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Working Paper 2015:6

Department of Economics
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Bridging Trade Barriers: Evaluating Models of Multi-Product Exporters

Björn Thor Arnarson

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Bridging Trade Barriers: Evaluating Models of Multi-Product Exporters[†]

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Abstract

In this paper I investigate the impact of a decrease in trade costs on firms' decisions to export. The main contribution of this paper is to evaluate empirically the theoretical predictions of several models of multi-product exporters. The focus is on the firm export entry decision and the within firm adjustment regarding product scope and intensity. For identification I use a *quasi-natural experiment*, the introduction of the Öresund bridge between southern Sweden and Denmark, to analyse the impact on firm behaviour. Using a difference-in-difference methodology, firms in the 'treated' municipality, Malmö, are compared to firms in more geographically distant Gothenburg and Stockholm ('controls'). For the 'treated' manufacturing firms a theoretically consistent positive effect is found for firm entry into exporting, aggregate firm trade flow and the number of products exported. The models of multi-product exporters evaluated do not provide a clear theoretical prediction regarding the impact on average trade value per product. In this paper, however, I find that around 70-80% of the increase in aggregate firm trade value is due to increases in the average trade value per product (the product intensive margin), while only 20-30% is due to increases in the number of products exported (the product extensive margin).

JEL classification: F14, F10, F13, F15.

Keywords: International Trade, Multi-Product Firms, Infrastructure, Market Access, Quasi-Natural Experiment, Trade Costs.

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1 Introduction

In the last decade, firm heterogeneity has been in the foreground of the international trade literature. Exporters are in general rather few, and are more productive, bigger, more profitable, more capital intensive, and pay higher wages than non-exporters in the same industry (Mayer and Ottaviano, 2008). This firm heterogeneity is well-acknowledged in the current trade literature and forms the basis of the standard Melitz (2003) model of trade. Even if we acknowledge that exporters vary from non-exporters, there is great heterogeneity *among* exporters. Mayer and Ottaviano (2008) identify some of these facts and find that the top 1% of exporters account for 40% of aggregate exports, and top the 10% for around 80%. Several recent papers have incorporated this product-level heterogeneity into theoretical models of multi-product multi-destination firms [see e.g., Bernard, Redding, and Schott (2011), Arkolakis, Muendler, and Ganapati (2014), Eckel and Neary (2010) and Mayer, Melitz, and Ottaviano (2014)]. However, the empirical validation of these models is limited. One exception is Berthou and Fontagné (2013), who used the introduction of the Euro as a natural experiment to analyse the behaviour of multi-product firms using the Bernard, Redding, and Schott (2011) model as a benchmark. Other examples include Bernard, Van Beveren, and Vandenbussche (2014), who use Belgian data to verify the empirical predictions of the product switching model of Bernard, Redding, and Schott (2010). This paper also relates to literature using quasi-natural experiments and/or improvements in transport infrastructure to identify their impact on economic activity [see e.g., Bernard, Moxnes, and Saito (2015), Volpe Martincus and Blyde (2013), and Coşar and Demir (2016)].

This paper contributes to the literature by taking several models of multi-product exporters to the data and analysing the impact of a decrease in trade costs. Using the introduction of the Öresund Bridge as a quasi-natural experiment, I compare the theoretical predictions to the observed impact. The introduction of the Öresund bridge has been used before by Åkerman (2009) to test the empirical validity of a simplified version of the Melitz (2003) model. He found how increased trade impacted aggregate productivity by reallocating production from the less productive to the more productive firms.

This paper's structure is as follows: section 2 reviews the literature and theoretical framework; section 3 discusses the natural experiment; section 4 describes the data; section 5, the empirical

specification. They are followed by a discussion of the results and the conclusions in sections 6 and 7.

2 Theoretical Framework and Related Literature

2.1 The Export Decisions of Multi-product Exporters

This paper empirically analyses the theoretical predictions for models of multi-product exporters (MPE) after a decrease in trade costs. The models evaluated are by Bernard, Redding, and Schott (2011), Arkolakis, Muendler, and Ganapati (2014), Eckel and Neary (2010) and Mayer, Melitz, and Ottaviano (2014) (henceforth referred to jointly as MPE models). The predictions are evaluated on the following margins of trade: the firm-extensive margin (the probability that a firm exports, M), the firm-intensive margin (aggregate export value of the firm, X) which is then decomposed into sub-margins, the product extensive (number of products, P) and the product intensive margin (average export per product, \bar{x}). See figure 1.

