I estimate a reduced form of (12), namely the following equation:

(14) *extensive margin of exports* $=\alpha+\beta_1$ *relative home market size* $+ \beta_2$ *GDP per capita* $+\beta_3$ *GDP per capita squared* $+\beta_4$ *remoteness* $+\beta_5$ *average firm size* $+\varepsilon_i$

The main variable interest is β_1. According to Equation (12), we should expect a negative sign.

Since the dependent variable is a proportion that lies between zero and one (including three 0's), it is not appropriate to estimate the model using OLS. Instead I use an estimator developed by Papke and Wooldridge (1996), later known as fractional logit.[33] Wagner (2001) discusses various econometric methods for dealing with proportions, and in the context of microeconometrics of exporting he applies the same estimator. In Appendix 5, I show that results are robust to applying OLS instead of fractional logit.

Since some countries are observed in different years, I include year dummies, as well as dummies for the regions that appear in Table 1. I also perform separate analyses for each region to see whether results are driven by a particular region.

[33] Also see Wooldridge (2012), pp. 748 -753 for a textbook discussion on fractional dependent variables and Ramalho, Ramalho and Murieta (2011) for a recent discussion. Computations were done by using the Stata command glm, proposed by Baum (2008).

Table 2. Determinants of the extensive margin on exports– results from fractional logit models based on the Enterprise Surveys dataset.

	All		All		Europe		Asia/Oceania		Latin America		Africa	
	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects
Relative home market size	−0.2731	−0.0323	−1.1605***	−0.1226***	−1.2997***	−0.2494***	−3.5453**	−0.2860**	−0.7518***	−0.0793***	−2.2500*	−0.1768*
	(0.2230)	(0.0265)	(0.3120)	(0.0319)	(0.3932)	(0.0786)	(1.4433)	(0.1192)	(0.2045)	(0.0215)	(1.1971)	(0.0958)
GDP per capita			0.1644***	0.0174***	0.2638***	0.0506***	1.6533	0.1334	0.1521**	0.0160**	−0.2907	−0.0228
			(0.0430)	(0.0047)	(0.0829)	(0.0167)	(1.1132)	(0.0915)	(0.0726)	(0.0079)	(0.4087)	(0.0321)
GDP per capita squared			−0.0058**	−0.0006**	−0.0081	−0.0016	−0.5935	−0.0479	−0.0065*	−0.0007*	0.0831	0.0065
			(0.0025)	(0.0003)	(0.0054)	(0.0011)	(0.4662)	(0.0379)	(0.0035)	(0.0004)	(0.0800)	(0.0062)
Remoteness			0.0000	0.0000	0.0010	0.0002	0.0001	0.0000	−0.0001	−0.0000	−0.0001	−0.0000
			(0.0001)	(0.0000)	(0.0008)	(0.0001)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Average firm size			1.4494***	0.1531***	0.5039	0.0967	2.5858***	0.2086***	1.0200	0.1075	1.9897***	0.1563***
			(0.3001)	(0.0303)	(0.6647)	(0.1279)	(0.5201)	(0.0405)	(0.8616)	(0.0909)	(0.4783)	(0.0348)
Constant	−1.8085***		−4.8437***		−8.8817		−7.4478***		−3.4645***		−4.2797***	
	(0.0873)		(0.7510)		(5.4562)		(1.5783)		(1.2177)		(1.1400)	
Log pseudo–likelihood	−34.14	−34.14	−31.36	−31.36	−7.622	−7.622	−6.082	−6.082	−8.328	−8.328	−8.841	−8.841
No of Observations	116	116	116	116	20	20	25	25	31	31	40	40
Predicted extensive margin		0.1369		0.1201		0.2590		0.0885		0.1208		0.0900
Doubling the relative home market size		−2.8309		−12.2536		−18.0051		−26.1787		−14.7041		−5.6948

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Robust standard errors in parentheses. Marginal effects and predicted extensive margins are evaluated at the mean of the independent variables. Year dummies are included in all regressions; regional dummies are included in the regressions for the whole sample.

Table 2 presents results from the regression analyses. Coefficients as well as marginal effects (evaluated at the mean of the other independent variables) are reported.[34] The first four columns present results based on the whole sample, where the first two show results without control variables. The other columns present results based on the regional subsamples.

The coefficient for the main variable of interest, *relative home market size*, is positive but not significant in the regression without controls. However, when control variables are included, it becomes significant and of the expected sign in the whole sample, as well as in all subsamples (albeit only at 10% level for Africa).[35] Hence, results support the hypothesis of a higher extensive margin of exports in small countries. What about the economic significance of the effect? The second last row of Table 2 shows the predicted extensive margin of exports (evaluated at the mean of the other independent variables), while the last row shows the predicted effects from doubling the *relative home market size*. For the average country in the whole sample this would lead to a reduction in the extensive margin of exports by 12.3%.[36]

Are these results robust to alternative specifications? Table 1 shows that median *relative home market size* is much lower than the mean: thus, the sample consists of many relatively small countries and a few large ones. A concern is therefore whether the results are driven by a few large countries. This is not the case. Omitting the 5% or the 10% largest countries from the sample does not alter the significance of the coefficient for *relative home market size*. In fact, the marginal effect becomes even higher in these reduced samples (about twice that in the full

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[34] Coefficients for dummies for years and regions are not reported, but are available upon request.

[35] The number of observations is somewhat low for the regional subsamples, and results for Asia/Oceania and Africa are not robust to alternative specifications (see Appendix 5). Therefore, results for the regional subsamples should be interpreted with care.

[36] For the whole sample, the marginal effect is equal to 0.123. The predicted extensive margin of exports is 0.120; thus an increase in relative home market size by one percentage point is predicted to lead to a decrease in the extensive margin of exports by 103% (i.e. below 0, which is not possible). We should, however, bear in mind that average relative home market size for the sample countries is only 0.120% (see Table 1), thus an increase of one percentage point is a very large increase. If, instead, we double the relative home market size, the predicted reduction in the extensive margin of exports is 103%*0.120= 12.3%. It can be argued that this reasoning is imprecise, since doubling of the relative home market size cannot be considered a marginal change, and this is a non-linear model. However, results from the linear model in Appendix 5 are close to the ones presented here (except for Asia/Oceania), so the approximations seem fairly good.

sample).[37] In Appendix 5, I present results from two other sensitivity analyses. First, I estimate Equation (14) using OLS. The marginal effects of *relative home market size* are similar to those from the main analysis and are reported in Table A1. Secondly, I perform an analysis redefining the extensive margin of exports. Instead of defining a firm as an exporter if it exports at least 20% of its output, I now define a firm as an exporter if it exports *any* amount. Obviously, this increases the extensive margin of exports – new summary statistics are shown in Table A2. Results from the regression analyses are reported in Table A3; they show that, also in this case, the marginal effects are similar to those in the main analyses.[38]

The coefficient for *average firm size* is positive and significant in the whole sample as well as for Asia/Oceania and Africa, and the results are robust to alternative specifications (see Appendix 5). Thus, larger average firm size is generally associated with a higher extensive margin of exports. The coefficient for *GDP per capita* is significant and of the expected sign for the whole sample, as well as for Europe and Latin America. Further, the coefficient for *GDP per capita squared* is negative and significant for the whole sample, as well as for Latin America. Consequently, there is some evidence of an inverse U relationship between the extensive margin of exports and welfare level, but the results are not robust to alternative specifications (see Appendix 5). Surprisingly, the coefficient for *remoteness* is not significant – in the whole sample, or in any of the subsamples. I tried replacing *remoteness* with alternative measures of average distance to the rest of the world such as an unweighted average. None of the alternative measures produced significant results for average distance. I also tried replacing *GDP per capita* and *remoteness* with their logs, and *GDP per capita*

[37] Moreover, omitting the 5% or 10% smallest countries does not alter the results for relative home market size in terms of significance or size of the marginal effect.
[38] I also experimented with calculating the relative home market size using population size rather than GDP. Results regarding the coefficient for relative home market size were not altered in terms of significance, but the marginal effects were somewhat lower. Since it is income level, rather than population size, that determines demand, I chose to present results with GDP as a measure of country size.

squared with (log of GDP per capita) squared. There was little change in the results regarding relative home market size.

To conclude, the empirical analyses support the hypothesis of larger extensive margins of exports within manufacturing industries in small countries than in large countries. Doubling the *relative home market size* is associated with a decrease in the extensive margin of exports by 12.3% for the average country.

5 Conclusions

In this paper I have presented a model of trade in manufactured goods where the well-known HME in the number of manufacturing firms coexists with a reverse HME in the number of manufacturing exporters. While small countries have lower profitability in manufacturing domestic sales due to increasing returns to scale and access to a small home market, they have higher profitability in manufacturing exports, due to access to a large foreign market. For the small country, this leads to the relative number of manufacturing firms being less than proportional and the relative number of manufacturing exporters being more than proportional to the relative country size. One consequence of this is that the extensive margin of manufacturing exports, defined as the proportion of firms that export, becomes higher in relatively small countries. These results contradict those from benchmark HME models, whether dealing with homogeneous or heterogeneous firms, which predict that the extensive margin of exports is independent of country size.

The prediction of larger extensive margins of exports in small countries is tested using data on firm level exports from 116 developing countries from the Enterprise Surveys dataset. Using a fractional logit analysis, I find that, for the average country, a doubling of home country GDP relative to the rest of the world's GDP is associated with a decrease in the extensive margin of manufacturing exports by 12.3%.

The dataset used in the present study has obvious limitations, as it covers only developing countries. A topic for future research is to obtain comparable firm level data for more developed countries, so that we would be able to test the relationship for these countries as well. Another topic for future research is to test more directly the hypothesis of the co-existence of an HME in domestic sales and a reverse HME in exports. As obtaining comparable data on the number of firms and exporters for a large set of countries would be very difficult, this could be done by using values of domestic sales and exports instead.

Appendices

Appendix 1. Derivation of demand functions

The upper level of the subutility function for manufactured goods in country *i* is given by:

$$U_i = \left(\sum_{k_i=1}^{m_i} C_i(k_i)^{\frac{\eta-1}{\eta}} + \sum_{k_j=1}^{m_j} C_i(k_j)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

k_i indexes an industry located in country *i*. The lower level is given by:

$$C_i(k_j) = \left(\sum_{\omega_j=1}^{s_{ji}n_j} c_i(k_j,\omega_j)^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

The price index in country *i* for manufactured goods produced within an industry located in country *j* is given by: $P_i(k_j) = \left(\sum_{\omega_j=1}^{s_{ji}n_j} \left(\tau_{ji} p(k_j,\omega_j) \right)^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}$. Since firms are symmetric, this reduces to Equation (4) in the text. The price index for manufactured goods in country *i* is given by: $Q_i = \left(\sum_{k_i=1}^{m_i} P_i(k_i)^{1-\eta} + \sum_{k_j=1}^{m_j} P_i(k_j)^{1-\eta} \right)^{\frac{1}{1-\eta}}$. Since industries are symmetric, this reduces to Equation (3) in the text. As pointed out by Helpman and Krugman (1985, p. 120), consumer expenditure shares on each product in a separable utility function of this kind depend on prices and the number of varieties only. By utility maximization of the upper level of the CES function, we get the following expression for demand in country *i* for a composite industry good produced in country *j*:

$$C_{ji} = \mu Y_i \frac{P_{ji}^{-\eta}}{Q_i^{1-\eta}}.$$

The share of expenditure for manufactured goods allocated to C_{ji} is hence equal to

(A1) $$\alpha_{ji} = \left(\frac{P_{ji}}{Q_i}\right)^{1-\eta}$$

Now, for a firm from country *j*, demand from country *i* is given by:

(A2) $$c_{ji} = \mu Y_i \alpha_{ji} \frac{\tau_{ji}^{\ 1-\varepsilon} p^{-\varepsilon}}{P_{ji}^{\ 1-\varepsilon}}$$

Since firms are symmetric and industries only differ by country of origin, I have omitted ω and k from the above expressions and let the first subscript denote the country where the good is produced, and the second subscript denote the country where the good is sold. Inserting from (A1) in (A2) gives equations (2) in the text. Inserting for (4) in (3) we can express Q_i as:

(A3) $$Q_i = p\left(m_i n_i^{\frac{\eta\text{-}1}{\varepsilon\text{-}1}} + m_j (s_{ji} n_j)^{\frac{\eta\text{-}1}{\varepsilon\text{-}1}} \tau^{1-\eta}\right)^{\frac{1}{1-\eta}}$$

Appendix 2. Derivation of the equilibrium

The equilibrium conditions for domestically produced goods and imports respectively in country *i* are given by:

(A4) $$c_{ii} = z_{ii} \Leftrightarrow \mu y_i \frac{\varepsilon - 1}{\varepsilon\varphi} \frac{n_i^{\frac{\varepsilon-\eta}{1-\varepsilon}}}{\left(m_i n_i^{\frac{1-\eta}{1-\varepsilon}} + m_j (s_{ji} n_j)^{\frac{1-\eta}{1-\varepsilon}} \tau^{1-\eta}\right)} = \frac{\varepsilon - 1}{\varphi} F$$

(A5) $$c_{ji} = z_{ji} \Leftrightarrow \mu y_i \frac{\varepsilon - 1}{\varepsilon\varphi} \frac{(s_{ji} n_j)^{\frac{\varepsilon-\eta}{1-\varepsilon}} \tau^{1-\eta}}{\left(m_i n_i^{\frac{1-\eta}{1-\varepsilon}} + m_j (s_{ji} n_j)^{\frac{1-\eta}{1-\varepsilon}} \tau^{1-\eta}\right)} = \frac{\varepsilon - 1}{\varphi} G$$

Dividing (A5) by (A4) and rearranging yields the following expression for the number of imported varieties relative to the number of domestic varieties in country *i*.

(A6) $s_{ji}\frac{n_j}{n_i} = t^{\beta}T^{\beta+1} \qquad t = \tau^{1-\varepsilon} \leq 1 \qquad T = \frac{F}{G} \leq 1 \qquad \beta = \frac{\eta - 1}{\varepsilon - \eta} > 0$

Trade liberalization, whether through increased *T* or in *t*, increases the number of imported varieties relative to domestic varieties. (A4), (A5) and (A6) represent two equations each: one for *h* and one for *f*. The first part of Equation (12) in the text follows directly from (A6) for *f*. Dividing (A4) for home by (A4) for foreign, using (A6) for both home and foreign, and rearranging yields Equation (9) in the text. Inserting (A6) for country *i* in (A5) for country *i* and rearranging gives the number of firms within an industry located in country *i*:

(A7) $n_i = \frac{\mu}{\varepsilon F}\frac{y_i}{m_i}\frac{1}{1 + \frac{m_j}{m_i}t^{\beta}T^{\beta}} \qquad \frac{\partial n_i}{\partial t} < 0 \qquad \frac{\partial n_i}{\partial T} < 0 \qquad i \neq j$

Note that trade liberalisation leads to a decline in the number of firms, n_i, in both countries. This is because trade liberalisation leads to substitution away from domestic varieties and over to foreign varieties. By combining (A6) and (A7) we get equation (13) in the text.

