# Essays on International Trade and Migration: Firm Behavior, Networks and Barriers to Trade

Aarhus University

Ph.D. Thesis

of

Diplom-Volkswirtin Sanne Hiller

born on the 20th of August, 1981 in Hannover, Germany

2011

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| Supervisors: | Prof. Valdemar Smith and Prof. Philipp Schröder, Aarhus University |
| Ph.D. Committee: | Prof. Tor Eriksson, Aarhus University |
| | Prof. Holger Görg, Christian-Albrechts-University Kiel |
| | Prof. Farid Toubal, University of Angers |

*It is not knowledge, but the act of learning, not possession but the act of getting there, which grants the greatest enjoyment.*

– Carl Friedrich Gauss

# Acknowledgements

Several people have contributed to this thesis in various ways. First of all, I am grateful to my supervisors Valdemar Smith and Philipp Schröder for their unconditional support and insightful guidance, both personally and professionally. On several occasions, their ways of behavior have struck me as outstandingly respectful, human and commendable. I would also like to thank my colleagues at the Aarhus School of Business and Social Sciences (ASBSS), Aarhus University, for providing an inspiring, open and friendly work environment. My thanks also go to our former Head of Department Peter Jensen for his work and engagement. I am indebted to our three very helpful secretaries Ann-Marie Gabel, Camilla Mikkelsen and Susan Stilling.

I am indebted to the members of my Ph.D. committee Tor Eriksson, Holger Görg and Farid Toubal. Their insightful comments and suggestions have improved my Ph.D. thesis substantially, and I would like to thank them for their work and time.

Also, I am very grateful to Gabriel Felbermayr and Wilhelm Kohler. Before and during my employment at the Chair of International Economics, Eberhard Karls University of Tübingen, they provided me with an excellent start into economic research, and have continuously supported me in professional and personal endeavors. Similarly, I would like to thank Erdal Yalcin and Davide Sala for amicable and respectful professional and personal interaction. Moreover, I would like to thank Ingo Geishecker and Joachim Wagner who provided me with inspiring feedback in my first year evaluation in the Ph.D. programme.

The generous funding from ASB has made it possible for me to take part in several conferences, thereby giving me the possibility to actively participate in the international

research community. My thanks go especially to my colleagues at the Institute for World Economy in Kiel. The yearly held joint workshop of the Aarhus School of Business and the Institute for World Economy has been a pleasure and benefited my scientific work. Also, I gratefully acknowledge financial support from the Solar foundation and hospitality of the Rotman School of Management, University of Toronto. I am especially indebted to Walid Hejazi and Ignatius Horstmann for welcoming me in Toronto for half a year.
My thanks go to Ulrik Dahl and Sebastian Schwarz from the Danish Export Association (DEA). They have contributed to my work by granting me access to their membership data without Chapter 3 could not have been written. Moreover, their perspective and thoughts on Danish exports has been very inspiring. Kasper Nørregaard Rasmussen helped me with collecting the data at the DEA in Silkeborg, and I would like to thank him for his work. Also, I am grateful to Jørn Hansen Schmidt from Statistics Denmark for his reliable support in data issues.
Several friends and colleagues supported me extraordinarily and in various ways during my Ph.D. studies. In particular, I would like to thank Lena Janys, Philipp Meinen, Pierpaolo Parrotta, Dario Pozzoli and Christian Gormsen Schmid for the good times and experiences we have shared. Our discussions have opened up for interesting perspectives and helped to improve my work. My thanks go to Christian Bjørnskov for generous sharing of data. Moreover, I would like to thank Stephan Russek for his friendship.
Many colleagues - on top of the above mentioned - have contributed to my papers by their comments and suggestions during conferences and in personal conversations. For this, I am grateful to Nina Heuer, Benjamin Jung and James Markusen (Chapter 1), Luis Diaz-Serrano, Jennifer Hunt, Luz Saavedra and Dhimitri Qirjo (Chapter 2) and Shon Fergusson (Chapter 3).
I would like to thank my spouse Robinson Kruse. His insights have improved my work substantially and I have greatly enjoyed his confidence, patience and sense of humor.
Lastly, I am indebted to my parents Ilse and Rolf Hiller. Their emotional care, intellectual encouragement and financial support, have been essential for my personal and professional development.

# Short Summary

This Thesis encompasses four essays on International Trade and Migration. It comprises three empirical essays on firm behavior in International Trade and one theoretical work concerned with the trade-off between export and Foreign Direct Investment (FDI). Subsequently, I will briefly summarize research question, method and results of each chapter.

In Chapter 1, entitled "The Export Promoting Effect of Emigration: Evidence from Denmark", we investigate whether emigration is beneficial to firm exports. The theoretical claim that ethnic networks encourage trade has found broad empirical support in the literature on migration, business networks and international trade. Ethnic networks matter for the exporting firm, as they exhibit the potential to lower fixed and variable cost of exporting. This paper provides a first attempt to identify the export-promoting effect of emigration on the firm-level. Using detailed Danish firm-level data, we can parsimoniously control for export determinants other than emigration, unobserved heterogeneity at the firm-level, as well as for self-selection of firms into exporting. Additionally accounting for taste similarity between Denmark and its trade partners, our findings suggest a positive effect of emigration on Danish manufacturing trade within Europe, thereby corroborating preceding studies on aggregate data. As a novel insight, our analysis reveals that low productivity firms benefit more from emigration than their those firms with high levels of productivity.

Chapter 2 is entitled "Immigration and the Product Margins of International Trade". As the previous Chapter, it deals with the link between trade and migration. Immigration exhibits the potential to lower barriers to trade. We provide an empirical assessment of the effect of immigration on manufacturing trade at the firm-level. In particular, we raise

the question whether immigration changes the range and average value of traded products. Moreover, the use of a matched employer-employee panel covering the years 1995 - 2005 enables us to disentangle whether the inflow of foreign labor matters for trade due to intra-firm employment of foreign expatriates or due to the presence of regional ethnic networks. We find that regional immigration increases overall imports and to a lesser extent matters for total exports. The local presence of immigrants fosters the exported and imported product range. However, the employment of foreign expatriates boosts total exports and imports via both, the intensive and extensive product margin. Our results have important implications for both immigration policy and firm employment decisions.

Chapter 3, entitled "Does Export Promotion Work in Denmark? Evidence from a Matching Approach" explores the role of professional export networks for export success. We empirically assess the following questions: Does the pooling of knowledge in export networks help firms to be more successful exporters? Do firms who become member in an export association exhibit higher export sales, ship more products or serve a greater number of markets in the future? Using Danish firm-level data from 1995 - 2006, we assess whether the major Danish export association fosters trade along these dimensions. Using an approach which combines matching techniques with difference-in-difference estimation, we find a positive causal effect of membership on export sales after entry into the association. Moreover, our estimates provide evidence for an immediate increase in the number of exported products. According to our estimates, there is no positive effect on the number of export destinations served.

Chapter 4 is coauthored with Erdal Yalcin. In this Chapter, entitled "Switching between Export and FDI", we theoretically address the following questions: Do firms become and remain exporters over time if they are confronted with an uncertain evolution of productivity over time? What are the determinants for switching from exporting to Foreign Direct Investment over time? Within a partial equilibrium model with a stochastic productivity evolution, we analyze the transition dynamics between domestic market serving, exporting or FDI. Within a tractable dynamic model with monopolistic competition, we

find that a stochastic productivity development generates hysteresis. Country specific competition, irreversible fixed costs, productivity growth and volatility drive the extent of entry and exit into exporting or FDI, as well as switching from exporting to FDI. We find that higher fixed costs and volatility increase the likeliness of serving mode continuity whereas a higher degree of competition and productivity growth raise the probability of serving mode switching.

# Contents

# Introduction

Globalization has evolved in multiple ways over the last decades. Recent political and economic integration steps have become visible and their absence unthinkable to producers, workers and consumers. The huge increase in international trade and Foreign Direct Investment (FDI) preceding the financial crisis have changed economic prospects and today's economic environment. Similarly, people's actions and attitudes are affected by their exposure to international migration flows and the potential to migrate in the future. These three elements of globalization, the cross-border movement of people, goods and investments are at the heart of this work. They are closely related to the institutional framework. In particular, these economic and political institutions are subject to change, as the recent European integration process exemplifies in an encompassing way. The three building blocks of globalization are closely intertwined, and thus, it is important to understand how they relate to each other. Economic policy, which neglects feedback between those channels, is likely to be mislead. As a prominent example, disregarding effects of immigration on trade leads to potentially flawed immigration policy conclusions and measures.

Consequently, this Thesis attempts to shed light on the nexus between trade and migration, as well as the link between exports and FDI. The majority of included essays take reference to one of the most influential papers in recent years by Melitz (2003). In his theoretical work, Melitz (2003) stresses the importance of firm heterogeneity in terms of productivity as a feature to be taken into account for analysis. His work has triggered a substantial output in both empirical and theoretical work leading to a better understanding of internationalization decisions of firms. As a core finding, only firms

which overcome a certain productivity threshold become exporters as only those are able to cover the fixed costs of exporting, which are at least partially sunk, in a profitable manner. Fixed costs of exporting consist of different components: In order to enter a foreign market, a firm has to acquire information about the destination country, it has to set up a distribution network abroad and it needs to adjust its export product to foreign standards or adjust it to market conditions. It is essential to both, the firm and the policy maker to understand what constitutes the fixed cost of exporting, and at the same time to gain insight of how they can be reduced. This stream of literature on heterogeneous firms in International Trade is one of the pillars of this Thesis.

It is complemented by a second stream of literature which has provided substantial insight into the role of networks for international transactions. This stream of literature is in my view best exemplified by the seminal work of Gould (1994) and Rauch (2001). Their relevance for my work stems from the role of ethnic networks as a trade-cost reducing - and therefore trade promoting - force, which leads to a complementary rather than substitutionary relation between trade and migration. Migration networks are based on a common ethnic origin of their members. They share knowledge about their country of origin wherever they locate - and this knowledge might be accessed by firms in the migrants' new home country, thereby fostering trade with the migrants' country of origin. Similarly, migrants may be a substitute of formal institutions if they are more able to enforce contracts within their own community. As a last notion, migrants may be more prone to consume products from their home countries or to use intermediate inputs from there in the production process. In this sense, migration exhibits the potential to foster trade. Chapters 1 and 2 assess the link between trade and migration using Danish firm-level data.

A trade-promoting role of networks is not unique to ethnic networks. Also, other kinds of networks may ease the matching of buyers and sellers or to help to reduce information incompleteness and thereby may enhance the potential to foster international transactions. One prominent example are professional export associations, i.e., a forum for firms who are or want to become an exporter and intend to share knowledge with other net-

work members. One example for these deliberately set-up networks is the Danish Export Association (DEA). It has been founded in the 1960 by some Danish firms as an attempt to promote exports of these companies. Nowadays, the DEA has grown substantially and acts as an umbrella organization of different industry-specific sub-networks. In this sense, the DEA can be conjectured to pool substantial knowledge on export markets accessible to its members. Chapter 3 investigates whether this export promotion agency leads to an improvement of its members' export performance.

As previously outlined, one market imperfection - the lack of full information - can potentially be reduced by international knowledge flows through migration networks. However, other sources of uncertainty remain. As one example, domestic firms have to decide on their engagement in exports or FDI under uncertainty about its own productivity evolution. In Chapter 4, which constitutes a joint work with Erdal Yalcin, we assume a substitutionary relation between exports and FDI, and we find that an uncertain evolution of productivity leads to a postponement of the investment decision leading to more persistence in the export, FDI or domestic status of the individual firm. In this framework, not only firm-level uncertainty about productivity affects decisions on internationalization, but also the degree of competition on the foreign market.

All in all, this Thesis uses both empirical and theoretical methods to gain deepened insight on the interplay between goods and factor flows.

For the sake of readability, reference to tables, figures or section do not repeat the number of the chapter in the text. For example, Table 2.1 in Chapter 2 is referred to as Table 1 in the written text.

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# Chapter 1

# The Export Promoting Effect of Emigration: Evidence from Denmark

## 1.1 Motivation

Denmark is confronted with a small but persistent outflow of high-skilled workers. This phenomenon is perceived as harmful due to a general shortage in supply of high-skilled labor, a lack of high-skilled immigration of similar size and due to composition effects on the labor market in particular since it is taking place simultaneously with low-skilled immigration. As a recent OECD report calls it: Denmark is subject to a "clear brain drain" (OECD 2008, p. 40). But potentially emigration may compensate the brain loss by easing export activities on international markets. A longstanding empirical literature pioneered by Gould (1994) has assessed the nexus between trade and migration, thereby establishing a positive link.

Some recent studies include Peri and Requena (2010), Felbermayr and Jung (2009), Bandyopadhyay et al. (2008), White (2007), Combes et al. (2005), Girma and Yu (2002), Light et al. (2002). In their influential paper, Rauch and Trindade (2002) study the trade promoting effect of Chinese networks. This study has been recently extended by Felbermayr et al. (2009) to cover multiple ethnic networks. Here, the Danish diaspora plays an outstanding role, as it constitutes the European network with the largest trade promoting effect.

To our best knowledge, this paper pioneers the use of firm-level data with export destinations to assess whether expatriate communities boost exports. From an international perspective, the case of Denmark is of particular interest, because the Danish network has been found to exhibit the largest trade promoting effect among European countries (Felbermayr et al. 2009). We contribute to the existing literature in four regards: First, we provide reliable estimates of the trade response to international labor movements. The reliability stems from exclusion of confounding factors unobserved at higher levels of aggregation, like unobserved heterogeneity on the firm-level and self-selection into exporting. Secondly, this paper is among the pioneers of papers that have independently emerged assessing the trade-migration nexus on the firm-level (Hatzigeorgiou and Lodefalk 2011, Koenig 2009). In this spirit, we use publicly available migration data which exist for all countries in the world, such that the empirical analysis can readily be ex-

tended to firm-level data from other countries using the same migration data. Thirdly, we provide new insights about the relative importance of the trade-promoting effect of emigration by comparing it to immigration.

Earlier theoretical and empirical literature has elaborated ample channels through which international labor movements can affect trade: First, emigrants may be prone to consume home country products as argued by Head and Ries (1998) or to use intermediate inputs which originate from their home country. Secondly, they may be more aware of business opportunities due to preferential information on their home market, thereby their presence abroad may alleviate matching between buyers and sellers as emphasized by Gould (1994) and Rauch and Casella (1998). In the same spirit, they could lower marketing cost in the foreign country, because lower-cost communication within the expatriate community abroad could lead to easier access to more consumers along the lines of Arkolakis (2010). Third, they may provide trust and confidence in international transactions in an environment which is characterized by incomplete contracts due to their ability to sanction opportunistic behavior (Greif 1989, 1993). Rauch (2001) provides a comprehensive review on the literature on networks and trade. On the contrary, the relation between the labor outflow and trade may also be substitutional rather than complementary: If emigrants carry technological knowledge and specific working skills abroad, where they enter the labor force or engage in entrepreneurial activities, they may modify the structure of production towards a substitution of previously imported goods and thereby reduce exports. Importantly, these channels may be active within firms rather than across firms: Related work emphasizes that emigration - in particular among high-skilled workers - partially reflects the allocation of workers within multinational firms across different plants in different countries (see e.g. Salt 1992, Tzeng 1995, Peixoto 2001, Larch and Lechthaler 2011). Multinational firms can relocate their workers, and thereby directly exploit the emigrants' knowledge advantage or benefit from enhanced exchange of information across plants in different countries.

Guided by recent theoretical work on the determinants of exporting (Melitz 2003, Jørgensen and Schröder, 2008), we parsimoniously control for export determinants other than emi-

gration, and establish a robust effect of emigration on Danish firm-level exports. Thus, we confirm the earlier finding that migration fosters trade on the basis of a micro-level data set. In some more detail, we find that a 1% increase in the emigrant stock increases Danish manufacturing exports to this country by 0.48%. This effect coexists with the export promoting effect of immigration which is slightly larger with an elasticity of 0.053%. Importantly, this emigration effect stems from an estimation which explicitly models similarity between Denmark and the country of destination by including measures of generalized trust, importance of religion, communist past and the political system. Moreover, we find that the effect of emigration is larger for low productivity firms than for their highly productive counterparts.

Section 2 presents our data and Section 3 discusses the empirical strategy. Section 4 presents the empirical results and Section 5 concludes.

## 1.2 Descriptive Statistics

Our data set combines Danish firm-level data with macroeconomic variables in order to assess how emigration affects manufacturing exports. The availability of emigrant stock data allows a cross-sectional analysis for the year 2001.[1] The emigrant stock is defined by the foreign-born principle from the perspective of the receiving country, i.e., every person who was born in Denmark and resides permanently in the new host country counts as a Danish emigrant (Parsons et al. 2007). This concept thus includes non-Danes who move abroad, either to their country of origin or to a third country. Importantly, data on the emigration stock is reliable, as it is obtained from bilateral immigration matrix compiled by the World Bank, and immigration data is of substantially better quality than emigration data. We opt for the use of this data set, even though Statistics Denmark provide longer time series data of emigrant stocks. The bilateral migration matrix from the World Bank can readily be merged with firm-level information from other countries. In this way, the cross-country pattern of the trade-migration nexus on the firm-level can be investigated systematically for firm-level data sets of several countries using the same

[1] http://www.migrationdrc.org/research/typesofmigration/global_migrant_origin_database.html

migration data base. This seems promising to us, as it enables us in future research to shed light on the differential impact of migration networks on trade (see Felbermayr et al. 2009).[2]

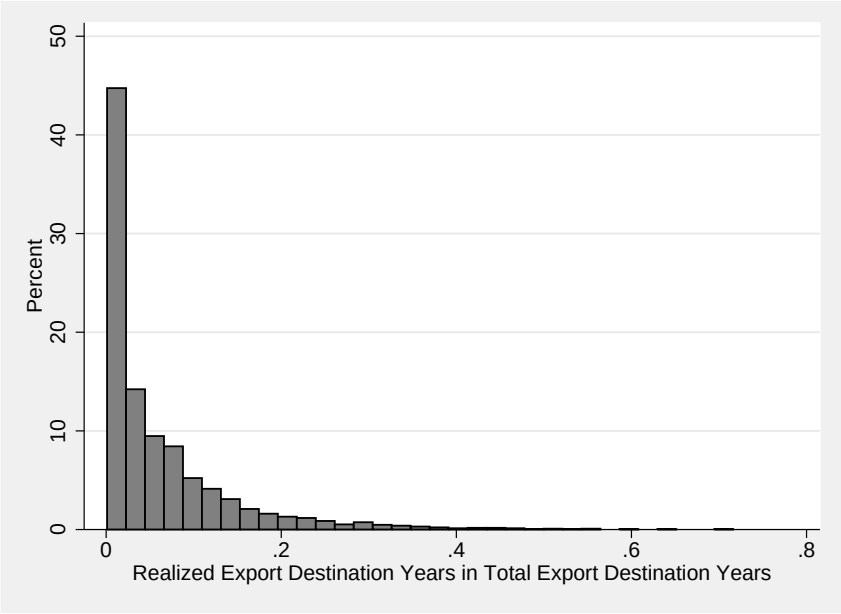
Most Danish emigrants live in Sweden (around 40000). Table 7 lists all destination countries in our sample together with the number of Danish residents and Danish exporters in the respective market. The emigrant distribution is highly skewed: Whereas a destination country features 1502 Danes on average, the median number of emigrants is only equal to 45. The mean (median) corresponds approximately to the number of Danes residing in Luxembourg (Cameroon and Syria, respectively).

Firm-level data is provided by Statistics Denmark and combines destination-specific export information with business account information (REGNSKAB). Our sample comprises manufacturing firms, which export to at least one export destination. We do not include firms with negative total revenue or negative export revenue as well as firms with an export revenue greater than the total revenue, which have been wrongly recorded. We exclude the top one percent of the labor productivity distribution in order to avoid that our results are driven by high-productivity firms. Moreover, we require that the firm has existed from 1995 onwards. This sample corresponds to half of all Danish manufacturing exporters, whereby the share of exporters in total firms amounts to around 40%. There is no size threshold in terms of firm size. However, results are robust when imposing a size threshold in terms of employees ($> 5$). There is an export threshold resulting from the way the export data is collected: Firms may choose not to report exports below DKK 7500 (around EUR 1000) to countries outside the EU.

The resulting sample is composed of 2300 firms, which sell to 158 countries. It is a typical firm-level export data set (compare Lawless 2009): A firm exports to 10 markets on average, but 50% percent of all firms exports to at most five destinations. This implies that our sample comprises a considerable amount of observations, where the export value is equal to zero. We will take care of this feature of the data as discussed

[2]Recently, the database has been extended to a panel, such that bilateral migrant stocks are available for every 10th year from 1960 to 2000. Unfortunately, the firm-level export data does not date back to 1990, such that the study could be extended to a 2-period panel.

Figure 1.1: Export Experience: Coverage of Years and Destinations




This Figure depicts a histogram of the share of cumulative destination-years served by a firm relative to the maximum of destination-year pairs (948).

in Section 3. Average total export sales by a firm across its destination markets amount to approximately EUR 9,306,409. Nevertheless, half of the firms export less than EUR 859,478. Average sales of a firm per market amount to EUR 58,901. The share of continuous exporters amounts to 8.56% in my sample for the period between 1995 and 2001. Generally, entry into and out of exporting is rather dynamic. Relative to the total number of firms, first time entry (conditional on no export activity before) in 2001 amounts to 7.85%, whereas first time entry in 2000 has been equal to 9.50%. This is also the maximum first time entry over the sample period, whereas the minimum entry share occurs in 1998 and amounts to solely 4.82%. Aside from relatively dynamic entry and exit patterns into and out of exporting, there is a share of continuous exporters which amounts to 42.22%.

To provide an idea about the export experience of Danish manufacturing exporters in our sample, Figure 1 plots a histogram of the cumulative pre-sample export experience of firms across all their export destinations as a share of total potential export experience

(948 export-destination-years), defined as the number of years (6) multiplied with the number of markets (158). Figure 1 shows that the largest mass of firms has less than 20% of the potential destination exposure over the sample span. Only a minor share of firms reaches a destination-year coverage above 60% of the potential maximum. This points toward a specialization of exporters with respect to specific markets or export years - continuous exporters do not offset this pattern even though they constitute a considerable share of the sample.

Table 1 provides summary statistics for the three main samples we use: In addition to the full sample (*'Full'*), we consider two sub-samples: The first sub-sample (*'Taste'*) consists of those countries, which have participated in the Eurovision Song Contest in 2000, because we use their votes as a proxy for taste similarity. Participant countries are indicated with an asterisk in Table 6. The second sub-sample (*'Trust'*) comprises all countries for which we have information on the level of generalized trust and importance of religion from the World Value Survey.

Based on this cross-sectional data set and sub-samples thereof, we will estimate how emigration affects export sales as described in the subsequent section.

Table 1.1: Summary Statistics of Three Main Sub-samples

| | Full (N=22461) | | | | Taste (N=12664) | | | | Trust (N = 20474) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. | Min | Max | Mean | Std. | Min | Max | Mean | Std. | Min | Max |
| Export Value in DKK (ln) | 13.282 | 2.267 | -0.013 | 23.255 | 13.520 | 2.309 | 1.371 | 21.887 | 13.362 | 2.274 | -0.013 | 23.255 |
| Emigrant Stock (ln of 1000) | 0.397 | 2.486 | -6.908 | 3.712 | 1.579 | 1.794 | -4.828 | 3.712 | 0.574 | 2.405 | -6.908 | 3.712 |
| Labor Productivity (ln of Sales per Worker) | | | | | 13.847 | 0.501 | 11.830 | 15.885 | 13.873 | 0.499 | 11.829 | 15.885 |
| State Dependence | 0.725 | 0.309 | 0.167 | 1.000 | 0.762 | 0.301 | 0.167 | 1.000 | 0.733 | 0.306 | 0.167 | 1.000 |
| Multilateral Resistance | 6706.360 | 16.648 | 6638.750 | 6718.040 | 6715.766 | 2.661 | 6706.180 | 6718.040 | 6706.754 | 16.956 | 6638.747 | 6718.040 |
| Song Contest Vote | | | | | 10.218 | 2.263 | 0.000 | 12.000 | | | | |
| Post-Communist Country | | | | | | | | | 0.136 | 0.342 | 0.000 | 1.000 |
| Monarchy | | | | | | | | | 0.358 | 0.479 | 0.000 | 1.000 |
| Religion Important | | | | | | | | | 0.476 | 0.233 | 0.160 | 1.000 |
| Social Trust | | | | | | | | | 37.260 | 15.675 | 3.792 | 64.270 |
| Scandinavia | 0.126 | 0.331 | 0.000 | 1.000 | 0.223 | 0.416 | 0.000 | 1.000 | 0.136 | 0.343 | 0.000 | 1.000 |
| America | 0.089 | 0.285 | 0.000 | 1.000 | | | | | 0.092 | 0.290 | 0.000 | 1.000 |
| Asia | 0.156 | 0.363 | 0.000 | 1.000 | 0.036 | 0.187 | 0.000 | 1.000 | 0.137 | 0.344 | 0.000 | 1.000 |
| Africa | 0.041 | 0.199 | 0.000 | 1.000 | | | | | 0.035 | 0.184 | 0.000 | 1.000 |
| Oceania | 0.021 | 0.144 | 0.000 | 1.000 | | | | | 0.022 | 0.148 | 0.000 | 1.000 |
| GDP (ln) | 19.564 | 1.617 | 12.788 | 23.128 | 19.561 | 1.457 | 15.841 | 21.594 | 19.749 | 1.425 | 15.492 | 23.128 |
| Population (ln) | 9.647 | 1.590 | 3.666 | 14.054 | 9.351 | 1.459 | 5.639 | 11.896 | 9.810 | 1.339 | 6.631 | 13.820 |
| Area (ln) | 12.291 | 1.878 | 3.219 | 16.653 | 12.073 | 1.296 | 5.756 | 16.653 | 12.384 | 1.757 | 6.471 | 16.653 |
| Landlockedness (Dummy) | 0.103 | 0.304 | 0.000 | 1.000 | 0.106 | 0.308 | 0.000 | 1.000 | 0.103 | 0.304 | 0.000 | 1.000 |
| Distance (ln) | 7.426 | 1.066 | 6.185 | 9.812 | 6.767 | 0.492 | 6.185 | 8.052 | 7.367 | 1.072 | 6.185 | 9.812 |
| Latitude | 40.828 | 22.723 | -44.283 | 64.150 | 52.900 | 7.012 | 32.083 | 64.150 | 40.953 | 22.773 | -44.283 | 60.133 |
| Rule of Law | 1.142 | 0.800 | -2.001 | 1.925 | 1.539 | 0.545 | -1.059 | 1.925 | 1.168 | 0.765 | -1.278 | 1.925 |

This Table depicts summary statistics of the three samples used. *Full:* OLS estimation sample (positive export sales only), *Taste:* Includes only those countries which have participated in the Eurovision Song Contest (Sub-sample of *Selection*). *Trust:* Includes only those countries for which trust data is available from Bjørnskov (2007).

## 1.3 Empirical Strategy

This section describes the econometric approach and discusses how we deal with some challenges in order to properly estimate how emigration affects export sales. Our analysis is based on the estimation of a gravity model on the firm level. In particular, we use the following model for firm exports $V_{fd}$ in order to identify the effect of the emigration on the intensive margin of firm exports for a cross-section in the year 2001:

$$V_{fd} = \alpha + Z_{fd}\delta + \nu_{fd}, \tag{1.1}$$

where $f = 1, ..., F$ indicates the firm and $d = 1, ..., D_f$ the country of destination. $Z_{fd}$ collects regressors that vary across destinations $d$ and some that additionally vary within the firm $f$. In particular, market size, accessibility, institutions and location as well as the variable of interest, namely the Danish emigrant stock in $d$, are included in $Z_{fd}$. We include all time-variant regressors in their first lag, i.e., for the year 2000. $\delta$ is the parameter vector which is to be estimated, and $\alpha$ is a constant. Moreover, $\nu_{fd}$ is assumed to be a composite error term such that

$$\nu_{fd} = c_f + c_{fd} + \epsilon_{fd}, \tag{1.2}$$

where $c_f$ and $c_{fd}$ are unobservable export determinants on the firm and the firm-destination level, respectively. Our specification allows for unobserved heterogeneity on the firm-level, even though we do not use a panel with a time dimension. It is important to account for firm heterogeneity, because export performance may be affected by unobserved factors like management practices and attitudes of the management. Similarly, we are able to account for specific ties between the firm and the export market. This enables us to avoid a potential bias originating from unobserved factors which drive firm export behavior. $\epsilon_{fd}$ is an idiosyncratic error term.

In order to account for bilateral unobserved firm-destination heterogeneity $c_{fd}$, we use pre-sample information on the firm's past export behavior in order to account for the importance of fixed cost of exporting, which are partially sunk. These costs are the main

driving force of state dependence as acknowledged by recent empirical work by Roberts and Tybout (1997) and Kaiser and Kongsted (2008) as well as by recent theoretical contributions (Jørgensen and Schröder, 2008). Since entry costs are heterogeneous across destination markets and presumably firm-specific, we use pre-sample information to approximate pair-specific unobserved heterogeneity $c_{fd}$ by a firm's export history, which we measure as $S_{fd} = \frac{1}{6}\sum_{t=1995}^{2000} E_{fd}^{t}$, such that $E_{fd}^{t}$ is equal to one if firm $f$ exports to market $d$ in time $t$ (and zero else).[3]

In our application, the number of firms $F$ is large relative to the number of their destinations $D_f$. Thus, we can use the within-transformation to net out unobserved firm-heterogeneity $c_f$ in order to estimate $\delta$:

$$(V_{fd} - \widetilde{V}_f) = (Z_{fd}\delta - \widetilde{Z}_f) + \nu_{fd} - \widetilde{\nu}_f, \tag{1.3}$$

where $\widetilde{V}_f = \frac{1}{D_f}\sum_{d=1}^{D_f} V_{fd}$, $\widetilde{Z}_f = \frac{1}{D_f}\sum_{d=1}^{D_f} Z_{fd}$ and $\widetilde{\nu}_f = \frac{1}{D_f}\sum_{d=1}^{D_f} \nu_{fd} = c_f + \frac{1}{D_f}\sum_{d=1}^{D_f} \epsilon_{fd}$. As suggested in Wooldridge (2003), we use the variance-covariance estimator suggested by Arellano (1987), since it is considered to be robust to within-group correlation and heteroscedasticity.