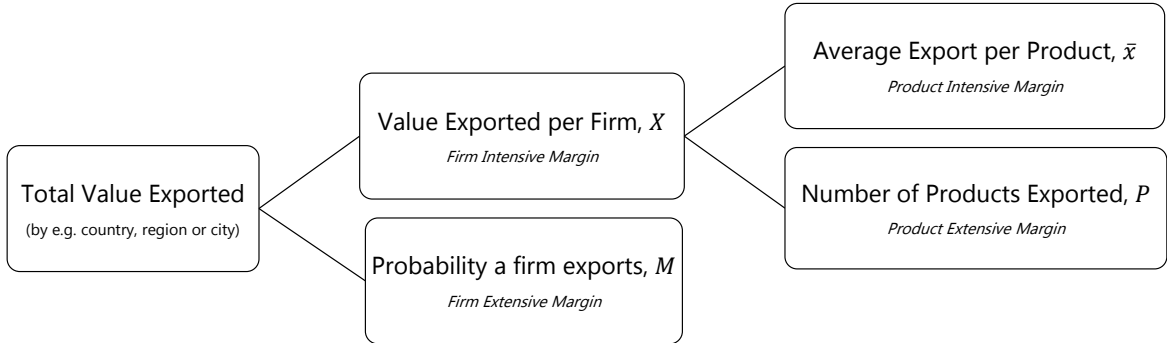


Figure 1: Decomposition of total exports into the margins of trade.

All the MPE models feature a selection mechanism, as in the Melitz model, in which the relatively more productive firms are able to self-select into exporting and overcome the associated fixed costs. A reduction in trade costs will lower the export threshold¹ for new firm entrants. If the cut-off to become an exporter decreases, then the number of exporters (the probability of exporting) increases since more firms are now competitive in the foreign market.²

¹“The productivity cut-off”, or the sunk cost of exporting.

²Increased competition may also cause the least productive firms to exit (shut-down). This relates to Roberts and Tybout (1997), who documented the importance of sunk costs of exporting. They found that previous entry had significant predicting power for future participation, indicating that there are sunk/fixed costs associated

Following a decrease in trade costs all MPE models predict an increase in firm aggregate trade flow (X), but differ in terms of the dynamics and mechanisms within the firm, at the product level. The model by Bernard, Redding, and Schott (2011) incorporates two types of fixed costs: a country specific fixed cost (e.g. to build distribution networks), and a product-specific fixed cost (e.g. due to regulatory standards or to product adjustments). A drop in trade costs would induce firms to *produce* fewer varieties and increase the export volume of products already being exported. Additionally, lower trade costs will make it profitable to *export* more varieties.³ The model by Eckel and Neary (2010) shows how increased competition may induce firms to focus on products close to their core competency. Mayer, Melitz, and Ottaviano (2014) incorporate competition effects in the destination market and show how increased competition drives firms to skew their export sales to their better performing products and alter their product mix. In both Eckel and Neary (2010) and Mayer, Melitz, and Ottaviano (2014), trade liberalisation would allow firms to export products further away from their core competency. Arkolakis, Muendler, and Ganapati (2014) integrate some of the aspects of Eckel and Neary (2010) and Bernard, Redding, and Schott (2011) in a single framework. Their model emphasises the importance of economics of scope and differences in market access across destinations. All four models predict that a decrease in trade costs will lead to an increase in the number of products exported.⁴

To summarise, all four of the MPE models⁵ predict that following a decrease in trade costs, there will be an increase in the following margins of trade: the propensity of firms to export

with exporting. Using a similar estimation strategy, corresponding results were found by Bernard and Jensen (2004) for US manufacturing firms and Gullstrand (2011) for the Swedish food sector. Other studies have looked at how sunk export costs may be destination-specific. Moxnes (2010) finds that while some costs of exporting are common for all countries (global), the country-specific costs are estimated to be up to three times higher. Gullstrand and Persson (2014) found that firms tended to stay longer in core compared to peripheral markets, indicating differing sunk costs based on the destination market.

³The model contains an analogous selection mechanism, as described above, at the firm level, but now at the product level. There is a within-firm selection effect of firms dropping their “worst” products in production (lowest attributes) and shifting resources towards their “better” products that they are now able to export. Hence it has become profitable to export a larger range of products due to a lower “product cut-off”.

⁴Mayer, Melitz, and Ottaviano (2014) note that this result is somewhat dependent on assumptions on the type of trade costs.

⁵Several other models have been constructed to explain the behaviour of multi-product firms. Feenstra and Ma (2008) build a model wherein firms exercise their market power over multiple products and optimise their product scope. Bernard, Redding, and Schott (2010) looks at the product switching behaviour of exporters in a simple model, suggesting that product switching contributes to a reallocation of resources within firms to their core. Goldberg et al. (2010) look at the impact of tariff reductions on the number of produced varieties. The mechanism in that paper is through how new imported input varieties can enable domestic firms to produce new varieties. Iacovone and Javorcik (2010) analysed the behaviour of Mexican firms following Mexico’s entry into NAFTA. They looked at how multi-product firms adjusted their product scope and related the adjustments to theoretical predictions. They found intense product churning (adding and dropping products) following trade liberalisation.