Inserting from (9) in (A6) for *f* yields the second part of Equation (12) in the text. Equation (10) in the text follows from Equation (12) and the corresponding equation for *f*.

Appendix 3. Criteria for specialisation in production of manufactured goods

Labour used in the manufacturing sector in country *i* is equal to:

(A8) $$l_i^I = m_i n_i\left(\varphi z_{ii} + F\right) + m_i n_i s_{ij}\left(\varphi z_{ij} + G\right) = m_i n_j \varepsilon F\left(\frac{n_i}{n_j} + t^\beta T^\beta\right)$$

The last equality follows from (7), (8) and (A6) for country *j*. By inserting from (A7) for both countries, we can express relative labour used in the manufacturing sector in country *i* versus country *j* as:

(A9) $$\frac{l_i^I}{l_j^I} = \frac{\frac{y_i}{y_j} + \frac{y_i}{y_j}\frac{m_i}{m_j}t^\beta T^\beta + \frac{m_i}{m_j}t^\beta T^\beta + t^{2\beta}T^{2\beta}}{1 + \frac{m_j}{m_i}t^\beta T^\beta + \frac{y_i}{y_j}\frac{m_j}{m_i}t^\beta T^\beta + \frac{y_i}{y_j}t^{2\beta}T^{2\beta}} \qquad \frac{\partial \mu^*}{\partial \frac{y_i}{y_j}} > 0$$

For specialisation to occur in a country, the total labour force in that country must be employed in the manufacturing sector, i.e. $l_i^I \geq y_i$, where we use the fact that $l_i = y_i$. This will happen if consumers' expenditure share for manufactured goods, μ, is higher than a critical value, μ^*. Define $L^I = \frac{l_h^I}{l_f^I}$, which denote relative labour used in the manufacturing sector in *h* versus *f*. From (A9) we see that for $M{=}Y$, L^I is lower than relative country size ($L^I < Y$), thus specialisation may occur in the large country. For $M{=}1$, L^I is larger than Y, thus specialisation may occur in the small country. For intermediate values of M, the probability of specialisation is lower, but for sufficiently high μ, specialisation may occur in either country, depending on the size of M.

For $M{=}Y$, we find μ^* by setting $l_f^I \geq y_f$ and inserting from (A7) in the second part of (A8):

$$\mu^* = \frac{1+Y^{-1}t^{\beta}T^{\beta}+Yt^{\beta}T^{\beta}+t^{2\beta}T^{2\beta}}{1+Y^{-1}t^{\beta}T^{\beta}+Yt^{2\beta}T^{2\beta}+t^{\beta}T^{\beta}} \qquad \frac{\partial\mu^*}{\partial Y}>0$$

For M=1, we find μ^* by setting $l_h^I \geq y_h$ and inserting from (A7) in the second part of (A8)

$$\mu^* = \frac{1+t^{\beta}T^{\beta}}{1+Y^{-1}t^{\beta}T^{\beta}} \qquad \frac{\partial\mu^*}{\partial Y}>0 \quad \frac{\partial\mu^*}{\partial t}<0 \quad \frac{\partial\mu^*}{\partial T}<0$$

In both cases, specialisation is most likely to occur when the countries differ greatly in size. The effect of trade liberalisation is somewhat different in the two cases. Trade liberalisation has two opposite effects on labour used in the manufacturing sector: i) it reduces labour used in manufacturing domestic sales, and ii) it increases labour used in manufacturing exports. For the case where M=1, the derivatives of μ^* with respect to t and T are negative. In the small country, ii) dominates over i), and trade liberalisation leads to increased use of labour in the manufacturing sector. This increases the probability of specialisation. For $M = Y$, the derivatives of μ^* with respect to t and T are ambiguous. But $\mu^* < 1$ for $0 < t^{\beta}T^{\beta} < 1$ and $\mu^* = 1$ for either prohibitive export costs or for completely liberalised trade. Thus, in the two limit cases where $t^{\beta}T^{\beta} = 0$ and $t^{\beta}T^{\beta} = 1$, specialisation will not occur. Further, μ^* declines when $t^{\beta}T^{\beta}$ is near 0 and increases when $t^{\beta}T^{\beta}$ is near 1. This is because ii) dominates in the large country when export costs are high, and i) dominates when export costs are low. This could indicate that specialisation is most likely to occur for intermediate values of export costs.

Appendix 4. Criteria for non-exporters in both countries

Equation (10) shows that the extensive margin of exports is larger in the small country, and Equation (12) shows that trade liberalisation increases the extensive margin of exports in both countries. Therefore, if export costs decrease, the extensive margin of exports will reach 1 in the small country first. Consequently, there will be non-exporters in both countries as long as Y is not too small relative to openness. From (12), we can write the proportion of firms that export in *h* as:

$$s_{hf} = \frac{a(t,T)}{b_{hf}(t,T)} \qquad a(t,T) = t^{\beta} T^{\beta+1} \qquad b_{hf}(t,T) = YM^{-1} \frac{1 + Mt^{\beta}T^{\beta}}{1 + M^{-1}t^{\beta}T^{\beta}}$$

Note that $b_{hf}(t,T)$ here equals the relative number of firms in *h* versus *f*, N. Criterion for the existence of non-exporters in *h*:

$$s_{hf} < 1 \Leftrightarrow a(t,T) < b_{hf}(t,T)$$

Let us focus on the case where $t=1$ and $T<1$, i.e. there are only fixed costs of exporting.[39] The derivatives of the functions a and b_{hf} with respect to T are given by:

$$\frac{\partial a}{\partial T} = (1+\beta)T^{\beta} > 0$$

$$\frac{\partial b_{hf}}{\partial T} = \frac{Y\beta T^{\beta-1}(M^2 - 1)}{(M + T^{\beta})^2} < 0$$

In addition, for $M=Y$, we have:

$$a(0) = 0 \text{ and } a(1) = 1$$

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[39] The case for $t<1$ and $T=1$ is almost analogous.

$b_{hf}(0) = 1$ and $b_{hf}(1) = Y$

Consequently, $b_{hf}(T)$ is a downward sloping curve, while $a(T)$ is an upward sloping curve that cuts the $b_{hf}(T)$ curve from below for a value of $a(T)$ between Y and 1. This corresponds to values of T between $Y^{\frac{1}{\beta+1}}$ and 1. Thus $T < Y^{\frac{1}{\beta+1}}$ is a sufficient but not necessary condition for $s_{hf} < 1$, while $T < 1$ is a necessary but not sufficient condition for $s_{hf} < 1$. The two points will be close when β is large, i.e. when η is large. In other words, if composite industry goods from different countries are good substitutes, the proportion of firms that export will reach 1 in the small country only when trade is highly liberalised and/or countries differ greatly in size. If they are poor substitutes, on the other hand, this will happen for intermediate values of trade costs and/or country size differences. This is reasonable, as a high η means that a domestic composite industry goods can easily substitute a foreign composite industry goods in the large country; thus, demand for small-country products from abroad is lower.

It can be shown that if T increases further beyond the intersection of $a(T)$ and $b_{hf}(T)$, all firms will export in the small country, while only a fraction will sell in the domestic market. In the large country, on the other hand, only a fraction will export while all firms sell in the domestic market. If T increases even further so that fixed export costs become lower than the domestic market entry costs i.e. $T > 1$, all firms may export in both countries, whereas only a fraction may sell in their domestic markets. The value of T for this to happen is given by the intersection between $b_{hf}(T)$ and $\frac{1}{a(T)}$.[40] A necessary but not sufficient condition for this to happen is $T > Y^{-\frac{1}{\beta+1}}$, whereas a sufficient but not necessary condition is $T > Y^{-\frac{2}{\beta+1}}$.

For $M=1$, $T < Y^{\frac{1}{\beta+1}}$ is a sufficient and necessary condition for $s_{ij} < 1$. Consequently, in this case the range of Y and T that makes possible an equilibrium with non-exporting firms in both countries is narrowed as compared to the case where $M=Y$. For values of $Y^{\frac{1}{\beta+1}} < T < Y^{-\frac{1}{\beta+1}}$, all firms will export in the small country, whereas only a fraction export in the large country. For $T > Y^{-\frac{1}{\beta+1}}$, all firms will export in both countries, while only a fraction will sell in their domestic markets.

[40] Note that $b_{hf}(T)$ is now equal to n_f / n_h, which denotes the number of exporters in the large country divided by the number of exporters in the small country (since all firms export).

Appendix 5. Results of sensitivity analyses

Table A1. Determinants of the extensive margin on exports – results from OLS regression based on the Enterprise Surveys dataset

	All	All	Europe	Asia/Oceania	Latin America	Africa
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Relative home market size	–0.0281	–0.1000***	–0.2215**	–0.1701	–0.0613***	–0.1901*
	(0.0195)	(0.0263)	(0.0902)	(0.1362)	(0.0139)	(0.0995)
GDP per capita		0.0195***	0.0415*	0.1301	0.0159*	–0.0325
		(0.0066)	(0.0193)	(0.1905)	(0.0089)	(0.0346)
GDP per capita squared		–0.0006	–0.0007	–0.0504	–0.0007	0.0086
		(0.0004)	(0.0013)	(0.0810)	(0.0004)	(0.0070)
Remoteness		–0.0000	0.0002	0.0000	–0.0000	–0.0000
		(0.0000)	(0.0002)	(0.0000)	(0.0000)	(0.0000)
Average firm size		0.1421***	0.1105	0.2441***	0.1062	0.1835***
		(0.0344)	(0.1521)	(0.0614)	(0.1084)	(0.0502)
Constant	0.1406***	–0.1293*	–1.1498	–0.3950*	–0.0131	–0.0882
	(0.0105)	(0.0759)	(1.2913)	(0.2019)	(0.1453)	(0.1027)
Observations	116	116	20	25	31	40
R–squared	0.0070	0.5376	0.7232	0.4933	0.1969	0.3596
Predicted extensive margin	0.1372	0.1372	0.2674	0.1206	0.1246	0.0923
Doubling the relative home market size	–2.4577	–8.7464	–15.4901	–11.4246	–11.0202	–5.9728

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Robust standard errors in parenthesis. The regressions for the whole sample include regional dummies, and all regressions include year dummies.

Table A2. Extensive margin of exports in the Enterprise Surveys dataset, all firms that export any amount

Group of Countries	All	Europe	Asia/ Oceania	Latin America	Africa
Variable	Extensive margin of exports	Extensive margin of exports	Extensive margin of exports	Extensive margin of exports	Extensive margin of exports
Min	0.000	0.163	0.000	0.026	0.000
Median	0.178	0.381	0.103	0.194	0.109
Mean	0.198	0.388	0.156	0.201	0.128
Max	0.775	0.775	0.477	0.516	0.394
No of obs.	116	20	25	31	40

Note: Extensive margin of exports = estimate of the proportion of manufacturing firms that export in each country. An exporter is defined as a firm that exports any amount.

Table A3. Determinants of the extensive margin on exports– results from fractional logit models based on the Enterprise Surveys dataset. All firms that export

	All		All		Europe		Asia/Oceania		Latin America		Africa	
	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects
Relative home market size	0.0864	0.0137	–0.8160***	–0.1179***	–0.9854**	–0.2335**	–3.7905***	–0.4002***	–0.4087**	–0.0643**	–1.1529	–0.1185
	(0.1923)	(0.0305)	(0.2455)	(0.0350)	(0.4664)	(0.1103)	(1.3535)	(0.1464)	(0.1609)	(0.0258)	(0.8808)	(0.0902)
GDP per capita			0.1808***	0.0261***	0.1406	0.0333	2.4766**	0.2615**	0.2184***	0.0344***	–0.4552	–0.0468
			(0.0499)	(0.0072)	(0.1714)	(0.0404)	(1.0478)	(0.1107)	(0.0733)	(0.0123)	(0.3094)	(0.0318)
GDP per capita squared			–0.0071**	–0.0010**	0.0033	0.0008	–0.8715**	–0.0920**	–0.0105***	–0.0016***	0.1154*	0.0119*
			(0.0032)	(0.0005)	(0.0105)	(0.0025)	(0.4279)	(0.0446)	(0.0037)	(0.0006)	(0.0622)	(0.0063)
Remoteness			0.0000	0.0000	0.0005	0.0001	0.0000	0.0000	–0.0000	–0.0000	–0.0001	–0.0000
			(0.0001)	(0.0000)	(0.0010)	(0.0002)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Average firm size			1.7259***	0.2494***	0.5832	0.1382	2.3708***	0.2503***	2.0473**	0.3223**	2.2563***	0.2319***
			(0.3063)	(0.0443)	(0.6549)	(0.1548)	(0.5579)	(0.0513)	(0.8462)	(0.1375)	(0.4398)	(0.0392)
Constant	–1.4064***		–4.8938***		–5.2163		–6.4631***		–5.0194***		–4.6379***	
	(0.0906)		(0.5709)		(6.8756)		(1.5625)		(1.3227)		(0.8657)	
Log pseudo–likelihood	–42.18	–42.18	–37.64	–37.64	–8.595	–8.595	–7.051	–7.051	–10.73	–10.73	–10.49	–10.49
No of Observations	116	116	116	116	20	20	25	25	31	31	40	40
Predicted extensive margin		0.1369		0.1369		0.3857		0.12		0.1957		0.1163
Doubling the relative home market size		–1.2009		–10.3346		–11.3208		–27.0135		–3.9603		–4.2889

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Robust standard errors in parenthesis. Marginal effects and predicted extensive margins are evaluated at the mean of the independent variables. Year dummies are included in all regressions, and regional dummies are included in the regressions for the whole sample.

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Chapter 4

Market-specific sunk export costs: The impact of learning and spillovers

Market-specific sunk export costs:

The impact of learning and spillovers

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Abstract

Firms may face substantial sunk costs when entering an export market. Whereas previous studies have focused on global or country-specific sunk export costs, this study analyses the importance of *market*-specific sunk export costs (defining 'market' as a product-country combination). We also study the impact of market-specific versus country-specific sunk export costs. Market-specific export costs are affected by various kinds of learning and spillover effects. We use firm-level panel data for Norwegian seafood exports distributed on products and countries. The results lend support to the existence of market-specific sunk costs.We also find evidence of learning and spillover effects, particularly within the same product group.