As an alternative estimation strategy, consistent estimation of $\delta$ can be achieved by approximating the firm fixed effect. For the proxy variable strategy, we assume that

$$c_f = a + w_f b + \zeta_f, \tag{1.4}$$

where $\zeta_f$ is an error term which is assumed to be uncorrelated with $w_f$ and $Z_{fd}$ across all $d = 1, ..., D_f$. $a$ and $b$ are parameters. Then, the regression model becomes

$$V_{fd} = (\alpha + a) + Z_{fd}\delta + bw_f + \zeta_f + \epsilon_{fd}. \tag{1.5}$$

As Melitz (2003) suggests, firm productivity is the driving force between a firm's export

[3]Even if Roberts and Tybout (1997) find that after two years, previous export experience has almost completely depreciated, we include a measure for the full observable firm-country export history. In this way, unobserved bilateral characteristics like management preferences can be accounted for. However, this approach limits the interpretability of the proxy as an inverse sunk cost measure.

behavior. Therefore, we assume that it constitutes an appropriate proxy for unobserved heterogeneity at the firm-level. In a nutshell, we will use one estimation strategy which uses the fixed effects transformation to deal with unobserved firm heterogeneity, and the alternative strategy, which relies on a proxy variable for the unobserved firm fixed effect. Importantly, we would expect the same point estimates from both strategies.

Moreover, we address two additional concerns. First, we need to account for potential endogeneity of the emigrant stock. This endogeneity can stem from two sources: First, if firms send employees abroad in order to expand their export sales in this particular market, a reverse causality problem arises. If firm behavior is anticipatory, lagging the emigrant stock does not solve this problem. We address this concern by instrumenting the emigrant stock by the emigrant flow in 1980. The second source of endogeneity stems from the omission of factors which simultaneously affect emigration and exports. The most important factor are preferences: Countries, where migrants are more prone to settle, may be the countries where preferences are most similar to Denmark (Rauch and Trindade 2002). According to Linder (1961), one would expect these countries with similar preferences to trade more with each other. The common approach to this problem is to assume that preferences are time invariant, and to include country fixed effects (Peri and Requena 2010). We cannot resort to this strategy, because our data lacks the time dimension. Instead we use two sets of proxy variables to account for similarity between Denmark and its trade partners: First, inspired by Felbermayr and Toubal (2010), we include a the trade partner's vote for Denmark in the Eurovision Song Contest as a proxy for preferences for a sub-sample. Secondly, we use information on a country's level of generalized trust and importance of religion from the World Value Survey augmented with information on the country's communist history and whether it is a monarchy in order to capture country level norms and values.[4]

Also, our estimation is potentially subject to a sample selection bias, because we only observe firms who decide to export. We use two approaches in order to deal with sample selection. First, we use a state-of-the-art approach, namely the Poisson Pseudo Maximum Likelihood estimation as suggested by Santos Silva and Tenreyro (2006). Secondly, we

[4]This data has been kindly provided by Christian Bjørnskov.

estimate a pooled Heckman Selection model on basis of the proxy variable strategy. We observe firm export sales $V_{fd}$ to a particular destination only if the firm decides to serve this particular market, as indicated by $V_{fd}^x$, i.e., when it makes positive profit from selling to country $d$.

$$V_{fd} = Z_1\delta_1 + u_1 \tag{1.6}$$

$$V_{fd}^x = 1\left[Z_1\delta_2 + \nu_2 > 0\right] \tag{1.7}$$

$Z_1$ is a set of explanatory variables and corresponds to $Z_{fd}$ from Equation 1. The proxy for firm heterogeneity, labor productivity, as well as a constant, industry and municipality dummies are absorbed in $Z_1$ for notational simplicity. The regressors $Z_1$ and the export decisions $V_{fd}^x$ are always observed, and the export sales $V_{fd}$ are only observed when the firm decides to export, i.e., when $V_{fd}^x = 1$. Then, we impose the following three assumptions: First, $(u_1, \nu_1)$ are independent of $Z_1$ with zero mean. Secondly, $\nu_2$ is standard normally distributed. Third, the conditional expectation of $u_1$ given $\nu_2$ is given by $\gamma_1\nu_2$ (Wooldridge 2002, p.17). Under these assumptions, it can be shown that the conditional expectation of export sales follows as

$$E\left[V_{fd}|Z_1, V_{fd}^x = 1\right] = Z_1\delta_1 + \gamma_1\lambda\left(Z_1\delta_2\right), \tag{1.8}$$

where $E$ is the expectation operator, and $\lambda$ is the inverse mills ratio defined as $\lambda(\cdot) = \frac{\phi(\cdot)}{\Phi(\cdot)}$, where $\phi(\cdot)$ is the standard normal density function, and $\Phi(\cdot)$ is the standard normal cumulative distribution function. Consistent estimates of $\delta_1$ can be obtained in a two-step estimation approach (Heckman 1979, Wooldridge 2002) by including an estimate of the inverse mills ratio into the OLS regression of the selected sample. This estimate can be obtained from a probit regression of the selection equation given in Equation 7. From this regression, we can test the Null hypothesis of no selection against the alternative of selection by using a $t$-test with $H_0 : \gamma_1 = 0$ and $H_1 : \gamma_1 \neq 0$, where a rejection indicates sample selection. This test does not require an adjustment of the variance-covariance matrix (in addition to cluster-robust standard errors), however, should the

Null hypothesis be rejected, standard errors should be corrected due to the presence of generated regressors.

For identification, it would be desirable but not strictly necessary to base the Heckman procedure on an exclusion restriction, i.e., to find an explanatory variable that drives the selection process but not the outcome equation (Wooldridge 2002, p. 564). In absence of an exclusion restriction - even if estimates are estimated with sufficient precision - a rejection of the Null of no sample selection might also indicate functional form miss-specification rather than sample selection. Even if this is troublesome on statistical grounds, economic theory strengthens the argument for sample selection.

The Heckman procedure is also used in context of the Instrumental Variable estimation in order to avoid that the interaction of sample selection and endogeneity of the emigrant stock drive our estimation results. To this end, we consider the following population model

$$V_{fd} = \alpha_1 M_d + X_1 \delta_1 + u_1 \tag{1.9}$$

$$M_d = \alpha_2 M_{d1980} + X_1 \delta_2 + u_2 \tag{1.10}$$

$$V_{fd}^x = 1\left[\alpha_3 M_{d1980} + X_1 \delta_3 + \nu_3 > 0\right], \tag{1.11}$$

where Equation 9 is the structural equation with the endogenous emigrant stock $M_d$, Equation 10 is the reduced form equation, where $M_{d1980}$, the emigrant flow in 1980 is the excluded instrument, and Equation 11 is the selection equation. It is noteworthy, that all exogenous variables enter the selection equation. Parameter estimates are obtained by Two Stage Least Squares estimation, which is augmented by the inverse mills ratio from a probit estimation of the selection equation (Wooldridge 2002, p. 568).

# 1.4 Empirical Results

## 1.4.1 Main Results

This section presents the estimation results. In particular, Table 2 presents our baseline results. Columns 1 - 3 present OLS, IV and Poisson estimation results, whereas column 4 - 6 depict estimation results for the proxy variable strategy. Table 3 presents results for the Heckman Selection model.

As our main result, we find that emigration positively affects firm exports throughout all specifications. The size of the effect differs and ranges from an elasticity of 0.032 in column 4 to 0.104 in column 2. Interestingly, the point estimate of both IV estimations (column 2 and 5) is larger than its OLS counterpart (column 1 and 4). This points to the potential presence of measurement error in the emigrant stock leading to an attenuation bias. The estimated elasticities are small relative to estimates in the related literature on immigration networks and exports as summarized in Peri and Requena (2010). However, these works are concerned with the response of trade to immigration rather than emigration. Moreover, in aggregate analysis, several studies do not find an effect of immigration on imports using aggregate data (for example Gould 1994 and Light et al. 2002). But from our disaggregate perspective, the foreign countries' imports of Danish manufacturing products are indeed affected by the number of Danish immigrants.

Before moving on to a more detailed analysis of the effect of emigration on trade, we will briefly discuss the estimates for the remaining variables included in the model:

**State Dependence:** The longer a firm's export experience with a particular destination - and thus the higher the fixed costs - the larger the export volume. Obviously, the state dependence proxy for pair-specific costs picks up bilateral characteristics like a management preference for a specific region, for example due to composition of the labor force or country of origin of the manager, and thus is not a pure fixed cost proxy. This is a merit rather than a flaw, as these unmeasurable export determinants would otherwise potentially bias the results.

**Labor Productivity:** As recent theoretical trade models predict (for example Melitz

2003), export sales increase in firm productivity. This holds through all specifications.

**Market Size:** The parameter estimate on the GDP is positive across all specifications, but it is not always significantly different from zero. It is in line with related findings that a country's size in terms of GDP significantly increases exports (compare Lawless 2010). The size of the population has positively estimated coefficients in all specifications, apart from the two Poisson models, where the point estimate turns negative. The area coefficient is greater than zero in all specifications apart from the two IV estimations, where it is negative but not significantly different from zero, such that generally export volume increases in the area of the destination country.

**Accessibility:** Unambiguously, firm exports are negatively affected by distance as it is commonly found in gravity-related literature (see for example Lawless 2010). The further away the country of destination is from all other countries in the world (multilateral resistance), the less exports from Danish companies it receives. This results from an 'extended gravity effect' (Morales et al. 2011) as a firm can benefit from from its export experience from similar markets - for example by drawing upon its own export experience in geographically close and thereby potentially culturally similar countries. Landlockedness exhibits a negative effect on export sales.

**Institutions:** Institutions are measured by distance from equator and rule of law (Kaufmann et al. 2010). Institutions as measured by rule of law exhibit an unambiguously positive effect on exports. Contrarily, the distance from the equator is estimated to have a negative effect on trade in three out of six specifications.

**Geography:** Four out of six estimations suggest that on average, Scandinavian countries receive a significantly higher export volume. Only in the fixed effects Poisson model (column 3), the Scandinavia dummy is statistically significant and smaller than zero. The Africa and Asia dummies are statistically significant and positive across specifications. This is presumably due to the relative ease of serving the European market, leading to market entry also for firms with low export sales, which in turn lowers average sales in Europe. Countries, which are American seem to exhibit a higher average export value as compared to Europe in all models apart from the Poisson estimations (columns 3 and

6). The coefficient on the Pacific dummy is never statistically significant and at the same time positive. It is significantly negative in all specifications apart from the IV estimation in column 5.

Summing up, we find a positive effect of emigration on firm exports, which is robust across different specifications and samples.[5] With respect to endogeneity concerns, our instrumental variable approach is comforting: We reject the null hypothesis of underidentification on basis of the Kleibergen-Paap Rank LM-test at the 1% significance level, and on the basis of the Kleibergen-Paap Rank F-test, we also reject the null hypothesis of weakness of the instrument (Kleibergen and Paap 2006). On basis of this sufficiently strong instrument, we cannot reject the Null hypothesis of exogeneity of the emigrant stock in our model in the proxy variable based estimation, whereas the Null hypothesis is rejected on the 1% percent level in the fixed effect estimation.

In addition, Table 3 provides results for a Heckman Selection model which has been estimated as described in Section 3. The first two columns represent an OLS-based sample selection correction which treats the emigrant stock as exogenous, whereas the last two columns instrument the emigrant stock by the emigrant flow in 1980. Column 1 and 3 provide coefficient estimates for the selection equation, whereas column 2 and 4 list estimates and p-values of the outcome equation. It is evident from the t-test on the inverse mills ratio that sample selection is indeed an issue that needs to be taken into account in the current estimation: In both cases, the Null hypothesis of insignificance of the inverse mills ratio is rejected on the 1% significance level.

Interpretation of the selection equation itself is not the focus of this paper, as it is concerned with isolation of the effect of emigration on the intensive margin of firm-level trade.[6] As expected from economic theory, emigration encourages market entry. In almost all cases, the directionality of effects in the selection and the outcome equation is the same, meaning that factors that encourage market entry also foster expansion of sales to the particular country of destinations. This is not true for country size in terms of

[5] Conclusions remain unchanged when estimating a quantile regression at the median and for a robust regression approach. Results are available from the author on request.

[6] A related paper by Koenig (2009) studies the nexus between immigration and foreign market entry using French firm level data.

population: Whereas firms are less likely to enter a market with a larger population, there export sales to a more populated market are larger other things equal. Similarly, firms are more likely to enter a Scandinavian market, whereas their export sales to Scandinavian countries are less on average, which highlights the relative ease of market access within Scandinavia and the presence of smaller exporters in these countries. Similarly, firms are less likely to enter all non-European markets, however, upon entry average sales to non-Europe are larger (with the exception of Oceania).

With respect to the effect of emigration on export sales, we find that accounting for sample selection by estimation of a Heckman Selection model reduces the coefficient size in both cases, the OLS and the IV estimation. In particular, we find that a 1% increase in the emigrant stock increases firm-level exports to the emigrants' new residence country by 0.033% (0.022%) for the OLS (IV) estimation. Comparing these point estimates to the previous results, which do not account for sample selection, we find a negligible drop in the OLS estimate (see Table 2, column 4) and approximately halves for the instrumental variable estimation (compare Table 2, column 5). Qualititively, the modified estimation strategy leaves the estimated effects of other covariates unchanged. As before, the Null hypothesis of exogeneity of the emigrant stock cannot be rejected.

In a nutshell, our results suggest that emigration exhibits a statistically significant, positive effect on Danish firm-level exports. As the Heckman Selection model with exogenous emigration suggests, a 1% increase in the emigrant stock leads to a 0.033% increase in export sales.

The next two subsections augment the specification in order to strengthen the causal interpretation of the estimated effect. Firstly, we account for cultural similarity in order to prevent a correlation between the migrant stock and the error term. Secondly, we introduce the immigrant stock into the model the omission of which might bias the results. Third, we use subsample analysis to argue that the effect of emigration on trade exists independently of unobserved FDI activities.

Table 1.2: Main Results

| | Fixed Effect Models | | | Proxy Variable Strategy | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | OLS | IV | Poisson | OLS | IV | Poisson |
| Emigrant Stock | 0.052 | 0.104 | 0.063 | 0.032 | 0.049 | 0.059 |
| | (0.000) | (0.000) | (0.003) | (0.002) | (0.004) | (0.096) |
| State Dependence | 2.103 | 2.062 | 6.705 | 1.642 | 1.632 | 2.74 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Labor Productivity | | | | 0.741 | 0.972 | 0.803 |
| | | | | (0.000) | (0.000) | (0.000) |
| **Market Size** | | | | | | |
| GDP (ln) | 0.242 | 0.261 | 0.231 | 0.088 | 0.075 | 0.372 |
| | (0.000) | (0.000) | (0.167) | (0.051) | (0.133) | (0.014) |
| Population (ln) | 0.035 | 0.067 | -0.220 | 0.169 | 0.231 | -0.331 |
| | (0.452) | (0.143) | (0.000) | (0.000) | (0.000) | (0.000) |
| Area (ln) | 0.058 | -0.0004 | 0.506 | 0.029 | -0.012 | 0.514 |
| | (0.000) | (0.973) | (0.000) | (0.032) | (0.377) | (0.000) |
| **Accessibility** | | | | | | |
| Distance (ln) | -0.972 | -0.865 | -0.896 | -0.851 | -0.746 | -0.799 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Multilateral Resistance | -0.042 | -0.043 | -0.013 | -0.031 | -0.027 | -0.012 |
| | (0.000) | (0.000) | (0.568) | (0.000) | (0.000) | (0.671) |
| Landlockedness (1 if landlocked) | -0.445 | -0.368 | -1.089 | -0.439 | -0.432 | -1.050 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Institutions** | | | | | | |
| Rule of Law | 0.227 | 0.152 | 1.337 | 0.138 | 0.157 | 1.322 |
| | (0.000) | (0.004) | (0.000) | (0.002) | (0.046) | (0.000) |
| Distance to equator (ln) | 0.006 | 0.012 | -0.033 | 0.004 | -0.004 | -0.034 |
| | (0.000) | (0.000) | (0.027) | (0.413) | (0.061) | (0.033) |
| **Geography** | | | | | | |
| Scandinavia (1 if Scandinavia) | 0.122 | 0.216 | -1.012 | -0.001 | 0.110 | 1.046 |
| | (0.049) | (0.002) | (0.001) | (0.981) | (0.110) | (0.001) |
| Africa (1 if Africa) | 0.693 | 0.380 | 1.515 | 0.581 | 0.370 | 1.399 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.093) | (0.000) |
| America (1 if America) | 0.102 | 0.085 | -1.335 | 0.355 | 0.392 | -1.469 |
| | (0.275) | (0.351) | (0.001) | (0.000) | (0.000) | (0.000) |
| Asia (1 if Asia) | 0.358 | 0.296 | 0.901 | 0.522 | 0.500 | 0.849 |
| | (0.000) | (0.000) | (0.026) | (0.000) | (0.000) | (0.064) |
| Pacific (1 if Pacific) | -0.725 | -0.446 | -4.643 | -0.271 | 0.019 | -4.749 |
| | (0.000) | (0.017) | (0.000) | (0.127) | (0.918) | (0.000) |
| Obs | 22461 | 19873 | 361100 | 22461 | 20419 | 361100 |
| Firms | 2300 | 1681 | 2300 | 2300 | 2263 | 2300 |
| Adj $R^2$ | 0.125 | 0.228 | | 0.204 | 0.208 | |
| Wald $\chi^2$ ($p$) | | | 0.000 | | | 0.000 |
| Exogeneity of Emigrant Stock ($p$) | | 0.000 | | | 0.292 | |
| Kleibergen-Paap rk LM ($p$) | | 0.000 | | | 0.000 | |
| $H_0$ : *Underidentification* | | | | | | |
| Kleibergen-Paap rk $F$ ($F$) | | 11362.96 | | | 11986.5 | |
| $H_0$ : *Weak Identification* | | | | | | |
| Critical Value (10% max. IV Size) | | 16.38 | | | 16.38 | |

This Table presents the main estimation results for the full sample. Standard errors are cluster-robust (by firm) all columns apart from the Heckman Selection model, which reports bootstrapped standard errors with 399 repetitions. The Proxy Variable Strategy estimations include industry and municipality dummies. For both IV regressions, the excluded instrument is the bilateral emigrant flow in 1980. Kleibergen-Paap test for underidentification has been suggested in Kleibergen and Paap (2006).

Table 1.3: Sample Selection Results

| | OLS | | IV | |
|---|---|---|---|---|
| | Selection Eq. | Outcome Eq. | Selection Eq. | Outcome Eq. |
| | 1a | 1b | 2a | 2b |
| Emigrant Stock | 0.013 | 0.033 | 0.014 | 0.022 |
| | (0.002) | (0.002) | 0.025 | (0.147) |
| State Dependence | 3.973 | 4.211 | 3.895 | 4.477 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Labor Productivity | 0.169 | 1.081 | 0.149 | 1.059 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| **Market Size** | | | | |
| GDP (ln) | 0.100 | 0.156 | 0.118 | 0.119 |
| | (0.000) | (0.000) | (0.000) | (0.018) |
| Population (ln) | -0.056 | 0.117 | -0.058 | 0.258 |
| | (0.000) | (0.005) | (0.000) | (0.000) |
| Area (ln) | 0.031 | 0.058 | 0.013 | -0.005 |
| | (0.000) | (0.000) | (0.022) | (0.703) |
| **Accessibility** | | | | |
| Distance (ln) | -0.263 | -0.946 | -0.191 | -0.553 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Multilateral Resistance | -0.012 | -0.035 | -0.010 | -0.001 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Landlocked | -0.127 | -0.516 | -0.075 | -0.543 |
| | (0.000) | (0.000) | (0.002) | (0.000) |
| **Institutions** | | | | |
| Rule of Law | 0.130 | 0.190 | 0.092 | 0.338 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Distance to Equator | 0.001 | 0.001 | 0.002 | -0.004 |
| | (0.109) | (0.580) | (0.002) | (0.007) |
| **Geography** | | | | |
| Scandinavia | 0.146 | -0.006 | 0.230 | 0.416 |
| | (0.000) | (0.929) | (0.000) | (0.000) |
| Africa | -0.134 | 0.364 | -0.183 | 0.036 |
| | (0.000) | (0.000) | (0.000) | (0.370) |
| America | -0.240 | 0.150 | -0.252 | 0.357 |
| | (0.000) | (0.113) | (0.000) | (0.000) |
| Asia | -0.086 | 0.428 | -0.143 | 0.438 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Pacific | -0.431 | -0.583 | -0.335 | 0.444 |
| | (0.000) | (0.003) | (0.000) | (0.010) |
| **Excluded Instrument** | | | | |
| Emigrant Flow 1980 | | | 0.008 | |
| | | | (0.350) | |
| Inverse Mills Ratio | | 1.301 | | 1.467 |
| | | (0.000) | | (0.000) |
| Exogeneity of Emigrant Stock (p) | | | | 0.332 |
| First Stage F on Excluded Instrument | | | | 109,317 |
| Obs | 361100 | 22461 | 262200 | 20419 |
| Adj $R^2$ | 0.709 | 0.189 | 0.707 | 0.194 |

This Table presents the main estimation results resulting from the Heckman Selection Model. The standard errors of the outcome equation are bootstrapped with 499 repetitions. All estimations include industry and municipality dummies. The excluded instrument is the bilateral emigrant flow in 1980. The selection equation has been estimated by a probit model, reported estimates are coefficients, not marginal effects.

### 1.4.2 The Role of Cultural Proximity

As indicated in Section 3, identification of the causal effect of emigration on firm level exports is cumbersome due to potential endogeneity of the emigrant stock. So far, we have used Instrumental Variables estimation, whereby we used the historical emigrant flow as an instrument for the current emigrant stock. The historical emigrant flow exhibits sufficient predictive power to be a non-weak instrument, which is due to the phenomenon that migrants tend to settle where there co-ethnic ancestors used to settle (Card 2001). Arguably, this approach takes care of endogeneity which is due to reverse causality, as the emigrant flow in 1980 was almost certainly not induced by today's export behavior of Danish manufacturers. Still, validity of the instrument may be questioned: If cultural and normative ties between Denmark and the emigrants' destination country are both, a major determinant of migration and exports at the same time, the instrument itself would correlate with these omitted factors and be invalid.

This section addresses this concern in depth. We suggest two sets of variables which measure cultural proximity between Denmark and its trade partners: First, inspired by Felbermayr et al. (2009), we use votes in the Eurovision Song Contest to approximate taste similarity between countries. Secondly, we suggest to use information on the level of generalized trust, whether the country was communist in the past, whether it is a monarchy and whether its inhabitants judge religion as important in the country of destination as proxy variables for normative similarity with respect to Denmark. Trust has been found to be important for trade, as it acts as a trade-promoting force (see Guiso et al. 2009). In our case, we do not consider bilateral trust, but are concerned with the overall level of trust prevailing in a country, as this provides a proxy for the overall normative framework of a country. The overall level of generalized trust is outstandingly stable over time (Bjørnskov 2006), such that we treat it as an exogenous variable (as we do with the other measures for cultural proximity). As we consider only one exporting and emigrant source country, the monadic measures of trust and ideology can be interpreted as proximity variables with respect to Denmark, and will be referred to as such. Recent literature points to the interplay between trust and migration in the sense that there is

evidence in favor of the acculturation of trust, i.e., for an adjustment of the trust levels of immigrants to the prevailing native levels (Dinesen and Hooghe 2010). This close tie corroborates the necessity to account for trust levels when assessing the trade-migration nexus.

Our results are summarized in Tables 4 and 5. As previous results have highlighted the need to account for sample selection, we report results for a Heckman Selection model. Following from the sets of proxies for cultural similarity, we use two different samples resulting from data availability: The first sample for which we have information on votes in the Eurovision Song contest is a rather homogenous sample of European countries together with Israel and Russia, whereas the second sample for which we have data on generalized trust covers a broader range of countries. We report in all cases the selection and the outcome equation for the respective subsamples with and without controls for cultural proximity in order. For the trust sample, we report both, the Heckman OLS and IV results. This is not possible for the Eurovision Song contest sample, as the probit model does not converge in this case.

For the homogenous Eurovision subsample, we find no statistically significant effect of emigration on neither the propensity to export to a given market, nor on the export value, when we do not account for taste similarity. The choice of a sample selection model however is supported by the data, as we can reject the Null of no sample selection on the one percent significance level. The Eurovision votes are entered in columns 2*a* and 2*b*. They exert no statistically significant effect in the selection equation, however, a pro-Danish vote in the contest increases Danish exports significantly. Including the proxy for taste similarity changes our conclusion with respect to the emigrant stock: We find that an increase in the emigrant stock hampers the market entry to the emigrants' country of origin. The direction of the effect is at odds with the trade-cost reducing rational discussed in the introduction, and potentially points towards an export substituting role of emigration. Especially in Europe, the Danish emigrant stock might reflect the intensity of Danish outward FDI with accompanying Danish labor, which substitutes direct exports from Denmark and potentially lowers the probability of direct export entry. Even if a transmission of knowledge occurs and a reduction in entry cost occurs due to emigration, this might be offset by export substitution via FDI. With respect to the intensive margin of firm-level trade, Danish residents abroad exert no effect on the value of export sales.

Yet the homogeneity of the sample might be a limitation especially because the Heckman Selection model is estimated without an exclusion restriction, which might worsen collinearity problems. Notably, collinearity due to a lacking exclusion restriction leads to power losses of the test for sample selectivity (Puhani 2000). Still, we are able to reject the Null hypothesis of no selection on the 1% level. We read this as indirect evidence in favor of our estimation strategy, and conclude that for the Eurovision subsample, emigration does not exert an export promoting role.

In order to investigate whether emigration fosters Danish exports to a broader set of destination countries, we measure culture in a different way. Table 5 summarizes these results. We find that both, OLS and IV Heckman results suggest that emigration does not affect selection into exporting when not accounting for cultural values (column 1*a* and 3*a*). With respect to the intensive margin of firm-level trade, IV estimates suggest

no statistically significant effect of emigration on trade, whereas OLS results suggest that a 1% increase in the emigrant stock increases export sales by 0.024%. In light of the fact that - based on a strong instrument - exogeneity of the emigrant stock cannot be rejected, we take this finding as evidence in favor of a trade promoting effect of emigration. Columns 2*b* and 4*b* support this claim even more: Accounting for cultural proximity, we find a trade promoting effect along the intensive margin using both Heckman IV and OLS, whereby again we prefer the latter one, as the Null of exogeneity of the emigrant stock cannot be rejected, even when we account for sample selection and cultural proximity simultaneously. In terms of magnitudes, we find that a 1% increase in the Danish expatriate population in a given country increases export sales to this market by 0.055% (0.058%) for the OLS (IV) case. With respect to export market entry, OLS (IV) results suggest that it is encouraged (not affected) by emigration as can be seen from columns 2*a* and 4*a*.

With respect to norms in the country of destination, we find the following results: The level of trust seems to discourage market entry, but upon entry fosters export sales (Columns 2*a* and 2*b*). Danish manufacturers are more likely to enter formerly communist countries, and ceteris paribus export more to these destinations. Entry is less likely when the partner country is a monarchy as Denmark, also, export sales are less. The importance of religion to a country's citizens seems not to affect market entry, but exhibits a negative impact on overall export sales.

To conclude, accounting for sample selection and endogeneity of the Danish emigrant stock, we find that a 10% increase in the Danish emigrant stock increases firm level exports by 0.55%.[7]

### 1.4.3 Additional Robustness Analysis

As a broad literature has found export promoting effects of immigration (for a recent example including also a literature overview, see Peri and Requena 2010), one may be

[7]The size of the effect varies across countries of destinations and different types of firms. Additional, unreported results support the notion that a minimum level of Danish residents is required for a positive effect of emigration on Danish export sales. Similarly, it seems that the ability to reap the fruits from emigration differs across firm sizes.

concerned that the export promoting effect of emigration in fact only approximates the export effect from immigration into Denmark. Indeed, four out of the top ten emigration destinations are also among the top ten sending countries to Denmark. These countries are Germany, Sweden, Norway and the United Kingdom. For the whole sample, the close ties between immigrant and emigrant stocks are reflected in a high correlation (0.63, significant at 1%). To address whether the export promotion is indeed caused by the Danish expatriate community, we augment our model which accounts for taste similarity by the immigrant stock to Denmark.

The estimation results are summarized in Table 6 (columns 1*a*, 1*b*). We subsequently compare them to our preferred specification from Table 5, columns 2*a* and 2*b*. With respect to the extensive margin, inclusion of the immigrant stock renders the effect of emigration on export market entry insignificant. Thus, it seems that the export promoting effect of emigration does not operate via the entry margin. With respect to the intensive margin, we draw a different conclusion: Accounting for the immigrant stock to Denmark leads to a moderate drop in the effect of emigration on export sales as compared to Table 5, column 2*b*: A 1% increase in the emigrant stock leads to a 0.048% increase in export sales in the emigrants' country of residence. The elasticity of exports with respect to immigration turns out to be slightly larger and also statistically significant at the 5% level. An increase of the immigrant stock to Denmark by 1% leads to 0.053% more export sales of Danish firms to the immigrants' source country. We can conclude that there is indeed an independent effect of Danish expatriate communities on Danish firms' sales abroad on top of a network effect due to immigration.

We have established that emigration indeed helps firms to overcome barriers to trade. What remains unresolved so far, is the role of multinational activity and FDI. It might be that the emigrant stock solely captures the engagement of large Danish multinational companies in the country of destination, and thereby does not capture the effect of the expatriate community per se on trade. As we are not able to measure the multinational status of a firm or its engagement in FDI activities abroad, we use a different procedure to satisfy ourself that the effect we estimate is indeed a network effect of emigration.