(firm-extensive margin, M), aggregate firm exports (firm-intensive margin, X), and the number of products exported (product extensive margins, P). The MPE models offer an ambiguous prediction for the impact on average export per product (product intensive margin, \bar{x}), as new products are exported less intensively.

2.2 Market Access, Transportation, Spatial Decay and Experiments

This paper relates broadly to literatures looking at the impact of market access, geography, transportation and distance on firm behaviour. Of particular relevance are cases where a natural experiment or similar exogenous variation is used for identification. First, the paper relates to literature using large policy shifts or policy-contingent events as source of exogenous variation. [Berthou and Fontagné \(2013\)](#) used the introduction of the Euro as a *natural experiment* to investigate the impact on firm behaviour. They compared their results to the predictions of the [Bernard, Redding, and Schott \(2011\)](#) model. They found a weakly positive effect on the firm intensive margin for all firms, mainly driven by the relatively larger firms in their sample. [Blonigen and Cristea \(2014\)](#) investigated the impact of airline traffic on local population, income and employment growth. For identification, they used the US deregulation of the aviation industry in 1978 as a *quasi-natural policy experiment*. They find that increased air travel improved regional economic growth.

Secondly, this paper relates to literature using natural experiments or historical events as exogenous shocks to transport infrastructure. [Volpe Martincus and Blyde \(2013\)](#) look at the importance of domestic transport infrastructure on international trade flows. For their identification, they looked at the impact of a large earthquake in Chile as a *natural experiment*. Using the variation in exposure to closed routes, they find that exports decreased due to less frequent shipments by exporters who had to alter their transportation routes due to damaged road infrastructure. [Volpe Martincus et al. \(2014\)](#) assessed the impact of trade costs on bilateral trade flows by exploiting a *natural experiment* when the San Martín International Bridge, connecting Uruguay and Argentina, was closed first due to demonstrations, and later as a consequence of bilateral negotiations. Their results suggest that a 1% increase in transport costs reduced firm exports by 6.5%, with the effect stemming from a reduction in the number and size of shipments. [Feyrer \(2009\)](#) uses the temporary closure of the Suez Canal from 1967 to 1975

to examine the effect of distance on trade flows and income. His identification is through the impact of increased sea distance and the associated increase in transportation costs.

Third, this paper relates to studies evaluating the impact of transport infrastructure and market access on economic outcomes. Several papers have used large scale road or highway construction projects as a policy experiment (natural experiment). For the US: [Michaels \(2008\)](#) investigated the impact on income and trade in rural counties; [Chandra and Thompson \(2000\)](#) looked at the distribution of economic activity towards counties with highways and away from others. A couple of papers use the Indian Golden Quadrilateral highway program to identify the impact of better market access on firm behaviour: [Datta \(2012\)](#) showed how firms with better access to highways reduced their stock of input inventories; [Ghani, Goswami, and Kerr \(2012\)](#) found that manufacturing activity grew disproportionately along the new road network for incumbent firms. For Brazil, [Bird and Straub \(2014\)](#) used the exogenous impulse to construct a radical new highway network following the decision to create a new capital city, Brasília. They found evidence that the road network reduced regional inequality. [Coşar and Demir \(2016\)](#) used large scale infrastructure investments in Turkey to identify the impact of internal transportation on regional market access. They showed that transport-intensive industries in regions with above average improvement in connectivity grew relative to the same industries in regions less affected. [Åkerman \(2009\)](#) used the introduction of the Öresund bridge to identify the impact on aggregate productivity in Malmö. He found a reallocation effect from the less productive firms exiting and the more productive expanding. [Bernard, Moxnes, and Saito \(2015\)](#) looked at buyer-seller relationships in Japan. They use the extension of the Shinkansen high speed railroad as a *quasi-natural experiment* to look at how firm networks are impacted by a drop in travel time. [Bernard, Moxnes, and Saito \(2015\)](#) argued that the new rail link reduced the search costs of finding input suppliers⁶ and found that sales and productivity of input-intensive firms increased relative to labour intensive firms close to new rail stations.

Finally, this paper relates to the literature looking at the spatial dispersion of economic activity. In their paper, [Bernard, Moxnes, and Saito \(2015\)](#) showed the strong tendency for firms to form business relationships locally, with the median (mean) supplier-customer distance being 30 (172) km. The difference in median and mean distance shows that even if most firms do not trade outside their local environment, some are able to overcome the distance barrier and

⁶For example, for materials, accounting, and distributional services.