Keywords: Market-specific sunk export costs, learning by exporting, export spillovers, gravity, panel data, random effects probit

JEL Classification: F10, F14, C33

1 Introduction

Recent years have seen the emergence of a literature which incorporates sunk export costs in models of international trade. This literature shows that, in the presence of such costs, not all firms export (see Melitz, 2003 or also Medin, 2003 for a model with firms with equal marginal production costs). Several empirical studies use firm-level data to study persistence in export behaviour and find evidence of sunk export costs (see e.g., Roberts and Tybout, 1997 and Bernard and Jensen, 2004). These studies focus on a firm's decision of whether or not to export as such. In this paper we analyse exporting firms' choice of export markets, i.e. their exports to individual markets (defining 'market' as the market for a particular product in a particular country. Analysing only the export decision as such misrepresents export costs when such costs are market specific. [41]

Some recent contributions focus on how firm-level export develops in different markets along extensive and intensive margins (see Mayer and Ottaviano, 2008; Bernard *et al*., 2011a). But only a few studies have investigated the importance of country-specific sunk export costs,[42] and, to our knowledge, no studies have investigated the importance of *market*-specific sunk export cost.

Models of global sunk export costs can explain how temporary export-promotion policies or macro-shocks (such as exchange-rate fluctuations) may have persistent effects on aggregated trade flows (see Baldwin, 1988; Baldwin and Krugman 1989; Dixit, 1989). If market specific sunk costs are important, temporary shocks may have persistent effects also on the number of trading partners or traded products. Further, persistence will be higher in markets with large

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[41] See Helpman *et al*. 2008; Chaney, 2008 for theoretical models of country-specific sunk export costs and Bernard *et al.*, 2011b for a model of country- and product- specific sunk export costs. In the presence of such costs, only the large and most productive firms find it profitable to export many products to many countries.

[42] Meinen (2012) estimates the importance of country-specific sunk costs. Moxnes (2010) demonstrates that both country-specific *and* global sunk export costs should be taken into account, otherwise, estimates of the effect of the latter will be biased. Evidence in Gullstrand (2011) suggests that country-specific sunk export costs vary with firm characteristics. Morales *et al*. (2011) estimate the magnitude of country-specific sunk export costs. Ottaviano and Martincus (2011) and Blanes *et al*. (2008) investigate the importance of region-specific sunk export costs in two and three regions, respectively.

sunk costs. Thus, knowledge about market-specific sunk export costs may have consequences for various types of export-promotion policies.[43]

The first aim of this article is to study the importance of market-specific sunk export costs. This is done in a new dataset that is particularly interesting due to its high level of detail: we have 11 years of panel data for all Norwegian seafood exporters, the countries they export to, and the products they export. Norway is one of the world's largest exporters of seafood, with an annual export value of 35.7 billion NOK in 2007 (approx. 7.28 billion USD). The industry is highly internationalized, with exports of a wide range of products to almost 200 countries; approximately 90 per cent of all Norwegian seafood production is exported.[44] The sector is therefore an interesting case for the study of international sales activity. Unlike earlier studies of sunk export costs, which focus on firms that produce what they export, our data include trading companies that buy all the seafood they export from other producers. Such firms constitute a significant part of all exporters, so including them is important for studying market-specific export.

Our second aim is to study whether learning and spillovers effects lead to reductions in export costs. Schmeiser (2012) develops a theoretical model where learning about exporting from other countries reduces firms' entry costs to a given country, denoting it 'learning to export'. In this article we allow for a range of effects like this: intra- and inter-country as well as intra- and inter-product. We hypothesise that a firm's export costs to a particular market can be reduced due to export experience, whether from that same country or from other countries (both within and between products). [45]

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[43] Generally there is evidence of positive effects from export promotion policies. See Hiller (2012) for a good overview of the literature.
[44] Figure based on information from the Norwegian Seafood Council.
[45] Some studies have used aggregated trade flows to investigate the impact of experience acquired in other export markets. See e.g. Nicita and Olarreanga (2000) or Evenett and Venables (2002). Some studies also examine how learning affects the probability of export to a particular country or market using firm-level data. See e.g. Fabling *et al*. (2011); Alvarez *et al.* (2010); Lawless (2011); Morales *et al*. (2011); Castagnino (2011); Gullstrand (2011) and Meinen (2012). These employ different learning variables from ours, and do not include such a rich variety of different effects. None of these distinguish

Concerning spillovers, we hypothesise that knowledge acquired by other exporters may spill over to potential exporters and reduce their market-specific export costs. Such spillover effects can have important policy implications. Earlier empirical evidence is mixed regarding spillovers that reduce global sunk export costs.[46] If, on the other hand, market-specific spillovers are more important than global spillovers, then policies aimed at exploiting spillovers could benefit from focus on encouraging export to certain markets rather than exports in general. Furthermore, firms targeting the same market would benefit from organizing themselves in 'exporting societies'. Some recent studies have found support for the hypothesis that spillovers reduce country- or market-specific export costs.[47] Most of these hypothesise that spillovers occur in the home country, from other exporters.[48] In line with a recent theoretical model presented in Krautheim (2012), we investigate spillovers from other exporting firms in the destination markets and not the home country, assuming there to be 'exporting societies' in the former. As for learning, we distinguish between inter- and intra-product spillovers, and find evidence of several effects.

Most other studies have focused on either learning or spillovers: but we include both in the same regression, as it is conceivable that both effects could influence sunk export costs at the same time. We also include in the same regression discrete variables on firms' lagged *presence* in markets, capturing the extensive margin, and continuous variables on firms' lagged export *value* to markets, capturing the intensive margin. We show that it is important to include both margins in the same regression, because the extensive margin induces more learning and spillover effects than the intensive margin. Furthermore, most other studies of

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between entering and continuing exporters within the same regression as we do, and all but Gullstrand (2011) and Meinen (2012) focus on entering firms only. Most of them also differ from ours in the econometric methods applied.

[46] See e.g. Clerides *et al*. (1998) and Bernard and Jensen (2004) for dynamic frameworks; and Aitken *et al*. (1997); Greenaway *et al*. (2004); and Barrios *et al*. (2003) for static frameworks.

[47] Requena Silvente and Castillo Giménez (2007), Koenig (2009) and Lawless (2011) find that spillovers affect *country*-specific export costs; while Alvarez *et al.* (2010), Koenig *et al*. (2010) and Fabling (2011) find that spillovers affect *market-spec*ific sunk export costs.

[48] An exception is Lawless (2011), who finds that if there is a high number of national firms exporting to a country, this increases the probability that a firm will enter that country.

learning and spillovers at the country (and possibly product) level focus on entrants, i.e. firms that did not export the product to the country the previous year. Nevertheless, in our paper we apply a dynamic model including entrants as well as continuing exporters (firms that exported the product to the country the previous year). By including interaction variables, we also allow for effects to be different for the two types of firms.[49] Whereas effects for continuing exporters may be interpreted as effects on fixed export costs alone, those for entrants may be interpreted as effects on the combination of fixed and sunk export costs. We know of no other paper that distinguishes between entrants and continuing exporters like this.

The remainder of this article is organized as follows: the next section presents the theoretical background for the estimation equation. Section 3 gives a more detailed presentation of the dataset we use, and other data used in the analysis. Results are presented in section 4, with concluding remarks offered in section 5.

2 Theoretical background

2.1 Profits from exporting

We follow Roberts and Tybout (1997) in modelling firms' export decisions in the presence of sunk export costs. They construct a multi-period model of firms' export participation decisions.

There are many firms that export one or more products to one or more countries. Consider *market-specific export:* i.e. firm *i*'s export of product *v* to country *j*. For each firm *i* in period *t*, the term $\pi^*_{ivjt}(\mathbf{p}_{vjt}, \mathbf{v}_{ivjt})$ denotes extra profits from exporting product *v* to country *j*. These are operating profits not adjusted for sunk cost of entering markets or for fixed costs of operating in a market. The vector $\mathbf{p}_{vjt}$ consists of variables that are exogenous for firms. It

[49] The only other papers we know of that include continuing exporters in addition to entrants are Gullstrand (2011) and Meinen (2012), who both focus on country-specific learning, not spillovers.

reflects product-, country- and time-specific factors. $\boldsymbol{v}_{ivjt}$ is a vector of factors that are firm-specific. It includes firm size, experience and market position.

We assume constant marginal costs. This allows us to treat each firm's export volumes in each market independently. We also assume that the price received by firm *i* for product *v* in country *j* is independent of export activities in other markets ($v' \neq v$ and/or $j' \neq j$). We assume that any effects of other firms' export on the price received by firm *i* are external. In Appendix 1 we describe how a profit function can be constructed on the basis of standard *CES* preferences, monopolistic competition, and constant marginal costs. In that case, the firm's operating profit is proportional to sales values in each market. Without sunk and fixed export costs, firm *i* will export product *v* to country *j* if $\pi^*_{ivjt}>0$.

Each firm faces fixed costs of exporting any product *v* to any country *j*, M_{ivjt}, and sunk costs of entering the market, G_{ivjt}. These are assumed to depend on a set of learning and spillover effects described in detail below. If there are no sunk costs, firm *i* will export product *v* to country *j* in period *t* if $\pi^*_{ivjt}>M_{ivjt}$. Sunk costs, G_{ivjt}, occur only when the firm enters the market, not if it is already present there.

2.2 Market-specific sunk export costs

Profits in any future period, $t+s$, π^*_{ivjt+s}, are uncertain to the firm. If there are market-specific sunk export costs, the decision to export to the market today hinges on expected future profits. If the firm exits the market one year and then re-enters later, the full sunk cost recurs.[50] We define the variable y_{ivjt} as taking on the value of 1 if firm *i* exports product *v* to a country *j* in period *t* and 0 otherwise.

[50] This assumption is made for simplicity. Other authors, such as Roberts and Tybout (1997), Bernard and Jensen (2004), Gullstrand (2011) and Meinen (2011), discuss the possibility that only part of the sunk costs recurs if the firm re-enters the market. Some authors also include exit costs in the theoretical formulation. Roberts and Tybout (1997) find that that most of the sunk cost must be repaid after one period of exit.

With market-specific sunk export costs, the single-period profit from exporting product *v* to county *j* becomes:

$$1 \qquad \pi_{ivjt}(y_{ivjt}) = \left[\pi^{*}_{ivjt} - (1 - y_{ivjt-1})G_{ivjt} - M_{ivjt}\right]y_{ivjt}$$

Equation 1 shows that in the presence of market-specific sunk export costs, previous export status will affect today's profit from exporting.[51] Since future profits are uncertain, at time *t* the firm chooses the infinite sequence of values $y^{+}_{ivjt}=\{y_{ivjt+s}|s\geq 0\}$ that maximizes the expected present value of current and future profits. Firm *i*'s optimal export strategy is the y^{+}_{ivjt} that satisfies the Bellman equation:

$$2 \qquad V_{ivjt} = \max_{y^{+}_{ivjt}}\left(\pi_{ivjt} + \delta E_t\left(V_{ivjt+1}(\Omega_{it}) \mid y_{ivjt}\right)\right)$$

E_t is an expectations operator conditioned on firm *i*'s information set at time *t*, Ω_{it}, and δ is the discount rate in each period. Consequently V_{ivjt} is the value of the optimal strategy for firm *i*'s export strategy for product *v* in country *j* in period *t*. A firm chooses to export in period *t* if the expected value of exporting exceeds the expected value of not exporting. Using eq. 1, we see that export in this period will be positive ($y_{ivjt}>0$) if:

$$3 \qquad \underbrace{\pi^{*}_{ivjt} + \delta\left[E_t\left(V_{ivjt+1}(\Omega_{it}) \mid y_{ivjt}=1\right) - E_t\left(V_{ivjt+1}(\Omega_{it}) \mid y_{ivjt}=0\right)\right]}_{\pi^{n}_{ivjt}} \geq (1 - y_{ivjt-1})G_{ivjt} + M_{ivjt}$$

Equation 3 shows that, in the presence of market-specific sunk export costs, the decision to export in period *t* depends on export status in period *t-1*. In the regression analysis, the effect of lagged export status on today's export decision is interpreted to indicate the importance of market-specific sunk export costs. The left-hand side of eq. 3 describes expected profits net of sunk and fixed export costs; this we denote π^{n}_{ivjt}.

Firm *i* therefore exports product *v* to country *j* in period *t* if:

[51] See Baldwin (1988), Dixit (1989) and Baldwin and Krugman (1989) for further discussion.

$$y_{ivjt} = \begin{cases} 1 & \text{if } \pi^n_{ivjt} \geq (1\text{-}y_{ivjt\text{-}1})G_{ivjt} + M_{ivjt} \\ 0 & \text{otherwise} \end{cases}$$

2.3 Learning and spillovers

Several other studies have hypothesised that learning and/or spillovers affect sunk export costs. Our model includes several learning and spillover effects that may influence firm *i*'s decision to export product *v* country *j*. [52] See Section 4 and Appendix 2 for detailed descriptions of all learning and spillovers effects investigated in the regression analysis.

We distinguish between effects on sunk costs and on fixed costs. Effects on sunk costs are present only for entrants, when past export experience is 0. (If $y_{ivjt-1} = 1$, then $G_{ivjt}=0$, so no variables can reduce G_{ivjt} further.) Effects on fixed costs are present for both entrants and firms that exported to the market in the previous period, so that reduced M_{ivjt} has consequences also for already-exporting firms. In other words, sunk costs are important for the decision to enter markets, whereas fixed costs also influence the decision to stay in a market. Consequently, we attempt to distinguish between the combined effect on fixed and sunk costs and on fixed costs alone by interacting learning and spillover variables with a categorical variable for the firm's presence in the market the year before (i.e. lagged export status).

We allow *G* and *M* to depend on firm *i*'s own experience from other markets and on other firms' experience from the same country. The firm's decision is therefore to export if:

$$\pi^n_{ivjt} \geq (1\text{-}y_{ivjt\text{-}1})G_{ivjt} + M_{ivjt} = (1\text{-}y_{ivjt\text{-}1})(G^0 - G^L y^*_{it-1} - G^S y^*_{i't-1}) + (M^0 - M^L y^*_{it-1} - M^S y^*_{i't-1}), \quad i \neq i'$$

This can be reformulated as

[52] Other articles deal with similar issues. See e.g. Clerides *et al.* (1998), Koenig (2009), Koenig *et al.* (2010), Lawless (2011) and Fabling *et al.* (2011), on spillovers; and Lawless (2011) and Morales *et al.* (2011), on learning.

4 $$\pi^{n}_{ivjt} - G^{0} - M^{0} \geq -G^{0} y_{ivjt-1} - G^{L}\left(1 - y_{ivjt}\right) y^{*}_{it-1} - G^{S}\left(1 - y_{ivjt-1}\right) y^{*}_{i'jt-1} - M^{L} y^{*}_{it-1} - M^{S} y^{*}_{i'jt-1}, \quad i \neq i'$$

Above, G^0 and M^0 denote market-specific sunk and fixed costs that are independent of learning and spillovers from *other* markets. G^L and M^L denote the reductions in sunk and fixed costs due to firm *i*'s experience from other markets (learning effects). These are specified to occur if firm *i* exported to any other market in the previous period. Firm *i*'s activities in other markets are indicated by the vector y^{*}_{it-1}. This vector consists of an indicator for presence with other products in the same country: $y_{iv'jt-1}$, $v' \neq v$; and a vector indicating presence in other countries (with the same product or with any product): $y^{*}_{ij't-1}$, $j' \neq j$. Consequently, G^L and M^L are coefficient vectors.[53] Other firms' activities are denoted with the vector $y^{*}_{i'jt-1}$, $i' \neq i$. G^S and M^S are therefore coefficient vectors for reductions in sunk and fixed costs because of spillovers.