Helpman et al. (2004) have established theoretically and empirically that firms sort into international activities along their productivity: Low productivity firms remain domestic firms, intermediate firms sort into exporting and high-productivity firms pursue FDI abroad. We thus split our sample into two sub-samples for firms with labor productivity below and above the median. We assume that according to the previously mentioned productivity ranking, the relatively unproductive firms are unlikely to be engaged in FDI activities, whereas the larger ones are likely to simultaneously engage in both exports and FDI. Thus, if we find evidence for a trade-promoting effect of emigration for the low-productivity sub-sample, we take this as enforcing earlier full sample evidence, because we are unlikely to omit FDI in our specification. For the high-productivity sub-sample, it is more likely that the emigrant stock approximates multinational activity and relocation of employees beyond national borders. Our results are displayed in Table 6, columns $2a$ and $2b$, for low-productivity firms, and in columns $3a$ and $3b$ for high productivity firms. We find that emigration does not exert an entry promoting effect for neither type of firms (columns $2a$ and $3a$). Still, we find again an export promoting effect of the Danish expatriate community along the intensive margin of export sales: A 1% increase in the Danish emigrant stock increases export sales abroad by 0.069% for low-productivity firms, and by 0.032% for high-productivity firms. As low-productivity firms are very unlikely to engage in FDI or to be a multinational company, the positive effect of emigration on export sales of low-productivity firms corroborates our finding of an export promoting effect of emigration on exports. In addition, the differently sized estimated effects may also reflect that the ability to overcome barriers to trade may differ according to the organizational capacity and size of the firm (OECD 1997).[8]

To summarize, the robustness analysis shows that Danish expatriate communities cause an increase in Danish manufacturing firm-level exports along the intensive margin. They exert an independent effect on firm-level trade at the intensive margin, which exists on top of a network effect from immigration and which is not capturing FDI activities of firms abroad.

[8]Interestingly, estimation of an interacted model reveals that upon an emigrant stock above the 95% percentile of the productivity distribution, the effected of emigration turns negative.

## 1.5 Conclusion

In this paper, we use firm-level data for Denmark in 2001 in order to explore the link between emigration and exports. The availability of rich firm-level data allows us to exploit pre-sample information to account for export sunk costs, unobserved heterogeneity at the firm level, as well as self-selection into export destinations. Moreover, in order to identify the causal effect of emigration on trade, we account for similarity between Denmark and its trade partners as a major confounding factor when assessing the export-emigration nexus. In order to corroborate our findings, we account for immigration and emigration simultaneously. Lastly, we provide supportive evidence to satisfy ourselves that the export promoting effect of emigration is not driven by multinational status of the firms in our sample.

Based on this novel firm-level data, our analysis corroborates the finding that emigration plays a trade-promoting role. We find that this effect mostly operates via the intensive margin. This points to the importance of lower marketing cost for Danish firms abroad due to superior communication within the Danish network, as well as an increased demand for Danish products in response to emigration. Importantly, this holds true for a broad set of countries. Still, accounting for similarity between countries, we find that a 10% increase in the emigrant stock increases firm-level exports by 0.48%. This effect is slightly less than the corresponding effect that foreign immigrants to Denmark have on export sales (0.53%). As an additional new insight, this benefit accrues to a larger extent to low-productivity firms. Thus, the bottom line is that those firms who face most difficulties in the internationalization process successfully use ethnic ties for expanding their sales abroad.

This paper opens up to explore whether this positive link between emigration and firm-level exports can also be found for developing countries. Especially in these countries, the feedback effect of emigration on the internationalization of small enterprises provides a promising road to compensate potential brain losses due to high-skilled emigration.

Table 1.4: The Role of Cultural Proximity: Eurovision Song Contest Votes

| | Eurovision Song Contest | | | |
|---|---|---|---|---|
| | Probit Selection Eq 1a | OLS Outcome Eq 1b | Probit Selection Eq 2a | OLS Outcome Eq 2b |
| Emigrant Stock | -0.019 | 0.040 | -0.025 | -0.020 |
| | (0.139) | (0.165) | (0.074) | (0.519) |
| State Dependence | 3.593 | 4.219 | 3.594 | 4.226 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Labor Productivity | 0.157 | 0.994 | 0.156 | 0.990 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| **Cultural Proximity** | | | | |
| Taste Similarity | | | 0.006 | 0.059 |
| | | | 0.298 | (0.000) |
| **Market Size** | | | | |
| GDP (ln) | 0.234 | -1.036 | 0.238 | -0.933 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Population (ln) | -0.113 | 1.708 | -0.114 | 1.628 |
| | (0.077) | (0.000) | (0.075) | (0.000) |
| Area (ln) | -0.003 | -0.150 | 0.001 | -0.122 |
| | (0.920) | (0.004) | (0.970) | (0.029) |
| **Accessibility** | | | | |
| Distance (ln) | -0.787 | -1.722 | -0.812 | -1.912 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Multilateral Resistance | -0.142 | -0.326 | -0.147 | -0.366 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Landlocked | 0.033 | -0.039 | 0.039 | 0.004 |
| | (0.578) | (0.754) | (0.509) | (0.972) |
| **Institutions** | | | | |
| Rule of Law | 0.000 | 0.882 | -0.013 | 0.726 |
| | (0.992) | (0.000) | (0.814) | (0.000) |
| Distance to Equator | 0.022 | 0.073 | 0.021 | 0.066 |
| | (0.001) | (0.000) | (0.002) | (0.000) |
| **Geography** | | | | |
| Scandinavia | 0.189 | 0.443 | 0.202 | 0.556 |
| | (0.005) | (0.001) | (0.003) | (0.000) |
| Asia | -0.269 | 0.256 | -0.335 | -0.310 |
| | (0.004) | (0.188) | (0.003) | (0.207) |
| **Selection Correction** | | | | |
| Inverse Mills Ratio | | 1.520 | | 1.520 |
| | | (0.000) | | (0.000) |
| Obs | 50600 | 12664 | 50600 | 12664 |
| (Pseudo-) $R^2$ | 0.630 | 0.198 | 0.630 | 0.204 |

This Table presents additional estimation results resulting from the Heckman Selection Model when accounting for taste similarity. The standard errors of the outcome equation are bootstrapped with 499 repetitions. All estimations include industry and municipality dummies. The selection equation has been estimated by a probit model, reported estimates are coefficients, not marginal effects.

Table 1.5: The Role of Cultural Proximity: Social Trust and Ideology

| | Probit Selection Eq 1a | OLS Outcome Eq 1b | Probit Selection Eq 2a | OLS Outcome Eq 2b | Probit Selection Eq 3a | IV Outcome Eq 3b | Probit Selection Eq 4a | IV Outcome Eq 4b |
|---|---|---|---|---|---|---|---|---|
| Emigrant Stock | 0.006 | 0.024 | 0.012 | 0.055 | 0.007 | 0.020 | 0.006 | 0.058 |
| | (0.246) | (0.059) | (0.023) | (0.000) | (0.316) | (0.376) | (0.372) | (0.026) |
| State Dependence | 3.892 | 4.270 | 3.894 | 4.348 | 3.825 | 4.605 | 3.825 | 4.607 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Labor Productivity | 0.167 | 1.091 | 0.167 | 1.091 | 0.148 | 1.071 | 0.148 | 1.069 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Cultural Proximity** | | | | | | | | |
| Social Trust | | | -0.002 | 0.007 | | | 0.000 | 0.010 |
| | | | (0.045) | (0.001) | | | (0.630) | (0.000) |
| Post-Communist Country | | | 0.109 | 0.420 | | | 0.164 | 0.407 |
| | | | (0.000) | (0.000) | | | (0.000) | (0.000) |
| Monarchy | | | -0.038 | -0.227 | | | -0.029 | -0.255 |
| | | | (0.073) | (0.000) | | | (0.174) | (0.000) |
| Religion Important | | | -0.004 | -0.508 | | | 0.044 | -0.542 |
| | | | (0.935) | (0.000) | | | (0.405) | (0.000) |
| **Market Size** | | | | | | | | |
| GDP (ln) | 0.131 | 0.185 | 0.129 | 0.155 | 0.157 | 0.159 | 0.153 | 0.178 |
| | (0.000) | (0.000) | (0.000) | -0.001 | (0.000) | (0.009) | (0.000) | (0.001) |
| Population (ln) | -0.088 | 0.123 | -0.079 | 0.198 | -0.070 | 0.298 | -0.075 | 0.298 |
| | (0.000) | (0.019) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) |
| Area (ln) | 0.032 | 0.052 | 0.029 | 0.010 | 0.009 | -0.035 | 0.005 | -0.070 |
| | (0.000) | (0.002) | (0.000) | (0.594) | (0.253) | (0.034) | (0.533) | (0.000) |
| **Accessibility** | | | | | | | | |
| Distance (ln) | -0.278 | -1.008 | -0.242 | -0.705 | -0.205 | -0.845 | -0.191 | -0.565 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Multilateral Resistance | -0.011 | -0.037 | -0.009 | -0.014 | -0.005 | -0.026 | -0.007 | -0.001 |
| | (0.000) | (0.000) | (0.000) | | | (0.000) | | (0.000) |
| Landlocked | -0.161 | -0.500 | -0.181 | -0.638 | -0.122 | -0.448 | -0.131 | -0.566 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Institutions** | | | | | | | | |
| Rule of Law | 0.111 | 0.188 | 0.156 | 0.234 | 0.091 | 0.286 | 0.108 | 0.158 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.031) |
| Distance to Equator | 0.000 | 0.000 | 0.000 | -0.011 | 0.000 | -0.001 | 0.000 | -0.011 |
| | (0.587) | 0.883 | (0.930) | (0.000) | (0.746) | (0.822) | (0.916) | (0.000) |
| **Geography** | | | | | | | | |
| Scandinavia | 0.173 | 0.048 | 0.274 | 0.193 | 0.316 | 0.445 | 0.340 | 0.445 |
| | (0.000) | (0.527) | (0.000) | (0.026) | (0.000) | (0.000) | (0.000) | (0.000) |
| Africa | -0.057 | 0.481 | -0.020 | 0.447 | -0.115 | 0.041 | -0.090 | 0.009 |
| | (0.173) | (0.000) | (0.632) | (0.000) | (0.011) | (0.695) | (0.050) | (0.939) |
| America | -0.178 | 0.135 | -0.171 | 0.099 | -0.160 | 0.270 | -0.161 | 0.283 |
| | (0.000) | (0.209) | (0.000) | (0.398) | (0.001) | (0.015) | (0.001) | (0.019) |
| Asia | -0.051 | 0.387 | -0.021 | 0.355 | -0.094 | 0.290 | -0.084 | 0.323 |
| | (0.145) | (0.000) | (0.562) | (0.000) | (0.020) | (0.003) | (0.000) | (0.001) |
| Pacific | -0.340 | -0.596 | -0.310 | -0.674 | -0.130 | -0.019 | -0.066 | 0.131 |
| | (0.000) | (0.006) | (0.001) | (0.003) | (0.182) | (0.931) | (0.780) | (0.570) |
| **Excluded Instrument** | | | | | | | | |
| Emigrant Flow 1980 | | | | | -0.009 | | 0.014 | |
| | | | | | (0.424) | | (0.252) | |
| Inverse Mills Ratio | | 1.352 | | | | 1.557 | | 1.557 |
| | | (0.000) | | | | (0.000) | | (0.000) |
| First Stage F | | | | | | 11123.83 | | 8895.73 |
| Exogeneity of Emigrant Stock (p) | | | | | | 0.501 | | 0.111 |
| Obs | 230000 | 20474 | 230000 | 20474 | 186300 | 18792 | 186300 | 18792 |
| (Pseudo-) $R^2$ | 0.692 | 0.176 | 0.692 | 0.184 | 0.698 | 0.182 | 0.698 | 0.184 |

This Table presents additional estimation results resulting from the Heckman Selection Model when accounting for taste similarity. The standard errors of the outcome equation are bootstrapped with 499 repetitions. All estimations include industry and municipality dummies. The excluded instrument is the bilateral emigrant flow in 1980. The selection equation has been estimated by a probit model, reported estimates are coefficients, not marginal effects.

Table 1.6: Additional Robustness Checks: Immigration and Productivity

| | with immigration | | low productivity | | high productivity | |
|---|---|---|---|---|---|---|
| | Probit Selection Eq 1a | OLS Outcome Eq 1b | Probit Selection Eq 2a | OLS Outcome Eq 2b | Probit Selection Eq 3a | OLS Outcome Eq 3b |
| Emigrant Stock | 0.008 | 0.048 | 0.005 | 0.069 | 0.008 | 0.032 |
| | (0.144) | (0.001) | (0.550) | (0.006) | (0.228) | (0.059) |
| State Dependence | 3.890 | 4.330 | 3.875 | 4.399 | 3.894 | 4.192 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Labor Productivity | 0.169 | 1.093 | 0.322 | 1.229 | 0.166 | 1.117 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Immigrant Stock | 0.019 | 0.053 | 0.025 | 0.075 | 0.015 | 0.038 |
| | (0.016) | (0.020) | (0.044) | (0.064) | (0.122) | (0.170) |
| **Cultural Proximity** | | | | | | |
| Social Trust | -0.002 | 0.007 | -0.002 | 0.012 | -0.002 | 0.005 |
| | (0.042) | (0.000) | (0.185) | (0.001) | (0.093) | (0.071) |
| Post-Communist Country | 0.106 | 0.419 | 0.137 | 0.348 | 0.084 | 0.429 |
| | (0.001) | (0.000) | (0.005) | (0.006) | (0.040) | (0.000) |
| Monarchy | -0.029 | -0.216 | -0.026 | -0.346 | -0.030 | -0.138 |
| | (0.177) | (0.000) | (0.427) | (0.000) | (0.298) | (0.027) |
| Religion Important | -0.009 | -0.566 | 0.000 | -1.050 | -0.011 | -0.312 |
| | (0.849) | (0.000) | (0.999) | (0.000) | (0.856) | (0.021) |
| **Market Size** | | | | | | |
| GDP (ln) | 0.132 | 0.186 | 0.169 | 0.089 | 0.108 | 0.229 |
| | (0.000) | (0.000) | (0.000) | (0.305) | (0.000) | (0.001) |
| Population (ln) | -0.095 | 0.139 | -0.122 | 0.307 | -0.081 | 0.059 |
| | (0.000) | (0.015) | (0.000) | (0.002) | (0.002) | (0.443) |
| Area (ln) | 0.035 | 0.009 | 0.029 | -0.060 | 0.041 | 0.045 |
| | (0.000) | (0.634) | (0.021) | (0.072) | (0.000) | (0.071) |
| **Accessibility** | | | | | | |
| Distance (ln) | -0.230 | -0.647 | -0.153 | -0.573 | -0.290 | -0.681 |
| | (0.000) | (0.000) | (0.003) | (0.000) | (0.000) | (0.000) |
| Multilateral Resistance | -0.009 | -0.013 | -0.005 | -0.006 | -0.012 | -0.018 |
| | (0.000) | (0.024) | (0.198) | (0.485) | (0.000) | (0.012) |
| Landlocked | -0.166 | -0.604 | -0.145 | -0.534 | -0.183 | -0.634 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Institutions** | | | | | | |
| Rule of Law | 0.150 | 0.190 | 0.194 | 0.189 | 0.124 | 0.178 |
| | (0.000) | (0.001) | (0.000) | (0.066) | (0.000) | (0.017) |
| Distance to Equator | 0.000 | -0.647 | -0.001 | -0.016 | 0.000 | 0.003 |
| | (0.846) | (0.000) | (0.686) | (0.000) | (0.975) | (0.020) |
| **Geography** | | | | | | |
| Scandinavia | 0.240 | 0.117 | 0.289 | 0.236 | 0.202 | 0.048 |
| | (0.000) | (0.206) | (0.000) | (0.099) | (0.001) | (0.668) |
| Africa | -0.023 | 0.468 | 0.038 | 0.308 | -0.061 | 0.526 |
| | (0.597) | (0.000) | (0.572) | (0.129) | (0.275) | (0.001) |
| America | -0.182 | 0.073 | -0.190 | 0.223 | -0.184 | -0.015 |
| | (0.000) | (0.504) | (0.010) | (0.252) | (0.002) | (0.919) |
| Asia | -0.033 | 0.320 | -0.045 | 0.251 | -0.023 | 0.325 |
| | (0.373) | (0.000) | (0.433) | (0.110) | (0.627) | (0.006) |
| Pacific | -0.345 | -0.746 | -0.220 | -0.744 | -0.451 | -0.715 |
| | (0.000) | (0.001) | (0.124) | (0.057) | (0.000) | (0.016) |
| **Selection Correction** | | | | | | |
| Inverse Mills Ratio | | 1.374 | | 1.539 | | 1.210 |
| | | (0.000) | | (0.000) | | (0.000) |
| Obs | 230000 | 20474 | 115000 | 8151 | 115000 | 12323 |
| (Pseudo-) $R^2$ | 0.693 | 0.179 | 0.697 | 0.162 | 0.687 | 0.163 |

This Table presents additional estimation results resulting from the Heckman Selection Model when accounting for taste similarity. The first two columns augments Table 5, column 2a/b by the immigrant stock to Denmark. Columns 2a and 2b consider only low-productivity firms (below median productivity), columns 3a and 3b are restricted to high-productivity firms (above median). The standard errors of the outcome equation are bootstrapped with 499 repetitions. All estimations include industry and municipality dummies. The selection equation has been estimated by a probit model, reported estimates are coefficients, not marginal effects.

Table 1.7: List of Countries

| | | | Number of Exporters by Firm Size | | | |
|---|---|---|---|---|---|---|
| | Country | Emigrant Stock | Total | Micro | Small | Medium | Large |
| 1 | Sweden* | 40921 | 1166 | 40 | 482 | 437 | 207 |
| 2 | Germany* | 35343 | 1243 | 43 | 516 | 471 | 213 |
| 3 | United States of America | 34089 | 701 | 57 | 244 | 256 | 144 |
| 4 | Norway* | 19756 | 1656 | 225 | 761 | 465 | 205 |
| 5 | United Kingdom* | 18869 | 970 | 30 | 361 | 388 | 191 |
| 6 | Canada | 18400 | 343 | 17 | 110 | 123 | 93 |
| 7 | Australia | 9024 | 308 | 12 | 80 | 122 | 94 |
| 8 | France* | 5864 | 811 | 21 | 288 | 319 | 183 |
| 9 | Spain* | 5749 | 607 | 16 | 195 | 237 | 159 |
| 10 | Switzerland* | 4530 | 733 | 46 | 267 | 266 | 154 |
| 11 | Philippines | 3861 | 92 | 2 | 9 | 30 | 51 |
| 12 | Turkey* | 3372 | 184 | 2 | 34 | 66 | 82 |
| 13 | Netherlands* | 3232 | 920 | 31 | 337 | 360 | 192 |
| 14 | Belgium and Luxembourg* | 2973 | 709 | 18 | 246 | 281 | 164 |
| 15 | Pakistan | 2626 | 49 | 1 | 4 | 15 | 29 |
| 16 | Italy | 2595 | 576 | 14 | 181 | 225 | 156 |
| 17 | Iceland* | 2476 | 578 | 43 | 201 | 205 | 129 |
| 18 | Luxembourg | 1526 | 137 | 1 | 40 | 58 | 38 |
| 19 | New Zealand | 1435 | 156 | 2 | 37 | 54 | 63 |
| 20 | Kuwait | 1268 | 83 | 0 | 8 | 29 | 46 |
| 21 | Latvia* | 1214 | 197 | 6 | 59 | 69 | 63 |
| 22 | Austria* | 1157 | 612 | 19 | 219 | 227 | 147 |
| 23 | South Africa | 978 | 188 | 6 | 35 | 75 | 72 |
| 24 | Jordan | 923 | 73 | 0 | 11 | 23 | 39 |
| 25 | Greece | 831 | 339 | 4 | 88 | 137 | 110 |
| 26 | Russian Federation* | 786 | 210 | 5 | 43 | 79 | 83 |
| 27 | Poland | 717 | 640 | 37 | 227 | 236 | 140 |
| 28 | Argentina | 711 | 104 | 1 | 18 | 31 | 54 |
| 29 | Finland* | 708 | 772 | 20 | 279 | 294 | 179 |
| 30 | Tanzania, United Rep. of | 700 | 18 | 0 | 7 | 5 | 6 |
| 31 | Ireland* | 698 | 410 | 7 | 129 | 161 | 113 |
| 32 | Uzbekistan | 616 | 7 | 0 | 0 | 1 | 6 |

Continued on next page

Table 1.7: List of Countries

| | | | Number of Exporters by Firm Size | | | | |
|---|---|---|---|---|---|---|---|
| | Country | Emigrant Stock | Total | Micro | Small | Medium | Large |
| 33 | Indonesia | 504 | 93 | 3 | 12 | 33 | 45 |
| 34 | Israel* | 486 | 252 | 6 | 74 | 85 | 87 |
| 35 | Ukraine | 445 | 65 | 1 | 7 | 23 | 34 |
| 36 | Thailand | 437 | 150 | 3 | 36 | 54 | 57 |
| 37 | Portugal | 387 | 356 | 6 | 106 | 140 | 104 |
| 38 | Zimbabwe | 378 | 15 | 0 | 6 | 2 | 7 |
| 39 | Brazil | 361 | 136 | 2 | 25 | 49 | 60 |
| 40 | Nepal | 355 | 8 | 0 | 3 | 1 | 4 |
| 41 | United Arab Emirates | 354 | 182 | 2 | 34 | 67 | 79 |
| 42 | Egypt | 312 | 112 | 3 | 14 | 44 | 51 |
| 43 | Japan | 311 | 401 | 19 | 127 | 142 | 113 |
| 44 | Mexico | 238 | 115 | 1 | 22 | 39 | 53 |
| 45 | Libyan Arab Jamahiriya | 237 | 9 | 0 | 0 | 2 | 7 |
| 46 | Chile | 221 | 115 | 4 | 16 | 40 | 55 |
| 47 | Lebanon | 215 | 78 | 1 | 11 | 23 | 43 |
| 48 | Algeria | 196 | 17 | 0 | 3 | 8 | 6 |
| 49 | Burkina Faso | 177 | 7 | 0 | 0 | 5 | 2 |
| 50 | Ghana | 174 | 24 | 1 | 2 | 10 | 11 |
| 51 | Nigeria | 162 | 37 | 0 | 5 | 14 | 18 |
| 52 | Cote d'Ivoire | 154 | 21 | 0 | 2 | 8 | 11 |
| 53 | Malaysia | 152 | 147 | 2 | 24 | 50 | 71 |
| 54 | Hong Kong | 143 | 227 | 13 | 48 | 81 | 85 |
| 55 | Kenya | 140 | 41 | 1 | 5 | 8 | 27 |
| 56 | Czech Republic | 136 | 321 | 19 | 76 | 122 | 104 |
| 57 | China | 135 | 186 | 4 | 40 | 76 | 66 |
| 58 | Mozambique | 119 | 2 | 0 | 0 | 1 | 1 |
| 59 | Venezuela | 117 | 57 | 0 | 6 | 18 | 33 |
| 60 | Morocco | 110 | 48 | 2 | 4 | 14 | 28 |
| 61 | Guinea | 101 | 5 | 0 | 1 | 2 | 2 |
| 62 | Hungary | 100 | 259 | 10 | 57 | 102 | 90 |
| 63 | Cuba | 94 | 8 | 0 | 0 | 1 | 7 |
| 64 | Colombia | 94 | 53 | 0 | 7 | 14 | 32 |
| 65 | Lithuania | 89 | 242 | 20 | 68 | 77 | 77 |

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Table 1.7: List of Countries

| | | | Number of Exporters by Firm Size | | | |
|---|---|---|---|---|---|---|
| | Country | Emigrant Stock | Total | Micro | Small | Medium | Large |
| 66 | Yemen | 86 | 26 | 0 | 2 | 6 | 18 |
| 67 | India | 80 | 121 | 1 | 19 | 43 | 58 |
| 68 | Romania* | 72 | 99 | 0 | 19 | 33 | 47 |
| 69 | Namibia | 69 | 150 | 8 | 41 | 41 | 60 |
| 70 | Bolivia | 66 | 10 | 0 | 1 | 1 | 8 |
| 71 | Taiwan | 61 | 170 | 5 | 36 | 55 | 74 |
| 72 | Ecuador | 57 | 33 | 0 | 3 | 11 | 19 |
| 73 | Peru | 54 | 50 | 0 | 6 | 16 | 28 |
| 74 | Ethiopia | 51 | 14 | 0 | 0 | 5 | 9 |
| 75 | Iraq | 51 | 7 | 0 | 1 | 0 | 6 |
| 76 | Malawi | 50 | 6 | 0 | 1 | 1 | 4 |
| 77 | Cyprus* | 48 | 123 | 2 | 18 | 39 | 64 |
| 78 | Uruguay | 48 | 39 | 0 | 2 | 11 | 26 |
| 79 | Nicaragua | 46 | 5 | 0 | 0 | 2 | 3 |
| 80 | Kyrgyzstan | 45 | 3 | 0 | 0 | 1 | 2 |
| 81 | Moldova, Rep.of | 45 | 7 | 0 | 0 | 1 | 6 |
| 82 | Panama | 39 | 27 | 0 | 5 | 6 | 16 |
| 83 | Croatia* | 39 | 94 | 0 | 16 | 33 | 45 |
| 84 | Syrian Arab Republic | 38 | 31 | 0 | 2 | 7 | 22 |
| 85 | Cameroon | 38 | 13 | 0 | 1 | 6 | 6 |
| 86 | Costa Rica | 36 | 20 | 0 | 4 | 4 | 12 |
| 87 | Zambia | 35 | 3 | 0 | 0 | 1 | 2 |
| 88 | Dominican Republic | 33 | 25 | 0 | 2 | 6 | 17 |
| 89 | Sri Lanka | 33 | 47 | 1 | 7 | 17 | 22 |
| 90 | Bahamas | 31 | 5 | 0 | 0 | 1 | 4 |
| 91 | Angola | 30 | 6 | 0 | 0 | 3 | 3 |
| 92 | Turkmenistan | 29 | 3 | 0 | 1 | 0 | 2 |
| 93 | Bahrain | 26 | 62 | 0 | 6 | 24 | 32 |
| 94 | Singapore | 26 | 215 | 8 | 56 | 73 | 78 |
| 95 | Viet Nam | 23 | 46 | 0 | 6 | 15 | 25 |
| 96 | Togo | 21 | 8 | 1 | 1 | 2 | 4 |
| 97 | Honduras | 21 | 8 | 0 | 0 | 2 | 6 |

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Table 1.7: List of Countries

| | | | Number of Exporters by Firm Size | | | |
|---|---|---|---|---|---|---|
| | Country | Emigrant Stock | Total | Micro | Small | Medium | Large |
| 98 | Estonia* | 21 | 247 | 9 | 68 | 80 | 90 |
| 99 | Paraguay | 21 | 12 | 0 | 0 | 4 | 8 |
| 100 | Belarus | 18 | 27 | 2 | 1 | 11 | 13 |
| 101 | Slovakia | 17 | 117 | 0 | 21 | 46 | 50 |
| 102 | Antigua and Barbuda | 16 | 4 | 0 | 0 | 1 | 3 |
| 103 | Congo | 16 | 9 | 0 | 1 | 5 | 3 |
| 104 | Kazakstan | 15 | 16 | 0 | 0 | 5 | 11 |
| 105 | Swaziland | 14 | 3 | 0 | 0 | 2 | 1 |
| 106 | Madagascar | 14 | 12 | 0 | 0 | 4 | 8 |
| 107 | Iran | 13 | 47 | 0 | 4 | 16 | 27 |
| 108 | Uganda | 13 | 9 | 0 | 1 | 2 | 6 |
| 109 | Gambia | 12 | 5 | 0 | 0 | 0 | 5 |
| 110 | Oman | 12 | 54 | 0 | 4 | 12 | 38 |
| 111 | Georgia | 12 | 5 | 0 | 0 | 2 | 3 |
| 112 | Bulgaria | 12 | 83 | 1 | 13 | 26 | 43 |
| 113 | Senegal | 11 | 15 | 0 | 3 | 4 | 8 |
| 114 | Saudi Arabia | 10 | 157 | 2 | 31 | 57 | 67 |
| 115 | Trinidad and Tobago | 10 | 21 | 0 | 1 | 8 | 12 |
| 116 | Armenia | 10 | 5 | 0 | 0 | 1 | 4 |
| 117 | Haiti | 10 | 10 | 0 | 3 | 4 | 3 |
| 118 | Djibouti | 9 | 3 | 0 | 1 | 1 | 1 |
| 119 | Malta* | 8 | 71 | 0 | 11 | 24 | 36 |
| 120 | Mali | 8 | 3 | 0 | 1 | 0 | 2 |
| 121 | Bermuda | 8 | 5 | 0 | 1 | 2 | 2 |
| 122 | Liberia | 8 | 7 | 0 | 1 | 4 | 2 |
| 123 | Albania | 8 | 1 | 0 | 0 | 0 | 1 |
| 124 | Belize | 8 | 4 | 0 | 0 | 0 | 4 |
| 125 | Slovenia | 7 | 156 | 3 | 32 | 55 | 66 |
| 126 | Papua New Guinea | 6 | 10 | 1 | 0 | 3 | 6 |
| 127 | Chad | 6 | 1 | 0 | 0 | 1 | 0 |
| 128 | Cambodia | 5 | 3 | 0 | 0 | 1 | 2 |
| 129 | Eritrea | 5 | 6 | 0 | 1 | 1 | 4 |
| 130 | Tunisia | 5 | 46 | 0 | 6 | 16 | 24 |

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Table 1.7: List of Countries

| | | | Number of Exporters by Firm Size | | | | |
|---|---|---|---|---|---|---|---|
| | Country | Emigrant Stock | Total | Micro | Small | Medium | Large |
| 131 | Rwanda | 5 | 4 | 0 | 0 | 1 | 3 |
| 132 | Bangladesh | 4 | 29 | 0 | 1 | 9 | 19 |
| 133 | Gabon | 4 | 6 | 0 | 0 | 1 | 5 |
| 134 | Grenada | 4 | 4 | 0 | 0 | 1 | 3 |
| 135 | Suriname | 3 | 6 | 0 | 0 | 1 | 5 |
| 136 | Cape Verde | 3 | 6 | 0 | 1 | 0 | 5 |
| 137 | Benin | 3 | 3 | 0 | 1 | 0 | 2 |
| 138 | Seychelles | 3 | 5 | 0 | 1 | 1 | 3 |
| 139 | Mongolia | 3 | 4 | 0 | 2 | 1 | 1 |
| 140 | Macau (Aomen) | 3 | 3 | 0 | 0 | 1 | 2 |
| 141 | Tonga | 3 | 1 | 0 | 0 | 0 | 1 |
| 142 | Saint Kitts and Nevis | 2 | 2 | 0 | 0 | 0 | 2 |
| 143 | Barbados | 2 | 19 | 0 | 0 | 6 | 13 |
| 144 | Korea | 2 | 196 | 3 | 49 | 70 | 74 |
| 145 | Sierra Leone | 2 | 10 | 0 | 2 | 4 | 4 |
| 146 | Lesotho | 2 | 1 | 0 | 0 | 1 | 0 |
| 147 | El Salvador | 2 | 11 | 0 | 0 | 5 | 6 |
| 148 | Mauritius | 2 | 32 | 0 | 6 | 10 | 16 |
| 149 | Fiji | 2 | 4 | 0 | 0 | 3 | 1 |
| 150 | Brunei Darussalam | 2 | 2 | 0 | 0 | 1 | 1 |
| 151 | Dominica | 1 | 2 | 0 | 0 | 0 | 2 |
| 152 | Guatemala | 1 | 27 | 0 | 5 | 7 | 15 |
| 153 | Bosnia and Herzegovina | 1 | 23 | 0 | 1 | 8 | 14 |
| 155 | Maldives | 1 | 6 | 0 | 0 | 0 | 6 |
| 157 | Guinea-Bissau | 1 | 2 | 0 | 0 | 1 | 1 |
| 158 | Jamaica | 1 | 15 | 0 | 1 | 5 | 9 |
| TOTAL | 158 | 237440 | 22461 | 896 | 6888 | 8102 | 6575 |

This Table lists all countries included in our sample ranked by the number of Danish residents. Moreover, it adds the number of Danish manufacturing firms serving the market in 2001. An asterisk indicates participation in the Eurovision Song Contest.