trade over very long distances domestically. They find that larger firms are able to overcome this domestic distance hurdle and build partnerships outside their local environment. This result resembles the stylised facts from the literature on international trade stating that exporters are rare and only the most productive firms export. [Hillberry and Hummels \(2008\)](#) also found this local behaviour for firms, and showed that the value of shipments within a zip-code were three times larger compared to outside the zip-code (roughly a 4-mile radius or ≈ 6.5 km).⁷ [Redding and Sturm \(2008\)](#) explored the impact of the division and reunification of East and West Germany as a *natural-experiment* to assess the importance of market access for economic development. They find that the *division* of Germany had led to a reallocation of population away from the border to other West-German cities and the loss was the most pronounced for relatively smaller cities. [Cristea \(2011\)](#) looked at the importance of face-to-face⁸ meetings for international trade and found that an increase in exports raised the local demand for business air travel, suggesting that face-to-face communication plays an important role in business relationship. [Niebuhr \(2006, 2008\)](#) analysed the impact on border regions from accession into the European union. She found that border regions realised higher integration benefits than did non-border regions.

The preceding discussion has established that first, distance and location impacts firms and their behaviour, and second, that transportation infrastructure has a disproportionately positive impact on the industrial growth of firms located nearby.

3 The Öresund Bridge: A Quasi-Natural Experiment

3.1 Historical Background

This paper uses the establishment of a physical connection between Denmark and Sweden, the Öresund bridge, for identifying the impact on firm export decisions (see figure 2). The idea of

⁷Other examples are [Brülhart, Carrère, and Trionfetti \(2012\)](#), who investigated the response of wages and employment to the fall of the Iron curtain in 1990. They argued that the opening up of the eastern block was a *natural-experiment*, exogenous to events in Austria, that impacted regions differently based on distance from the border. Using a band of 50 km around the border, they found a statistically significant and positive effect on wages and employment.

⁸[Storper and Venables \(2004\)](#) discussed the costs and benefits of face-to-face communication. First, it is an efficient communication technology; second, it solves many issues related to misaligned incentives and trust; third, it facilitates socialization and learning; fourth, it creates psychological motivation by encouraging competition. They noted however, that these benefits come at a cost, both pecuniary and in terms of other informational costs (e.g. travel time, monitoring and miscommunication).

creating a fixed land connection between Denmark and Sweden dates back to the 19th century. The first ideas for connecting the two countries were suggested in 1865 by the Swedish rail engineer Claes Adelsköld. In 1872, the English engineer Edwards and the Danish businessman Pedersen presented the first formal proposal. Their plan was to build a tunnel connection between Helsingborg in Sweden and Helsingør in Denmark. Several additional ideas were suggested over the years. In 1973 an agreement was signed between the two nations about a bridge between Malmö and Copenhagen that was expected to be completed in 1985. As a part of the agreement, Kastrup airport was to be relocated to the Island of Saltholm, but in 1978, the Danish authorities rejected that move, and plans for the bridge were suspended. In 1991, the governments signed a new agreement for a bridge (fixed link) over the Öresund. Uncertainty⁹ continued due to political opposition in Sweden and concerns over possible environmental effects. It was not until June 1994 the final permission was granted by the Swedish government and contracts were signed with contractors in November 1995. The Öresund bridge was opened on July 1st 2000. It connects the Swedish city of Malmö to the Danish capital, Copenhagen. The bridge is around 8 km long. The total fixed connection (≈ 16 km) also consists of an artificial island, Pepperholm, and a tunnel. Before the bridge opened, there was a ferry that connected Malmö with Copenhagen, the Limhamn-Dragör (LD) line. The most common way to cross the strait was, however, the Helsingborg-Helsingør (HH) ferry, located 65 km north of Malmö's city centre. According to figures collected by Knowles (2006), around 95% of trucks crossing the strait in 1999 used the HH ferry and only a small minority (5%) the LD line.¹⁰

⁹The uncertainty continued since a couple of months after the agreement had been ratified in parliament, a new government took charge in Sweden. Within the government, the Centre Party was concerned about the potential environmental effects, which delayed the final approval. Additionally, public opinion was split towards building a connection between Denmark and Sweden in those years. Falkemark and Gilljam (1994) discussed this issue and referred to an SOM institute public opinion poll in Sweden that found that opposition to the bridge increased from 1991 to 1993, from 36% to 44% while the supporting group shrunk, from 38% to 26%. They also note that the opposition was large in Denmark, showing 61% against while 21% supporting a fixed connection in 1994.

¹⁰The HH line transported 73% of passengers across the Öresund strait in 1999, with other crossing points in Malmö and nearby area accounting for the rest. All such ferries were discontinued after the opening of the bridge except for the HH ferry.