2.4 The regression equation

In line with several other studies (e.g., Roberts and Tybout, 1997) we specify a reduced form of the latent variable π^{n}_{ivjt}-G^0-M^0. Therefore we do not specify the profit function but approximate it with an expression in exogenous firm, product, country, and time variables and combinations of the four dimensions. Thus, we write

$$\pi^{n}_{ivjt} - G^{0} - M^{0} = \mathbf{z}_{ivjt}\boldsymbol{\eta} + e_{ivjt}$$

The vector **z** consists of variables that are specific to the firm, the product or country, or any combination of the three. These are captured by dummy variables and by other variables as

[53] If the firm learns through own export activities in the same market, also y_{ivjt-1} is part of the vector y^{*}_{it-1} when multiplied by M^L. This effect cannot be separated from the effect of market-specific sunk costs. Effectively, these reductions in fixed costs due to learning are sunk costs. Both effects are captured by y_{ivjt-1} in the regression analysis.

described in section 4. e_{vijt} denotes noise. Based on eq. 4 we therefore specify the binary choice equation as:

5 $$y_{ivjt} = \begin{cases} 1 \text{ if } 0 \le \alpha_0 y_{ivjt-1} + \alpha_1 (1 - y_{ivjt-1}) y_{iv'jt-1} + \alpha_2 y_{ivjt-1} y_{iv'jt-1} + \alpha_3 (1 - y_{ivjt-1}) y^*_{ij't-1} \\ + \alpha_4 y_{ivjt-1} y^*_{ij't-1} + \alpha_5 (1 - y_{ivjt-1}) y^*_{i'jt-1} + \alpha_6 y_{ivjt-1} y^*_{i'jt-1} + \mathbf{z}_{ivjt} \boldsymbol{\eta} + e_{ivjt} \\ 0 \text{ otherwise} \end{cases}$$

We hence have a model where the dependent variable lagged one period is among the explanatory variables. Its coefficient is α_0. A positive α_0 implies that having exported to the market in the previous year increases the probability of exporting there this year, and it is interpreted as the sunk cost parameter of serving that single market (but again – it may also capture learning from own experience in the market in question).

In eq. 5 we include several other variables interacted with a categorical variable for whether the firm is an entrant, $(1-y_{ivjt})$, or a continuing exporter, y_{ivjt}. Effects for entrants may be interpreted as combined effects on fixed costs and sunk costs. These are captured by α_1, α_3 and α_5. Effects for continuing exporters may be interpreted as effects on fixed costs and are correspondingly captured by α_2, α_4 and α_6.

We pay particular attention to α_1, which denotes the effects of experience from exporting other products to a country on the fixed or sunk costs of introducing a new product in the same country (note the interaction with $1-y_{ivjt-1}$). We expect a positive effect. One interpretation of this variable is that it captures country-specific learning. [54] Another is that it reflects country-specific sunk export costs, which may accrue in addition to pure market-specific sunk export costs. For example, costs related to establishing a sales office may be specific to the country, not to the market. In this case, having exported another product to the

[54] Arkolakis and Muendler (2010) find that among Brazilian firms, large firms selling many products, typically export their top products to many countries. Furthermore, they sell a smaller amount of their lowest-selling products than do small exporters. To explain this they develop a model where firms face market-specific sunk export costs that may decline with the number of products the firm sells in a country. They do not discuss learning effects as such, but an obvious explanation for the mechanism described in the paper is learning to export from other products in the same country, as described above.

country the year before reduces sunk costs of starting to export a new product to the same country, because the country-specific part of the entry cost is already paid for. Not taking this effect into account will give upward biased estimates of the effect of market-specific sunk export costs.[55]As was the case for market-specific sunk export costs and learning, it is not possible to separate the effect of country-specific sunk export costs from country-specific learning. Also in this case the reduction in fixed costs due to learning can be interpreted as sunk costs. α_1 denotes the effect of both, and in the regression analysis $y_{iv'jt-1}$ will capture both effects.

α_2 is the equivalent to α_1 for continuing exporters and we interpret it as country-specific learning. It will increase the probability that the firm will continue to export to a given market (note the interaction with y_{ivjt-1}).

α_3 and α_4 denote the reduction in market-specific sunk and fixed costs from experiences from other countries, and we interpret them as learning effects. As indicated above, $y^*_{ij't-1}$ is a vector of varying indicators of experience from other countries. Together with $y_{iv'jt-1}$ it constitute the vector y^*_{it-1} in equation 4; it captures the number of countries to which the firm exports product *v* and the number of countries to which the firm exports all products as well. $y^*_{i'jt-1}$ is a vector of indicators of the number of *other* firms exporting the same or different products to the country, and we interpret the coefficients α_5 and α_6 as capturing spillover effects.

We include the learning and spillover variables both along the extensive and the intensive margins. Learning and spillover variables along the extensive margin are in accordance with two recent theoretical models. In Schmeiser (2012), learning to export to a particular country is a function of the number of countries the firms has previously exported to, while in

[55] Moxnes (2010) studies country-specific versus global sunk export costs. He argues that not including country-specific export participants in the analysis will overestimate the effect of global sunk export costs. Further, Meinen (2011) argues that export experience from another country may reduce country-specific sunk export costs if these have a global component.

Krautheim (2012) spillovers in the destination markets are a function of the number of other exporters present there. Nevertheless, contrary to these studies we also model learning and spillovers as functions of export intensity, and include variables of export *value* that correspond to the learning and spillover variables described above. For simplicity, these variables are not included in the equations above, but are described in detail in section 4 and in Appendix 2.

The probability that firm *i* exports product *v* to country *j* in period *t* is now given by the probability regression equation:

6 $$P(y_{ivjt}=1)=f\begin{pmatrix}\alpha_0 y_{ivjt-1},\alpha_1(1-y_{ivjt-1})y_{iv'jt-1},\alpha_2 y_{ivjt-1}y_{iv'jt-1},\alpha_3(1-y_{ivjt-1})y^*_{ij't-1},\\ \alpha_4 y_{ivjt-1}y^*_{ij't-1},\alpha_5(1-y_{ivjt-1})y^*_{i'jt-1},\alpha_6 y_{ivjt-1}y^*_{i'jt\text{-}1},\mathbf{z}_{ivjt}\boldsymbol{\eta}\end{pmatrix}$$

2.5 Econometric issues

Unobserved heterogeneity is likely to create persistence in the dependent variable. If it is not corrected for, α_0 will be overestimated. To handle this problem, we estimate 6 using a random effects probit model. This is in accordance with several other studies on sunk export costs (see Roberts and Tybout, 1997; Clerides *et al*., 1998; Bugiamelli and Infante, 2002; Bernard and Jensen, 2004; and Gullstrand, 2011). Unobserved heterogeneity is modelled at the firm-product-country level, and the method implies assuming that the error term consists of two terms:

$$e_{ivjt}=\varepsilon_{ivj}+u_{ivjt}$$

where ε_{ivj} captures elements that are time-invariant and specific to firm-product-country. Remaining noise is captured by u_{ivjt}. There may also be unobserved heterogeneity at other levels. To correct for this, we include firm, year, product, and year-product dummies.[56]

[56] We also experimented with running a regression including country dummies, but the results were qualitatively almost identical to results presented here.

An important problem is the *initial conditions* problem (see Heckman, 1981). This concerns how to treat the first observation of the lagged dependent variable. Export experience is likely to be correlated with unobservable characteristics. However, simply including y_{ivj0} as an explanatory variable for y_{ivj1}, implies treating y_{ivj0} as exogenous and hence uncorrelated with the unobservable characteristics – which is not likely to be true.

Several solutions have been proposed in the literature. Wooldridge (2005) suggests capturing the correlation between unobserved heterogeneity and y_{ivj0} by including, as auxiliary explanatory variables for every year in the regression, all observations for all years of the time-variant exogenous variables together with y_{ivj0}, and then running a standard random effects probit regression. We use this methodology but choose to include the within means of the time-variant exogenous variables instead of all observations, in order to make the computational task manageable.[57] The Wooldridge method then consists in considering the unobserved heterogeneity, ε_{ivj}, as the expression:

$$\varepsilon_{ivj} = \lambda_0 + \lambda_1 y_{ivj0} + \boldsymbol{\lambda_2}\bar{\mathbf{x}}_{\mathbf{ivj}} + \mu_{ivj}$$

Above $\bar{\mathbf{x}}_{\mathbf{ivj}}$ now denotes the vector of the within mean of all time-variant right-hand variables in eq. 7. $\boldsymbol{\lambda}_{\mathbf{i}}$ is the vector of coefficients to be estimated and μ_{ivj} is the remaining unobserved individual effect which is assumed *iid* $N[0,\sigma^2_\mu]$. Our learning and spillover variables are constructed with interactions with dummy variables for non-presence (1-y_{ivjt-1}) or presence (y_{ivjt-1}) in markets. The regression equation becomes:

7 $$P(y_{ivjt}=1) = f\begin{pmatrix} \alpha_0 y_{ivjt-1}, \alpha_1(1-y_{ivjt-1})y_{iv'jt-1}, \alpha_2 y_{ivjt-1}y_{iv'jt-1}, \alpha_3(1-y_{ivjt-1})y^*_{ij't-1}, \\ \alpha_4 y_{ivjt-1}y^*_{ij't-1}, \alpha_5(1-y_{ivjt-1})y^*_{i'jt-1}, \alpha_6 y_{ivjt-1}y^*_{i'jt-1}, \mathbf{z}_{ivjt}\boldsymbol{\eta}, \lambda_0, \lambda_1 \mathrm{y}_{\mathrm{ivj1}}, \bar{\mathbf{x}}_{\mathrm{ivj}}\boldsymbol{\lambda_2} \end{pmatrix}$$

[57] An advantage of the Wooldridge method is that it also corrects for potential serial correlation in u_{ivjt} caused by ε_{ivj} being correlated with the explanatory variables (see Chamberlain, 1984, and Mundlak, 1978). Furthermore, it reduces the variance of the unobserved heterogeneity, σ^2_ε. As pointed out by Heckman (1981), a large σ^2_ε may overestimate the effect of the lagged dependent variable.

which is estimated using a random effects probit estimation.

We use this Wooldridge-modified random effects probit regression as our baseline regression (referred to as WREP), but we compare the results with the standard random effects probit regression (referred to as REP). The Wooldridge methodology implies that several of our variables are included together with their within means. This is important when interpreting the results.

3 Data and descriptive statistics

We use a panel dataset of all seafood exporters in Norway for the years 1996 to 2007, provided by Statistics Norway. Export is disaggregated on firms, products and countries. For the whole period, the most important export destinations in terms of export value are Denmark, Japan, France, the UK and Russia; the most important exported products are Fresh Whole Salmon/Trout, Stockfish/Clipfish/Salted Whitefish and Frozen Whole Pelagic Fish.

Unlike earlier studies of sunk export costs, which focus on firms that export their own production, our data also include trading companies that buy all the seafood they export from other producers.[58] It is a great advantage that our data include these firms. However, they make it difficult to merge our data with data on firm characteristics, such as production or total factor productivity. Other empirical studies of sunk export costs often find such characteristics important for entry into the export activity. Nevertheless, such characteristics are probably less important for our study because, as explained below, we concentrate on market-specific export entry, not global export entry. We also proxy for differences in the ability to export by using information about firm exports. For example, total export value is a proxy for firm size and may capture time-variant productivity differences. We further account

[58] We cannot identify these trading companies, but they probably constitute around 30 per cent of all seafood exporters (see Melchior and Medin, 2002). These firms are thus important for the study of market-specific export.

for time-invariant unobserved heterogeneity by including random effects at the firm-product-country level, as well as firm, product, and product-year dummies.

Most other studies have focused on manufacturing firms, and an important question is whether the results from our study can be generalised to other sectors. Admittedly, seafood has some specific characteristics. For one thing, some seafood product groups are necessarily quantity-restricted, as fishing rights for caught fish are distributed by quotas. However, in Appendix 1 we show that that our analysis is also relevant for the distribution of a given export volume across countries. In addition, important product groups in our data are farmed fish, and these are not quantity-restricted to the same extent as caught fish. Furthermore, many manufacturing sectors are also characterised by varying degrees of quantity restrictions.

Much seafood constitutes more homogeneous product groups than manufactured products. Some findings indicate that sunk and fixed export costs are more important for heterogeneous products than for homogeneous ones (Rauch, 1999). We expect sunk costs, e.g. related to adjustment to different product and veterinary standards, to be present also for seafood exporters. Nevertheless, Melchior (2003) shows that the sunk costs of exporting are far higher among Norwegian IT exporters than among seafood exporters. If anything, then, our results underestimate the general impact of market-specific sunk and fixed costs.

3.1 Full dataset versus the sample used for regression analysis

Firms in our data export in total 376 product groups at eight-digit HS-level to 196 countries. On average 496 (out of 1242) firms are active each year during the sample period, yielding an average of 376 x 196 x 496 = 37,112,704 firm-product-country observations each year: prohibitively large for data computation purposes. Nevertheless, it is not adequate to include all firms in the regression analyses, and we aggregate products into 18 groups.

3.1.1 Firms

We do not include temporary exporters in the regression analysis as our purpose is to study firms' exports to specific markets, not firms' global exports. There are several different kinds of potential sunk costs of entering into the export activity: global as well as product-specific sunk costs may accrue, in addition to market- and country-specific sunk costs. We wish to focus on the two latter. Therefore, we include only firms that export all years throughout the sample period (in total 146) and only those firm-product combinations that that are positive all years. This reduces the number of firms to 116.[59] This allows us to analyse market- or country-specific sunk export costs separately, without running the risk of incorrectly interpreting them as global or product-specific sunk export costs.

There are three additional advantages of reducing the sample in this way. Firstly, we do not risk incorrectly interpreting sunk production costs as sunk export costs. If a firm enters into export activity or starts exporting a new product, we cannot know whether this is due to production start-up or to export entry, since we do not have information about firms' production. Secondly, we get a more homogeneous sample and reduce bias from omitted firm-level and firm-product-level variables that are not captured by the proxies for firm characteristics or random effects/dummies. Thirdly, it allows us to deal with acquisitions. If one firm acquires another firm it is reasonable that the price includes, and therefore reflects, already-paid sunk costs. Thus, these costs are reflected in an observation of increasing market coverage due to acquisitions. Firms that are acquired by other firms represent exits in the dataset and are not included in our sample.