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# Chapter 2

# Immigration and the Product Margins of International Trade

## 2.1 Introduction

The economic effects of immigration on the host country are strongly debated, and their scientific exploration is essential to the ongoing political debate on immigration policy. One strand of literature has focused on the impact of immigration on international trade. Some examples include Peri and Requena (2010), Felbermayr and Jung (2009), White (2007), Combes et al. (2005), Herander and Saavedra (2005), Girma and Yu (2002), Rauch and Trindade (2002), Dunlevy and Hutchinson (1999), Head and Ries (1998) and Gould (1994). Foreign expatriates have the potential to lower barriers to trade, as they carry relevant market-specific information, may improve contract enforcement (Rauch 2001) and help firms to discover business opportunities abroad due to their superior knowledge about their home market (Casella and Rauch 2002). In a nutshell, immigration exhibits the potential to lower both variable and fixed trade costs, which in turn matter for both firm entry into trade as well as the value and range of traded goods.

Recent theoretical and empirical research documents the dominant role played by multi-product firms in the economy in general, and in trade in particular (Bernard et al. 2010b, Goldberg et al. 2010). The theoretical and empirical literature in the tradition of heterogeneous firm models in the spirit of Melitz (2003) extends earlier work on multi-product firms, which comprises among others Brander and Eaton (1984), Shaked and Sutton (1990), Eaton and Schmidt (1994), as well as Johnson and Myatt (2003). Examples of more recent contributions include Ottaviano and Thisse (2010), Eckel and Neary (2010), as well as Nocke and Yeaple (2008). A recent paper by Bernard et al. (2010a) highlights the intra-firm reallocation across products and destination countries. The authors show - inter alia - that the within-firm composition of exports is decisively affected by variations in variable and fixed trade costs. Both, the presence of local migrant networks, and the employment of foreigners by firms may affect these costs.

This paper combines the two different streams of literature and provides a first attempt to assess how immigration affects trade and trade composition within the firm.[1] It con-

[1] An independently conducted unpublished study by Hatzigeorgiou and Lodefalk (2011) also uses matched employer-employee data from Sweden to address the trade-migration nexus. Koenig (2009) uses French firm-level data to analyze the link between export market entry and immigration.

tributes to the existing literature by distinguishing two channels by which immigration may matter for firm trade: Firstly, it discriminates between foreign employment in the trading firm and the presence of a local immigrant network. Thereby it provides novel insights with respect to their relative importance. Is immigrant knowledge that a firm can access directly by employing a foreigner the driving factor for a trade promoting role of immigration? Or does the number of immigrants residing in a region - irrespective of their employment - also matter for trade via a broader network effect? Secondly, it pioneers assessing the adjustment mechanism within the firm through which migration affects exports and imports. Do firms trade more products or a higher average value per product if they are exposed to local ethnic networks or if they decide to employ foreigners? In order to address these questions, this analysis exploits the panel structure of a matched employer-employee data set, which contains information of Danish manufacturing exports and imports for 168 destination markets for the years between 1995 and 2005.

Our major results are in line with both, the literature which empirically assesses the migration-trade nexus as well as the recent theoretical advances on multi-product firms: Immigration fosters trade. In particular, we find that the local immigrant networks foster firm-level imports and to a lesser extent exports. The employment of foreigners from a firm's trade partner countries benefits both firm-level imports and exports. Importantly, both regional migrant networks and employees with a different ethnic background encourage an adjustment of the traded product portfolio by increasing the range of traded varieties. Our results are qualitatively and quantitatively robust to several variations of the empirical specification. In particular, we account for reverse causality of foreign employment and sample selection.

Section 2 provides a theoretical motivation and a brief literature review. Section 3 presents the data. The empirical strategy is described in Section 4. Section 5 presents the results, which are discussed in Section 6. Finally, Section 7 concludes.

## 2.2 Theoretical Motivation and Literature Review

This study relates to two different theoretical and empirical strands of literature. First, this paper links to studies analyzing the interaction between trade and international labor mobility. Secondly, it is related to the literature on multi-product firms and their export behavior.

First, a broad theoretical and empirical economic literature argues that immigration exhibits the potential to benefit trade through the reduction of barriers (Gould 1994, Head and Ries 1998). The ways how migration can potentially lower trade cost are ample (see Dunlevy and Hutchinson 1999): Immigrants may be more aware of trade opportunities with their home countries which arise due to cost differentials, product differentiation or foreign demand and thereby they may lower information cost (compare Casella and Rauch 2002). Moreover, immigrants are able to communicate in their native tongue and to translate between the domestic and foreign language, which fosters international transactions (Melitz 2008) and lowers both variable and fixed trade costs. Also, they may grease the wheels of international commerce through the provision of trust and confidence in international transactions. Trust is particularly important if economic transactions take place across national borders, as contract enforcement is difficult to ensure across distinct jurisdictions. Here, immigrants may sanction opportunistic behavior and convey information on those failing to meet contractual obligations (Rauch 2001, Herander and Saavedra 2005). For imports, in addition to these cost channels, a substantial mass of migrants may create a demand for goods which are imported from the country of origin (Combes et al. 2005).

In a nutshell, empirical evidence is supportive for a trade-creating effect of migration on trade. Most recently and at the most detailed disaggregation level available so far, Peri and Requena (2010) establish a positive effect of immigration: They use regional transaction data on exports by destination to establish that immigration encourages firms to start exporting rather than to increase the export value, i.e., that the trade creation of immigration operates via the extensive margin of trade rather than via the intensive margin. The authors also provide a short overview about earlier empirical findings. The

estimated immigration elasticity of exports spans between 0.08% and 0.57%, whereby the majority of studies finds an elasticity around 0.1%. With few exceptions, these studies are cross-sectional (among the exceptions: Bandyopadhyay et al. 2008, Girma and Yu 2002, Peri and Requena 2010). The network effects of migration has been found to differ across ethnic networks (Felbermayr et al. 2009). Immigration into Denmark and its connection to Danish trade has been assessed by White (2007). Using aggregate trade data between Denmark and 170 countries spanning from 1980 to 1990, he finds a positive connection, where the immigration elasticity is estimated at 0.328% for imports and 0.572% for exports. These elasticities occupy the top end of effects estimated for other countries. The majority of empirical studies finds that migration matters more for imports than for exports. Often this finding is interpreted in favor of the prominent role of the preference channel, meaning in favor of a stimulation of import demand due to specific consumption desires of immigrants. Similarly, this may be true the case if foreign expatriates prefer to use intermediate inputs in the production process which originate from their country of origin. At the firm-level, it is possible to account for the interplay between imports and exports, which recent empirical and theoretical literature acknowledges as important (Castellani et al. 2010, Kasahara and Lapham 2008). However, to the best of our knowledge, so far no study using matched employer-employee data has accounted for this feature of trading firms.

Secondly, this paper relates to recent theoretical and empirical advances on multi-product firms. This literature follows up on Melitz (2003) and incorporates the product dimension as a source of firm heterogeneity. Most recently, Bernard et al. (2010a) provide a general equilibrium model with multiple firms and destinations. Alternative roads of modeling have been taken, but they are less closely related to our analysis, because they either impose symmetry on products and firms (Ottaviano and Thisse 2010, Allanson and Montagna 2005) or allow for firms which are large relative to the market (Eckel and Neary 2010). Other important contributions include for example Nocke and Yeaple (2006), Feenstra and Ma (2008) as well as Arkolakis and Muendler (2010).

The paper perhaps closest to our current application is Bernard et al. (2010a), as it

focuses strongly on the interaction between country-, product- and firm-heterogeneity: In order to export, firms participate in a lottery entailing sunk cost, upon which firm profitability is revealed. Subsequently, firms choose among a continuum of destination markets and products. Importantly, firm profitability depends on both the firm's intrinsic ability as well as product characteristics, which vary across products and potentially also across destination markets. The model of Bernard et al. (2010a) generate testable predictions on both selection across firms - i.e., whether firms are forced to exit the market, stay domestic or start to export - and on selection within the firm - i.e., the product range selection.

As the traditional literature has established, immigration exhibits the potential to lower trade costs through various channels. According to the Bernard et al. (2010a) framework, a cost reduction has the following implications for the within-firm composition of exports (predictions from Bernard et al. (2010a), proposition 2, follow in italic print). *First, if an immigrant inflow incites a drop in variable trade cost, the number of products supplied by an exporting firm to a given market (subsequently called "product extensive margin" or "product scope" as in Arkolakis and Muendler (2010)) increases*(Bernard et al. (2010a)). In response to lower variable trade costs, it becomes profitable to export also those products with low attributes which were previously only sold in the home country, because the reduction in trade costs lowers the product price in each market, and thereby increases revenue and variable profits. As a consequence, fixed export cost for products with low attributes can be profitably covered after trade liberalization. *Secondly, if an immigrant inflow incites a drop in variable trade cost the effect on the average export sales of a firm across its products on a market (subsequently called "product intensive margin" or "product scale" as in Arkolakis and Muendler (2010) ) is ambiguous*(Bernard et al. (2010a)). On the one hand, due to the lower price of already exported products, firms export more of those products which are already exported to a given market. On the other hand, the introduction of new goods to the market, which are exported there in low amounts, implies a fall in average exports per product. *Thirdly, if instead immigration induces a reduction in fixed export cost, the effect on the extensive product*

*margin remains is positive* (Bernard et al. (2010a)): As before, lower export fixed cost make it profitable to export also products with lower product attributes (in small volumes, though). *Fourth, if immigration induces a reduction in fixed export cost, the effect on the intensive product margin is unambiguously negative* (Bernard et al. (2010a)). This is due to the compositional effect in favor of a small amounts of "worse" products, because a lower value of product attributes suffices to generate profitable export. Thus, the theoretical prediction - albeit detailed in the various channels - is ambiguous as the overall effect.

## 2.3 Data Description

### 2.3.1 Data Sources

In order to assess the impact of immigration and employment of foreign expatriates on trade behavior at the firm-level, we use Danish firm-level data on firms that trade with at least one foreign country. Firm-level data is provided by Statistics Denmark: Data on exports (imports) is destination specific and covers around 10,500 different goods measured in value at the 8-digit level. We aggregate products to the 2-digit level and count the number of products a firm exports (imports) per market and calculate their average value. The second data source is the "Integrated Database for Labor Market Research", a longitudinal employer-employee register. The third data source are business accounts (REGNSKAB), which cover the manufacturing industry from 1995 onwards. We restrict our analysis to manufacturing trading firms, i.e., firms that are either engaged in exporting or importing or both, and use a 2-digit industry-specific deflator to deflate monetary values.

We do not include firms with negative total revenue or negative export revenue or negative import purchases as well as firms with an export revenue greater than the total revenue, because these values presumably are a mistake in the data. We obtain an unbalanced panel of 7143 manufacturing traders, which covers the time period from 1995 to 2005. This sample is merged with population data on all people registered in Denmark. From

the Danish registry, we obtain the country of origin of residents in Denmark who are first generation immigrants and match those that are in employment to our firm-level information.

Finally, this firm-destination data set is complemented with macroeconomic information on the county and country level, whereby it comprises 168 trade partners of Denmark. Excluding Bornholm and the city of Copenhagen, we consider 13 out of 15 Danish regions.[2] The GDP and GDP per capita series originate from Heston et al. (2009), whereas our measure for institutional quality, rule of law, is drawn from Kaufmann et al. (2010). In this way, we obtain two different samples of firms who are engaged in international trade. The sample of exporters (importers) has 218,871 (123,886) observations. These two samples have 67,706 observations in common, which consist of firms which sell to and buy from a particular country in a given year.

Table 1 provides extended information about these two samples. The general picture reveals the following: Export sales are greater in the importer sample than in the exporter sample, whereas import purchases are greater in the exporter sample. This reflects that on average, two-way traders sell more abroad and buy more from foreign markets. Similarly, this holds true for the number of exported and imported varieties, as well as their average value. It will be important to account for this systematic level difference in our estimation. Moreover, importing firms seem to be more prone to employ foreigners which are born in a trade partner country as compared to exporting firms. The respective means amount to 0.181 in the exporter and 0.246 in the exporter sample. However, this presumably reflects the supply of people from the respective country in the region where the firm is located: The average immigrant stock in the exporter sample again exceeds the mean of the importer sample. Compare Section 3.3 for further description of immigration patterns into Denmark. Comparing firm characteristics across the two sub-samples reveals that the importer sample exhibits larger and more productive firms which pay higher wages on average.

[2] In 2006, Denmark has implemented an administrative reform. The former 15 regions including 270 municipalities have been replaced by five regions and 98 municipalities. We use the terms region and county interchangeably thereby always referring to the pre-reform county.

Table 2.1: Summary Statistics: Exporter and Importer Sample

Exporter Sample
$N^x = 218871$

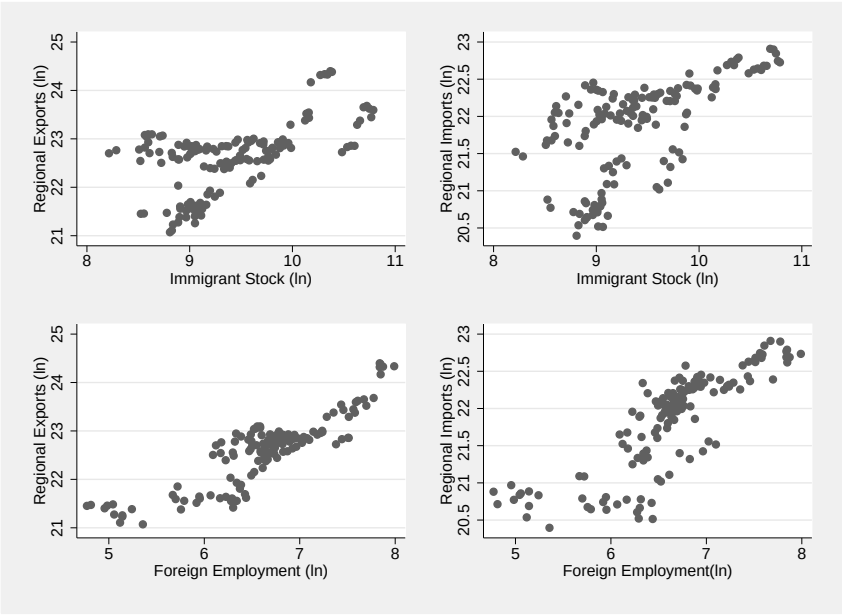
| | Mean | SD | Min | Max |
|---|---|---|---|---|
| ln Exports | 12.795 | 2.386 | 0.000 | 22.426 |
| ln Imports | 12.762 | 2.778 | 0.000 | 20.207 |
| ln Number of Export Products | 0.338 | 0.581 | 0.000 | 3.497 |
| ln Number of Import Products | 0.655 | 0.735 | 0.000 | 3.526 |
| ln Average Value Per Export Product | 12.457 | 2.234 | 0.000 | 21.678 |
| ln Average Value Per Import Products | 12.107 | 2.465 | 0.000 | 19.376 |
| ln Immigrant Stock | 4.785 | 1.718 | 0.000 | 9.164 |
| Immigrants Employed | 0.181 | 1.358 | 0.000 | 126.000 |
| ln Number of Employees | 4.339 | 1.428 | 0.000 | 9.451 |
| ln Productivity | 12.965 | 0.468 | 6.908 | 16.922 |
| ln Average Hourly Wage | 5.155 | 0.192 | 2.944 | 7.722 |
| ln Real GDP per capita | 9.909 | 0.679 | 7.035 | 11.197 |

Importer Sample
$N^m = 123886$

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| ln Exports | 13.899 | 2.499 | 0.000 | 22.426 |
| ln Imports | 12.492 | 2.631 | 0.000 | 21.145 |
| ln Number of Export Products | 0.615 | 0.742 | 0.000 | 3.497 |
| ln Number of Import Products | 0.515 | 0.677 | 0.000 | 3.638 |
| ln Average Value Per Export Product | 13.284 | 2.328 | 0.000 | 21.678 |
| ln Number of Import Products | 11.977 | 2.378 | 0.000 | 21.145 |
| ln Immigrant Stock | 5.234 | 1.579 | 0.000 | 9.164 |
| Immigrants Employed | 0.246 | 1.514 | 0.000 | 108.000 |
| ln Number of Employees | 4.219 | 1.438 | 0.000 | 9.451 |
| ln Productivity | 12.969 | 0.480 | 6.908 | 16.922 |
| ln Average Hourly Wage | 5.143 | 0.194 | 2.079 | 7.722 |
| ln Real GDP per capita | 10.028 | 0.598 | 7.035 | 11.197 |

This Table depicts summary statistics for the importer and exporter sample pooled over the sample period from 1995 - 2005. The presence of two-way traders in our sample leads to 67,706 overlapping observations.

Figure 2.1: Immigration, Foreign Employment and International Trade



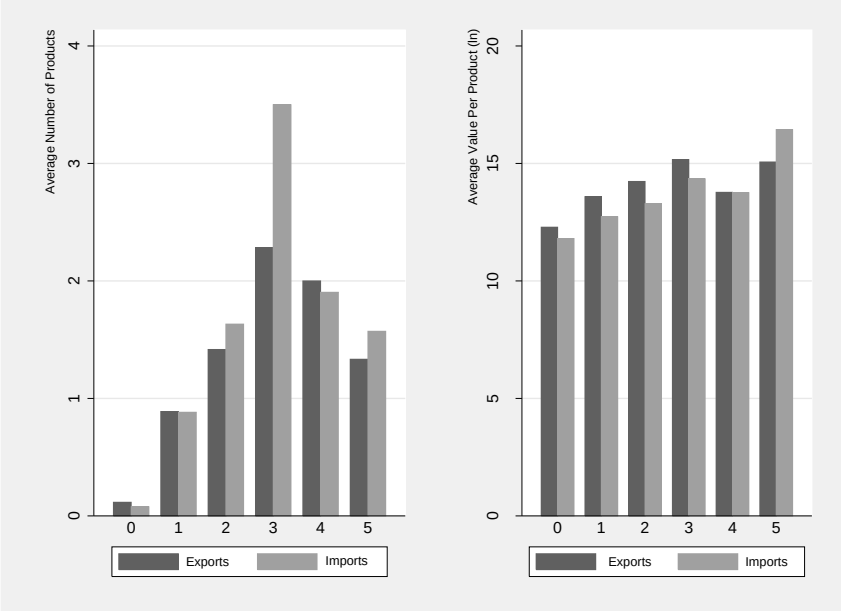

This Figure displays the relation between immigration and foreign employment with imports and exports at the regional level. The data is pooled over all years 1995 - 2005, and summed over all destination countries.

### 2.3.2 The Link Between Foreign Employment and Foreign Trade

This data set is used to empirically assess the nexus between trade and migration on the firm-level. Figure 1 displays the relation between trade and the regional immigrant stock as well as between trade and foreign employment in a given region. The data has been aggregated over all countries of destination and is plotted for all years of the sample. The graph suggests that the regional immigrant stock correlates positively with both, exports and imports at the regional level. Similarly, the overall value of regional imports and exports seems to increase in the number of foreign employees in firms belonging to a given region.

This points to a potential role for migrants in promoting trade also in the small open economy Denmark in line with the theoretical reasoning from Section 2. Still, the graph remains silent over the channel of influence of immigration in two regards: First of all, do migrants promote trade only if they are employed in a firm or is there a separate role for regionally residing immigrant groups? Secondly, the mechanism of adjustment within

Figure 2.2: Immigrant Employment and the Product Margins of International Trade




This Figure depicts the average number of products as well as the average value of traded products (in $ln$) exported/imported by a firm by foreign employment categories (group means). Foreign employment categories are defined by the number of employees from a trade partner country in the following way. 0: 0, 1: 1 - 10, 2: 1-10, 3: 10 - 50, 4: 50 - 100, 5: more than 100.

the firm is unclear: Does migration relate systematically to the margins of trade, i.e., with the number of traded goods and the average value per traded good?

With respect to the composition of firm-level trade, Figure 2 provides some descriptive insight. It depicts the number of products and the average product value (in ln) which are imported and exported by firm-country couples pooled over the entire sample. The data is grouped by foreign employment categories, such that category 0 corresponds to firm-destination couples where the firm does not employ a migrant from the destination country and category 1 indicates that a firm-destination pair is characterized by one foreign worker from a given destination. The remaining categories are defined accordingly with 2 referring to 2-10 immigrants, 3 to 10-50, 4 to 51 - 100 and 5 to more than 100 employed immigrants. The left panel depicts the extensive product margin of trade, i.e., the number of goods that a firm trades with a country of destination on average. Considering the employment categories, the number of products traded by firm-destination

pairs increases in the number of employees that the firm employs from a given destination up to category 3, which corresponds to a maximum of 50 foreign employees. Afterwards, the average number of traded products starts to decrease. With respect to the product intensive margin, the right panel of Figure 2 also displays that it is on average increasing with the number of foreigners from the trade partner country employed in the firm. However, similarly to the pattern found for the extensive product margin, a decay can be observed: When the number of foreign employees exceeds 50, both, the average export value and the average import value per product slightly drops.

A comparison of the pattern across both margins reveals that the employment of one immigrant as compared to none seems to exert a stronger effect on the extensive margin as compared to the intensive margin, where the evolution is rather smooth in the immigrant employment category. It seems that the employment of one foreigner helps substantially to introduce a product in his country of origin, whereas he only moderately affects the value of a traded product.

Table 2.2: Top 15 Origin Countries and Immigrant Employment

| | Country | Immigrant Stock | Employed | |
|---|---|---|---|---|
| | | | All | With Trade |
| 1 | Turkey | 23315 | 1410 | 476 |
| 2 | Germany | 19382 | 1297 | 1012 |
| 3 | Bosnia | 13104 | 204 | 93 |
| 4 | Norway | 10128 | 444 | 340 |
| 5 | Lebanon | 9498 | 122 | 32 |
| 6 | Sweden | 8765 | 507 | 356 |
| 7 | Iran | 8212 | 224 | 68 |
| 8 | United Kingdom | 7814 | 640 | 462 |
| 9 | Poland | 7753 | 551 | 348 |
| 10 | Vietnam | 7495 | 573 | 92 |
| 11 | Iraq | 6578 | 61 | 8 |
| 12 | Sri Lanka | 6109 | 685 | 28 |
| 13 | Pakistan | 4677 | 242 | 31 |
| 14 | Iceland | 4319 | 243 | 101 |
| 15 | United States | 3815 | 171 | 135 |

This Table depicts the number of immigrants by country of origin for the top 15 migrant sending countries, and the number of employees in the manufacturing sector. Numbers are an average over the time period from 1995 to 2005.

### 2.3.3 Source Countries and Destination Regions of Danish Immigration

On average, the immigrant stock from a particular country amounts to 1157 residents in Denmark. However, 50% of sending countries send less than 87 migrants. On average, most immigrants come to Denmark from Turkey (23315), Germany (19328), Bosnia (13104) and Norway (10128). Table 2 summarizes the top 15 countries which send migrants to Denmark. These four sending countries account for around 73% of the total immigrant stock. They are very heterogeneous, and suggest distinct migration motives ranging from refuge seeking to work related migration. Similarly, the number of immigrants employed in the Danish manufacturing sector differs considerably: 1297 Germans are employed in the manufacturing firms in our sample. Out of these, the major-

Table 2.3: Immigration and Immigrant Employment by County

| | County | Immigrant Stock | Employed | |
|---|---|---|---|---|
| | | | All | With Trade |
| 1 | Copenhagen | 42513 | 1604 | 990 |
| 2 | Aarhus | 27674 | 1456 | 817 |
| 3 | Fyn | 18365 | 646 | 298 |
| 4 | Frederiksborg | 17308 | 660 | 389 |
| 5 | North Jutland | 13770 | 505 | 187 |
| 6 | Vejle | 12102 | 667 | 311 |
| 7 | South Jutland | 11483 | 755 | 477 |
| 8 | Roskilde | 9062 | 316 | 257 |
| 9 | West Zealand | 8214 | 327 | 89 |
| 10 | Ringkjøbing | 7754 | 697 | 223 |
| 11 | Ribe | 7568 | 479 | 311 |
| 12 | Storstrøm | 7039 | 118 | 63 |
| 13 | Viborg | 5203 | 456 | 249 |

This Table depicts the number of immigrants by county and the number of immigrant employees in the manufacturing sector by county. Copenhagen refers to Copenhagen county without Copenhagen City.

ity, namely 1012 German foreign expatriates work in firms which trade with Germany, whereas this holds true for only 476 Turks out of 1410 employed Turks.

Table 3 shows that the immigrants spread differently across Denmark. Most of the foreign population settles in Copenhagen County (44187), followed by Aarhus County (28643), Fyn (18624), Frederiksborg (17796) and North Jutland (14451).

In a nutshell, this section has provided some descriptive evidence of the conjecture that immigration is associated with a greater engagement of firms in international trade. The next section presents the econometric methodology which is used to address in rigorous manner, whether immigration positively affects firm-level trade.

## 2.4 Empirical Strategy

Theoretical considerations as outlined in Section 2 and descriptive evidence have lead to the conjecture that immigration fosters a firm's engagement into international transactions by lowering trade costs. In order to explore this link between trade and immigration systematically, we use a linear OLS regression model given by

$$\ln v_{ijt}^{x} = \beta' X_{ijt} + \phi_r + \theta_k + \eta_t + \psi_i + \xi_j + \epsilon_{ijt}, \tag{2.1}$$

where $v_{ijt}^{x}$ is a firm $i$'s export sales to country $j$ at time $t$. $r$ indicates the Danish region and $k$ indicates the 2-digit manufacturing industry. $\phi_r$, $\theta_k$, $\eta_t$, $\xi_j$ and $\psi_i$ are region, industry, time, country and firm fixed effects. For practical implementation, we follow Andrews et al. (2006), and use firm-country pair fixed effects and include dummy variables for industry, region and time fixed effects. $\epsilon_{ijt}^{k}$ is an idiosyncratic error. $\beta$ is a parameter vector. $X_{ijt}$ is a set of regressors which includes our variables of interest, namely the stock of immigrants from country $j$ residing in region $r$ at time $t$ and the number of immigrants from country $j$ employed in firm $i$ at time $t$ originating from country $j$. Moreover, it accounts for several confounding factors: At the firm-level, we include firm size, the average wage and labor productivity measured by value added per worker. This allows us to account for firm size and skill composition, and to approximate the firm's ability to integrate workers with a non-Danish ethnic background and thereby the propensity to hire foreign workers. Moreover, we account for the source country characteristics by inclusion of GDP per capita. We estimate the corresponding model for import purchases, which we shall denote by $v_{ijt}^{m}$ subsequently.

To address how immigration affects the composition of trade, we decompose the aggregate export value into the number of traded products, $n_{ijt}^{x}$, and the average value per product traded with a partner country, $\bar{z}_{ijt}^{x}$. The value of an export shipment at the firm-level, $v_{ijt}^{x}$, is defined as:

$$v_{ijt}^{x} = n_{ijt}^{x} \bar{z}_{ijt}^{x}. \tag{2.2}$$

Again, we define these margins accordingly for firm-level imports as indicated by superscript $m$. Then, we can assess how the intensive and extensive product margin are affected by employment of foreigners and the presence of immigrants in the surroundings of the firm by estimating

$$r^x_{ijt} = \beta' X_{ijt} + \phi_r + \theta_k + \eta_t + \psi_i + \xi_j + \epsilon_{ijt}, \tag{2.3}$$

where $r^x_{ijt} = \ln \bar{z}^x_{ijt}$ ($r^x_{ijt} = \ln n^x_{ijt}$) for the intensive export product margin (extensive export product margin), and accordingly for imports.

Our model measures the intensive and extensive margin without an explicit modeling the dynamics at the product margin. A recent paper by Iacavone and Javorcik (2010) considers the dynamics of product creation and destruction within firms. Our definition of the extensive product margin at the firm-country level corresponds to "net churning", i.e., the difference between products created and destroyed within a firm.

The identification of the immigration effect on trade is subject to two major caveats: First of all, as raised by Rauch and Trindade (2002), migrant networks may approximate similar preferences across countries, and this taste similarity per se may lead to a larger amount of trade (in differentiated goods) between countries as put forward by Linder (1961). We assume that preferences are time invariant, and therefore taken into account for implicitly by inclusion of country fixed effects. A second source of endogeneity stems from the demand for foreign labor in economically dynamic and internationalized environments. Peri and Requena (2010) tackle this challenge by instrumenting the regional immigrant stock by its prediction based on historical migration levels, arguing that immigrant communities tend to agglomerate for non-economic reasons. In our case, we have the chance to observe the behavior at the firm-level, and consider the regional immigrant stock as exogenous to the firm, given that we can capture the level of immigrant employment at the firm. The employment of foreigners is a decision that a firm makes in light of its internationalization strategy. Firm which trade large volumes with a specific country may need foreign employees from this country in order to organize their business. Thus,

immigrant employment can be conjectured to be endogenous due to reverse causality. Subsequently, we will use an instrumentation strategy to account for reverse causality as discussed in Section 5.3.