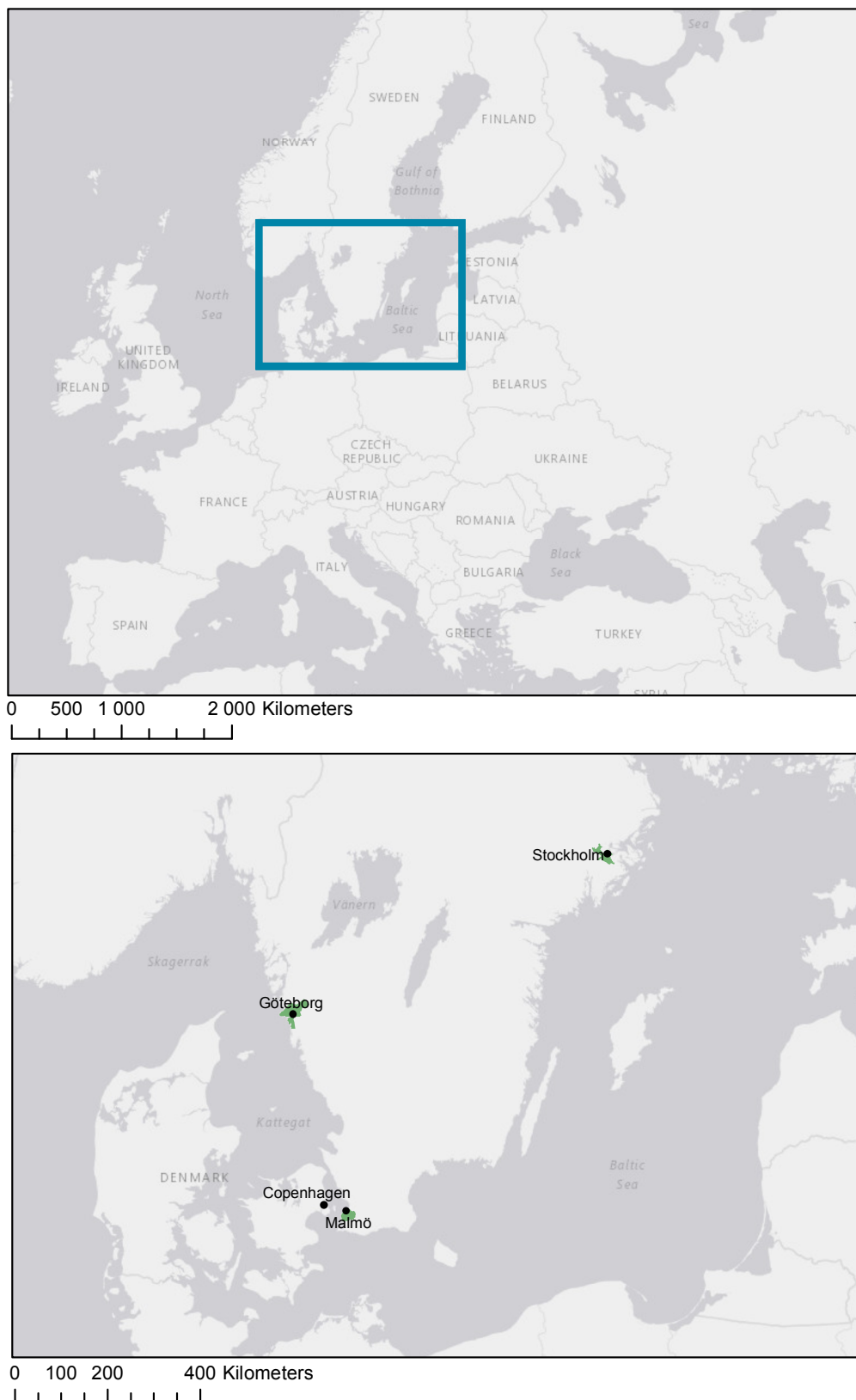


Figure 2: Geographic representation of the areas. The Öresund bridge connects Malmö and Copenhagen.

3.2 Impact on Trade Costs

This paper exploits the opening of the Öresund Bridge as a *quasi-natural experiment*¹¹ that provides an exogenous variation in trade costs based on geographical proximity to the bridge. The responses of firms are compared across the three largest cities in Sweden, Malmö (population in 2015: 322 000), Gothenburg (pop. in 2015: 548 000) and the capital Stockholm (pop in 2015: 923 000). These cities are used in the analysis since they share many similar characteristics, are the three largest in Sweden, and serve therefore as natural comparisons. The city of Malmö is located on the southern tip of Sweden, while Gothenburg and Stockholm are on the west and east coasts respectively. See figure 2 for a graphical representation.