[59] An alternative to including only firm-product combinations that are positive all years could be to include those that are positive at least one year during the sample period. Results from the regression analysis are robust to which of the two methods we apply.

Even though we focus solely on entry into new countries by existing firms-product channels, our sample shows considerable variation. Average entry and exit rates are both around 25 per cent.

3.1.2. Products

Many of the 8-digit HS-level products are similar. We therefore aggregate them into 25 groups, of which 22 are fairly homogeneous in terms of production and exporting conditions.[60] Further, we merge export data with data for country- and product-level import from the COMTRADE database, where products are on 6-digit HS-level.[61] After these operations we are left with 18 product groups in our regression analysis.

3.1.3 Countries

Export data are merged with data for countries from several databases. Data for GDP and GDP per capita (in current NOK), and GDP growth (in fixed US dollars, three-year moving average) are provided by the World Bank, from the World Development Indicators (WDI).[62] Three indicators of good governance (regulatory quality, rule of law and control of corruption) are provided by the World Bank, from the Worldwide Governance Indicators (WGI).[63] Geographical distances are great-circle distances (in kilometres) based on coordinates for the capitals as found in Gyldendal (1970). Data for country-specific exchange

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[60] These groups are Conserved Fish, Whitefish (fresh whole, fresh fillet, frozen whole and frozen fillet), Farmed Fresh Whitefish (whole and fillet), Farmed Salmon/Trout (fresh whole, fresh fillet, frozen whole and frozen fillet), Caught Whole Salmon/Trout (fresh and frozen), Clipfish/Stockfish/Salted Whitefish, Meal/Oil/Industry, Pelagic (fresh whole, fresh fillet, frozen whole and frozen fillet), Salted Herring, Shellfish and similar (fresh, frozen and conserved), Smoked Salmon, and Miscellaneous. Products are particularly heterogeneous in Meal/Oil/Industry and Miscellaneous, while Conserved Fish consists of products with a much higher level of manufacturing than the others. Sunk costs for these three products group may therefore differ considerably from the others, and we omit them from the sample used for regression analysis.

[61]Aggregations of 6- and 8-digit HS-level products do not fully correspond. For four of our groups, the deviation is severe, so we exclude them from the sample used for regression analysis. Export of these product groups is marginal. These groups are: Caught Salmon/Trout (fresh and frozen) and Farmed Whitefish (whole and filet).

[62] WDIs for the Faroe Islands lack GDP growth figures for the whole period and GDP for 1997, so our figures for the Faroes come from the Statistics Faroe Islands. Growth figures are in current USD. WDIs for Brunei lack GDP for the year 2007, so we have estimated that figure. WDIs for Qatar lack growth figures for the years 1996–2000, so we have supplemented with growth figures from the IMF.

[63] Data for the Faroe Islands and Greenland are lacking in the WGIs, so we have set figures for these countries equal to those s for Denmark.

rates come from the CIA World Factbook, and data for country- and product-level import from the COMTRADE database.[64] Compared to our export data, 52 countries are missing from the above-mentioned databases.

3.1.4 The sample

The first year of the period (1996) is used to construct lagged variables, and the sample therefore spans the period 1997 to 2007. Following the methods described above, the sample now contains 116 firms, 18 products, 268 firm-product combinations, and 144 countries. This gives 38,592 observations each year. One observation represents export of one product from one firm to one country: this we refer to as an *export market channel*. On average, only 5.5 per cent of these are positive each year.

Compared to the whole dataset, the sample is biased towards larger firms that export more products to more countries. Although the number of firms is highly reduced in the sample, it still covers 49 per cent of total Norwegian seafood export value during the period and 66 per cent of all markets with positive import. Obviously, this is not a representative sample of all exporting firms, but, since our focus is on market- or country-specific entry, our aim is to study the behaviour of permanent exporters and not that of all firms. In the present study, the entire population of permanent exporters, small as well as large, are included, as are most countries in the world. In addition, unlike other studies, our data include pure trading companies. Many studies of sunk costs apply samples that are biased towards more successful firms or markets. Often, only firms that are operational during the whole sample period are included, and several studies do not include small firms (e.g., Roberts and Tybout, 1997;

[64] A problem with the COMTRADE data is that some countries fail to report import of certain products in certain years, even if import was positive. It is not possible to distinguish these missing observations from observations that are in fact zero. In the case where import of product v to country j was positive at least one year during the sample period, we replace the zero observations with the mean of the positive observations from the years these were reported. If import of product v to country j was zero all years, these remain zero. Nevertheless, results from the regression analysis are robust to alternative methods, such as treating all missing observations as zero.

Bernard and Jensen, 2004). Further, some studies of country-specific export include only the most important importing countries (Moxnes, 2010).

3.2 Preliminary evidence

In the presence of market-specific sunk export costs, we should expect firms to export to a limited number of markets. On average, only 5.5 per cent of all export market channels are positive each year, thus if firm-product combinations chose countries randomly we would see entry and exit rates of 94.5 per cent. Both these rates amount to approximately 25 per cent, thus there is persistence. This could indicate sunk export costs, because such costs make entry and exit costly. In section 3.2.1 we present evidence of persistence in country-product specific export as well as in country specific export.

Our analysis is closely related to the analyses of extensive and intensive margins of trade frequently found in recent literature (e.g., Bernard *et al.*, 2007; Chaney, 2008; Mayer and Ottaviano, 2008; Bernard *et al.*, 2011a). The extensive margin of trade refers to the number of exporters (and potentially their number of export products and destinations), while the intensive margin of trade refers to the value of one firm's export (potentially distributed across products and countries). In section 3.2.1 we present characteristics of our sample along the different extensive and intensive margins, with special focus on variables related to sunk costs, learning and spillovers.

3.2.1 Survival function of firms

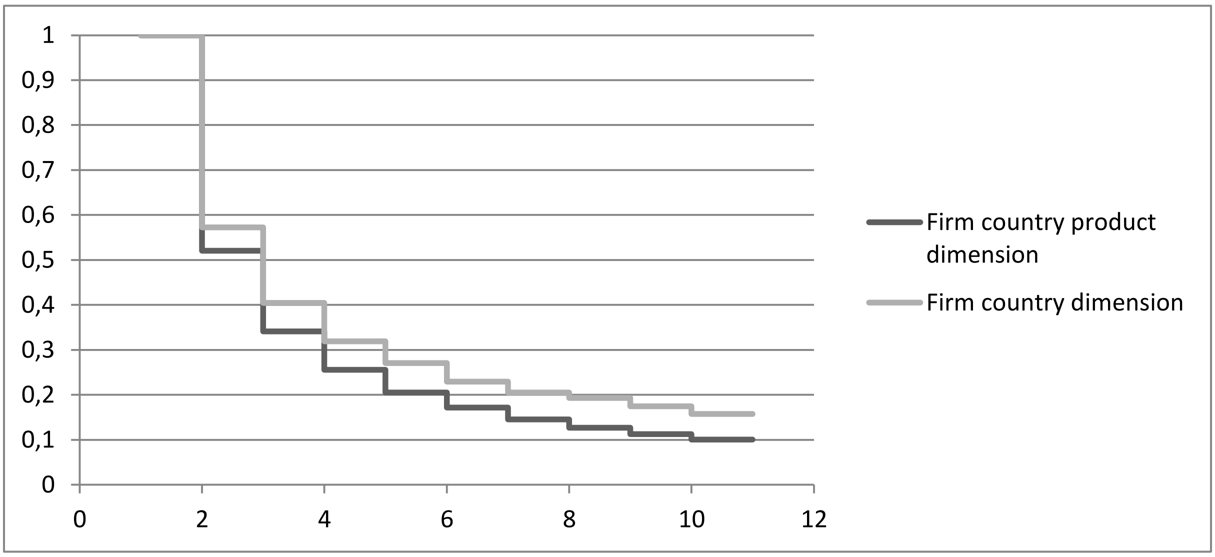
One way of analysing persistence is to calculate the Kaplan-Meier survival function. Figure 1 graphs the Kaplan-Meier survival functions for market-specific export (firm-product-country dimension) and for country-specific export (firm-country dimension). The survival function shows the share of export channels that were positive in year 1 that continued to be positive in subsequent years. Note that year 1 in Figure 1 refers to the year when the firm enters. Since a firm may enter and exit a market (country) several times in the course of the sample years, we have treated each period of positive market- (country-) specific export from a given firm as one observation. The case of a firm that enters, exits, and then re-enters is hence treated as two different observations in calculating the survival functions. Also note that our sample suffers from left-censoring: we do not observe the year of entry for export channels that are positive in the year 1996. When calculating the survival functions, we therefore include only observations that enter in 1997 or later. As a consequence, the persistence evidenced in Figure 1 underestimates persistence in our sample: all firms that exported in 1996 are excluded from the analysis in order to avoid problems with left-censoring. This includes firms that exported to a market in all the years covered. The share of positive export market channels is now reduced from 5.5 to 3.9 per cent, whereas the share of positive export country channels is reduced from 8.2 to 4.5 per cent.

Graph 1 shows that, despite the low probability of exporting to a particular market, as much as 52 per cent of positive firm-market combinations that start exporting one year continue to be positive the subsequent year. The corresponding figure for firm-country combinations is 57 per cent.[65] After 11 years, 10 per cent of the export *market* channels survived, while 16 per cent of the export *country* channels survived.

The survival functions show that firm-country persistence is higher than firm-product-country persistence. This is not surprising, as the latter is part of the former. Nevertheless, it indicates that both market- and country-specific sunk export costs may accrue. In the regression analysis we attempt to distinguish between the two, and show how the former may be overestimated if the latter is omitted.

[65] Eaton *et al*. (2008) find that, among Colombian exporters, only about one third of firms as well as firm-country combinations are still exporting the year after entry.

Graph 1 Kaplan-Meier survival estimates, firms in markets and in countries



3.2.2 Learning and spillovers

Table 1 presents characteristics of firms that are related to the learning variables included in the regression analysis.[66]

Table 1 Characteristics of firms in the sample, year 2000

	Intensive margins		Extensive margins			
	Firm export value (NOK mill.)*	Export value of a firm to a market (NOK mill.)*	No. of markets a firm exports to*	No. of countries a firm exports to*	No. of products a firm exports*	Average no. of countries a firm exports a product to**
5 percentile	1.5	0.005	1	1	1	1
Median	40	0.36	20	9	6	6
Mean	143	4.7	31	13	6.7	7.1
95 percentile	623	21	93	38	15	18.2
Correlation with firm export value	1	0.08***	0.81***	0.72***	0.50***	0.57***

Note: *Figures are based on the 116 firms, but include all 25 products and 196 countries. ** Figures are based on the 268 sample firm-product combinations, but include all 196 countries. The variable is calculated by taking the average number of countries per product for each firm. The column shows how this variable varies across firms in the sample. ***Significant at the 1% level.

[66] Figures are for the year 2000, which was an 'average' year in terms of the number of export markets per firm and the average value of an export market channel. We construct learning variables based on all countries to which a firm exports and all products a firm exports, since learning might occur from a firm's temporary as well as permanent export. Therefore, except for the last column, figures in Table 1 include all 25 products and 196 countries, but only the 116 firms in our sample. Figures in the last column include all 196 countries, but only the 268 firm-product combinations in the sample.

Table 1 shows that the distribution of firms is highly skewed: there are many small firms and a few large ones. In fact, the 5 per cent largest firms in terms of export value accounted for 41 per cent of exports and 30 per cent of all positive export market channels in the sample. The number of markets per firm (column 3) may be high either because the firm exports to many countries (column 4), or because it exports many products (column 5). Again, the distribution is skewed: most firms sell few products in few countries.

The last row in Table 1 presents correlation coefficients between the different variables and firm export value, which we use as a proxy for firm size. All coefficients are positive and highly significant. Hence, it is the small firms that tend to export few products to few countries. There is also a positive, albeit much smaller, correlation between sales in each market and firm size. This lends support to our hypothesis of sunk and fixed costs: Many firms concentrate their exports in a limited number of markets.[67]

Table 2 presents characteristics of countries and markets that are related to the spillover variables included in the regression analysis. It shows that the distribution of exporters per country or market is skewed: most countries and markets have few Norwegian exporters present. In fact, there was only one Norwegian exporting firm present in as much as 15 per cent of the countries and 33 per cent of the markets. In the regression analysis we distinguish between intra-product spillovers (firms that export the same product to the same country), and inter-product spillovers (firms that export any product to the same country). The average number of Norwegian firms in each market is only 7.7, which is less than one quarter of the average number of firms in a country (31).

In the presence of spillovers, we should expect firms to cluster in the same countries or markets. A high share of the export value is concentrated in a few large countries. The 5% top

[67] Other empirical studies find patterns similar to those described above (see Mayer and Ottaviano, 2008, for a survey of European firms; Bernard et al., 2009 for US firms). Most exporters tend to be small and export to a few markets. Some few, very large exporters which also export to numerous markets account for a large share of total export value.

countries imports 53 % of total export of Norwegian seafood. As expected, these countries also have a high number of Norwegian exporters present (164 on average). Furthermore, there are on average 132 other Norwegian exporters present in an average firm's portfolio of destination countries. The same is true for markets: as much as 67 per cent of total Norwegian seafood export is concentrated in the top 5 per cent markets, and on average there are 34 Norwegian exporters present in these markets. In the regression analysis we include variables that control for market attractiveness. Still, clustering in a limited number of markets seems to characterise the data. [68]

Table 2 Characteristics of countries and markets in the sample, year 2000

	Country characteristics			Market characteristics	
	Intensive margin	Extensive margins		Intensive margin	Extensive margin
	Norwegian export value to a country (NOK mill.)*	No. of products a country imports*	No. of firms that export to a country*	Norwegian export value to a market (NOK mill.)**	No. of firms that export to a market**
Min	0.002	1	1	0.001	1
Median	11	6	8	0.9	3
Mean	263	8.8	31	35	7.7
Max	4224	23	247	2209	75

Note: *Figures include those of the 144 sample countries that had positive import of Norwegian seafood in the year 2000 (total 118), but include all firms that exported Norwegian seafood in the year 2000 (total 484) and all 25 products. ** Figures include those sample markets with positive import of Norwegian seafood in the year 2000 (total 837), but include all firms that exported Norwegian seafood in the year 2000 (total 484).

4 Results

We estimate eq. 7 using a random effects probit model where the Wooldridge method is used for correcting for initial conditions as described in section 2.5. We refer to this model as WREP. For comparison purposes we also report results from a random effects probit model where we do not correct for initial conditions (referred to as REP). The regression equations include lagged export status and several learning and spillover terms. The learning and spillover effects are interacted with indicators for lagged export status (y_{ivjt-1}) to capture

[68] Spillover variables in the regression analysis include all firms and firm-product combinations, as do country characteristics in Table 2. The reason is that spillovers might come from temporary exports as well as permanent ones. Figures include those sample markets with positive import in the year 2000 (in total 837), and all firms.

effects on the probability of staying in a market and indicators for lagged absence in a market ($1-y_{ivjt-1}$) to capture effects on the probability of entering a market. Consequently, we distinguish between effects for continuing exporters and entrants in a market. In addition, the vector **z** contains a range of firm-specific, product-specific and country-specific variables (and combinations of the three), both time-independent and time-varying.