## 2.5 Empirical Results

### 2.5.1 Main Results

Table 4 summarizes our main results. Column (1) and (2) show the estimation results for overall exports and imports, column (3) to (4) contain results for the extensive product margin, column (5) and (6) refer to the intensive product margin. Below the point estimate, we report $p$-values and base inference on a cluster-robust variance-covariance matrix.

**Immigration:** We find that immigration exhibits no statistically significant positive effect on total export sales. But it is positively associated with firm imports: A 1% increase in the immigrant stock in country $j$ leads to a 0.1% increase in import purchases from the partner country. On the contrary, the employment of immigrants in the manufacturing firm exhibits no significant effect on import purchases, but leads to an increase in export sales: The employment of one additional foreigner from a trade partner country increases exports to his country of origin by 1.2 %. The channel which drives the immigration effect on trade for both regional immigration and employment is the extensive product margin in both cases. More precisely, the number of imported products (exported products) increases by 0.07% (0.04%) in response to a 1% increase in the immigrant stock. Both increases are statistically significant at the 1% significance level. Similarly immigrant employment matters exclusively via the extensive product margin. In this case, the employment of an additional foreigner increases the number of exported products by 0.5% and the number of imported product by 1%.

**Trade Status:** We find that two-way traders have a higher level of export sales and import purchases than their one-directional trading counterparts. The level difference manifests itself in both, product scale and scope, whereby for both directions of trade,

Table 2.4: Main Results (Firm-Country FE OLS)

| | Total | | Extensive | | Intensive | |
|---|---|---|---|---|---|---|
| | $v^x_{ijt}$ | $v^m_{ijt}$ | $n^x_{ijt}$ | $n^m_{ijt}$ | $\bar{z}^x_{ijt}$ | $\bar{z}^m_{ijt}$ |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| ln Immigrant Stock $(t-1)$ | 0.018 | 0.103 | 0.040 | 0.070 | -0.022 | 0.034 |
| | 0.357 | 0.002 | 0.000 | 0.000 | 0.218 | 0.280 |
| Immigrants Employed $(t-1)$ | 0.012 | 0.010 | 0.005 | 0.010 | 0.007 | 0.000 |
| | 0.068 | 0.283 | 0.048 | 0.013 | 0.202 | 0.995 |
| Two-Way Trader $(t-1)$ | 0.117 | 0.140 | 0.045 | 0.048 | 0.072 | 0.093 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Real GDP per capita $(t-1)$ | 1.221 | 1.663 | 0.141 | 0.293 | 1.080 | 1.369 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Number of Employees $(t-1)$ | 0.444 | 0.432 | 0.049 | 0.098 | 0.395 | 0.334 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Productivity $(t-1)$ | 0.114 | 0.089 | 0.012 | 0.018 | 0.101 | 0.071 |
| | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 |
| ln Average Hourly Wage $(t-1)$ | 0.311 | 0.120 | -0.012 | 0.102 | 0.323 | 0.019 |
| | 0.000 | 0.120 | 0.294 | 0.000 | 0.000 | 0.795 |
| $R^2$ | | | | | | |
| within | 0.017 | 0.016 | 0.031 | 0.026 | 0.013 | 0.017 |
| between | 0.086 | 0.025 | 0.049 | 0.088 | 0.067 | 0.013 |
| overall | 0.102 | 0.030 | 0.047 | 0.096 | 0.076 | 0.013 |
| $N$ | 218871 | 123886 | 218871 | 123886 | 218871 | 123886 |
| Groups | 57328 | 36602 | 57328 | 36602 | 57328 | 36602 |

This Table presents regression results. The specification is given in equation 1. The variance-covariance matrix is cluster-robust, the level of clustering is the observational unit, i.e., firm-country pairs. Two-sided $p$-values are reported below coefficient estimates. All specifications include year-, region-, and industry fixed effects.

the intensive margin plays the more important role.

**GDP per capita:** The foreign country's GDP per capita is an important push factor for international labor mobility (Mayda 2010). Moreover, it captures market size. We find a positive association between the foreign GDP and firm-level exports (1.221%), whereby the decomposition reveals that this is largely due to an increased value per product exported (1.080) rather than a higher number of goods shipped (0.141%). Similarly, the foreign country's GDP per capita exhibits a significant effect on the total value of imports

(1.663%), which mostly stems from a higher average value per product (1.080%).

**Firm Size:** Unsurprisingly, firm size is positively related to export sales (0.444%). It affects mostly the average value per product exported (0.395%) rather than the number of products (0.049%). Also, import purchases are positively affected by the level of employment in a firm. As for export sales, the link runs through the intensive rather than the extensive product margin, as indicated by the estimated elasticities, which amount to 0.334 and 0.098, respectively.

**Firm Productivity:** Interestingly, we find that labor productivity, measured as value added per worker, increases overall export sales through both increasing the number of products exported (0.012%) as well as the average value per product (0.101%), whereby the latter channel outweighs the former in quantitative importance. The positive link between the range of exported varieties and firm productivity is in line with Bernard et al. (2010a): Firms which exhibit a higher ability can more easily overcome the fixed cost of exporting new products as they generate sufficient variable profits, even if the product exhibits lower value attributes. However, the (clearly dominating) effect on the intensive margin is theoretically ambiguous (Bernard et al. 2010a). The effect of firm productivity on imports is qualitatively similar, but less pronounced in terms of magnitude. The estimated elasticities amount to 0.089% for total import purchases, 0.018% for the extensive product margin and 0.071 for the intensive product margin.

**Average Hourly Wage:** In order to capture other time variant factors, like the skill-composition within the firm, we include the average hourly wage. We find that it is positively linked to total export sales (0.311%). In the decomposition between product scale and scope, it is statistically significant only in the latter case with point estimates of -0.012 and 0.323, respectively. With respect to imports, we find no significant effect on import purchases. However, there is evidence for an increase in the number of products in response to a higher average hourly wage. The statistically significant estimate is 0.102.

In a nutshell, we find that the presence of immigrants in the region where a firm is located fosters immigrant purchases from the migrants' country of origin. Contrastingly, we do not find that the presence of immigrants matters for firm exports. But those foreigners

who are employed in a firm lead to an economically and statistically significant increase in firm-level exports without increasing import purchases. The next section aims at analyzing the robustness of this link between foreign employment, regional presence of immigrants and firm-level trade.

### 2.5.2 Robustness Checks

In the preceding section, immigration has been found to foster the engagement of Danish manufacturing firms in international trade. In this section, we illustrate the robustness of our results by changing the country coverage of the sample and by including a measure for institutional quality. For the sake of brevity, we focus exclusively on the estimates of immigration and immigrant employment rather than on all coefficients, unless they differ tremendously from the results shown in Table 4.

Table 5 excludes Denmark's largest neighbor and second-largest immigrant sending country from the sample. The main conclusions remain unchanged: Regional immigration matters for imports but not for exports. However, for this sub-sample, we cannot reject the Null hypothesis that the effect of foreign employment has no impact on firm trade. But we find evidence for a change in the composition of trade: Employment of a foreigner significantly increases the number of imported products (1.6%). But as it simultaneously decreases the average value per product (-1.7%), the overall effect turns out not to be significantly different from zero.

This section has discussed the robustness of our results along important modifications of our main estimation. However, it remains to the subsequent section to assess whether they are robust to a correction for sample selection, and whether we can conclude that the migration effects on Danish firm-level trade are causal.

Table 2.5: Additional Results (Firm-Country FE OLS): Exclusion of Germany

| | Total | | Extensive | | Intensive | |
|---|---|---|---|---|---|---|
| | $v^x_{ijt}$ | $v^m_{ijt}$ | $n^x_{ijt}$ | $n^m_{ijt}$ | $\bar{z}^x_{ijt}$ | $\bar{z}^m_{ijt}$ |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| ln Immigrant Stock $(t-1)$ | 0.012 | 0.118 | 0.039 | 0.068 | -0.026 | 0.049 |
| | 0.524 | 0.000 | 0.000 | 0.001 | 0.152 | 0.121 |
| Immigrants Employed $(t-1)$ | 0.012 | -0.001 | 0.004 | 0.016 | 0.008 | -0.017 |
| | 0.140 | 0.931 | 0.192 | 0.000 | 0.247 | 0.300 |
| Two-Way Trader $(t-1)$ | 0.120 | 0.149 | 0.044 | 0.046 | 0.076 | 0.103 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.234 |
| ln Real GDP per capita $(t-1)$ | 1.181 | 2.150 | 0.126 | 0.250 | 1.054 | 1.900 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Number of Employees $(t-1)$ | 0.432 | 0.390 | 0.047 | 0.087 | 0.384 | 0.303 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Productivity $(t-1)$ | 0.109 | 0.078 | 0.012 | 0.016 | 0.097 | 0.062 |
| | 0.000 | 0.000 | 0.000 | 0.007 | 0.000 | 0.003 |
| ln Average Hourly Wage $(t-1)$ | 0.309 | 0.109 | -0.013 | 0.093 | 0.322 | 0.015 |
| | 0.000 | 0.191 | 0.243 | 0.000 | 0.000 | 0.842 |
| $R^2$ | | | | | | |
| within | 0.016 | 0.017 | 0.033 | 0.028 | 0.012 | 0.019 |
| between | 0.076 | 0.011 | 0.043 | 0.064 | 0.059 | 0.005 |
| overall | 0.093 | 0.012 | 0.044 | 0.071 | 0.070 | 0.004 |
| $N$ | 206494 | 111041 | 206494 | 111041 | 206494 | 111041 |
| Groups | 54840 | 33857 | 54840 | 33857 | 54840 | 33857 |

This Table presents regression results which exclude Germany from the sample. The specification is given in equation 1. The variance-covariance matrix is cluster-robust, the level of clustering is the observational unit, i.e., firm-country pairs. Two-sided $p$-values are reported below coefficient estimates. All specifications include year-, region-, and industry fixed effects.

Table 2.6: Additional Results (Firm-Country FE OLS): Including 'Rule of Law'

| | Total | | Extensive | | Intensive | |
|---|---|---|---|---|---|---|
| | $v^x_{ijt}$ | $v^m_{ijt}$ | $n^x_{ijt}$ | $n^m_{ijt}$ | $\bar{z}^x_{ijt}$ | $\bar{z}^m_{ijt}$ |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| ln Immigrant Stock $(t-1)$ | 0.023 | 0.144 | 0.042 | 0.081 | -0.019 | 0.062 |
| | 0.353 | 0.001 | 0.000 | 0.000 | 0.422 | 0.116 |
| Immigrants Employed $(t-1)$ | 0.012 | 0.000 | 0.006 | 0.013 | 0.006 | -0.013 |
| | 0.181 | 0.980 | 0.025 | 0.010 | 0.462 | 0.237 |
| Rule of Law $(t-1)$ | 0.268 | 0.261 | 0.079 | -0.099 | 0.188 | 0.360 |
| | 0.000 | 0.045 | 0.000 | 0.005 | 0.001 | 0.004 |
| Two-Way Trader $(t-1)$ | 0.118 | 0.179 | 0.043 | 0.047 | 0.075 | 0.132 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Real GDP per capita $(t-1)$ | 1.137 | 1.493 | 0.121 | 0.368 | 1.016 | 1.126 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Number of Employees $(t-1)$ | 0.544 | 0.485 | 0.063 | 0.113 | 0.481 | 0.372 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Productivity $(t-1)$ | 0.237 | 0.174 | 0.029 | 0.030 | 0.208 | 0.144 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Average Hourly Wage $(t-1)$ | 0.208 | 0.078 | -0.036 | 0.112 | 0.244 | -0.035 |
| | 0.000 | 0.395 | 0.007 | 0.000 | 0.000 | 0.689 |
| $R^2$ | | | | | | |
| within | 0.021 | 0.019 | 0.033 | 0.028 | 0.017 | 0.020 |
| between | 0.099 | 0.031 | 0.039 | 0.081 | 0.083 | 0.016 |
| overall | 0.115 | 0.037 | 0.038 | 0.088 | 0.092 | 0.017 |
| $N$ | 131843 | 75170 | 131843 | 75170 | 131843 | 75170 |
| Groups | 48692 | 30471 | 48692 | 30471 | 48692 | 30471 |

This Table presents regression results including a time-variant measure of institutional quality, namely 'rule of law' which originates from Kaufmann et al. (2010). The specification is given in equation 1. The variance-covariance matrix is cluster-robust, the level of clustering is the observational unit, i.e., firm-country pairs. Two-sided $p$-values are reported below coefficient estimates. All specifications include year-, region-, and industry fixed effects.

### 2.5.3 Sample Selection and Causality

In order to deepen the insight on the link between trade and migration gained in the previous sections, we address two additional concerns in this subsection, namely sample selection and reverse causality concerns. So far, we have based our estimations on a potentially non-randomly selected samples, as we only observe only firms with positive export sales to (or import purchases from) a country. Indeed, using a regression-based test for sample selection as suggested by Wooldridge (1995) confirms this conjecture, as we reject the Null of no sample selection for both, the exports and also for imports on a 1% significance level. Consequently, we implement the sample selection correction procedure as suggested in Wooldridge (1995) and summarize results in Table 7.

Using the sample selection correction procedure as suggested by Wooldridge (1995), our main conclusion remain qualitatively unchanged. As Table 7 shows, we find again that the local presence of foreigners boosts imports but not export sales. In particular, a 1% increase in the regional immigrant stock increases import purchases by 0.133%. This increase stems from the import of a broader range of products (0.109%). The effect of immigration on the intensive product margin is statistically insignificant. Even though total export sales remain unaffected by immigration, their composition changes: In particular, an increase of the stock of foreigners from a trade partner country increases the number of products exported by the firm to the country under consideration. The main change when correcting for sample selection is that the estimates turn slightly larger as compared to our benchmark results from FE OLS as reported in Table 4.

With respect to employment of foreign expatriates, our results are also comfortingly stable. We find that the employment of one additional foreign expatriate increases export sales by 1.7%. This effect operates mostly through the extensive product margin: The number of exported products increases by 0.8% in response to the employment of one additional foreigner. The employment of foreign expatriates affects exclusively exports. Imports are totally unaffected by foreign employment.

Thus, accounting for sample selection corroborates our previous findings. All previous estimations have accounted for cross-country differences in institutional quality by in-

Table 2.7: Additional Results (Wooldridge 1995 Sample Selection Correction)

| | Total | | Extensive | | Intensive | |
|---|---|---|---|---|---|---|
| | $v^x_{ijt}$ | $v^m_{ijt}$ | $n^x_{ijt}$ | $n^m_{ijt}$ | $\bar{z}^x_{ijt}$ | $\bar{z}^m_{ijt}$ |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| ln Immigrant Stock $(t-1)$ | 0.034 | 0.133 | 0.060 | 0.109 | -0.026 | 0.024 |
| | 0.253 | 0.036 | 0.000 | 0.000 | 0.341 | 0.688 |
| Immigrants Employed $(t-1)$ | 0.017 | -0.014 | 0.008 | 0.008 | 0.009 | -0.021 |
| | 0.036 | 0.346 | 0.005 | 0.117 | 0.222 | 0.146 |
| Two-Way Trader $(t-1)$ | 0.151 | 0.085 | 0.078 | 0.063 | 0.073 | 0.022 |
| | 0.000 | 0.009 | 0.000 | 0.000 | 0.000 | 0.470 |
| ln Real GDP per capita $(t-1)$ | 1.078 | 1.217 | 0.081 | 0.431 | 0.997 | 0.786 |
| | 0.000 | 0.000 | 0.007 | 0.000 | 0.000 | 0.000 |
| ln Number of Employees $(t-1)$ | 0.586 | 0.519 | 0.061 | 0.120 | 0.524 | 0.399 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Productivity $(t-1)$ | 0.286 | 0.192 | 0.023 | 0.029 | 0.262 | 0.163 |
| | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 |
| ln Average Hourly Wage $(t-1)$ | 0.521 | 0.237 | -0.044 | 0.133 | 0.566 | 0.104 |
| | 0.000 | 0.090 | 0.034 | 0.000 | 0.000 | 0.430 |
| Adj $R^2$ | 0.288 | 0.218 | 0.271 | 0.281 | 0.238 | 0.178 |
| $N$ | 218871 | 123886 | 218871 | 123886 | 218871 | 123886 |

This Table presents regression results from an estimation with sample selection correction as suggested in Wooldridge (1995). Standard errors are obtained by bootstrap with 399 replications. Two-sided $p$-values are reported below coefficient estimates. All specifications include year-, region-, and industry fixed effects.

clusion of country fixed effects. In a similar manner, we have accounted for different propensities to employ foreign workers who originate from a trade partner country by using firm fixed effects throughout all estimations. Even though one may want to argue that this procedure purges all sources of endogeneity of immigrant employment, some concerns may remain if one believes that the hiring of immigrants is a strategic measure to increase export sales by boosting either the number of traded products or their average value, or to help firms to source foreign inputs. In order to accommodate this concern, we estimate the model displayed in Table 8 using an Instrumental Variable approach.

We use as an instrument the average number of immigrants from a given country who

are employed in other firms in the same industry together with the number of foreigners from countries different from $j$ employed in firm $i$. The first instrument captures the potential supply of manufacturing workers in a given industry at time $t$. We assume that the presence of foreigners from country $j$ in other firms of the same industry has no direct effect on the export sales or import purchases between firm $i$ and country $j$, other than through the link via the immigrant network across firms. The number of foreigners from all other countries but $j$ captures the firms' willingness to employ foreign workers in general, and is thereby correlated with immigrant employment. It is arguably exogenous, as the general presence of foreigners in a company should not affect its export or import decision with respect to a particular export destination unrelated to the immigrant. Of course, this relies on the assumption that other factors like the firm's ability to integrate foreign workers or to access knowledge embedded in the employees is time-invariant and thereby absorbed in the fixed effects.

This set of instruments performs satisfactorily for both firm-level exports and imports. We can reject the Null of Weak Instruments according to the Kleibergen-Paap $F$-test and we cannot reject the Null of joint instrument validity on conventional significance levels on basis of the Hansen $J$-test. Based on these panel IV regression results, which are reported in Table 8, we confirm that the presence of immigrants in the region where a firm is located exerts no statistically significant effect on the overall level of firm exports. Even though the local immigrant network increases the number of exported products, this effect is almost offset by a reduction in traded value per product. With respect to foreign employment, we find that foreign experts in the firm increase both export sales and import purchases. The employment of foreigners thereby increases both the number of traded products and their average value per export destination (for imports, the intensive margin coefficient is marginally insignificant). Most strikingly, we find that the size of the effect is almost ten times the size of the FE OLS counterpart (compare Table 4): Employment of an additional foreign expatriate increases firm exports by 13.% and boosts import purchases from this source country by 18.9%.

To conclude, the IV estimation confirms our previous result that both, local immigrant

Table 2.8: Additional Results (Firm-Country FE IV)

| | Total | | Extensive | | Intensive | |
|---|---|---|---|---|---|---|
| | $v^x_{ijt}$ | $v^m_{ijt}$ | $n^x_{ijt}$ | $n^m_{ijt}$ | $\bar{z}^x_{ijt}$ | $\bar{z}^m_{ijt}$ |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| ln Immigrant Stock $(t-1)$ | 0.015 | 0.101 | 0.039 | 0.069 | -0.024 | 0.032 |
| | 0.431 | 0.002 | 0.000 | 0.000 | 0.191 | 0.304 |
| Immigrants Employed $(t-1)$ | 0.136 | 0.189 | 0.059 | 0.075 | 0.077 | 0.114 |
| | 0.001 | 0.016 | 0.000 | 0.001 | 0.034 | 0.108 |
| Two-Way Trader $(t-1)$ | 0.116 | 0.140 | 0.045 | 0.047 | 0.071 | 0.093 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Real GDP per capita $(t-1)$ | 1.213 | 1.628 | 0.137 | 0.281 | 1.076 | 1.347 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Number of Employees $(t-1)$ | 0.424 | 0.395 | 0.041 | 0.085 | 0.384 | 0.310 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| ln Productivity $(t-1)$ | 0.113 | 0.088 | 0.012 | 0.018 | 0.101 | 0.070 |
| | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 |
| ln Average Hourly Wage $(t-1)$ | 0.315 | 0.118 | -0.010 | 0.101 | 0.325 | 0.017 |
| | 0.000 | 0.129 | 0.370 | 0.000 | 0.000 | 0.813 |
| $R^2$ | 0.0138 | 0.012 | 0.024 | 0.019 | 0.012 | 0.015 |
| $N$ | 200268 | 110185 | 200268 | 110185 | 200268 | 110185 |
| Groups | 38725 | 22901 | 38725 | 22901 | 38725 | 22901 |
| Kleibergen-Paap (p) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Kleibergen-Paap (F) | 36.550 | 22.814 | 36.550 | 22.814 | 36.550 | 22.814 |
| Hansen J (p) | 0.461 | 0.766 | 0.461 | 0.766 | 0.461 | 0.766 |

This Table presents regression results from an IV regression with firm-country fixed effects. Instrumental Variables are the average industry immigrant employment from a given country net of the firm, and a firms' overall number of foreign employees from countries other than $j$. The variance-covariance matrix is cluster-robust, the level of clustering is the observational unit, i.e., firm-country pairs. Two-sided $p$-values are reported below coefficient estimates. All specifications include year-, region-, and industry fixed effects. Critical values for the Kleibergen-Paap $F$-test are from Stock and Yogo (2005) and amount to 19.93, 11.59, 8.75 and 7.25 for 10%, 15%, 20% and 25% maximal IV size.

networks and foreign employment are important determinants of firm-level exports and imports in the case of Denmark. It suggests that FE OLS based results are potentially a lower bound of the trade-promoting effect that immigrants exert.

## 2.6 Discussion

Our results are qualitatively and quantitatively in line with earlier empirical results on the nexus between trade and migration. The elasticity of overall firm imports with respect to local immigrant networks exhibits an estimated elasticity of around 0.1%. This effect size occupies the lower end of previously estimated trade elasticities as summarized in Peri and Requena (2010). As outlined in Wagner et al. (2002), the finding that immigration matters more for imports rather than for exports is found in several studies (see for example Head and Ries 1998, Dunlevy and Hutchinson 1999), and this may be attributed to the fact that the preference channel matters for imports but not for exports. However, our finding contrasts Gould (1994) who finds that immigration affects exports stronger than imports in case of the United States. Similarly, White (2007) finds a stronger trade-promoting effect of immigration on exports rather than imports for the case of Denmark. However, this paper constitutes the first attempt to account for firm heterogeneity when estimating the trade-migration nexus and thus is able to account for firm-heterogeneity.[3] We corroborate the finding of Peri and Requena (2010) that the regional immigrant stock affects the extensive rather than the intensive product margin.

With respect to the central predictions on the behavior of multi-product firms on export markets as exemplified by Bernard et al. (2010a), we confirm that migrant linkages indeed exert influence on trade costs and thereby affect the composition of firm-level trade. Mostly, immigration and the employment of foreign workers increases the number of exported products rather than the average value per exported good. Relating results back to Bernard et al. (2010a), throughout estimations local immigrant communities lower the intensive product margin (though not always significantly), whereas the impact of foreign employees on the average traded value per product never shows a negative coefficient estimate. This suggests that the type of trade cost affected by each type of migration is probably distinct. From Bernard et al. (2010a) and our estimation, we can conclude that the employment of foreigners does not exclusively affect the fixed cost of

[3]Unreported results show that a failure to account for unobserved firm heterogeneity leads to statistically significant effects of immigration on firm-level exports.

exporting, but also operates via variable cost reductions: The effect of employment on the intensive margin of exports is positive throughout estimations, but the theoretical model predicts an unambiguously negative effect of fixed cost reductions.

Our results contribute some insights relevant to both, macroeconomic and microeconomic policy making. First of all, immigration seems to benefit the Danish manufacturing sector by fostering the engagement of Danish manufacturing firms in trade activities. In particular, the presence of immigrants seems to broaden the traded product range and thereby contributes to a diversification process for both, exports and imported inputs. Importantly, this effect is seen for immigration in a very broad sense, capturing not only immigrants employed in sectors other than manufacturing, but also people who are unemployed or not yet/no longer part of the labor force. However, if Danish manufacturing firms employ foreign expatriates, they exhibit a positive effect on the firm's total export sales to the migrant's country of origin.

Thus, the trade promoting effect of immigration at the firm and in the region stresses the importance of labor market integration of foreign workers. Rosholm et al. (2006) point out that organizational change has led to an increased need in efficient communication skills, and that immigrants have presumably been adversely affected by this tendency. But communicative needs are heterogeneous across countries, and there is a chance to gain from the distinct communication and skill profile of the foreign worker through feedback effects on the trade performance of employers.

## 2.7 Conclusion

This paper investigates the trade-migration nexus on the firm-level using a matched employer-employee data set for Danish firms covering the years from 1995 to 2005. We disentangle whether the inflow of foreign labor matters for trade due to intra-firm employment of immigrants or due to the presence of regional ethnic networks. In our estimations, we account for potential endogeneity of immigrant employment and for sample selection. Our main results are robust and in line with both, the theoretical literature on multi-product firms and the one on ethnic networks. First of all, we find that both, local

immigrant communities and foreign employees promote firm-level trade. Secondly, we establish that regional immigration boosts overall imports and total exports, whereby imports are affected in a more pronounced way. Thirdly, we find that immigration matters for the composition of firm-level trade by increasing the number of both imported and exported varieties. As a fourth novel insight, we find that the employment of foreign expatriates fosters total export sales by increasing both the number of traded products and the average value per traded product. Moreover, we find evidence for an effect of foreign employees on total import purchases: In response to foreign employment, firms increase the range of imported goods.

Our results open up to three extensions: First of all, it would be desirable to explore the role of immigrant skill and occupation on the trade-migration nexus. Secondly, it would be interesting to investigate in depth the linkages within regional migrant networks and across firms. For example, regional immigration might foster trade because service firms employ foreign expatriates which communicate and interact with immigrants employed in manufacturing firms. Third, it would be insightful to explore whether the effect on the export and import value operates through price or quantity.

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# Chapter 3

# Does Export Promotion Work in Denmark?
# Evidence from a Matching Approach

## 3.1 Motivation

How can firms overcome barriers to trade? This question has raised the interest of managers, policy makers and economists all over the globe. As barriers to trade are diverse, so is the answer to this question. Firms need to collect information on potential export destinations in order to be successful in selling their product abroad. They need to know, which of their products they can sell abroad. They need to learn to grasp chances, in order to successfully expand their international sales.

The recent economic literature has established the importance of knowledge flows beyond the borders of the firm. A particularly important role for international transactions has been ascribed to international networks, and they have been extensively studied in both theoretical and empirical work (see for example Rauch 1999, Rauch 2001, Rauch and Trindade 2002). Similarly, firms may benefit from the knowledge embedded in surrounding firms, such that regional export spillovers have been found to matter (Koenig et al. 2010) for a firm's export performance. On top of these networks that arise naturally, also deliberately set up networks exist, which regard it as their mission to promote their members' exports. Some studies assess empirically, whether export promotion indeed exhibits a positive effect on trade (see for example Lederman et al. 2004, Volpe Martincus and Carballo 2008, Volpe Martincus and Carballo 2010a, Volpe Martincus 2010b and Volpe Martincus et al. 2010c). Moreover, a couple of studies investigate how financial support affects exports (Bernard and Jensen 2004, Görg et al. 2008, Girma et al. 2009)

This paper considers the causal effect of export promotion on firm-level export sales, the coverage of foreign markets, and the number of unique traded products. It complements the existing literature in terms of geographical coverage: To our best knowledge, previous studies have considered how export promotion agencies affect firm-level trade in developing countries (Lederman et al. 2004, Volpe Martincus and Carballo 2008, 2010a, 2010b, 2010c, Volpe Martincus et al. 2010, Volpe Martincus et al. 2011). The role of export promotion agencies can be conjectured to be very different in a country with high exposure to trade like Denmark. Is there still something to be learned for exporting firms in Denmark from joining an export association?

We find that for a sample of Danish manufacturing firms, firms benefit from becoming a member in the major Danish export association. The membership is associated with an increase in export sales, which amounts to 87% in the third year after entry and reduces to 47% in the subsequent year. In addition to the increase in export sales, which is economically significant, we find that membership increases the number of exported products. Our estimates suggest no effect of membership on the number of countries served.

The remainder of this paper is structured as follows. Section 2 provides an overview over the related literature, Section 3 presents the data, Section 4 introduces the econometric methodology, Section 5 describes and discusses our empirical results. Section 6 concludes.

## 3.2 Literature Review

International business and economics literature has devoted considerable attention towards the exploration how export promotion agencies and their activities affect firm export performance. These studies cover a wide methodological range: Business-studies tend to rely on self-assessment of firms participating in export promotion programmes, whereas economic studies tend to rely on objective performance measures. Plant-, firm- and country-level data is considered, mostly in a panel dimension. Some firm-level studies use firm-level exports which is product- and destination-specific (for example Volpe Martincus and Carballo 2008). The regional coverage of firm-level data studies is limited to South America, China, Ireland, Spain and the United States of America. Overall, there is evidence for a positive effect of export promotion, whereby the size of the effect and whether it occurs along the extensive or intensive margin of international trade varies across studies.