The introduction of the bridge impacted trade costs in several ways. In the literature, both distance and travel time are common proxies for trade costs [see, for example: Coşar and Demir (2016), Volpe Martincus and Blyde (2013) Volpe Martincus et al. (2014), Bernard, Moxnes, and Saito (2015), Feyrer (2009)]. To assess the impact of the Öresund bridge on trade costs, the optimal transport/travel routes are calculated in terms of time and road kilometres between Copenhagen and Malmö, Gothenburg and Stockholm. Table 1 shows the optimal route for trucks travelling from all three cities to Copenhagen both before and after the construction of the bridge. The transit time from Malmö decreased by around 67%, while for Gothenburg and Stockholm, the changes were 16% and 9%. Despite the decrease in travel time, the HH link may still be the most economical route for truck drivers from Stockholm or Gothenburg, since it is 40-50 km shorter and offers other benefits,¹² reinforcing that the benefits of the bridge

¹¹Events that are truly exogenous are often dubbed in economics as natural experiments. The name may be puzzling since there is little natural nor experimental about most “natural” experiments. To add to the confusion, no single definition exists, and several variations of the term are used in the literature. Shadish, Cook, and Campbell (2002) defined a natural experiment as “not really an experiment because the cause usually cannot be manipulated” or “a study that contrasts a naturally occurring event such as an earthquake with a comparison condition.” Shadish, Cook, and Campbell (2002) define a *quasi-experiment* as an experiment lacking random allocation into groups. The *quasi-natural experiment* terminology is not used universally in the literature but is growing in popularity. This can be seen from recent handbook chapters in which five papers are referred to as using a quasi-natural experiment despite none of them employing that terminology originally. The Handbook of Regional and Urban Economics (2004) referred to Davis and Weinstein (2002) and Brakman, Garretsen, and Schramm (2004); the Handbook of International Economics (2014) to Bernhofen and Brown (2005); and the Handbook of Economic Growth (2014) to Hanson (1996) and Hanson (1997). Examples of papers discussed using the quasi-natural experiment terminology are Bernard, Moxnes, and Saito (2015) and Blonigen and Cristea (2014).

¹²Knowles (2006) discussed possible reasons behind this: first, the route is shorter to all destinations in Denmark by at least 40 to 50 km compared to the bridge; secondly, the ferry can be used to fulfil meal break requirements for drivers (45 minutes every 4.5 hours); finally, favourable multi-journey fares were offered to a small number of long-journey truck operators. Taking this into consideration, it is not clear that the Öresund bridge is more economical for firms located north of the HH link connection. Knowles (2006) found, for example, that the fixed link truck traffic was well below forecasts due to the HH ferry unexpectedly transporting a similar amount of traffic. He found that in 2001, the bridge diverted 16.9% of truck traffic from the HH ferry and created an

disproportionally favour Malmö.

Table 1: Transport route comparison to Copenhagen, minutes (km).

	Malmö	Gothenburg	Stockholm
via Helsingborg ferry	135 (111)	214 (268)	398 (607)
via Dragör-Limhamn ferry	122 (36)	279 (312)	469 (648)
via Öresund bridge	40 (42)	180 (313)	363 (655)
Difference (%)	-67.2 (16.7)	-15.9 (16.8)	-8.8 (7.9)

Travel times are calculated with Google Maps between city centres. Total travel time with the Helsingborg-Helsingør ferry is assumed to be 50 minutes (underestimated by around 20 minutes by Google maps). The crossing time is 20 minutes, minimum check-in is 15 minutes before departure plus loading/unloading time. The same time structure is assumed for the old Dragör-Limhamn Ferry. Note: Difference is calculated for optimal route before (marked in bold).

The change from having a strait to cross compared to a fixed link offers other benefits, such as efficiency gains to firms in terms of increased reliability and flexibility with 24/7 access to Denmark¹³ and avoiding possible bottlenecks in the transportation process. Suggestive evidence of such benefits of the bridge comes from a transport survey from the Swedish Road Administration (Vägverket, 2006). They found that trucks using the Öresund bridge, compared to the harbours, were less often fully loaded and more often empty. They argued that this is due to shorter distances between Denmark and Sweden, as many trucks drive over the bridge with goods only in one direction, without the need to fill the truck for the reverse trip, as is the case for longer journeys.¹⁴ Better connections and increased market access lower search costs for business partners through reduced travel time (e.g. for face-to-face business meetings). As discussed above (see e.g. Bernard, Moxnes, and Saito (2015)), firms tend to build business relationships locally, and a distance barrier of several hundred kilometres is likely to discourage distant firms.¹⁵ The value of prompt delivery is highlighted by Hummels and Schaur (2013), who found that an extra day in transit time was equivalent to a tariff of between 0.6-2.1 per cent. While the geographic distance is the same between Malmö and Copenhagen, the fixed connection reduces travel time and substantially improves flexibility in travelling over the strait. I argue therefore, that the Öresund bridge alters the perception of distance inducing firms in

additional 16%. Figures from Öresundsbro Konsortiet (2013) showed, however, that the share of trucks crossing the Öresund strait using the bridge has risen steadily from its opening, from around 30% in the first full year to just over 50% in 2012.

¹³The HH link ferry does offer 24/7 trips while the number of trips from Limhamn was more limited.

¹⁴Volpe Martincus et al. (2014) show similar suggestive evidence, as the number and size of shipments was affected following the closure of the San Martín International Bridge connecting Uruguay and Argentina.