Main results are presented in Table 3. The table only reports results on variables that reflect market-specific sunk and fixed costs, learning and spillovers. Results for other explanatory variables (and for their time-independent averages in the Wooldridge model) are reported and discussed in Appendix 3. It should be noted that in comparing the magnitude of the coefficients of the Wooldridge random effects probit model (the WREP model) with those of the random effects probit model (the REP model), the coefficients should be scaled with the models' estimate of $\sqrt{1-\rho}$.[69] Also the estimated ρs are reported in Table 3. It is evident that the WREP approach is important for dealing with unobserved heterogeneity. By applying the WREP model, ρ is substantially reduced from 0.278 in the REP model to 0.047. This demonstrates that the Wooldridge model reduces possible bias of α_0 due to large σ_ε (see section 2.5 for discussion).

In addition to the coefficients and their standard errors, we report average partial effects (APEs). The APEs for the WREP model are calculated using coefficients scaled with $\sqrt{1-\rho}$, as described in Wooldridge (2012, p. 628).[70] [71] In our data, the probability of serving an export market is on average very low - the average predicted probability is 5.40 per cent. The APEs should therefore be evaluated relative to that.

[69] ρ is the proportion of total variance contributed by the constant cross-period variance due to unobserved heterogeneity, which is given by σ^2_ε in the REP model and σ^2_μ in the WREP model. $\rho=\sigma^2/(\sigma^2+1)$ (see Wooldridge, 2005; Arulampalam and Stewart, 2009).

[70] The APEs should be interpreted with some care. We have not been able to calculate their standard errors because bootstrapping is too time consuming - running one regression takes more than 50 hours. Still, even though the significance of the APEs may differ from the significance of the coefficient, it is the latter that indicate whether an independent variable has a significant effect on the dependent variable.

[71] The APEs for dummy variables indicate the average of the difference in the predicted probability as the dummy changes from 0 to 1.

Table 3 Regression results – learning and spillovers

		WREP			REP		
		Coeff.		APE	Coeff.		APE
	market export status	1.124	***	0.07064	1.802	***	0.14471
		(0.053)			(0.053)		
	market export value	0.017	***	0.00056	0.024	***	0.00081
		(0.003)			(0.004)		
Learning	**country export status, other products. (1-y)**	0.173	***	0.00584	0.735	***	0.02813
		(0.024)			(0.021)		
	country export status, other products. y	0.543	***	0.02404	0.35	***	0.01370
		(0.035)			(0.031)		
	export intensity, same country, other products. (1-y)	-0.001	*	-0.00004	-0.001		-0.00002
		(0.001)			(0.000)		
	export intensity, same country, other products. y	-0.002	***	-0.00006	-0.002	***	-0.00007
		(0.001)			(0.001)		
	number of other countries, same product. (1-y)	0.03	***	0.00100	0.044	***	0.00146
		(0.002)			(0.002)		
	number of other countries, same product. y.	0.016	***	0.00053	0.031	***	0.00105
		(0.003)			(0.002)		
	average export intensity, other countries, same product. (1-y)	-0.003	*	-0.00011	0.001		0.00003
		(0.002)			(0.002)		
	average export intensity, other countries, same product. y	-0.003		-0.00008	0.001		0.00002
		(0.003)			(0.002)		
	number of other countries, all products. (1-y)	0.001		0.00005	-0.014	***	-0.00045
		(0.002)			(0.002)		
	number of other countries, all products . y	0.002		0.00007	-0.017	***	-0.00057
		(0.002)			(0.002)		
	average export intensity, other countries, all products. (1-y)	0.001		0.00004	0.000		0.00001
		(0.002)			(0.002)		
	average export intensity, other countries, all products. y	0.001		0.00002	-0.001		-0.00004
		(0.002)			(0.002)		
Spillover	**number of other firms, same product. (1-y)**	0.022	***	0.00072	0.044	***	0.00147
		(0.002)			(0.001)		
	number of other firms, same product. y	0.017	***	0.00055	0.034	***	0.00114
		(0.002)			(0.002)		
	average export intensity, other firms, same product. (1-y)	0.025)	***	0.00081	0.057	***	0.00193
		(0.005)			(0.004)		
	average export intensity, other firms, same product. y	0.03	***	0.00099	0.065	***	0.00219
		(0.007)			(0.006)		
	number of other firms, all products. (1-y)	0.004	***	0.00014	0.003	***	0.00009
		(0.001)			(0.000)		
	number of other firms, all products. y	0.002	*	0.00006	0.001		0.00002
		(0.001)			(0.001)		
	average export intensity, other firms, all products. (1-y)	0.006		0.00019	0.010	***	0.00033
		(0.005)			(0.003)		
	average export intensity, other firms, all products. y	-0.011	**	-0.00037	-0.004		-0.00014
		(0.006)			(0.004)		
	country value, other firms, same product. (1-y)	-0.001	***	-0.00003	-0.002	***	-0.00006
		(0.000)			(0.000)		
	country value, other firms, same product. y	-0.001	***	-0.00003	-0.002	***	-0.00005
		(0.000)			(0.000)		
	country value, other firms, all products. (1-y)	-0.000	***	-0.00001	-0.000	***	0.00001
		(0.000)			(0.000)		
	country value, other firms, all products. y	-0.000		-0.00000	-0.000		-0.00000
		(0.000)			(0.000)		
	rho	0.047	***		0.278	***	
		(0.007)			(0.009)		

Note: Standard deviations in parentheses. (1-y) and y denote interacted with entrance and continuance, respectively. *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Number of observations is 424,512. Value variables are in NOK million. Year dummies, product dummies, firm dummies, regional dummies and product-year dummies were included in the regressions but are not reported. Random effects are for firm-product-country. The number of firm-product-country observations is 38,592. Log-likelihood and σ for WREP are -27 294 and 0.221. Log-likelihood and σ for REP are -31,670 and 0.620

4.1 Sunk costs, learning and spillovers

4.1.1 Market-specific sunk costs

The effect of sunk export costs is captured by the variable *market export status,* which is equal to y_{ivjt-1}. The coefficient is positive and significant in both regression models, which gives support to the hypothesis of market-specific sunk costs. This holds true for our baseline regression, WREP, as well as for the REP regression. As expected, the coefficient is considerably higher for the REP model than it is for the WREP model. The scaled coefficient is 1.53 for the former and 1.10 for the latter. This underlines the importance of adequately correcting for unobserved heterogeneity. Both results imply that the probability of serving a market increases with lagged export status in that market. According to the APE from the WREP model, the probability of exporting to a market increases by more than 180% (from 3.9 to 11.0 percentage points) if the firm exported to the market the previous year as compared to if it didn't. Our results seem quite robust. We experimented with running regressions excluding the largest firm from the regressions, which account for 13.2 per cent of total exports and 13.3 per cent of the total number of positive export market channels. This did not alter the results much. Neither did excluding the 5% smallest or largest firms.[72]

4.1.2 Market-specific learning

As discussed in section 2.3, it is not possible to distinguish the effect of market-specific sunk export costs from the effect of market-specific learning. Thus the positive coefficient for *market export status* may also indicate the firms' export costs have been reduced through learning.

Additional learning effects from export intensity in the market are analysed separately by including the variable *market export value* in addition to *market export status*. The effect of

[72] We also ran separate regressions for various product categories. Lagged export status was significant for most categories. An exception is Fresh White Fish. It was highest for Clipfish/Stockfish/Salted Whitefish – not surprising, as this is a more heterogeneous product group where quality differences are important.

export value on a given market is also positive and significant, but small compared to export status. Export value is given in NOK million (corresponding to about USD 0.11 million in the year 2000). Comparing APEs, for the two variables show that in order for *market export value* to match the effect from the mere presence in the market, a firm must increase its market-specific exports by about NOK 125 million. As a comparison, median export value from a firm to a market is only NOK 0.36 million (see Table 1).

4.1.3 Country- versus market-specific sunk costs.

The variable *country export status, other products* equals 1 if firm *i* exported other products to country *j* last period and 0 otherwise. When interacted with ($1-y_{ivjt-1}$) this variable may capture the effect of country-specific sunk costs that come in addition to market-specific sunk costs. For example, costs related to acquiring information about a country's business culture and legislation are specific to that country rather than to the market.[73] If the firm exported other products, but not product *v*, to country *j* in the last period, then part of *G* is already paid, making it less costly to start exporting product *v*.

The results on country-specific export status are important. If these effects are not taken into account, they will be captured as market-specific effects. Comparable regressions where we excluded the *country export status, other products* (interacted with dummy for entry as well as continuance) resulted in coefficients for lagged export status which were greater than those reported in Table 3. Exclusion of country-specific effects is therefore an important misspecification that results in overestimation of market-specific sunk costs.

The importance of country-specific sunk costs also becomes evident when we run regressions on the country dimension only. Such regressions yield larger coefficients for the lagged dependent variable as compared to our baseline firm-product-country regressions.

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[73] Information gathering is believed to be an important part of sunk export costs (see Roberts and Tybout, 1997).

4.1.4 Country-specific learning

Firms may learn about exporting a given product to a given country from their export experience with other products in the same country (see section 2.4), and *country export status, other products* may also reflect country-specific learning. Finding customers is one example of how experience with exporting a product can reduce the costs of exporting another product. A firm that exported product *v* to country *j* in the last period may have established contacts with several customers in that country. Those same customers may be interested in another product, *v'*, and so the costs related to finding customers for *v'* will be lower for a firm entering the market for *v'* in *j* this period. For a continuing exporter, it may also be easier to keep existing customers for *v'* in *j* if the firm exported other products there the previous period.

Its coefficient is positive and significant. This is the case both when the firm was not in the market in the previous year (interact 1-y_{ivjt-1}) and when it was (interacted with y_{ivjt-1}). Having exported another product to a country in the past year increases the probability of entering the country with a new product this year by 11.1 per cent (from 5.2 to 5.8 percentage points) and the probability of continuing to export a particular product to the country by 49.6 per cent (from 4.9 to 7.34 percentage points). Since in this case the effect is higher for continuing exporters than for entrants, this may indicate that the former are better at exploiting learning effects than the latter. Medin and Melchior (2002) also present qualitative evidence on such intra-country learning: From interviews with Norwegian seafood exporters, they found that different products were often sold to the same customers, and that costs of introducing a new product in a country were significantly lower if the firm exported other products to the country.[74]

[74] Note that these results can also reflect the presence of country specific sunk export costs

Also for market experience, there may be an additional learning effect from export intensity. In this case, firm *i*'s export value of other products to country *j* should reduce its costs of exporting product *v* to country *j*. The effect is captured by the variable *export intensity, same country, other products.* Our results indicate no additional learning effects from export intensity, as the coefficients are negative and partly significant. These effects may indicate that firms tend to remain specialised in their export markets, given high export values. One reason for such specialisation effects may come from the supply side: firms may have limited production capacity, so that the *export value* of other products does not increase the probabilities of starting or continuing to export a given product.

4.1.5 Learning from export experience in other countries

Firms may also learn about exporting to a specific market from their own experience in other countries. Demand patterns, customs procedures and competition legislation may be similar across countries, so export experience in other countries may make it easier to export to a given country. The effect is likely to increase with the number of other countries to which the firm exports. Some effects, like learning about demand patterns, may be product-specific, while others, like learning about business culture, may be more general. We therefore distinguish between intra-product effects, captured by the variable *number of other countries, same product,* and inter-product effects captured by the variable *number of other countries, all products*. Again, there may be additional learning effects from export intensity in other countries.

The results show positive effects of having product-specific experience from other countries: the variable *number of other countries, same product,* is positive and significant for both entrants and continuing exporters. However, the effect is smaller than for intra-country learning. If the firm exported a product to an additional country in the past year, the probability of entering a given country with the product this year increases by 1.9% and the probability of continuing to export the product to a given country by 1.0%.[75] There is no evidence of learning across product groups from other countries. Furthermore, there seem to be no additional learning effects along the intensive margins, neither within product groups (captured by average *export intensity, other countries, same product*), nor between product groups (captured by average *export intensity, other countries, all products*).

4.1.6 Comparison with other studies

Summing up, the results on learning from own export experience seem to indicate that such effects are strongest within one and the same country. A firm's presence with a product in a given country seems to induce learning about exporting another product to that country. There are also learning effects within product groups across countries, but no effects between countries and products. Learning from own export experience in other countries takes place through the extensive margin (number of other countries to which the firm exports), and not the intensive margin (average export value to other countries).There is some evidence of learning from own export intensity in the same market, but effects are small.

Also other studies have documented learning effects from exporting. Some, among them Schmeiser (2012), Eaton *et al.* (2008), Lawless, (2009) and Albornoz *et al*. (2012), find that export expands through gradual entrance, possibly caused by learning. Lawless (2011), Morales *et al*. (2011), Castagnino (2011), Alvarez *et al.* (2010), Fabling *et al*. (2011), Gullstrand (2011) and Meinen (2012) all find that export experience in other countries or markets increases the probability of exporting to a particular country or market. These studies define learning variables somewhat differently than we do, and do not include learning effects along the extensive and intensive margins as we do. None of these distinguish between entering and continuing exporters within the same regression as we do, and all but Gullstrand

[75] These results confirm the qualitative results from interviews with Norwegian seafood exporters in Medin and Melchior (2002). They found evidence on learning from experience in other countries, but the effect was less important than experience within the same country.

(2011) and Meinen (2012) concentrate on learning effects for entering firms only. Most of these studies also differ from ours in the econometric methods applied.

4.1.7 Spillovers from other exporters

Firms' export experience is knowledge that may spill over to other firms and reduce their export costs. Spillover effects are likely to be stronger the larger the number of other exporters in the country. Some spillovers, such as information about demand, may be product-specific, whereas others, such as information about business culture, may be more general. We capture these spillover effects with the variables *number of other firms, same product;* and *number of other firms, all products*. As for learning, we also include corresponding effects along the intensive margin.

We find evidence of positive spillovers along the extensive margin. The number of other firms selling the same product in the same country has a positive and significant effect on the probability of starting to export to the market and on the probability of staying in the market. The APEs show that an additional Norwegian firm exporting a product to a country increases the probability of a firm exporting the same product to the same country by approximately 1% (for entrants as well as for continuing exporters). There is also some evidence of inter-product spillovers, but effects are smaller. It should be noted that these revealed spillover effects are net of any competition effects, which would tend to reduce the coefficients. The results are in line with findings in Medin and Melchior (2002), where interviews with Norwegian seafood exporters showed that firms consider it advantageous if there are other Norwegian exporters present in a market.