Alvarez and Crespi (2000) use Chilean plant level data to assess the treatment effect of three governmental export promoting activities managed by the National Agency for Export Promotion: exporter committees, presence in international trade fairs and the utilization of a business information system. They find that participation in exporter committees foster exports more than participation in trade fairs or the utilization of

a business information system. More recently, Volpe Martincus and Carballo (2010a) employ an efficient semi-parametric quantile treatment effect strategy in order to assess how export promotion affects exports across the firm distribution in Chile. They find that main beneficiaries from Chilean export promotion are firms with a low export volume or firms located at the extreme tails of the distributions of number goods and number of markets, which corresponds to the finding of Wilkinson and Brouthers (2006). Görg et al. (2008) couple a non-parametric matching with a difference-in-difference estimation in order to assess whether government support boosts exports at the plant level for a panel of Irish plants. They find that grants which are large enough can help firms to compete better abroad and sell more. They find no evidence for an effect of grants on export starting. Similarly, Girma et al. (2009) use an unbalanced Chinese firm-level panel which covers the years 1999-2005. They employ an IV Tobit estimation strategy and find evidence for a positive impact of production subsidies on firm exports along the intensive margin. According to their results, the intensity of the effect varies with firm characteristics: It is strongest for firms which make profits, are located in the interior of the country or belong to capital-intensive industries. Their finding is in contrast to Volpe Martincus and Carballo (2008). Using Peruvian firm-level data for the years 2001 to 2005, they find that the activities of the main Peruvian export association causes an increase in the number of exported products and markets served, but not in export sales. More recently, Volpe Martincus and Carballo (2010c) use data on Uruguayan firms between 2000 and 2007 to explore how support by Uruguay's export agency affects the product and destination margins of exporting firms and find that export assistance helps firms to enter a new geographic market in particular in Latin America or the Caribbean, or to introduce a new differentiated product. Anyways, it does not prove to significantly affect the probability to enter a new OECD market or to generally export a new product. Recently, Volpe Martincus and Carballo (2010b) use Colombian firm-level data to assess the effectiveness of different services of export promotion agencies, and find that bundling services is most effective.

At a more aggregate level, Gil et al. (2008) establish a positive effect of governmental

export promotion on the regional level in Spain. Looking from a slightly different angle, Rose (2007) analyzes a cross-section of countries using a gravity model and finds that each additional consulate abroad raises bilateral exports by 6 to 10 percent. But, Lederman et al. (2010) argue that export promotion agencies differ fundamentally from foreign missions and assess their impact on national exports based on survey data of 173 countries. They establish a robust positive effect of export promotion expenditure on exports with substantial decreasing returns to scale. Volpe Martincus et al. (2010) use Latin American sector-level data to assess how export promotion affect the extensive margin of goods on the country level. Both exporter country's embassies and consulates in the importing country as well as specialized public export promotion agencies are considered. According to their results, export promotion of both types never exhibits a negative effect on the goods extensive margin. Secondly, specialized export promotion exhibits a positive effect in more sectors than the mere presence of embassies, and the effect is larger on average. Third, the distinction between differentiated goods, reference-priced goods and homogeneous goods reveals that the effect of specialized trade promotion (diplomatic representation) increases (decreases) in the degree of differentiation.

In a nutshell, the related literature establishes an important role to the promotion of exports for export success in particular along the extensive margin for developing countries. However, the effects of export promotion for developed countries is less clear: Bernard and Jensen (2004) find no effect of governmental grants on export success. In light of this disparity, it will be interesting to broaden the country portfolio to a small open economy, Denmark, using data which is described in the next section.

## 3.3 Data and Descriptive Analysis

Membership data has been kindly provided by the Danish Export Association[1] (henceforth, DEA). DEA is a private non-profit association, which seeks to promote trade between Danish and foreign firms. It is the largest export promotion agency in Denmark, and has been founded in 1965 on initiative of three private firms. Nowadays,

[1] www.dk-export.dk

DEA is an umbrella organization which covers twelve industry networks, namely Airport, Cruise and Ferry, Fishing Equipment, Hospitality, Marine, Marine China, Mining and Quarry, Offshore Energy, Postal and Logistic, Railway, Energy and Energy China. According to its mission statement, DEA encourages the exchange of information and close cooperation between members and promotes joint initiatives to foster export sales of its members. Its activities cover the creation of networks between Danish exporters of all sizes, the organization and execution of exhibitions, symposia, workshops and meetings with potential clients and partners. Moreover, DEA arranges meetings where its members can share their knowledge.

From the raw data on firm membership, we can retrieve the year of entry in the export association and the exit year (if applicable). Firms can enter industry networks separately, and may be member of several networks simultaneously. We do not take into account heterogeneity of subnetworks. This is due to the fact that we do not always observe entry and exit year, and some networks are too small when merged with the firm-level information. In order to measure membership as precise as possible, we consider the earliest year of entry as the year where the membership starts and take the latest observed exit year as the end of membership. Moreover, due to the bookkeeping system at DEA, there is a considerable number of firms who are registered as former members, but for whom it is unclear, when membership ended. We discard all firms of our sample who have at some point been member in the Export Association if there is uncertainty with respect to the time span. This is important in order to avoid to capture member firms in the control group. Moreover, we exclude firms which have become DEA member in 1995 in order to be able to match on pre-sample information.

This DEA data set is merged to firm-level data of Statistics Denmark. We can identify around 100 manufacturing firms who have been or become member in DEA in our sample period. Our unbalanced panel covers the years from 1995 - 2006, which is the time span for which firm-level information is available. More specifically, we consider a sample of manufacturing firms. This is important, because it enables us to deflate with an industry specific price index. In order to be able to use the information on DEA membership in

Table 3.1: Entry and Membership in the Danish Export Association

| Year | Members | Net Entry | Permanent Entry | Total Number of Firms |
|---|---|---|---|---|
| 1995 | 32 | | | 3146 |
| 1996 | 32 | 0 | 1 | 3155 |
| 1997 | 34 | 4 | 0 | 2974 |
| 1998 | 40 | 6 | 3 | 2999 |
| 1999 | 43 | 3 | 2 | 2952 |
| 2000 | 43 | 0 | 2 | 2761 |
| 2001 | 50 | 7 | 5 | 2714 |
| 2002 | 53 | 3 | 2 | 2714 |
| 2003 | 56 | 3 | 3 | 2705 |
| 2004 | 72 | 16 | 16 | 2608 |
| 2005 | 81 | 9 | 10 | 2452 |
| 2006 | 94 | 13 | 12 | 2450 |
| Total | 630 | 64 | 54 | 33.630 |

This Table depicts the membership and entry pattern into the DEA over the sample period. Net entry is the differences between entry and exit at time $t$. Permanent entry is the number of firms who enter DEA and remain in the organization throughout the sample period.

a meaningful way, firms for which we know that they have been DEA members at some point in time, but do not know the time period, are excluded. Similarly, we consider only those exporters who stay members of the association over the sample period. With these restrictions, 54 entries of firms into DEA occur during the sample period, which lead to permanent membership. The total number of member observations over the sample period amounts to 630. As the vast majority of DEA members are exporting or even two-way traders, all subsequent results are conditional on the firm being an exporter.[2] We do not include any firm which has been a member in DEA prior to 1995, in order to ensure comparability.

These constraints lead to membership and entry dynamics as depicted in Table 1. Over time, the number of manufacturing members increases to 94 observed in 2006. Most of entry takes place in 2004, 2005, and 2006. This increase presumably reflects a change in the DEA's organizational structure: In 2004, the director of the organization has changed, and since then, DEA staff itself has grown considerably. The total number of exporting

[2]But it is not a pre-condition to be an exporter when joining the export association. Moreover, there is no size threshold imposed on joining firms.

firms in our sample decreases over time from 3146 firms to 2450 firms in 2006, reflecting a general evolution in the Danish firm landscape. Thus the share of DEA members among exporting firms amounts to around 3.8% in 2006, and has been increasing steadily from around 0.7% in 1995.

Table 2 provides summary statistics on the overall sample as well as on the member and non-member sub-sample. It conveys a clear message: Member firms have higher export sales than non-members, serve considerably more markets and ship more products than non-member firms. Not only do they seem to exhibit a better export performance. They also outperform non-member firms in the number of employees, the average hourly wage paid as well as in total sales.

But is this performance difference driven by self-selection of the high performance firms into the DEA? Or does the DEA cause the superior export performance of its members? In order to disentangle the causal effect of DEA membership on export performance, we are employing a matching approach paired with difference-in-difference estimation, which is presented in the next section.

Table 3.2: Summary Statistics

| | Mean | Median | SD | Min | Max | *N* |
|---|---|---|---|---|---|---|
| **All firms** | | | | | | |
| Export Performance | | | | | | |
| Total Export Sales (ln) | 14.684 | 15.122 | 2.870 | 0 | 23.737 | 33630 |
| Number of Products | 3.633 | 2 | 4.246 | 1 | 45 | 33630 |
| Number of Export Markets | 9.936 | 4 | 13.286 | 1 | 125 | 33630 |
| Firm Characteristics | | | | | | |
| Employees (ln) | 3.283 | 3.219 | 1.381 | 0 | 9.451 | 33630 |
| Average Hourly Wage (ln) | 5.100 | 5.100 | 0.238 | 2.708 | 7.722 | 33630 |
| Total Sales (ln) | 17.032 | 16.939 | 1.548 | 8.694 | 240.722 | 33630 |
| **DEA members** | | | | | | |
| Export Performance | | | | | | |
| Total Export Sales (ln) | 17.157 | 17.755 | 2.529 | 8.889 | 21.542 | 200 |
| Number of Products | 9.685 | 6 | 9.528 | 1 | 45 | 200 |
| Number of Export Markets | 26 | 22 | 21.091 | 1 | 90 | 200 |
| Firm Characteristics | | | | | | |
| Employees (ln) | 4.466 | 4.151 | 1.669 | 1.099 | 9.036 | 200 |
| Average Hourly Wage (ln) | 5.294 | 5.293 | 0.144 | 4.762 | 5.841 | 200 |
| Total Sales (ln) | 18.504 | 18.385 | 1.701 | 14.902 | 22.559 | 200 |
| **Non-members** | | | | | | |
| Export Performance | | | | | | |
| Total Export Sales (ln) | 14.669 | 15.017 | 2.866 | 0 | 23.737 | 33430 |
| Number of Products | 3.597 | 2 | 4.168 | 1 | 42 | 33430 |
| Number of Export Markets | 9.840 | 4 | 13.167 | 1 | 125 | 33430 |
| Firm Characteristics | | | | | | |
| Employees (ln) | 3.276 | 3.219 | 1.376 | 0 | 9.451 | 33430 |
| Average Hourly Wage (ln) | 5.095 | 5.100 | 0.238 | 2.708 | 7.722 | 33430 |
| Total Sales (ln) | 17.024 | 16.932 | 1.543 | 8.694 | 24.072 | 33430 |

This Table depicts summary statistics for the estimation sample and two sub-samples for DEA members and non-members pooled over time.

## 3.4 Empirical Strategy

Matching techniques have become an important tool of empirical trade studies in the recent years. Their use extends from testing the learning-by-importing hypothesis (Wagner 2002), export market exit and firm dynamics (Girma et al. 2003), the wage premium of foreign ownership (Girma and Görg 2007), the Euro effect on trade (Chintrakarn 2008), or the effect of foreign acquisition on wages and productivity (Bandick 2011).

This exposition is based on Girma and Görg (2007). We aim at assessing how membership in the Danish Export Association affects trade outcomes for exporting firms. Now define $M_{it} \in \{0, 1\}$ be an indicator of whether firm $i$ becomes a DEA member at time $t$. The outcome variables which we consider are export sales, the number of exported products and the number of export destinations. For expositional simplicity, we consider export sales as an example and denote export sales after DEA entry by $z^1_{it+s}$, $s \geq 0$ . Export sales without entry into DEA at time $t + s$ are denoted by $z^0_{it+s}$. The difference between these two outcomes $z^1_{it+s} - z^0_{it+s}$ is the causal effect of DEA membership on sales abroad. However, this quantity is not observed: whenever $z^1_{it+s}$ is observable, $z^0_{it+s}$ is not - and vice versa.

We define our treatment as entry into the Danish export association, and assess whether association is successful in promoting their members by fostering these outcomes. As it might take some time for the membership effect to manifest itself, we estimate the membership effect for four different periods after entry into the association. We exclude all firms from our analysis, which - upon entry within our sample period - exit the DEA within the sample period. Thus, we measure the effect of entry into DEA for firms who stay as compared to firms who never become member of the export promotion agency.

As suggested in the microeconometric literature (Heckman et al. 1997, Dehejia and Wahba 2002) and as implemented in Girma and Görg (2007), we define the average effect of DEA membership on members as

$$E\{z^1_{t+s} - z^0_{t+s} | M_{it} = 1\} = E\{z^1_{t+s} | M_{it} = 1\} - E\{z^0_{t+s} | M_{it} = 1\}. \tag{3.1}$$

In order to identify the so-called treatment effect on the treated, we need to construct a counterfactual measure for the export sales of a DEA member had it not become a member, which is the last term in equation 1. One potential approximation candidate is $E\{z^0_{t+s}|M_{it}=0\}$, i.e., the average export sales of those firms who have not joined the trade network. But this choice is prone to be problematic, as there may be contemporaneous factors which are correlated with both, the treatment status, $M_{it}$, and the outcome. Thus, we need to select our control group more wisely. One approach to define this control group, are matching techniques. Ideally, we would like to compare identical firms, which differ only in membership status. Practically, we compare firms that are highly similar based on a set of measurable characteristics apart from their membership status.

Our matching strategy is based on propensity score matching as suggested by Rosenbaum and Rubin (1983). This means that we match firms on the basis of the probability of being treated, which is assessed by estimation of the following Probit model:

$$P\left(M_{it}=1\right)=F\left(X_{it-1}\right) \tag{3.2}$$

where $X_{it}$ captures a set of observable firm characteristics, which explain both, firm export sales and membership status in DEA. Our variable selection criterion is that the explanatory variables are (individually) statistically significant at the 10% significance level. This leads us to the choice of three different sets of conditioning variables: First, we include the lagged number of employees, the lagged average hourly wage, lagged sales and a linear time trend. Secondly, we only include the lagged export sales similar to Volpe and Carballo (2008) and a linear time trend. Thirdly, we include lagged export sales, the lagged number of destinations, the lagged number of products, and all covariates from the first specification. For future reference, we denote these three specifications by PSP 1, PSP 2 and PSP 3.

Note that we perform matching based on firm characteristics before treatment. From this model, we can predict the probability of entering the Danish Export Association for all firms. Denote the group of member firms by T, and their probability of receiving

treatment by $p_i$. Similarly, denote the group of firms who do not become network members by C, and their probability of receiving treatment by $p_j$. Then, the estimator for the causal effect of membership in general form is given by

$$\mu = \sum_{i \in T} \left( z_i - \sum_{j \in C} g(p_i, p_j) z_i \right), \tag{3.3}$$

where $g(\cdot)$ is a weighting function. The microeconometric literature has suggested different weighting functions, for example nearest neighbor matching and kernel matching. We employ Kernel matching with a Epanechnikov Kernel with a 0.003 bandwidth as well as Nearest Neighbor Matching with one neighbour.

In order to apply matching methods to panel data, Girma et al. (2003) suggest to perform matching on repeated cross-sections. Also, we consider this as preferable in our setting. However, as we observe only few firms who enter DEA every year (compare Table 1), this is not applicable in our case. As a compromise, we split the sample in two periods covering the years from 1996 to 2002 and 2003 to 2006 and account for time variation in the sub-period by including a time trend in the specification used to estimate the propensity score.

Following Girma and Görg (2007), we exploit the panel structure of the data and combine matching with a difference-in-differences estimation strategy. This approach has the advantage that it accounts for unobserved time-invariant firm heterogeneity and thus improves estimation quality and reliability considerably. This has been pointed out by Blundell and Costas Dias (2000) as well as by Smith and Todd (2005a). According to Heckman et al. (1997), this estimator is then given by

$$\delta = \sum_{i \in T} \left( \Delta z_i - \sum_{j \in C} g(p_i, p_j) \Delta z_i \right), \tag{3.4}$$

where $\Delta z$ is the difference of export sales, number of export products or export markets before and after treatment, i.e., entry into the DEA. An alternative approach, which is based on a direct weighting scheme, has been suggested by Abadie (2005), but will not

be pursued further in this paper.

## 3.5 Empirical Results

### 3.5.1 Matching Quality

For a successful matching procedure, the treated and the control group should be a similar as possible in terms of matching covariates after matching. We use two different tests, which have been suggested in Caliendo and Kopeinig (2008), to assess matching quality. The first test is regression based and uses the propensity scores estimated from equation 2 and it has initially been suggested by Smith and Todd (2005b). Consider the average hourly wage as an example of our matching covariates and denote it by $w$. Denote the estimated propensity scores by $\widehat{P}(X)$, where $X$ is a matrix of variables included in the model. Then, define $M$ as a dummy which assumes value one if a firm is DEA member and zero otherwise. Then, the following regression is estimated by OLS:

$$w = \beta_0 + \sum_{k=1}^{4} \beta_k \widehat{P}(X)^k + \sum_{k=1}^{4} \eta_k M \widehat{P}(X)^k + \epsilon, \tag{3.5}$$

where $\beta_k$ and $\eta_k$ are parameters and $\epsilon$ is an error term. We test whether $\eta_k$ are jointly significant. If we fail to reject the Null hypothesis, this provides evidence for a fulfilled balancing condition, as additional powers of the propensity score do not provide additional information (Smith and Todd 2005b). This test regression is run for each covariate which is used for matching.

As a second test, we compare the standardized bias before and after matching. Again using the average hourly wage $w$ as an example, the standardized bias is defined as

$$SB(w) = 100 \frac{\frac{1}{N} \sum_{i \in A} \left( w_i - \sum_{j \in C} g(p_i, p_j) w_j \right)}{\sqrt{\frac{1}{2} \left( Var_{i \in A}(w) + Var_{j \in C}(w) \right)}}, \tag{3.6}$$

i.e., it measures the difference in means between members and matched non-members, normalized by equally weighted subgroup variances, $Var_{i \in A}$ and $Var_{j \in C}$. As denoted by

Table 3.3: Balancing $F$-test

| PSP 1 | $p(\eta_1 = ...\eta_k = 0)$ |
|---|---|
| Employees $(t-1)$ | 0.079 |
| Average Wage $(t-1)$ | 0.543 |
| Sales $(t-1)$ | 0.061 |
| Year | 0.281 |
| | |
| PSP 2 | |
| Export Sales $(t-1)$ | 0.467 |
| Year | 0.737 |
| | |
| PSP 3 | |
| Export Sales $(t-1)$ | 0.447 |
| Destinations $(t-1)$ | 0.004 |
| Products $(t-1)$ | 0.000 |
| Employees $(t-1)$ | 0.128 |
| Average Wage $(t-1)$ | 0.004 |
| Sales $(t-1)$ | 0.423 |
| Year | 0.001 |

This Table summarizes balancing results for the $F$-test from the test regression given by equation 5.

Girma and Görg (2007) with reference to Rosenbaum and Rubin (1985), a standardized bias of 20 can be regarded as large.

Moreover, we consider three different specifications of the propensity score as described in equation 2 and two different matching algorithms to satisfy ourselves with respect to the robustness of our results.

Table 3 summarizes the results of the $F$-test for joint significance of $\eta_1, ...\eta_k$ in regression 5. For propensity score specification 1, henceforth PSP 1, we fail to reject the null for all covariates apart from sales and employees on a 10% significance level, i.e., balancing properties cannot be regarded as fully satisfactory in this specification. In the second specification, abbreviated as PSP 2, we fail to reject the Null of joint insignificance on the ten percent significance level. In the third specification, PSP 3, we fail to reject the Null of joint insignificance for all variables apart from the number of destinations, the number of products, the average hourly wage and the linear time trend. To conclude, this test indicates superiority of PSP 2 as compared to PSP 1 and PSP3. Notably, the inclusion

of lagged export sales in the PSP 1 model turns estimates on employees, average wages and sales insignificant in the Probit model as given in equation 2. Thus, even if PSP 2 is based on lagged export sales only, these are presumably the most important measurable determinant of participation in the Danish Export Association. Moreover, lagged export sales determine export sales today. Thus, lagged export sales are highly correlated with both, entry into the DEA and our outcomes.

Table 4 presents the balancing tests for Kernel and Nearest Neighbor Matching (henceforth, KM and NN). Across propensity score specifications and time horizons, we find that Nearest Neighbor Matching leads to a more substantial reduction in the standardized bias (henceforth, $SB$, see equation 6). As in the previous test, PSP 2 performs relatively well and exhibits an $SB$ below 20 for $s = 1$ and $s = 2$ in the case of NN matching. For Kernel matching, $SB$ is larger, but still acceptable. For the two remaining time horizons, the performance of PSP 2 in terms of $SB$ worsens, but still remains in a tolerable range relative to the other two propensity score models.

In all cases equality of means cannot be rejected on the basis of a $t$-test which strengthens confidence in success of the matching procedure. Reconciling all test results, PSP 2 paired with NN is our preferred specification. We present matching estimates for all strategies in the next section.

Table 3.4: Summary of Further Balancing Tests

| | Nearest Neighbor Matching | | | | | | Kernel-Matching | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | *SB* | | *t*-test | | Mean | | *SB* | | *t*-test | |
| | Treated | Control | % | %-Red. | *t*-Stat. | *t* | Treated | Control | % | %-Red | *t*-Stat. | *t* |
| | | | | | | $s = 1$ | | | | | | |
| | | | | | | PSP 1 | | | | | | |
| Employees $(t-1)$ | 4.415 | 4.302 | 8.000 | 87.600 | 0.330 | 0.740 | 4.415 | 4.129 | 20.300 | 68.600 | 0.840 | 0.404 |
| Average Wage $(t-1)$ | 5.215 | 5.223 | -4.6 | 93.800 | -0.21 | 0.831 | 5.215 | 5.174 | 22.7 | 69.700 | 0.990 | 0.323 |
| Sales $(t-1)$ | 18.238 | 18.001 | 15.900 | 76.300 | 0.620 | 0.538 | 18.238 | 17.927 | 20.800 | 68.900 | 0.860 | 0.395 |
| Year | 2002.700 | 2002.600 | 3.1 | 96.500 | 0.16 | 0.875 | 2002.700 | 2001.900 | 29.8 | 65.900 | 1.290 | 0.201 |
| | | | | | | PSP 2 | | | | | | |
| Export Sales $(t-1)$ | 16.977 | 17.265 | -11.8 | 82.900 | -0.59 | 0.554 | 16.977 | 16.560 | 17.1 | 75.300 | 0.74 | 0.459 |
| Year | 2002.700 | 2002.300 | 12.400 | 85.800 | 0.600 | 0.549 | 2002.700 | 29.600 | 29.600 | 66.200 | 1.260 | 0.212 |
| | | | | | | PSP 3 | | | | | | |
| Export Sales $(t-1)$ | 16.977 | 16.873 | 4.300 | 93.800 | 0.190 | 0.853 | 16.977 | 16.686 | 11.900 | 82.700 | 0.510 | 0.611 |
| Destinations $(t-1)$ | 24.500 | 25.556 | -6.2 | 91.900 | -0.20 | 0.843 | 24.500 | 21.583 | 17.1 | 77.500 | 0.61 | 0.543 |
| Products $(t-1)$ | 8.278 | 7.833 | 6.400 | 89.800 | -0.23 | 0.817 | 8.278 | 6.593 | 24.100 | 61.500 | 0.90 | 0.371 |
| Employees $(t-1)$ | 4.146 | 4.111 | 21.500 | 66.600 | 0.84 | 0.404 | 4.146 | 4.179 | 16.700 | 74.000 | 0.77 | 0.446 |
| Average Wage $(t-1)$ | 5.215 | 5.243 | -15.4 | 79.500 | -0.69 | 0.495 | 5.215 | 5.182 | 17.8 | 76.300 | 0.77 | 0.446 |
| Sales $(t-1)$ | 18.238 | 17.954 | 19.100 | 71.600 | 0.72 | 0.474 | 18.238 | 17.987 | 16.800 | 75.000 | 0.67 | 0.502 |
| Year | 2002.700 | 2002.600 | 1.000 | 98.800 | 0.05 | 0.959 | 2002.700 | 2002.000 | 25.600 | 25.600 | 1.111 | 0.271 |
| | | | | | | $s = 2$ | | | | | | |
| | | | | | | PSP 1 | | | | | | |
| Employees $(t-1)$ | 4.449 | 4.454 | -0.400 | 99.400 | -0.010 | 0.989 | 4.449 | 4.099 | 23.500 | 61.200 | 0.850 | 0.398 |
| Average Wage $(t-1)$ | 5.206 | 5.165 | 22.300 | 69.600 | 1.040 | 0.302 | 5.206 | 5.150 | 30.300 | 58.700 | 1.150 | 0.257 |

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Table 3.4: Summary of Further Balancing Tests

| | Nearest Neighbor Matching | | | | | | Kernel-Matching | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | $SB$ | | $t$-test | | Mean | | $SB$ | | $t$-test | |
| | Treated | Control | % | %-Red. | $t$-Stat. | $t$ | Treated | Control | % | %-Red | $t$-Stat. | $t$ |
| Sales $(t-1)$ | 18.275 | 18.129 | 9.400 | 85.500 | 0.330 | 0.740 | 18.275 | 17.862 | 26.500 | 59.200 | 0.950 | 0.346 |
| Year | 2001.900 | 2002.000 | -2.800 | 96.500 | -0.120 | 0.905 | 2001.900 | 2001.000 | 35.200 | 56.700 | 1.320 | 0.193 |
| | | | | | PSP 2 | | | | | | | |
| Export Sales $(t-1)$ | 16.992 | 17.084 | -3.700 | 94.400 | -0.160 | 0.870 | 16.992 | 16.435 | 22.500 | 66.200 | 0.840 | 0.407 |
| Year | 2001.900 | 2001.800 | 4.300 | 94.700 | 0.180 | 0.858 | 2001.900 | 2000.900 | 38.300 | 52.900 | 1.410 | 0.164 |
| | | | | | PSP 3 | | | | | | | |
| Export Sales $(t-1)$ | 16.992 | 17.121 | -5.200 | 92.200 | -0.210 | 0.836 | 16.992 | 16.636 | 14.300 | 78.400 | 0.530 | 0.598 |
| Destinations $(t-1)$ | 25.071 | 28.286 | -18.100 | 75.900 | -0.490 | 0.624 | 25.071 | 21.677 | 19.100 | 74.600 | 0.590 | 0.558 |
| Products $(t-1)$ | 9.036 | 7.929 | 14.800 | 78.600 | 0.500 | 0.622 | 9.036 | 6.445 | 34.500 | 49.800 | 1.150 | 0.256 |
| Employees $(t-1)$ | 4.449 | 4.068 | 25.600 | 57.800 | 0.960 | 0.340 | 4.449 | 4.202 | 16.600 | 72.600 | 0.580 | 0.564 |
| Average Wage $(t-1)$ | 5.206 | 5.218 | -6.900 | 90.600 | -0.250 | 0.804 | 5.206 | 5.162 | 23.500 | 67.900 | 0.880 | 0.383 |
| Sales $(t-1)$ | 18.275 | 18.096 | 11.500 | 82.300 | 0.430 | 0.668 | 18.275 | 17.977 | 19.100 | 70.600 | 0.670 | 0.509 |
| Year | 2001.900 | 2002.500 | -22.800 | 72.000 | -0.960 | 0.341 | 2001.900 | 2001.100 | 30.400 | 62.600 | 1.140 | 0.259 |
| | | | | | $s=3$ | | | | | | | |
| | | | | | PSP 1 | | | | | | | |
| Employees $(t-1)$ | 4.560 | 4.068 | 30.900 | 49.600 | 0.890 | 0.378 | 4.560 | 3.758 | 50.500 | 17.700 | 1.410 | 0.168 |
| Average Wage $(t-1)$ | 5.124 | 5.133 | -5.200 | 86.000 | -0.170 | 0.867 | 5.124 | 5.086 | 21.900 | 41.200 | 0.610 | 0.545 |
| Sales $(t-1)$ | 18.188 | 17.745 | 26.900 | 51.000 | 0.770 | 0.448 | 18.188 | 17.471 | 43.500 | 20.500 | 1.220 | 0.234 |
| Year | 2000.000 | 2001.000 | -47.800 | -66.000 | -1.520 | 0.139 | 2000.000 | 1999.800 | 11.700 | 59.300 | 0.320 | 0.748 |
| | | | | | PSP 2 | | | | | | | |
| Export Sales $(t-1)$ | 16.783 | 16.243 | 21.500 | 61.300 | 0.690 | 0.494 | 16.783 | 15.465 | 52.600 | 5.400 | 1.510 | 0.142 |

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Table 3.4: Summary of Further Balancing Tests

| | Nearest Neighbor Matching | | | | | | Kernel-Matching | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | *SB* | | *t*-test | | Mean | | *SB* | | *t*-test | |
| | Treated | Control | % | %-Red. | *t*-Stat. | *t* | Treated | Control | % | %-Red | *t*-Stat. | *t* |
| Year | 2000.000 | 2000.600 | -29.900 | -3.700 | -1.060 | 0.298 | 2000.000 | 1999.400 | 27.200 | 5.400 | 0.770 | 0.449 |
| | | | | | | PSP 3 | | | | | | |
| Export Sales $(t-1)$ | 16.783 | 16.584 | 7.900 | 85.800 | 0.210 | 0.831 | 16.783 | 15.909 | 34.800 | 37.300 | 0.950 | 0.352 |
| Destinations $(t-1)$ | 22.313 | 20.438 | 10.000 | 82.100 | 0.220 | 0.829 | 22.313 | 16.164 | 32.700 | 41.400 | 0.800 | 0.432 |
| Products $(t-1)$ | 9.125 | 7.938 | 14.400 | 77.800 | 0.350 | 0.730 | 9.125 | 4.875 | 51.400 | 20.400 | 1.360 | 0.185 |
| Employees $(t-1)$ | 4.560 | 4.231 | 20.700 | 66.300 | 0.530 | 0.597 | 4.560 | 3.871 | 43.400 | 29.300 | 1.150 | 0.261 |
| Average Wage $(t-1)$ | 5.124 | 5.107 | 9.500 | 74.600 | 0.310 | 0.762 | 5.124 | 5.089 | 19.900 | 46.700 | 0.550 | 0.585 |
| Sales $(t-1)$ | 18.188 | 18.007 | 11.000 | 80.000 | 0.280 | 0.781 | 18.188 | 17.594 | 36.000 | 34.300 | 0.950 | 0.351 |
| Year | 2000.000 | 2001.200 | -56.800 | -97.400 | -1.820 | 0.079 | 2000.000 | 1999.800 | 11.400 | 60.300 | 0.320 | 0.753 |
| | | | | | | $s=4$ | | | | | | |
| | | | | | | PSP 1 | | | | | | |
| Employees $(t-1)$ | 4.606 | 4.421 | 11.400 | 81.400 | 0.330 | 0.746 | 4.606 | 3.867 | 45.700 | 25.400 | 1.220 | 0.233 |
| Average Wage $(t-1)$ | 5.117 | 5.132 | -8.600 | 78.900 | -0.260 | 0.800 | 5.117 | 5.077 | 22.800 | 44.000 | 0.610 | 0.547 |
| Sales $(t-1)$ | 18.225 | 18.125 | 5.900 | 89.300 | 0.170 | 0.863 | 18.225 | 17.567 | 39.300 | 28.800 | 1.040 | 0.305 |
| Year | 1999.800 | 2000.200 | -21.400 | 53.600 | -0.630 | 0.534 | 1999.800 | 1999.300 | 28.000 | 39.300 | 0.750 | 0.462 |
| | | | | | | PSP 2 | | | | | | |
| Export Sales $(t-1)$ | 16.794 | 16.160 | 25.000 | 53.800 | 0.780 | 0.443 | 16.794 | 15.548 | 49.100 | 9.100 | 1.350 | 0.187 |
| Year | 1999.800 | 2000.500 | -39.200 | 14.900 | -1.270 | 0.215 | 1999.800 | 1999.000 | 42.900 | 6.900 | 1.160 | 0.256 |
| | | | | | | PSP 3 | | | | | | |
| Export Sales $(t-1)$ | 16.794 | 16.980 | -7.300 | 86.400 | -0.200 | 0.841 | 16.794 | 15.947 | 33.400 | 38.200 | 0.870 | 0.391 |
| Destinations $(t-1)$ | 22.533 | 16.867 | 29.500 | 47.000 | 0.680 | 0.504 | 22.533 | 17.021 | 28.700 | 48.500 | 0.650 | 0.520 |

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Table 3.4: Summary of Further Balancing Tests

| | Nearest Neighbor Matching | | | | | | Kernel-Matching | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | $SB$ | | $t$-test | | Mean | | $SB$ | | $t$-test | |
| | Treated | Control | % | %-Red. | $t$-Stat. | $t$ | Treated | Control | % | %-Red | $t$-Stat. | $t$ |
| Products $(t-1)$ | 9.200 | 6.133 | 36.200 | 44.400 | 0.860 | 0.396 | 9.200 | 5.184 | 47.400 | 27.200 | 1.170 | 0.253 |
| Employees $(t-1)$ | 4.606 | 4.262 | 21.300 | 65.300 | 0.530 | 0.600 | 4.606 | 3.931 | 41.800 | 31.800 | 1.060 | 0.299 |
| Average Wage $(t-1)$ | 5.117 | 5.235 | -68.100 | -66.500 | -0.970 | 0.341 | 5.117 | 5.070 | 26.900 | 34.300 | 0.730 | 0.470 |
| Sales $(t-1)$ | 18.225 | 18.238 | -0.800 | 98.600 | -0.020 | 0.984 | 18.225 | 17.630 | 35.500 | 35.700 | 0.900 | 0.377 |
| Year | 1999.800 | 2000.700 | -46.300 | -0.600 | -1.530 | 0.138 | 1999.800 | 1999.200 | 32.200 | 30.100 | 0.870 | 0.394 |

This Table summarizes balancing tests for all time horizons $s = 1, ..., 4$ and all propensity score specifications PSP 1, PSP 2 and PSP 3.