¹⁵The road distance from Malmö to Copenhagen is now only 42 km, compared to 313 and 655 km from Gothenburg and Stockholm.

Malmö to enter and/or increase their trade in the Danish market. Since firms tend to build business relationships locally, the export decisions of firms in Gothenburg and Stockholm, should not be altered to the same extent.

To summarise, firms in the city of Malmö (the 'treated' city, where the bridge was built) experienced a larger decrease in trade costs following the introduction of the Öresund bridge compared to the more geographically distant cities of Gothenburg and Stockholm (the 'controls'). The bridge disproportionally lowers both variable trade costs (proxied by transit time) and fixed/sunk costs (search costs, market access costs) of exporting for firms in Malmö compared to the control cities.

4 Dataset

The dataset used for this paper is a firm level census provided by Statistics Sweden (SCB). It includes information on all firms within the municipalities of Malmö, Gothenburg and Stockholm from 1997 to 2011. Firms with less than 4.5 mkr. in yearly trade to all destinations were dropped.¹⁶ The dataset includes information about trade flows at the firm-product-destination level with time-consistent 8-digit CN level product classification. All products with positive trade value are included.¹⁷ The final sample includes 1746 firms, of which 282 are in Malmö, 585 in Gothenburg, and 879 in Stockholm. A comparison of basic firm characteristics across the three cities can be found in table 2. The table shows a simple comparison of means for firms in Malmö compared to Stockholm and Gotheburg and the associated t-statistics. No significant differences are found between firms in Gothenburg and Malmö, while the firms in Stockholm are larger.¹⁸ Information on the sectoral composition of the sample can be found in appendix A, table A1.¹⁹

In this paper we are interested in investigating the impact of the Öresund bridge on trade flows to Denmark. A natural first step is therefore to analyse how firm level trade has evolved in the three municipalities both before and after the introduction of the bridge in 2000. Figure 3

¹⁶This is due to firms with less in yearly trade not being obligated to report the trade values to SCB. The threshold value has been 4.5 mkr. from 2005, but had previously been 2.2 mkr. To keep the sample of firms consistent the same threshold (4.5 mkr.) is used for the entire period. The results are robust for the inclusion of these firms.

¹⁷For robustness, minimum yearly trade values per product of 1.000 and 10.000 SEK are used.

¹⁸This is not surprising, since we expect the capital city to attract the headquarters of firms.

¹⁹Around 68% to 82% of firms exported to Denmark during the period. See the sample of firms that exported to Denmark in A table A2.

Table 2: Comparison of firms exporting to Denmark in Malmö versus firms in Gothenburg and Stockholm (1999).

	Malmö	vs. Gothenburg		vs. Stockholm	
		Gothenburg	t	Stockholm	t
Log tot. export to all dest.	17.0	17.1	-0.74	17.2	-1.46
Log export to DK (X)	14.5	14.4	0.22	14.3	0.75
Log firm sales	18.3	18.3	0.060	18.8	-2.77 ^a
Log nr. of employees	3.65	3.56	0.51	3.98	-1.91 ^c
Log firm assets	17.8	17.7	0.60	18.2	-2.24 ^b
P to all dest.	30.2	41.4	-1.79 ^c	39.3	-1.65 ^c
P to DK	14.2	13.3	0.19	11.9	0.54
P_{10} to DK.	8.99	7.98	0.37	7.37	0.63
Firm start year	1983.3	1983.8	-0.48	1983.0	0.33
Log TFP	1.39	1.16	1.66 ^c	1.13	2.02 ^b
Nr. of exporters	116	194	.	280	.
N	310			396	



The graph shows for each municipality the average percentage change in total firm trade value to Denmark of manufacturing firms. The Öresund bridge opened in mid-2000 and for the graph the trade value by each firm in that year is used as a base. This is calculated as the average for each municipality of $\ln(\text{trade value to Denmark})_{it} - \ln(\text{trade value to Denmark})_{i,2000}$.

Figure 3: Average change in firm trade value to Denmark by municipality relative to the base year(2000).

shows that the average firm trade to Denmark was stable prior to the introduction of the bridge, while after its opening, the average firm trade value increased faster in Malmö relative to the control municipalities.²⁰

4.1 Empirical Challenge

An important issue for identification of causal effects in this paper is the non-random allocation of firms into 'treatment' groups which gives rise to concerns of endogeneity and selection. Addressing these concerns, the sample under observation is limited to firms located in the same municipality during the entire period, from 1997 to 2011. Firms founded after 1997 are dropped to limit the possible impact of firms being founded or moved to Malmö with the intent to trade over the bridge to Denmark. Additionally, firms that were founded in 1997 or before with the intention to trade to Denmark may reduce the significance of the results since they contribute to a pre-bridge trend.²¹