Regarding spillovers along the intensive margin, we find evidence of intra-product spillovers (captured by *average export intensity, other firms, same product),* but not of interproduct spillovers (captured by *average export intensity, other firms, all products*). We have also included the total value of other firms' export (of the same or all products) as a possible source of spillovers, but most coefficients are negative and significant. We interpret this as a dominating competition effects.

Summing up, we find strong indications of intra-product spillovers along the extensive margin (number of other firms exporting a particular product to the country) as well as the intensive margin (their average export value). There is also some evidence of inter-product spillovers along the extensive margin (number of other firms exporting any product to the country), but not along the intensive margin. We find is no evidence of spillovers from total export value of other Norwegian firms to the country.

One risk is that our spillover variables may capture market attractiveness rather than actual spillovers. To control for this, we have included several indications of market attractiveness (see section 4.3.1). We also experimented with including country dummies in our regressions. The results for the spillover variables remained very similar to those reported in Table 3, indicating that they capture actual spillovers.

Our results are in line with the theory of spillovers presented in Krautheim (2012), which predicts spillovers to be a function of the number of other exporters to the country question. Most empirical studies consider the impact of concentration of export activity within a region or industry in the exporting firm's home country. Regarding spillovers that affect global export costs, results are mixed.[76] However, evidence regarding spillovers that affect country- or market-specific export costs is more clear: Requena Silvente and Castillo Giménez (2007), Koenig (2009), and Lawless (2011) find that spillovers affect country-specific export costs; while Alvarez *et al.* (2010), Koenig *et al*. (2010) and Fabling *et al*. (2011) find that spillovers affect market-*spe*cific sunk export costs. As opposed to our study, these studies focus solely on firms entering into different markets, not on firms that continue to export. Koenig *et al*.

[76] See e.g., Clerides *et al*. (1998); Bernard and Jensen (2004); Aitken *et al*., (1997); Barrios *et al*. (2003); and Greenaway *et al*. (2004).

(2010) distinguish between fixed and variable export costs in two separate regressions, and find that only the former are affected by spillovers.

4.2 Alternative explanations

4.2.1 Internal learning and spillovers

We have assumed, like most studies of export decisions referred to here, that learning as well as spillover effects are external to firms. It may be, however, that learning and (to a lesser extent) spillover effects are endogenous. A firm may want to try exporting to a market not only because it believes that this market is profitable, but also because it knows that it will learn from exporting and therefore takes into account that entry into other markets later will become easier (for example by reducing uncertainty). In this case, a firm's entries across markets are not independent. This is discussed in Albornoz *et al.* (2012), who analyse sequential exporting and argue that firms internalise learning effects, especially for the first market they enter. We have not modelled the decision to enter into export activity as such, since we include only firm-product observations that are positive each year. If learning effects are particularly important for the *first* export decision, the problem of assuming that learning effects are external to the firm is not important in our investigation. Furthermore, if learning is internalised into the firms' decision problem, it is not clear whether the resulting interdependence would alter our results, since the sequence of entry into new markets could well be the same.

Furthermore, it may be that firms take into account that their export decisions make it more likely that also other firms will follow. A firm may, for instance, try to choose countries or markets where spillovers are less likely to materialise (in order to avoid that other firms benefit from its knowledge) – or markets where spillovers are more likely to materialise (in order to benefit from mutual spillover effects). Again it is not clear whether internalised spillover effects like would alter the sequence of market entrances.

4.2.2 Fixed versus sunk costs

In section 2 we hypothesised that learning and spillovers impact on fixed and sunk export costs, and this is our motivation for distinguishing between effects on entering firms and continuing exporters. Other interpretations are also possible.

Our approach differs from some other contributions in how we interpret the effect of interaction variables between learning/spillover variables and lagged export status (i.e. the effect for continuing exporters). If the coefficients for our learning and spillover variables for continuing exporters are positive, we interpret this as supporting the hypothesis that learning and spillovers reduce fixed, and not sunk costs.

An alternative interpretation could be that sunk costs are greater for certain types of firms. If our learning and spillover variables reflect characteristics of firms rather than actual learning and spillovers, and sunk export costs vary according to these characteristics, then positive coefficients for continuing exporters can reflect the fact that sunk costs are higher for firms with those characteristics. In such cases, persistence, and hence the probability of continuing to export, should be higher for the firms with the characteristics in question. Other authors (e.g., Bugamelli and Infante, 2003, Máñez *et al.*, 2008 and Gullstrand, 2011), who do not distinguish between sunk and fixed export costs, interpret coefficients for interaction variables between lagged export status and firm (and possibly country) characteristics this way.

For example, we include the number of other markets the firm exports to, and we find a positive effect for continuing exporters. Using the alternative interpretation, this should indicate that firms that export to many markets face greater market-specific sunk export costs. We find such an interpretation counterintuitive and therefore choose to interpret the positive coefficient as reductions in fixed costs due to learning.

A related alternative interpretation is that learning/spillovers impact on continuing exporters' sunk as well as fixed costs, because lower sunk costs make exit and re-entry less costly. [77] This is an effect that works in the opposite direction of the effect from increased probability of staying in the market due to reduced fixed cost from learning/spillovers. If anything then, the impact of learning/spillovers on fixed costs is underestimated in our model.

4.3 Other independent variables

Our regressions include a range of other explanatory variables. Here we offer only a short description of these, but the regression results are reported in Appendix 3.

4.3.1 Other variables

As a proxy for productivity, firm size is often included in studies of sunk export costs, and it is generally found to be positively related the probability of exports (see e.g. Roberts and Tybout, 1997). Lacking data for productivity, production or capital stock, we use the log of the firm's total export value. The variable is lagged one year and is called *size*. We further correct for the firm's specific competitive advantage by including variables that reflect the firm's position in the market, the country and for the product relative to Norwegian firms: *leader market*, *leader country* and *leader product*. The variables are lagged one year. Note that the *size* and *leader* variables vary over time in the firm-product-country, firm-country, firm-product, and firm dimensions. They may therefore capture differences in exporting ability that vary over time. In addition, we include firm dummies to correct for time-invariant differences in exporting ability. Consequently, although we lack data for several firm-characteristics, we believe that we have adequately corrected for differences in the ability to export along the different dimensions.

[77] This is not correct if our assumption about full recurrence of the sunk cost after one period of exit holds. In that case, a reduction in a firm's sunk cost due to learning/spillovers will fully depreciate after one period of exit, so the probability of staying in the market is not affected. Roberts and Tybout (1997) find that that most of the sunk cost must be repaid after one period of exit.

We include the variable *import adjusted*, defined as log of import (from all countries) of product *v* to country *j*, in order to capture demand and demand differences for each product within and between the countries included in the regressions.[78] We also include changes in the *country-specific* exchange rates, *appreciation.*

As suggested by the gravity literature of international trade, we include log of GDP (*gdp*), log of GDP per capita (*gdp per capita*), and log of distance (*distance*). [79] In addition we include three-year moving averages of growth rates in GDP (*gdp growth*). The governance qualities of a country may influence its attractiveness as a market. We include three measures of governance indicators: *regulatory quality*, *rule of law,* and *control of corruption*. Of the above-mentioned variables, only *leader* variables, *import adjusted*, *gdp growth*, *control of corruption* and *distance* prove to be significant and with the expected signs (see Appendix 3 for discussion).

4.3.1 Dummy variables

Ideally, but not possible in our model, we should correct for unobserved heterogeneity by including fixed effects on the firm-product-country combination. This would have corrected for all time-invariant unobserved heterogeneity in all combinations of the three dimensions. An alternative approach would be to include dummies on the following combinations of variables: firm-product, firm-country, and country-product, in addition to random effects on the firm-product-country combination. This, on the other hand, would yield a large number of independent variables – prohibitively large for data computational purposes. We therefore choose to include dummies along the dimensions where we have few other independent variables to account for heterogeneity.

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[78] In some versions of our regressions we also included total Norwegian exports and Norway's export share (in the world market) of each product. These were included to reflect Norway's comparative advantages and time-varying supply characteristics. Results varied. The results presented here are when product-year dummies were included; these variables capture time-varying product-specific effects.

[79] See Feenstra *et al.* (2001) for a survey.

We include dummies for (i) products, to capture supply and demand side differences across products; (ii) product-year, to capture production and demand cycles; (iii) firms, to compensate for the lack of data for firm characteristics such as productivity differences; (iv) regions; [80] (v) EU-countries; (vi) the USA; [81] and (vii) countries for which Norway has a free trade agreement with.[82]

Although our analysis includes many standard gravity variables capturing differences between countries, a concern in interpreting the results is that persistence in firm-market export may be due to unobserved characteristics of countries. We therefore experimented with running a regression also including country dummies, but the results were qualitatively almost identical to those presented here.

5 Conclusions

In this article we have investigated the importance of sunk export costs by examining persistence in firms' export behaviour of firms. Unlike earlier studies, which have focused on global or country-specific sunk export costs, we have concentrated on the costs for already-established exporters of entering a particular market. We find that having exported to a particular market the previous period increases the probability of exporting to the same market in the current period with more than 180 per cent as compared to not having exported to the market. This we interpret as evidence of the existence of market-specific sunk export costs.

Furthermore, we have investigated how market-specific export costs are affected by learning and spillovers. We have looked for a wide range of learning spillover effects, intra- and inter-product as well as intra- and inter-country. These effects may occur along the extensive margin as well as along the intensive margin. We also investigate how learning and spillovers

[80] Europe, Asia, Africa and the Americas.
[81] Anti-dumping duties have been imposed on Norwegian exports of salmon in the US market.
[82] Separates dummies are included for the European Economic Area (EEA), and for countries that became EU members in 2004 and in 2007 (FTAEEA04 and FTAEEA007). Norway had generous free trade agreements with these countries (for seafood) that became void when they joined the EU.

affect sunk and fixed costs differently, by analysing the decision to enter new markets separately from the decision to stay in existing markets. Whereas the probability of starting export activities is related to sunk and fixed costs combined, the probability of staying in export markets is related to fixed costs only. Several new effects are identified.

Our evidence indicates that firms learn about exporting to a particular market from their own exporting experience in the market in question as well as from own export experience in other markets. Learning effects appear to be strongest for presence within one and the same country: having exported another product to that country in the past year increases the probability of entering the country with a new product this year by 11.1 per cent and the probability of continuing to export a particular product to the country by 49.6 per cent. Whereas a firm's *presence* in the country seems to induce learning, we found no learning effects from high export *value* of other products of the country. Our results further indicate that learning effects are present within product groups across countries, but absent between countries and products. Learning from own export experience takes place through the extensive margin (number of other countries the firm exports to), and not through the intensive margin (average export value to other countries).

We also provide evidence on spillovers from the presence of other Norwegian exporters. As opposed to most other studies, which concentrate on spillovers in the home country, we focus on spillovers in the destination country. Our results indicate that a greater number of other Norwegian exporters in a given country increases the probability of export to that country. We find indications of intra-product spillovers along the extensive margin (number of firms exporting a particular product to the country) as well as long the intensive margin (their average export value). There is also some evidence of inter-product spillovers along the extensive margin (number of firms exporting any product to the country), but not along the intensive margin (their average export value). There is no evidence of spillovers from total Norwegian export value to country.

Appendix 1

In section 2.1 we proposed that the profit function $\pi^*_{ivjt}(\mathbf{p}_{vjt},\mathbf{v}_{ivt})$ could be represented as proportional to sales in a given market, independently of sales of other products in the country or of the same product in other countries. With standard CES preferences with elasticity of substitution $\sigma>1$, firm i's demand for a variety v sold in country j can be written as:

A1 $$q_{ivj} = p_{ivj}^{-\sigma}\mu_{vj}Y_jP_j^{\sigma-1}$$

Above, q_{ivj} denotes demanded quantity, and p_{ivj} denotes the price charged by firm i for product v in country j. Demand depends on (potential) country-specific preferences for product v, μ_{vj}, country j's income level, Y_j, and an overall price index in country j, P_j, taken as exogenous for firm i.

Assume that firm i produces under constant marginal costs. Marginal costs of supplying product v in country j are then given by:

A2 $$c_{ivj} = \tau_{vj}w/a_{iv}$$

Above, c_{ivj} denotes firm, product and country-specific marginal costs. These depend on variable transportation costs, τ_{vj}, marginal production costs, w, and a firm-product specific productivity parameter, a_{iv}. Profits for firm i from exporting are given by:

A3 $$\Pi_i = \sum_j\sum_v \pi^*_{ivj}(\mathbf{p}_{vj},\mathbf{v}_{iv}) - \mathbf{C}_{ivj}$$

Above, $\pi^*_{ivj}(\mathbf{p}_{vj},\mathbf{v}_{iv})$ represents operating profits from exporting good v to country j. It depends on product-country characteristics, **p**, that are exogenous for the firm and firm-product characteristics, **v**. The vector **C** denotes sunk/fixed costs (in this appendix we suppress the time dimension so that fixed and sunk costs are treated similarly), which could be firm-specific, firm-product specific, firm-country specific and firm-product-country specific. This vector therefore captures all sunk/fixed costs discussed in the text, as well as others. In the empirical specification in the text we focused on firm-country and firm-product-country specific sunk/fixed costs. The profit function can now be written:

A4 $$\Pi_i = \sum_j \sum_v \left(p_{ivj} q_{ivj} - \frac{\tau_{vj} w}{a_{iv}} q_{ivj} \right) - \mathbf{C}_{ivj}$$

The firm charges a price that is a mark-up, $\sigma/(\sigma-1)$, over marginal costs:

$$p_{ivj} = \frac{\sigma}{\sigma-1} \frac{\tau_{vj} w}{a_{iv}}$$

Operating profits from exporting product *v* to country *j* are therefore:

A5 $$\pi^*_{ivj} = \left(p_{ivj} q_{ivj} - \frac{\tau_{vj} w}{a_{iv}} q_{ivj} \right) = \left(\frac{1}{\sigma-1} \frac{\tau_{vj} w}{a_{iv}} \right) q_{ivj} = \left(\frac{1}{\sigma-1} \right)^{1-\sigma} \sigma^{-\sigma} \left(\frac{\tau_{vj} w}{a_{iv}} \right) \mu_{vj} Y_j P_j^{\sigma-1}$$

Operating profits are therefore proportional to sales. As seen, these profits π^*_{ivj} depend on variables exogenous to the firm (captured by the vector $\mathbf{p}_{\mathrm{vj}}$) and variables that are product and firm-specific (captured by the vector $\mathbf{v}_{\mathrm{iv}}$). Therefore we write the profit equation in the text as $\pi^*_{ivj}(\mathbf{p}_{\mathrm{vj}},\mathbf{v}_{\mathrm{iv}})$.