### 3.5.2 The Effect of DEA Membership on Exports

As previously discussed, this section presents estimates of the causal effect of DEA membership on export performance measured in terms of export sales, number of export products and number of destination countries. These estimates are presented in Table 5 together with $p$-values for the test of that DEA membership exerts no or a negative effect on export sales, the number of export destinations or the number of exported products. These $p$-values are based on analytical standard errors according to Abadie and Imbens (2006), as Abadie and Imbens (2008) prove that the bootstrap fails to provide correct standard errors for matching estimators. Recall that treatment is defined as firm entry into the DEA conditional on subsequent membership in the organization. This implies that we omit firms which have left the association after entry. With this in mind, our estimates should be interpreted as an upper bound of trade creation effects. Please note that our estimations for different time horizons are based on distinct samples, which has been done to be able to use as many treated observations as possible in each estimation.

Table 5 summarizes our estimation results. The subsequent discussion starts from our preferred specification, PSP 2 with NN matching, and subsequently relates to PSP 2 with KM. Export sales are measured in natural logs, such that $\delta$ multiplied by 100 measures the percentage change in export sales which is caused by entry into the DEA. According to our preferred propensity score specification, PSP 2, we find that DEA membership exhibits a positive effect on export sales three and four years after entry. It takes a while until a new member can benefit from the export knowledge pooled in the DEA. In the first two years after entry, membership does not exhibit an effect which is greater than zero. However, point estimates reflect a gradual increase over time, and the effect turns to be significantly positive in the third year. Then, the effect is substantial and amounts to export sales which are 47% higher for a member three years after entry and 82% higher four years after entry. The gradual increase in the effect over time is also reflected in the size of the two point estimates for the two years after entry. The general picture carries over to the KM estimates, where the point estimates increase over time for all propensity score specifications. However, we never reject the Null hypothesis that point

estimates are less or equal to zero. A similar picture emerges from the KM estimates which rely on a different specification of the propensity score model. But considering the PSP 1 specification with NN matching, we confirm our previous finding that DEA membership turns beneficial two years after entry: DEA membership increases export sales by around 85%. In this specification, the effect turns insignificant but remains positive in the following year.

The number of destination countries is not affected by DEA membership. This results from all specifications of the propensity score for both NN and Kernel matching. Still, the estimated effects increase in the time after entry up to $s = 3$ for all propensity score specifications but for PSP 3 and both matching methods.

Contrastingly, we find evidence for an increase in export products due to DEA membership: NN matching with PSP 2 indicates no effect on the number of export products, but moving to Kernel matching, we find that the number of exported products increases by 0.625 one year after entry, and to 0.905 two years after entry. Estimates obtained from PSP 1 are very similar in size and evolution after entry. For all three propensity score specifications, we find a positive and significant effect of DEA membership on the number of traded products when we employ Kernel matching. This is confirmed by NN matching estimates with PSP 1 and PSP 3. Yet, in these cases participation in the network manifests itself by a stronger increase in the number of traded products: Point estimates for PSP 1 amount to 1.25 (1.42) and 1.50 (2.42) in the first and second year after entry. For PSP 3, we find a significantly positive effect also for the third period after entry

All in all, our estimates indicate that DEA membership matters for export success. Its important role in export promotion stems from increasing the number of exported products, and boosting export sales rather than broadening the range of export destinations. However, the benefits of entry do not manifest immediately for export sales, but fade in over a period of two years after entry. This reflects that at the beginning of the membership, the firm cannot immediately access all knowledge pooled in the association, but needs to invest further in getting to know other members and to interact with them.

Moreover, activities which are set up to foster export sales like participation in trade fairs or assemblies take place all over the year. Thus, it is not surprising that the gain from membership arises in the long run. Then, firms experience a strong boost in their export sales, amounting to 48% after the third, and 82% after the fourth year. Our estimates suggest that firms immediately benefit from an increased number of exported products after entry into the DEA.

Similar to earlier related work, we find that export promotion helps to foster exports. But our results differ in important ways: Volpe and Martincus (2008) find that export promotion fosters exports almost exclusively along the extensive destination and product margins, rather than the intensive margin of exports. On the contrary, Görg et al. (2008) find that sufficiently large investment grants, which indirectly might support exports, lead to an increase in export sales, but play no role on the extensive margin of trade. This suggests that export promotion plays a different role in developing and developed countries: As Volpe and Martincus (2008) argue, national reputation effects may render it even more difficult to enter new product or geographical markets. The opposite is probably true for Danish firms: In the journal of the DEA, Dansk Eksport (2005), the administrative director of a big member company says that even for his company, it is an advantage to be jointly participate at trade fairs and to be visible as one part of a large national stand. Thus, the reputational and potentially informational barriers to overcome might be considerably lower in the case of a developed small open economy like Denmark. But, on the contrary, for Danish manufacturing firms it may be much more important to be in a common network with its suppliers which potentially translates into lower variable cost.

## 3.6 Conclusion

This paper addresses the question whether and how export promotion works in a developed small open economy. In order to explore the role of different channels through which exports may be fostered, we use firm-level information on exported products and export destination on top of export sales. We employ a difference-in-difference estimation technique to estimate the causal effect of membership in the export association on firm-level trade.

From our analysis, we can conclude that the Danish Export Association is certainly a pool of high-performance firms both in terms of export sales, the number of export destinations and the number of export products. But more importantly, this is not due to cherry-picking: indeed, we find that DEA membership causes an increase in export sales and encourages the shipment of more products. The increase in export sales manifests itself two years after entry, whereas the increase in exported products occurs already in the first year after the beginning of the membership.

Our results corroborate an interesting finding of earlier work: For developed countries, export promotion indeed seems to be more important for the intensive margin of firm-level trade rather than the extensive margin, whereas for developing countries the reverse is true. This suggests that benefits from the pooling of knowledge differ substantially by the level of economic development and overall trade exposure in the country.

Table 3.5: Difference-in-Difference Matching Estimates

**Nearest Neighbor Matching**

| | PSP 1 | | PSP 2 | | PSP 3 | |
|---|---|---|---|---|---|---|
| $s$ | $\widehat{\delta}$ | $p(\delta \leq 0)$ | $\widehat{\delta}$ | $p(\delta \leq 0)$ | $\widehat{\delta}$ | $p(\delta \leq 0)$ |
| | | | Export Sales | | | |
| 1 | -0.079 | 0.637 | 0.184 | 0.125 | 0.067 | 0.349 |
| 2 | 0.134 | 0.350 | 0.190 | 0.254 | -0.133 | 0.680 |
| 3 | 0.852 | 0.072 | 0.476 | 0.103 | 0.385 | 0.155 |
| 4 | 0.477 | 0.146 | 0.818 | 0.053 | 0.145 | 0.372 |
| | | | Destination Markets | | | |
| 1 | 0.167 | 0.440 | 0.917 | 0.216 | 0.861 | 0.218 |
| 2 | 0.714 | 0.334 | 0.286 | 0.413 | -1.500 | 0.838 |
| 3 | 1.750 | 0.178 | 1.875 | 0.183 | 1.625 | 0.356 |
| 4 | 2.200 | 0.160 | 1.400 | 0.249 | -2.400 | 0.866 |
| | | | Number of Products | | | |
| 1 | 1.250 | 0.072 | 0.167 | 0.397 | 1.417 | 0.020 |
| 2 | 1.500 | 0.034 | -0.714 | 0.817 | 2.429 | 0.028 |
| 3 | 0.813 | 0.210 | -0.188 | 0.575 | 1.563 | 0.109 |
| 4 | 0.733 | 0.248 | 0.867 | 0.207 | 0.067 | 0.477 |

**Epanechnikov Kernel Matching**

| | PSP 1 | | PSP 2 | | PSP 3 | |
|---|---|---|---|---|---|---|
| $s$ | $\widehat{\delta}$ | $p(\delta \leq 0)$ | $\widehat{\delta}$ | $p(\delta \leq 0)$ | $\widehat{\delta}$ | $p(\delta \leq 0)$ |
| | | | Export Sales | | | |
| 1 | 0.001 | 0.496 | 0.016 | 0.416 | 0.011 | 0.445 |
| 2 | 0.087 | 0.367 | 0.109 | 0.335 | 0.108 | 0.337 |
| 3 | 0.115 | 0.340 | 0.136 | 0.313 | 0.141 | 0.306 |
| 4 | 0.172 | 0.335 | 0.194 | 0.314 | 0.197 | 0.312 |
| | | | Destination Markets | | | |
| 1 | 0.489 | 0.263 | 0.526 | 0.247 | 0.515 | 0.252 |
| 2 | 0.468 | 0.313 | 0.522 | 0.293 | 0.498 | 0.302 |
| 3 | 0.709 | 0.335 | 0.639 | 0.351 | 0.726 | 0.332 |
| 4 | 0.570 | 0.364 | 0.483 | 0.384 | 0.372 | 0.410 |
| | | | Number of Products | | | |
| 1 | 0.650 | 0.101 | 0.654 | 0.103 | 0.647 | 0.102 |
| 2 | 0.915 | 0.044 | 0.905 | 0.046 | 0.944 | 0.040 |
| 3 | 0.265 | 0.373 | 0.224 | 0.392 | 0.308 | 0.353 |
| 4 | 0.168 | 0.420 | 0.145 | 0.431 | 0.316 | 0.352 |

This Table summarizes the matching estimates for the effect of DEA membership on export sales, number of export destinations and number of products shipped by time after entry into the Danish Export Association $s$. Samples differ across horizons, in increasing time after entry, the number of treated firms amounts to 36, 28, 16 and 15. Nearest neighbor matching is done for one neighbor. The bandwidth for the Epanechnikov kernel is set to 0.003.

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# Chapter 4

# Switching Between Export, FDI and Domestic Market Activity

*This paper is joint work with Erdal Yalcin.*

## 4.1 Introduction

The importance of Foreign Direct Investment (FDI) and International Trade has risen over the last two decades (Worldbank 2008). Domestic companies have steadily increased their exports to foreign markets and expanded their foreign plant shares as a means of foreign market access (UNCTAD 2008). These developments have led to an increased research effort in understanding firm behavior on international markets (see Greenaway and Kneller (2007) for a recent survey). Since the seminal work of Melitz (2003) on export behavior and industry dynamics, the triad of productivity, economies of scale, and selection are considered to be the major forces behind international enterprise behavior.

Accounting for firm heterogeneity, Melitz (2003)'s New New Trade Theory lays the basis to explain firms' sorting into exporter status. Helpman et al. (2004) introduce FDI into this framework where in equilibrium the most productive firms tend to serve foreign markets via FDI, less productive firms become exporters, and low-productivity firms tend to restrict their activity to the domestic market. This sorting finds vast empirical support, see for example Baldwin and Gu (2003), Helpman (2006), Wagner (2006) or Mayer and Ottaviano (2007), Oberhofer and Pfaffermayr (2008). The resulting sorting pattern in these models is rooted in the cost structure: The export activity brings about higher variable costs due to transportation and relatively low fixed costs of market entry. Differently, firms which serve the foreign market as a foreign direct investor commonly face lower variable costs, but considerably higher fixed costs arising from the replication of production facilities abroad or information cost on the institutional environment. This cost structure depicts the proximity-concentration trade-off as introduced by Brainard (1993). Helpman et al. (2004) derive in their setting a final firm distribution within an industry by combining the proximity-concentration trade-off framework with firm productivity heterogeneity. However, it does not access the dynamics between entry into export and FDI, as well as the switching from exporting to FDI, and thus turns out to be insufficient for transition analysis. But recent economic studies increasingly acknowlegde the importance to understand transition dynamics in an uncertain world. See for example Das et el. (2007), Yalcin (2009), Sala, Schröder and Yalcin (2010), Aw et al. (2011) and

many more.

Our paper complements the existing literature, as it provides answers to two empirically relevant questions: First, how does an uncertain productivity evolution affect a firm's export entry and exit decision into foreign markets? Secondly, conditional on being an exporter, how does it affect the decision to subsequently engage in FDI? We address these questions using a real option approach in partial equilibrium. In order to match closely with the related literature, we assume a monopolistically competitive market as in Melitz (2003). This allows us to address how competition and fixed entry cost affect the firm entry and exit into exporting or FDI activities, as well as the transition from exporting to FDI. Similarly, we address how firm-characteristics affect entry, exit and the export-FDI transition. For tractability, we take the perspective of a single firm, which is subject to a stochastic productivity evolution. Firm productivity is assumed to follow a Geometric Brownian motion. Following the seminal real option theory of Dixit (1989), we apply numerical methods in order to solve for critical productivity thresholds for entry, exit and transition cut-offs.

Our main results show that firm exit and entry into exporting and FDI, as well as the transition from export to FDI, is determined by productivity fundamentals, namely growth and volatility. But also, market characteristics like the degree of competition and irreversible fixed or switching costs determine, whether a firm serves a market continuously or not. In particular, a high productivity growth rate fosters frequent market entry and exit in both, FDI or exporting. Similarly, it encourages switching from export into FDI. This is due to the fact that sunk cost of entry or switching can easily be recouped due to an increase in productivity. Similarly, ceteris paribus, a highly volatile productivity development encourages late market entry and late market exit after entry. However, if the initial cost constellation is such that market entry takes place via exporting, a volatile productivity path encourages switching from exporting to FDI.

The remainder is structured as follows: Section 2 presents the theoretical model. Section 3 presents and discusses the numerical results, and Section 4 concludes.

## 4.2 The Model

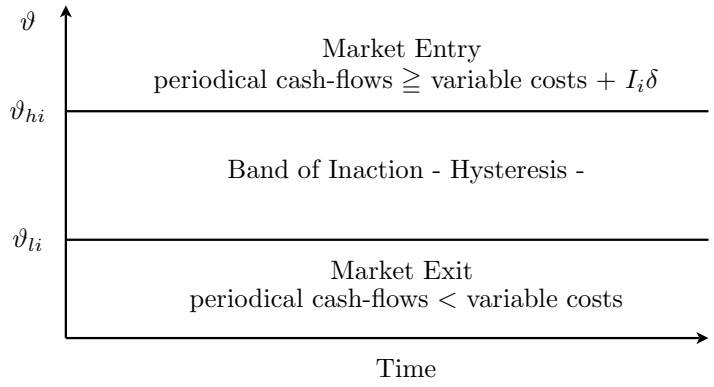
This Section introduces the theoretical model. It is structured in the following way: First, we briefly introduce hysteresis as a key concept to our analysis. Secondly, we derive optimal periodical cash-flows and present how entry and exit cut-offs are derived in a real option framework. Subsequently, we turn to an exporter's decision to stop exporting and start to engage in FDI.

Note that for notational simplicity, derivations for entry and exit on the foreign market consider only the export case. This is possible without loss of generality, because the entry and exit decision of the firm via exporting or FDI are structurally equivalent in our set-up: the only difference stems from the levels and relative sizes of fixed and variable costs. As exporting is associated with (partly) irreversible fixed costs $I_E^N$ which arise for example in order to establish a new distribution and service-network, FDI requires a new plant and therefore its fixed costs $I_F^N$ are strictly higher compared to exporting. In serving the destination market through exports the firm faces iceberg transport costs $\tau > 1$ which are avoided in the FDI mode. Given these cost structures, the investor is confronted with a proximity-concentration trade-off where he experiences a comparative variable cost advantage in the export strategy and a comparative fixed cost advantage in the FDI mode.

### 4.2.1 The "Band of Inaction" on the Foreign Market

Real option analysis takes an extended perspective of investment problems, in the sense that it incorporates future scope for action in the firm value and thus in the decision problem. Consider first a situation where a domestic firm intends to export and sales on the domestic market are normalized to 0. Given the possibility to switch between the inactivity and exporting, there are two state variables, productivity and export status. Moreover, engagement into exporting is subject to a fixed cost, which is partially sunk. In this set-up, the value of a domestic firm, which does not earn profits on the export market, consists of its option value. This option value, which we denote as $V_D(\vartheta)$ captures potential future returns associated with selling abroad. On the contrary, the value of an

Figure 4.1: Hysteresis




This Figure depicts the productivity thresholds levels which trigger entry, $v_{hi}$, and exit $v_{li}$, where $i$ indicates exports or FDI. $\delta$ is a discount rate, and $I$ are entry costs, which are partially sunk.

exporting firm is different: The exporter's value, $V(\vartheta)$, consists of perpetual cash-flows and the option to leave the market if the productivity evolution is sufficiently undesirable. Generally, the investor will stay only in the domestic market if productivity stays between $(0, \vartheta_h)$ and keep on staying in the export state if productivity lies in between $(\vartheta_l, \vartheta_h)$. The market entry and exit cut-offs do not coincide. This phenomenon is depicted in Figure 1 and represents a standard real option result: Due to sunk cost associated with a foreign market activity, the firm does not exit from the market as soon as its productivity level falls below the entry threshold, but remains in its current state. The existence of these two critical productivity cut-offs which determine a firm's market entry and exit decision can be explained by the distinctive relevance of the accruing types of costs. According to the Marshallian investment rule an investor enters a new market if the periodical cash-flows cover both, periodical variable costs and annualized fixed costs. As a consequence, the market entry cut-off $\vartheta_h$ is determined by both, fixed and variable cost. If the initial fixed costs are at least partly sunk, an investor will not exit a market if the state variable falls below the entry cut-off, since the fixed costs are sunk anyway. Due to the possibility of a future recovery of the state variable, in particular if it is assumed to develop stochastically, the exit cut-off $\vartheta_l$ will be therefore always lower than the entry cut-off $\vartheta_h$. Implicitly, an investor is confronted with a band of inaction which lies in

between these two cut-offs. This inaction is known as hysteresis and generally defined as "the failure of an effect to reverse itself as its underlying cause is reversed" (Dixit, 1989).

### 4.2.2 Foreign Market Entry by Export or FDI

In order to derive the productivity thresholds which trigger export entry and exit, we first derive periodical export cash-flows. Subsequently, we introduce stochastic productivity evolution. For a concise presentation, we present only the scenario, where the firm enters the market via exports.

Consider a risk-neutral investor who intends to export to a new foreign market with his product brand $X_i$ under monopolistic competition. By comparing the investment values of these two market entry modes the investor decides on whether to enter the market directly through FDI or by exporting. Preferences of the representative consumer in the destination country are given by

$$\begin{aligned} &U_t(Q_t, Y_t) = Q_t^{\gamma} Y_t^{1-\gamma} \\ &\text{with} \quad Q_t = \left( \sum_{i=1}^{n_t} X_{i_t}^{\rho} \right)^{\frac{1}{\rho}}, \quad 0 < \rho < 1, \quad 0 < \gamma < 1, \end{aligned} \tag{4.1}$$

where $\rho$ is the degree of substitutability across differentiated goods, and $Y$ is a freely-traded homogeneous good that is produced in all countries. The income share spent on heterogeneous goods is denoted by $\gamma$.

Such preferences imply the following demand function for variety $i$,

$$\begin{aligned} &X_{i_t} = \frac{p_{i_t}^{-\eta}}{P_t^{-\eta}} \cdot \frac{\gamma \xi_t}{P_t}, \\ &\text{with} \quad \eta = \frac{1}{1-\rho}, \quad P_t = \left( \sum_{j_t}^{n_t} p_{j_t}^{1-\eta} \right)^{\frac{1}{1-\eta}}, \end{aligned} \tag{4.2}$$

where $\xi_t$ is the destination country's gross national expenditure, $P_t$ the price index and $p_{it}$ the price of variety $i$ at time $t$. The investor assumes that the expenditure share spent on good $Q$ and the price index $P$ do not change over time. Consequently, equation (4.2)

represents the investor's perceived demand function which can be summarized to

$$p_t = ZX_t^{-\frac{1}{\eta}} \qquad (4.3)$$
$$\text{with} \quad Z = P^{\frac{\eta-1}{\eta}}(\gamma\xi)^{\frac{1}{\eta}},$$

where the subscript $i$ is omitted, as the considered firm exports only one brand. Due to the fact that the investor is the only producer of brand $i$, he possesses market power which depends on the destination country's elasticity of substitution. Therefore, he will charge a price $p = w_h \frac{Z}{\nu}$, where $\nu$ is the inverse mark-up of price over marginal costs and $w_h$ the wage rate in the home market. The wage is determined in the homogeneous-good industry. Technology in the destination country is less productive and therefore, wages $w_d$ are lower.[1] By reformulating the demand function as

$$p = ZX^{\nu-1}, \qquad (4.4)$$

it is possible to model the extent of market power following Bertola (1998). For $\nu$ close to 1 the market power is low since substitutability between the varieties is high ($\rho \to 1$). On the other hand for $\nu$ close to zero the investor possesses market power since the demand function becomes less elastic.

On the technology side production is described by

$$X_t(L_t) = \vartheta_t L_t^{\theta} \qquad (4.5)$$
$$\text{with} \quad 0 < \theta < 1 \quad \text{and} \quad \vartheta_t > 0,$$

where labor $L_t$ is the only periodically used input and $\vartheta_t$ the firm embedded productivity

[1] In the subsequent simulation we assume $w_d = w_h$ but still maintain higher variable costs in the export mode due to transport costs $\tau > 1$. The introduction of lower variable costs in the FDI mode amplifies the derived effects but does not act as a countervailing force.

level. Based on the following maximization problem

$$\Pi_E = \max_L p\ X_E - Lw_h \quad \text{s.t.} \quad X_E = \frac{X_{DE}}{\tau} \quad \text{s.t.} \quad X_{DE} = \vartheta L^\theta \quad \text{s.t.} \quad p = Z{X_E}^{(\nu-1)}, \tag{4.6}$$

with $X_{DE}$ as the domestic output produced for the destination country, periodical export cash-flows result as

$$\begin{aligned} &\Pi_E(\vartheta) = M_E \vartheta_E^\kappa \\ &\text{with} \quad M_E = Z^{\frac{1}{1-\nu\theta}} \left(\frac{\nu\theta}{w_h \tau^{\frac{1}{\theta}}}\right)^{\frac{\nu\theta}{1-\nu\theta}} (1-\nu\theta) \quad \text{and} \quad \kappa = \frac{\nu}{1-\nu\theta}. \end{aligned} \tag{4.7}$$

Accordingly, cash-flows in the FDI mode with $\tau = 1$ result as

$$\begin{aligned} &\Pi_F(\vartheta) = M_F \vartheta^\kappa \\ &\text{with} \quad M_F = Z^{\frac{1}{1-\nu\theta}} \left(\frac{\nu\theta}{w_d}\right)^{\frac{\nu\theta}{1-\nu\theta}} (1-\nu\theta) \quad \text{and} \quad \kappa = \frac{\nu}{1-\nu\theta}. \end{aligned} \tag{4.8}$$

With reference to recent trade models (Helpman et al. 2004; Yeaple, 2008) in the remainder we assume $\kappa \geq 1$. Periodical profits increase linearly or convexly in $\vartheta$.
Furthermore, firm embedded productivity $\vartheta$ evolves exogenously over time as a stochastic process. Specifically, we assume a Geometric Brownian motion with

$$d\vartheta_t = \alpha\vartheta_t dt + \sigma dz_t, \tag{4.9}$$

where $dz_t$ is an increment of the standard Wiener Process satisfying $\mathbb{E}(dz) = 0$ and $\mathbb{E}(dz^2) = dt$. The annual growth rate is given by $\alpha$. The instantaneous volatility is denoted by $\sigma$. Both parameters are assumed to be time and state invariant. In $t = 0$ a firm observes its current productivity level $\vartheta_0$ and the random productivity in $t$ is then $\vartheta_t$. The solution of the previous stochastic differential equation can be written as

$$\vartheta_t = \vartheta_0\ e^{\int_0^T (\alpha - \frac{1}{2}\sigma^2)dt + \int_0^T \sigma dz_t}. \tag{4.10}$$

Since $\ln \vartheta_t$ is normally distributed with

$$N \sim \left( \ln \vartheta_0 + (\alpha - \frac{1}{2}\sigma^2)t, \sigma^2 t \right), \tag{4.11}$$

the expected periodical profit growth results as

$$\mathbb{E}\left(\frac{M_E \vartheta_t}{M_E \vartheta_0}\right) = \exp(\alpha') \quad \text{with} \quad \alpha' = \alpha\kappa + \frac{1}{2}\kappa\sigma^2(\kappa - 1), \tag{4.12}$$

where $\alpha'$ is the trend rate of productivity growth which is adjusted for $\kappa > 1$.[2] For linear periodical profits ($\kappa = 1$) annual growth turns out to be equal to $\alpha$. With reference to the capital asset pricing model (Sharpe, 1964), $\mu$ represents the appropriate return for an asset associated with the same risk pattern as represented by the Geometric Brownian motion (4.9). Therefore, in equilibrium the difference between the appropriate return $\mu$ and the growth rate $\alpha$ represents a firm's opportunity costs $\delta = \mu - \alpha$.

Accounting for $\kappa > 1$ the adjusted discount rate becomes

$$\delta' = r - (r - \delta)\kappa - \frac{1}{2}\kappa(\kappa - 1)\sigma^2. \tag{4.13}$$

Within a Marshallian investment choice problem an investor compares the expected gross firm values $V_i(\vartheta)$ of the two entry modes with their respective entry fixed costs

$$V_E(\vartheta) - I_E^N = \int_0^\infty M_E \vartheta^\kappa e^{\alpha' t} e^{-\mu' t} dt - I_E^N \tag{4.14}$$

$$V_E(\vartheta) - I_E^N = \frac{M_E \vartheta^\kappa}{r - (r - \delta_u)\kappa - \frac{1}{2}\kappa(\kappa - 1)\sigma^2} - I_E^N \tag{4.15}$$

$$\text{with} \quad \vartheta = \vartheta_0$$

and chooses the entry strategy with the highest net investment value. However, such an approach neglects influential aspects. Given at least partly irreversible fixed costs and the possibility of postponing the investment, each investment strategy is associated with an option value which needs to be accounted for. Additionally, besides the entry fixed

[2] Appendix 4.4 presents the derivation of $\alpha'$.

costs $I_E^N$ there exist furthermore by assumption abandonment benefits $I_E^A$ which are taken into account before entering the market and which generate an option value enforcing to stay longer only in the domestic market or in the export market. We impose that $I_E^N > I_E^A$. Therefore, an appropriate framework derives the value function of all possible states, staying permanently domestic, being an exporter or foreign direct investor in a more complex way.[3] Due to numerical and analytical restrictions, in the remainder we present partial equilibrium results for relevant scenarios.

The derivation of critical productivity cut-offs and the value functions is achieved by applying the asset spanning method (Dixit 1994). The common differential equation for the option value $V_D(\vartheta)$ results by constructing a portfolio which contains one unit of the option to invest, and a short position of $n = \frac{\partial V_D(\vartheta)}{\partial \vartheta}$ units of output:[4]

$$\frac{1}{2}\sigma^2\vartheta^2 V_D''(\vartheta) + (r-\delta)\vartheta V_D'(\vartheta) - rV_D(\vartheta) = 0 \tag{4.16}$$
$$\text{with} \quad V_D''(\vartheta) = \frac{\partial^2 V_D(\vartheta)}{\partial \vartheta^2} \quad \text{and} \quad V_D'(\vartheta) = \frac{\partial V_D(\vartheta)}{\partial \vartheta}.$$

The general solution to this equation is

$$V_D(\vartheta) = A_{1E}\vartheta^{\beta_1} + A_{2E}\vartheta^{\beta_2}. \tag{4.17}$$

$A_{1E}, A_{2E}$ are constants which remain to be determined, whereas $\beta_1$ and $\beta_2$ are roots of the quadratic equation under risk neutral valuation, such that[5]

$$\beta_1 = \frac{1}{2} - (r-\delta)/\sigma^2 + \sqrt{\left((r-\delta)/\sigma^2 - \frac{1}{2}\right)^2 + 2r/\sigma^2} > 1, \tag{4.18}$$

$$\beta_2 = \frac{1}{2} - (r-\delta)/\sigma^2 - \sqrt{\left((r-\delta)/\sigma^2 - \frac{1}{2}\right)^2 + 2r/\sigma^2} < 0. \tag{4.19}$$

If productivity approaches zero, the option value of market entry approaches zero. For

[3] A formulation of all possible serving mode strategies within a single analytical framework results in a non-linear equation system which does not converge. Therefore, we split the optimization problems in subsets in order to present a partial equilibrium result.

[4] We use Ito's lemma with $dV_D(\vartheta) = \frac{\partial V_D(\vartheta)}{\partial \vartheta} d\vartheta + \frac{1}{2}\frac{\partial^2 V_D(\vartheta)}{\partial \vartheta^2}(dx)^2$.

[5] Appendix 4.4 presents the derivation of these solutions.

this reason, the coefficient $A_{2E}$ in equation (4.17) is equal to zero and the value of the domestic firm follows as

$$V_D = A_{1E}\vartheta^{\beta_1} \quad \forall \quad \vartheta \in (0, \vartheta_{hE}), \tag{4.20}$$

where $\vartheta_{hE}$ denotes the critical productivity level at which the firm switches from purely domestic activity to export market entry.

The value of the firm which exports, $V_E$, consists of two components, namely the cash flows, $\frac{M_E\vartheta^\kappa}{\delta'}$, as derived earlier and the option value to abandon the foreign market if productivity falls too far. Thus, the value of the active firm has to suffice the differential equation

$$\frac{1}{2}\sigma^2\vartheta^2 V_E''(\vartheta) + (r-\delta)\vartheta V_E'(\vartheta) - rV_E(\vartheta) + \frac{M_E\vartheta^\kappa}{\delta'} = 0, \tag{4.21}$$

with the general solution

$$V_E = B_{1E}\vartheta^{\beta_1} + B_{2E}\vartheta^{\beta_2} + \frac{M_E\vartheta^\kappa}{\delta'}. \tag{4.22}$$

If productivity rises enormously, the option to abandon the market is far out of the money, and thus tends to zero if $\vartheta \to \infty$. Therefore, the coefficient $B_{1E}$ has to be equal to zero, and the value of the firm results as

$$V_E = B_{2E}\vartheta^{\beta_2} + \frac{M_E\vartheta^\kappa}{\delta'} \quad \forall \quad \vartheta \in (\vartheta_{lE}, \infty), \tag{4.23}$$

where $\vartheta_{lE}$ is the critical productivity level at which an exporter stops his exporting activity.

In order to determine the market entry and exit cut-off productivity levels, $\vartheta_{hE}$ and $\vartheta_{lE}$, along with the coefficients $A_{1E}$ and $B_{2E}$, we consider the value matching conditions: At the threshold $\vartheta_{hE}$, a purely domestic firm will start to serve the foreign market and pay

the fixed cost $I_E^N$ if

$$V_D(\vartheta_{hE}) = V_E(\vartheta_{hE}) - I_E^N. \tag{4.24}$$

Smooth pasting requires that

$$V_D'(\vartheta_{hE}) = V_E'(\vartheta_{hE}). \tag{4.25}$$

An exporting firm will drop its activity and withdraw to serving solely the domestic market at the threshold $\vartheta_{lE}$ if the following value-matching and smooth-pasting conditions are fulfilled:

$$V_E(\vartheta_{lE}) = V_D(\vartheta_{lE}) - I_E^A \tag{4.26}$$

$$V_E'(\vartheta_{lE}) = V_D'(\vartheta_{lE}). \tag{4.27}$$

Thus, by plugging in the state-dependent firm values as given in equations (4.20) and (4.23) into equations (4.24) to (4.27), we obtain a system of four equations in four unknowns, which is highly non-linear and can be solved numerically for the productivity cut-off values, at which a firm either enters or exits the export market:

$$\frac{M_E \vartheta_{hE}^{\kappa}}{\delta'} + B_{2E}\vartheta_{hE}^{\beta_2} - A_{1E}\vartheta_{hE}^{\beta_1} = I_E^N \tag{4.28}$$

$$\frac{\kappa M_E \vartheta_{hE}^{\kappa-1}}{\delta'} + \beta_2 B_{2E}\vartheta_{hE}^{\beta_2-1} - \beta_1 A_{1E}\vartheta_{hE}^{\beta_1-1} = 0 \tag{4.29}$$

$$\frac{M_E \vartheta_{lE}^{\kappa}}{\delta'} + B_{2E}\vartheta_{lE}^{\beta_2} - A_{1E}\vartheta_{lE}^{\beta_1} = -I_E^A \tag{4.30}$$

$$\frac{\kappa M_E \vartheta_{lE}^{\kappa-1}}{\delta'} + \beta_2 B_{2E}\vartheta_{lE}^{\beta_2-1} - \beta_1 A_{1E}\vartheta_{lE}^{\beta_1-1} = 0 \tag{4.31}$$

This system allows us to solve numerically for the cut-off productivity levels of export market entry and exit. Moreover, we accordingly obtain the system of equations which determines the productivity thresholds for market entry and exit of an FDI firm. Recall, that exporting and FDI are characterized by a different cost structure, i.e., the entry cost for FDI are larger than those for exporting, but there are no transportation costs in FDI

mode. The latter point is reflected in the different periodical cash-flows as depicted in equations 7 and 8.

### 4.2.3 Switching from Export to FDI

Once an investor has decided to enter the foreign market as an exporter, he might experience a strong increase in productivity. In such a case, there exists a critical productivity level above which exporting is no longer the preferable market serving mode. Instead, at this critical productivity level $\vartheta_S$, the firm is willing to sink additional mode switching cost $I_S$ in order to serve the foreign market via FDI. In this case, the value of an exporting firm $V_E$ comprises not only the export cash-flows, but also the option value of future FDI engagement, such that

$$V_E = \frac{M_E \vartheta^\kappa}{\delta'} + C_1 \vartheta^{\beta_1} \quad \forall \quad \vartheta \in (0, \vartheta_S). \tag{4.32}$$

Ruling out foreign market exit and switching back from FDI to exporting, the value of a firm which is in FDI mode is given by[6]

$$V_F = \frac{M_F \vartheta^\kappa}{\delta'} \quad \forall \quad \vartheta \in (\vartheta_S, \infty). \tag{4.33}$$

Thus, the productivity cut-off $\vartheta_S$ at which an exporting firm switches its market serving mode can be determined from the value matching and smooth pasting condition

$$V_E(\vartheta_S) = V_F(\vartheta_S) - I_S \tag{4.34}$$

$$V'_E(\vartheta_S) = V'_F(\vartheta_S). \tag{4.35}$$

[6] A switch from FDI to export is considered to be irrelevant if additional sunk switching costs arise. Since the FDI mode's variable costs are the lowest achievable ones, there is no rational behind paying irreversible switching costs in order to pay higher variable costs.

Plugging in firm values as represented in equations (4.32) and (4.33) yields

$$\frac{M_E \vartheta_S^{\kappa}}{\delta'} + C_1 \vartheta_S^{\beta_1} - \frac{M_F \vartheta_S^{\kappa}}{\delta'} = -I_S \tag{4.36}$$

$$\frac{\kappa M_E \vartheta_S^{\kappa-1}}{\delta'} + \beta_1 C_1 \vartheta_S^{\beta_1-1} - \frac{\kappa M_F \vartheta_S^{\kappa-1}}{\delta'} = 0. \tag{4.37}$$

From this system of equations, we determine numerically the productivity threshold at which an exporting firm stops exporting and serves the market as a foreign direct investor.

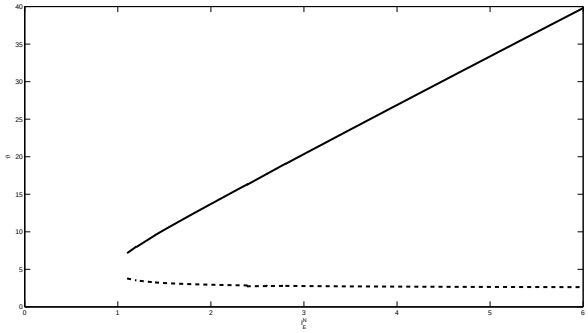
## 4.3 Numerical Results

### 4.3.1 Entry into Export or FDI

Given the stochastic evolution of firm productivity, the prevalence of switching into and out of exporting hinges on the extent of hysteresis, as depicted in Figure 1. The further apart the critical level of productivity which triggers market entry is from the one which triggers market exit, the less likely it is that the firm reverts its initial choice. Figures 2 - 5 represent our main results. The productivity entry (exit) cut-off levels are drawn as a solid (dashed) line. As discussed in Section 2.1, the exit cut-off is always strictly below the entry threshold. For expositional purpose, we still refer to firm a for which exporting rather than FDI is an attractive option of initial foreign market operations. For a discussion of the trade-off between exports and FDI, compare Yalcin (2009). Moreover, we consider exports and FDI as substitutes. For a discussion of the exporting and FDI decision with the possibility of simultaneous execution, see Rob and Vettas (2002).

How do conditions on the foreign market affect whether the firm enters the market and - upon entry - whether it leaves the foreign market? As Figure 2 shows, the critical productivity level of market entry $\vartheta_{hi}$ increases in the fixed costs of market entry, whereas the market exit threshold $\vartheta_l$ stays at a similar level for the range of market entry costs. This implies that the region of hysteresis, i.e., the range between the cut-off values, increases in $I_E^N$. That is, firms which exhibit high fixed costs of exporting, are less likely to serve the export market discontinuously (still under the assumption that FDI is not

Figure 4.2: Market Entry Costs



This Figure shows the export entry and exit cut-offs as a function of market entry costs. Parameters are set to $\theta = 0.7$, $\tau = 20$, $r = 0.06$, $I_E^A = -1$, $\sigma = 0.15$, $\alpha = 0.02$, $\nu = 0.6$, $I_E^N = 4$ if not considered in the respective panel.

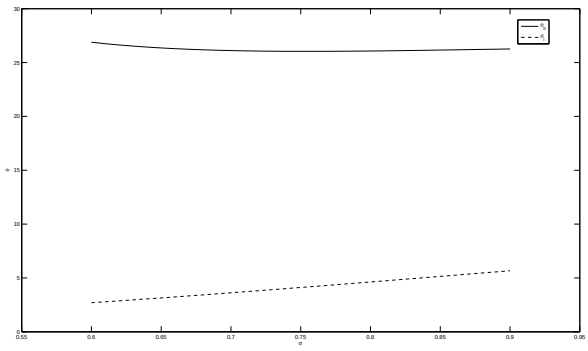
an attractive alternative). In the underlying parametrical example, once the market is entered e.g. at fixed costs of $I_E^N = 5$, productivity has to fall dramatically below the initial entry cut-off in order to generate serving mode discontinuity ($\vartheta_l = 4 < \vartheta_h = 31$). The fixed cost insensibility of the lower bound in the underlying example depends on the abandonment benefits which are at $I_E^A = -1$. In other words, one unit of the initial fixed costs can be liquidated on the foreign market (e.g. selling export specific firm entities). The lower the abandonment benefits turn out to be, the stronger does the exit threshold decrease if the entry fixed costs increase (result not shown).

**Result 1:**

*The likeliness of switching in and out of exporting decreases in* $I_E^N$*. The range of inaction increases further the lower the abandonment benefits* $I_E^A$ *turn out to be. The lesser fixed costs* $I_E^N$ *are sunk, the narrower becomes the range of hysteresis, with* $I_E^N = I_E^A \Rightarrow \vartheta_{lE} \rightarrow \vartheta_{hE}$*.*

Which role does competitive pressure play for export entry and exit? Figure 3 illustrates the productivity cut-offs at which a domestic firm starts to export or an exporting firm stops to export. Firms with little market power - exhibiting a large inverse mark-up - are prone to serve the export market discontinuously relative to firms with a high mark-up.

Figure 4.3: Competition



This Figure depicts the export entry and exit cut-offs as a function of competition. Parameters are set to $\theta = 0.7$, $\tau = 20$, $r = 0.06$, $I_E^A = -1$, $\sigma = 0.15$, $\alpha = 0.02$, $\nu = 0.6$, $I_E^N = 4$ if not considered in the respective panel.

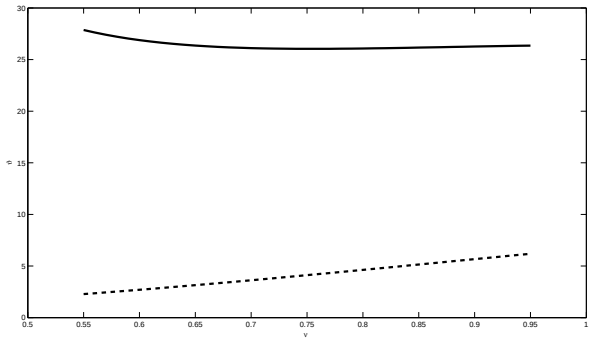
This is, because in countries with a high degree of competition, the band of inaction turns out to be relatively smaller than in countries with low competition. Competition matters for the firm mostly through its effect on the exit cut-off: Ceteris paribus, a more competitive market triggers earlier exit in an uncertain world.

**Result 2:**

*Higher competition leads to weaker hysteresis. A higher level of $\nu$ implies a lower $\vartheta_{hE}$ and a higher $\vartheta_{lE}$ as compared to lower levels of $\nu$.*

Similar to foreign market conditions, also productivity fundamentals as its growth rate and instantaneous volatility impact the entry and exit pattern of firms on the export market. Figure 4 depicts the variation of productivity growth and its impact on the critical thresholds. Accordingly, firms with higher growth rates enter the foreign market at a relatively lower level of productivity. Simultaneously, they tolerate a fall in productivity up to a relatively lower level: Ceteris paribus, higher productivity growth will allow a firm to cover the same fixed cost starting at a lower productivity level, which explains the lower entry cut-off $\vartheta_{hE}$. On the other hand, once in the market, the investor can bear a stronger inverse productivity development since in the medium term he can expect a deterministic positive growth. Still, different growth rates $\alpha$ affect the range of inactivity

Figure 4.4: Productivity Growth




This Figure shows the export entry and exit cut-offs as a function of productivity growth. Parameters are set to $\theta = 0.7$, $\tau = 20$, $r = 0.06$, $I_E^A = -1$, $\sigma = 0.15$, $\alpha = 0.02$, $\nu = 0.6$, $I_E^N = 4$ if not considered in the respective panel.

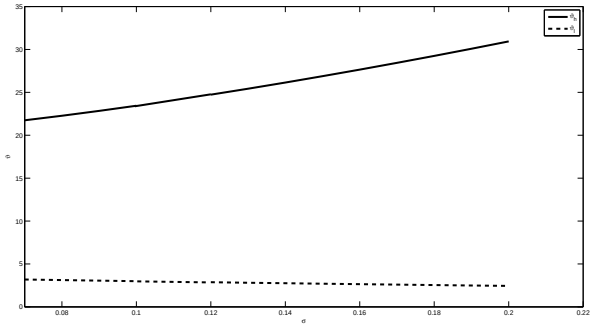
only mildly.

The level of productivity volatility affects the market entry and exit cut-offs more pronouncedly as depicted in Figure 5. The higher the productivity volatility $\sigma$ is, the higher becomes the entry cut-off $\vartheta_{hE}$. Simultaneously, the exit threshold decreases. A firm which faces high productivity uncertainty tends to postpone the investment decision in order to gather further information on productivity development. This postponement is expressed in higher entry thresholds. Once in the market, higher volatility offers the chance to reverse an unfavorable productivity development and therefore an investor tolerates a stronger drop in productivity, which again explains the lower exit cut-offs. Similar to the fixed costs, the range of inactivity increases dramatically in $\sigma$. Firms with high productivity volatility countervail the prevailing risk by entering a market at high productivity levels. Implicitly, these firms enter markets after a longer postponement period. However, once in the market, exiting is unlikely.

**Result 3:**

*Hysteresis is mildly influenced by a change in productivity growth $\alpha$, but it reacts relatively stronger if productivity uncertainty $\sigma$ increases. For $\sigma \uparrow$, the entry threshold $\vartheta_{hi}$ increases, and $\vartheta_{li}$ decreases, raising the probability of serving mode continuity.*

Figure 4.5: Productivity Volatility




This Figure depicts the export entry and exit cut-offs as a function of volatility. Parameters are set to $\theta = 0.7$, $\tau = 20$, $r = 0.06$, $I_E^A = -1$, $\sigma = 0.15$, $\alpha = 0.02$, $\nu = 0.6$, $I_E^N = 4$ if not considered in the respective panel.

Consider now a firm, for which exporting is no attractive alternative to FDI. In our set-up, the effect of changes in fixed entry cost, competition, productivity growth and volatility exhibit the same qualitative effects on FDI as on exporting.

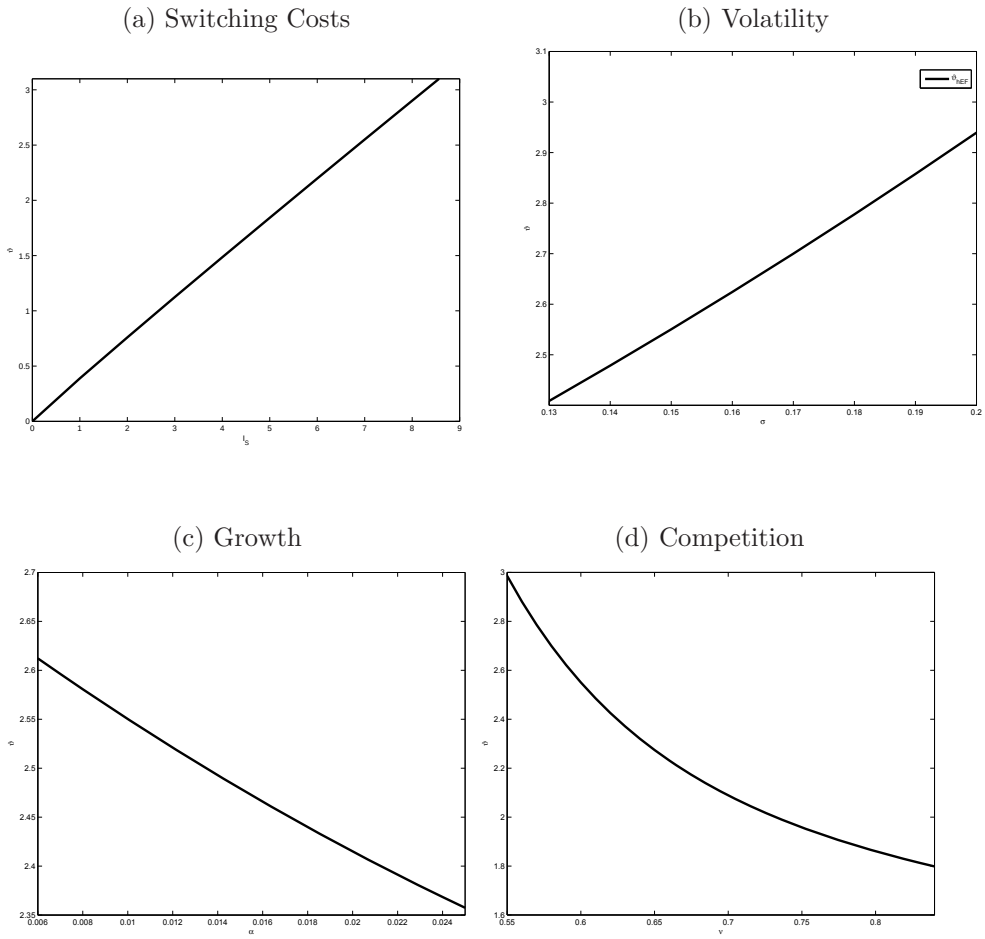
**Result 4:**

*If FDI is the only reasonable foreign market serving mode given $I_F^N > I_E^N$ and $\tau \geq 1$, the impact of changes in entry and exit fixed costs, productivity growth, uncertainty, and country specific competition is qualitatively the same as in the previous scenario, whereas quantitative effects differ.*

### 4.3.2 Switching from Export to FDI

Finally, consider a firm which serves a foreign market through exports and contemplates switching into FDI. How do switching costs, volatility, productivity growth and competition affect a firm's switching behavior? Opposed to the earlier analysis, we neglect the FDI abandonment option and do not determine the exit threshold. This is due to the fact that we assume that FDI is the ultimate objective of any firm, since it exhibits the lowest achievable variable costs by paying sunk costs: in this case, incrementally first the export market entry cost $I_E^N$ and then switching cost $I_{EF}$. We postulate, that within the

Figure 4.6: Switching From Export to FDI




This Figure depicts the export entry and exit cut-offs. Parameters are set to $\theta = 0.7$, $\nu = 0.6$, $\alpha = 0.02$, $r = 0.06$, $\sigma = 0.15$, $\tau = 20$, $I_S = 7$, $I_E^N = 4$ if not considered in the respective panel.

proximity-concentration trade-off framework, once a market is served through FDI, an investor will never switch back to exporting, due to the fixed costs $I_E^N$ and $I_{EF}$ which are sunk. Certainly, productivity might develop in such an adverse manner forcing the firm to leave the market forever. The corresponding nominal exit cut-off lies far below the two previous $\vartheta_{lE}$ since the incurred sunk costs are on the highest possible level. In the remainder we focus on the critical switching cut-off $\vartheta_S$.

Aggregate fixed switching costs $I_S$ for a change in serving mode from export to FDI are assumed to be higher than in a case in which firms start to serve the foreign market immediately through FDI. Although an investor might gather information as exporter

and decrease marketing and information cost, still, periodical profits from the FDI serving mode need to cover the costs for a new plant $I_{EF}^N < I_F^N$ and furthermore the sunk costs of the export platform which is assumed to be shut down after the serving mode switch:

$$I_S = I_{EF}^N - I_E^A + I_E^N, \tag{4.38}$$

where $I_{EF}^N$ are the fixed entry costs for FDI from an export mode. Within this setting, there is a trade-off between entering a foreign market stepwise through exporting and FDI earlier and entering directly through FDI at a later time. On the one hand, entering the market via exports reduces the inherent FDI entry costs from $I_F^N$ to $I_{EF}^N$ as an investor gains experience through exporting, but on the other hand the fixed cost reduction is achieved through an initial export investment which needs to be covered if it is given up later. Therefore, compared to a direct market entry through FDI, total accruing fixed costs will be higher, but market entry via exporting takes place earlier.

Figure 6 shows that the productivity threshold for switching from exporting to FDI increases in the respective fixed cost $I_S$. This type of higher costs can be explained in two ways. Either abandonment benefits for the export platform worsen or the inherent FDI entry fixed costs rise, over time or across firms. The observed rise in the entry cut-off accords with economic intuition, as the investor has to cover higher sunk costs. In contrast higher productivity growth causes a reduction in the switching threshold $\vartheta_S$ which is in line with earlier observations. As the investor can cover a bigger share of fixed costs at higher growth rates over time he is willed to switch into FDI earlier. Both volatility in productivity growth and a rise in competition are accompanied by a decrease in market entry thresholds as before.

**Result 5:**

*Qualitatively, a switching from exporting to FDI is influenced through changes in $\alpha, \sigma, \nu$ and fixed costs $I_S$ in the same way as market entry into exporting.*

To conclude, the exit and entry pattern of firms into exporting and FDI is determined by productivity fundamentals productivity growth and volatility. But also, market charac-

teristics like the degree of competition and irreversible fixed or switching costs determine, whether a firm serves a market continuously or not.

This result has some implications for the policymaker: Whereas foreign market entry cost and the degree of competition abroad is certainly beyond reach of the policy maker, he may still affect export and FDI decisions through the productivity channel. An increase in productivity growth or a reduction in its volatility, which are plausible consequences of a successful innovation policy, potentially lead to a more dynamic entry and exit pattern on the foreign market.

## 4.4 Conclusion

This paper uses a real option approach to assess firm entry and exit decisions into Foreign Direct Investment (FDI) and exporting. Introducing a monopolistically competitive market structure into the classical investment decision model allows us to provide insights into the determinants of transitions into and out of exporting and FDI. Moreover, we can address which factors encourage switching from exporting to FDI.

Our dynamic partial equilibrium model therefore allows to understand transition dynamics on foreign markets, which is essential given the empirical observation of frequent entry and exit on export markets. We are able to identify four decisive dimensions which determine the extent of hysteresis in the presence of uncertain productivity growth in a monopolistically competitive market. We show that higher entry fixed cost lead to higher entry cut-offs increasing hysteresis and decreasing the likeliness of frequent market entry and exit. In the same line, a more volatile productivity, a lower productivity growth and lower competition in the destination country increase the range of hysteresis and reduce the probability of switching.

Our model provides testable predictions on entry and exit into and out of export and FDI, as well as the transition from exporting to FDI. Upon availability of appropriate firm-level data, this opens up to future empirical analysis.

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# Mathematical Appendix

## The Adjusted Expected Growth Rate

Given the Geometric Brownian motion

$$d\vartheta_t = \alpha\vartheta_t dt + \sigma\vartheta_t dz_t \tag{4.39}$$

with $dz_t = \epsilon_t\sqrt{dt}$ and $\epsilon_t \sim N(0,1)$ we define a function

$$f(\vartheta_t) = \vartheta_t^{\kappa} \qquad \text{and} \qquad \kappa \ln \vartheta_t = \kappa y_t, \tag{4.40}$$

where $y_t$ represents an arithmetic Brownian Motion. Therefore, the exponential function $f(\vartheta_t)$ can be expressed as

$$\vartheta_t^{\kappa} = e^{\kappa y_t}. \tag{4.41}$$

The solution of $y_t$ is given by

$$y_t = y_0 + \int_0^t (\alpha - \frac{1}{2}\sigma^2)ds + \int_0^t \sigma dz_s. \tag{4.42}$$

Therefore, the expected value of the exponential function $f(\vartheta_t)$ can be expressed as

$$\mathbb{E}(x_t^{\kappa}) = e^{\kappa y_0} e^{(\alpha - \frac{1}{2}\sigma^2)t\kappa} e^{\int_0^t \sigma dz_t}. \tag{4.43}$$

The last term in equation (4.43) still includes a random variable. By defining a moment generating function it is possible to evaluate its expected value.

**Moment Generating Function**

Consider a normally distributed random variable $Z_t$ with

$$Z_t \sim N(m, \chi^2). \tag{4.44}$$

We can write

$$\mathbb{E}(e^{\kappa Z_t}) = \int_{-\infty}^{\infty} \frac{1}{\chi\sqrt{2\pi}}\, e^{\left(-\frac{(Z_t-m)^2}{2\chi^2}\right)}\, e^{\kappa Z_t} dz_t \tag{4.45}$$

$$= e^{\left(m\kappa+\frac{\chi^2\kappa^2}{2}\right)}. \tag{4.46}$$

In the underlying case $m = 0$ and $\chi = 1$ hold. Furthermore, the random variable in the Brownian motion is related to $\sqrt{dt}$ with

$$dz_t = \epsilon_t\sqrt{dt} \tag{4.47}$$

which leads to

$$\mathbb{E}(e^{\kappa\sigma Z_t}) = e^{\frac{\kappa^2\sigma^2 t}{2}}. \tag{4.48}$$

Therefore, applying this result to equation (4.43), the expected value of the exponential function $f(\vartheta_t)$ is given by

$$\mathbb{E}(\vartheta^\kappa) = e^{\kappa y_0} e^{(\alpha-\frac{1}{2}\sigma^2)t\kappa} e^{\frac{\kappa^2\sigma^2}{2}t}. \tag{4.49}$$

Using equation (4.41), the expected value results as

$$\mathbb{E}(\vartheta_t^\kappa) = \vartheta_0^\kappa e^{[\alpha\kappa+\frac{1}{2}\kappa\sigma^2(\kappa-1)]t}. \tag{4.50}$$

Finally, the expected cash-flows result as

$$\mathbb{E}(\Pi_i(\vartheta_t)) = M_i\vartheta_0^\kappa e^{[\alpha\kappa+\frac{1}{2}\kappa\sigma^2(\kappa-1)]t}. \tag{4.51}$$

The adjusted growth rate for convex profits with $\kappa > 1$ is then given by

$$\alpha' = \alpha\kappa + \frac{1}{2}\kappa\sigma^2(\kappa-1). \tag{4.52}$$

## Homogeneous Differential Function

The solution of a homogeneous differential function of second order

$$\frac{1}{2}\sigma^2\vartheta^2\frac{\partial^2 F_i(\vartheta)}{\partial\vartheta^2} + (r-\delta)\vartheta\frac{\partial F_i(\vartheta)}{\partial\vartheta} - rF_i(\vartheta) = 0 \tag{4.53}$$

is a linear combination of any two linearly independent solutions, as

$$A_i\vartheta^\beta. \tag{4.54}$$

Substituting this guess solution into the differential equation leads to the quadratic equation

$$\frac{1}{2}\sigma^2\beta(\beta-1)A_i\vartheta^\beta + (r-\delta)\beta A_i\vartheta^\beta - rA_i\vartheta^\beta = 0 \tag{4.55}$$

$$\frac{1}{2}\sigma^2\beta(\beta-1) + (r-\delta)\beta - r = 0. \tag{4.56}$$

The resulting two solutions for $\beta$ are

$$\beta_1 = \frac{1}{2} - \frac{r-\delta}{\sigma^2} + \sqrt{\left[\frac{r-\delta}{\sigma^2} - \frac{1}{2}\right]^2 + \frac{2r}{\sigma^2}} > 1 \tag{4.57}$$

$$\beta_2 = \frac{1}{2} - \frac{r-\delta}{\sigma^2} - \sqrt{\left[\frac{r-\delta}{\sigma^2} - \frac{1}{2}\right]^2 + \frac{2r}{\sigma^2}} < 0 \tag{4.58}$$

and the final solution for the quadratic equation is

$$F_i(\vartheta) = A_{i1}\vartheta^{\beta_1} + A_{i2}\vartheta^{\beta_2}. \tag{4.59}$$