For a firm with fixed supply, our model requires only minimal adjustments. To illustrate this, consider a firm that sells one product only. We simplify by setting w=1 and a=1, so that marginal costs are $c_j=\tau_j$ .Profits are:

$$\Pi = \sum_j \left(p_j q_j - \tau_j q_j \right) - \mathbf{C}_j$$

The corresponding profit-maximization problem is a constrained one, since the sum of exports cannot exceed the total quota, Q. The Lagrangian for the maximization problem is:

A6 $$L = \sum_j \left(p_j q_j - \tau_j q_j \right) - \mathbf{C}_j - \lambda \left(\sum_j q_j - Q \right)$$

The first-order conditions are

$$\frac{\partial L}{\partial q_j} = p_j \left(\frac{\sigma-1}{\sigma} \right) - \left(\tau_j + \lambda \right) = 0$$

A7

$$\sum_j q_j = Q$$

As compared to our unconstrained maximization problem, the problem corresponds to adding a constant (shadow price of quotas) to the marginal cost. The shadow price in turn depends on export costs and income levels in the two countries which are exogenous to the firm.

Appendix 2

Table A2.1 Independent variables

Independent variable	Description
Market export status	Lagged export status. A dummy equal to 1 if firm *i* exported product *v* to country *j*. It reflects the importance of market-specific sunk exporting cost or learning.
Country export status	A dummy equal to 1 if firm *i* exported other products to country *j l*ast year. Reflects the importance of country-specific sunk costs and learning from own experience of exporting other products to country *j*.
Number of other countries, same product	Number of other countries (not including country *j*) firm *i* exported product *v* to last year. Reflects learning from experience in other countries.
Number of other countries, all products	Number of other countries (not including country *j*) firm *i* exported all products to last year. Reflects learning from experience from exporting to other countries.
Number of other firms, same product	Number of other Norwegian firms (not including firm *i*) that exported product *v* to country *j* the previous year. Reflects market-specific spillovers.
Number of other firms, all products	Number of other Norwegian firms (not including firm *i*) that exported all products to country *j* the previous year. Reflects country-specific spillovers from exporters.
Market export value	The firm's export value of product *v* to country *j* the previous year. Reflects additional learning effects from being deep in the market, and corresponds to *market export status*
Export intensity, same country, other products	The export value of other products (not including product *v*) from firm *i* to country *j* the previous year. A learning variable corresponding to *country export status.*
Average export intensity, other countries, same product	Export value of product *v* from firm *i* to other countries (excluding country *j*), divided by *number of other countries, same product*. A learning variable corresponding to *number of other countries, same product*.
Average export intensity, other countries, all products	Export value of all products from firm *i* to other countries the previous year, divided by *number of other countries, all products.* A learning variable corresponding to *number of other countries, all products*.
Average export intensity, other firms, same product	*Country value, other firms, same product* divided by *number of other firms, same product*. A spillover variable corresponding to *number of other firms, same product.*
Average export intensity, other firms, all products	*Country value, other firms, all products,* divided by *number of other firms, all products*. A spillover variable corresponding to *number of other firms, all products*.
Country value, other firms, same product	Export value from other Norwegian firms (excluding firm *i*) of product *v* to country *j* the previous year. An additional spillover variable.
Country value, other firms, all products	Export value from other Norwegian firms (excluding firm *i*) to country *j* the previous year. An additional spillover variable.
Leader, market	Export value of product *v* from firm *i* to country *j*, divided by Norway's export value of product *v* to country *j*. Lagged one year.
Leader, country	Export value of all products from firm *i* country *j*, divided by Norway's total export value to country *j*. Lagged one year.
Leader, product	Export value of product *v* from firm *i* to all countries, divided by total Norwegian exports of product *v*. Lagged one year.
Size	Log of firm *i's* export value. A proxy for firm size. Lagged one year.
Gdp	Log of GDP. In 1000 current NOK.
Gdp per capita	Log of GDP per capita. In 1000 current NOK.
Growth in gdp	3-year moving averages of growth rates in GDP (fixed UD$).
Appreciation	Growth in the exchange rate between NOK and the local currency.
Distance	Log of distance from Norway to country *j*. In km.
Import	Log of import of product *v* in country *j*. In 1000 current NOK. Missing observations are replaced by mean.
Regulatory quality	Perceived quality of a government's regulatory quality, normally distributed for country ranking.
Rule of law	Perceived quality of rule of law, normally distributed for country ranking.
Control of corruption	Perceived control of corruption, normally distributed for country ranking.
Dyear	Dummy equal to 1 for all years except, 2007.
Dregion	Dummy equal to 1 for all regions, except Africa.
Dproduct	Dummy equal to 1 for all products, except fresh fillets of whitefish.
Dfirm	Dummy equal to 1 for all firms, except one.
Dyearproduct	Dummy equal to one for all year - product combinations, except fresh fillets of whitefish in 2007.
DUSA	Dummy equal to 1 for USA.
DEU	Dummy equal to 1 for EU member countries.
DFTA	Dummy equal to 1 for countries with which Norway has free trade agreements.
DEEA	Dummy equal to 1 for EFTA countries.
DFTAEEA04	Dummy for new EU member countries in 2004 with which Norway previously had free trade agreements.
DFTAEEA07	Dummy for new EU member countries in 2007 with which Norway previously had free trade agreements.

Appendix 3 Other explanatory variables

In the main text we report and discuss results for lagged export status and for learning and spillover variables. In this appendix we report and discuss results from the other variables included as well as the results for the time independent means of the variables included in the WREP model. We also include the estimated ρ and the estimated coefficients for lagged export status and lagged export value of the product for reference purposes. The results tables are included as Tables A3.1, A3.2 and A3.3

We include dummies for (i) products, to capture supply and demand side differences across products (ii) product-year, to capture cycles on the production and demand side; (iii) firms, to compensate for the lack of data for firm characteristics such as productivity differences; (iv) regions[83]; (v) EU-countries; (vi) the USA[84]; and (vii) countries for which Norway has a free trade agreement with.[85]

A3.1 Leader

The estimated coefficients of the three leadership variables, *leader market, leader country and leader product* are all positive and significant. Leaderships in the market, the country and for the product (in the previous period) have positive effects on the probability of exporting a product to a market. This is as expected. Note that the estimated effects seem to be larger for the market, smaller for the country and smallest for leadership in a given product.

A3.2 Firm size

The variable *firm size* (log of the firm's total export value) is not significant. This contradicts with earlier studies, where firm size is found to significantly increase the probability of export. This result reflects the inclusion of our dummy variables. Firm dummies reflect firm

[83] Europe, Asia, Africa and the Americas.
[84] Anti-dumping duties have been imposed on Norwegian exports of salmon in the US market.
[85] Separates dummies are included for the European Economic Area (EEA), and for countries that became EU members in 2004 and in 2007 (FTAEEA04 and FTAEEA007). Norway had generous free trade agreements with these countries (for seafood) that became void when they joined the EU.

characteristics, and product-year dummy variables reflect product dynamics. Hence our firm size variable reflects only firm size dynamics that can not be attributed to product specific dynamics. The results therefore reflect that firm export growth (when we have controlled for other variables) mainly occurs through expansion in existing export channels rather than through entrance in new markets.

A3.3 World trade

We include the variable *import* which is defined as log of import (from all countries) of product *v* to country *j*, as explanatory variable. It captures demand and demand differences for each product within and between the countries included in the regressions. The coefficient is positive and significant.

A3.4 Exchange rates

An appreciation of Norwegian kroner relative to the currency of country *j* has no significant effect on the probability of export. Results from other studies are mixed: Bernard and Jensen (2004) find a weak effect of the industry specific exchange rate. Campa (2002) finds a significant effect of changes in the firm-specific exchange rate, where each firm's exchange rate is calculated according to its export markets. Clerides *et al*. (1998) also find an effect in some cases. Meinen (2012) and Gullstrand (2011) find no effect of country specific exchange rates. However, Gullstrand (2011) finds a negative effect of country specific exchange rate variation.

A3.5 Market size and transport costs

The variable measuring market size, *gdp*, is not significant. Income level, measured by *gdp per capita,* is insignificant. The fact that market size becomes insignificant is because we also include the countries' total import of the seafood product in question. Furthermore, country specific time-invariant averages of this variable are included in the WREP regression. Note however, that *gdp* also turns out insignificant in its time invariant average version (see table A3.2). Growth of gdp (*growth, gdp*) has positive and significant coefficients, however. Export presence is more prevalent in markets with high growth rates. This may possibly reflect positive expectations about profitability in emerging markets. Further, the effect of *distance* is negative and significant, as expected, in the two models. These results correspond to results found in the gravity literature of international trade (see Feenstra *et al*., 2001). Since distance is time invariant, its mean is not included among the auxiliary time independent variables in the WREP model.

A3.6 Governance indicators

The two indicators of good governance (*regulatory quality and rule of law*) have insignificant coefficients in the WREP model (but positive and significant in the other models). The reason for this result may be that these indicators are highly persistent across countries over time. Their time invariant means have positive, but not significant coefficients in the WREP model. *control of corruption*, is negative and significant in the REP model, but positive and significant in the WREP model. The difference between REP model and the WREP model can be explained with the fact that time-invariant average of this indicator is included in the WREP model. In this case, the economic interpretation is interesting. *Control of corruption* has a negative and significant coefficient in the REP model. *Ceteris paribus* therefore, corruption does not seem to discourage Norwegian seafood exporters. From the Wooldridge regressions, however, the time variation for the *Control of corruption* variable has a positive and significant effect. The coefficient of the time-invariant mean is negative and significant. Thus, when controlling for time invariant mean and when taking into account initial conditions, it seems that corruption deters Norwegian exporters. One potential explanation is that unobserved firm-market characteristics that affect firms' abilities to handle corruption are correlated with the initial value of the dependent variable. This interpretation implies that many firm-market combinations have good abilities to handle corruption. When initial conditions are controlled for, the isolated effect of corruption is negative (giving a positive coefficient for *Control of corruption*). Again, our results indicate the importance of adequately correcting for unobserved heterogeneity.

A3.7 Trade policy relevant dummy variables.

The trade policy dummies included in the regressions are generally insignificant. Both the USA and EU have imposed trade reducing restrictions on imports of Norwegian seafood. This is so in particular for farmed salmon and trout. Still the results are insignificant in the WREP model (but we obtain negative and significant results in the REP model). Also, note that the signs are the opposite for the countries for which Norway had free trade agreements prior to their EU membership.

Table A3.1 Other regression results

	WREP			REP		
	Coeff.		St. dev	Coeff.		St.dev
market export status	1.124	***	0.053	1.802	***	0.053
market export value	0.017	***	0.003	0.024	***	0.004
leader, market	0.076	***	0.015	0.250	***	0.014
leader, country	0.037	***	0.006	0.067	***	0.005
leader, product	0.009	***	0.003	0.007	***	0.003
Size	0.012		0.015	-0.023		0.015
appreciation	0.000		0.000	0.000		0.000
Gdp	0.095		0.200	0.109	***	0.007
gdp per capita	0.150		0.200	0.010		0.014
gdp growth	0.012	***	0.003	0.006	**	0.002
regulatory quality	0.008		0.046	0.149	***	0.027
rule of law	-0.008		0.057	0.069	**	0.033
control of corruption	0.113	***	0.042	-0.123	***	0.026
import adjusted	0.043	***	0.014	0.011	**	0.005
EU	-0.024		0.106	-0.184	***	0.036
USA	-0.039		0.057	-0.190	***	0.073
FTA	-0.055		0.056	-0.003		0.034
FTAEEA04	0.163		0.115	0.019		0.045
FTAEEA07	0.161		0.138	0.288	***	0.062
distance	-0.130	***	0.023	-0.162	***	0.025
Rho	0.047			0.278		

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Number of observations is 424,512. Value variables are in NOK million. Year dummies, product dummies, firm dummies, regional dummies and product-year dummies were included in the regressions but are not reported. Random effects are for firm-product-country. The number of firm-country-product observations is 38,592. Log-likelihood and sigma for WREP are -27 294 and 0.221. Log-likelihood and sigma for REP are -31,670 and 0.620.

Table A3.2 Coefficients for time-independent means of variables included in the WREP regression. Learning and spillover variables.

	Coeff.		St.dev
market export status	-0.09100		0.06830
market export status	-0.02230	***	0.00255
market export value	-2.77500	***	0.07830
country export status, other products. (1-y)	-2.07800	***	0.07530
country export status, other products. y	0.00062		0.00088
export intensity, same country, other products. (1-y)	-0.00019		0.00093
export intensity, same country, other products. y	0.01030	***	0.00314
number of other countries, same product. (1-y)	-0.00297		0.00391
number of other countries, same product. y.	0.00844	**	0.00352
average export intensity, other countries, same product. (1-y)	0.00550		0.00393
average export intensity, other countries, same product. y	-4.19700	***	0.07730
number of other countries, all products. (1-y)	-4.19800	***	0.07730
number of other countries, all products . y	-0.03460	**	0.01480
average export intensity, other countries, all products. (1-y)	-0.03590	**	0.01480
average export intensity, other countries, all products. y	0.01030	***	0.00242
number of other firms, same product. (1-y)	-0.01110	***	0.00261
number of other firms, same product. y	0.03140	***	0.00684
average export intensity, other firms, same product. (1-y)	0.00702		0.00863
average export intensity, other firms, same product. y	-0.00502	***	0.00099
number of other firms, all products. (1-y)	-0.00382	***	0.00106
number of other firms, all products. y	-0.00141		0.00531
average export intensity, other firms, all products. (1-y)	-0.01260	*	0.00708
average export intensity, other firms, all products. y	-0.00104	***	0.00025
country value, other firms, same product. (1-y)	0.00056	*	0.00029
country value, other firms, same product. y	0.00010	*	0.00006
country value, other firms, all products. (1-y)	0.00017	**	0.00007
country value, other firms, all products. y	0.69100	***	0.02230

Note: Distance and USA dummy, which are time-invariant: and firm size, which is captured by firm dummies, are not included.

Table A3.3 Coefficients for time-independent means of variables included in the WREP regression. Other variables.

	Coeff.		St.dev
leader, country	-0.01980	**	0.00861
leader, product	-0.01220	**	0.00500
appreciation	-0.00001		0.00007
Gdp	-0.06100		0.20000
gdp per capita	-0.16300		0.20000
growth, GDP	-0.00700		0.00534
Government indicator Regulatory quality	0.06830		0.05520
Government indicator Rule of law	0.08600		0.06750
Government indicator Control of corruption	-0.20500	***	0.05220
Import adjusted	-0.03730	**	0.01460
EU	-0.07640		0.11100
FTA	0.07860		0.06650
FTAEEA04	-0.23000	*	0.12800
FTAEEA07	0.07120		0.14900

Note: Distance and USA dummy, which are time-invariant: and firm size, which is captured by firm dummies, are not included.

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