The location of a fixed connection in Malmö between Sweden and Denmark may not have been the most obvious choice. Helsingborg, a city 65 km north of Malmö, was often suggested as a preferred/alternate location for a bridge/tunnel in earlier plans.²² This was due to the fact that the shortest distance across the Öresund strait was between Helsingborg in Sweden, and Helsingør (HH) in Denmark (only 3.5 km compared to the 15.9 km from Malmö). Additionally, crossing the strait with the HH ferry was, and still is, the shortest route in terms of road distance to all destinations in Denmark, if the origin is north of Helsingborg. Hence, if there were some historical selection of firms to municipalities due to a possible fixed connection over the strait, it is uncertain that firms would have chosen Malmö rather than Helsingborg before the final decision was made in 1994. Therefore, even if the allocation of firms to groups (i.e. to treated vs. non-treated cities) is non-random, the introduction of the bridge still provides an exogenous shock to trade costs benefiting firms in Malmö to a greater extent than firms located in Gothenburg and Stockholm.²³

²⁰The figure shows the average growth rate of firm trade value relative to the year 2000. Hence a value of 0.2 would be interpreted as the firms having on average increased their total trade value to Denmark by 20% since the introduction of the Öresund bridge in 2000.

²¹Firms intending to export to Denmark were unlikely to wait for the bridge to open before building a presence in that foreign market.

²²There are still ongoing discussions regarding building a connection there in the near future.

²³Note that in the empirical specification all results are relative to firms in the control municipalities. Hence, if firms in Gothenburg and Stockholm are positively affected by the Öresund Bridge, it will reduce the estimated effects.

Finally, as the Öresund bridge opened shortly after the introduction of the Euro common currency, in mid-2000, there may be concerns of trade diversion from Sweden to Euro member states, as Sweden did not adopt the Euro. This concern is reduced because Denmark has been pegged to the Euro since its inception in 1999, and to its predecessor, the ECU, from 1996. Hence, I argue that if there exists a trade-diversion effect, it will impact both trade to the treated destination (Denmark) and the control destinations. This is also in line with the results of Gullstrand and Olofsdotter (2014), who found that the potential bystander effect of the Euro had minimal or no impact on Swedish firms.

5 Empirical Specification

5.1 Preliminary Specification

The main objective of this paper is to assess empirically the theoretical predictions of MPE models following a reduction in trade costs. We break down the exports of firms into the four margins of trade illustrated in figure 1. For the preliminary specification I decompose the trade flows of firms to *Denmark only*. First, the aggregate exports of firm i to Denmark in year t , X_{it} , is decomposed into the number of exported products (P_{it}) and the average export value per product (\bar{x}_{it}) within a firm.

$$X_{it} = P_{it} * \bar{x}_{it}, \quad \bar{x}_{it} = \frac{X_{it}}{P_{it}} \quad (1)$$

To identify the effects of interest we first use the following preliminary empirical difference-in-difference specification:

$$y_{it} = \alpha_i + \lambda_{st} + \beta_1 bridge + \epsilon_t \quad (2)$$

where y_{it} can take three different variables, X , P and \bar{x} , all variables are in logs. Additionally, α_i is a firm fixed effect, λ_{st} is a 2-digit sector-year fixed effect and ϵ_t an error term. For identification, a standard difference-in-difference approach is used to identify the effect on the margins. A dummy variable, *bridge* (the treatment), is defined as equal to 1 if a firm is located in Malmö, the destination is Denmark, and the year is 2001 or later. As the Öresund bridge opened in mid-year 2000 it is unclear whether that year should be included in the pre- or post-bridge period and is therefore dropped. The standard errors are clustered on municipality.²⁴

²⁴Bertrand, Duflo, and Mullainathan (2004) and Cameron and Miller (2015) suggest that in a difference-in-

5.2 Baseline Specification

A potential concern²⁵ with the preliminary specification is that some firms may be expanding to *all* destinations and not just to Denmark and the treatment effect we estimate could therefore partly capture this trend. For the *baseline specification*, trade flows to alternative destinations are added to control for this concern. The argument for using additional destinations is therefore that the bridge reduces the bilateral trade costs between Sweden and Denmark while other bilateral costs are unaffected.²⁶ The destinations used are adjacent countries and all EU-15 member states.²⁷ The relative importance of each destination is similar across the municipalities in 1999 as can be seen from table A3 in appendix B.

In the baseline specification, we therefore decompose the trade flows within a destination. Total bilateral exports (X_{ijt}) of firm, i to destination j in year t , is which is then decomposed into the number of products (P_{ijt}) and average trade per product (\bar{x}_{ijt}) within a firm.

$$X_{ijt} = P_{ijt} * \bar{x}_{ijt}, \quad \bar{x}_{ijt} = \frac{X_{ijt}}{P_{ijt}} \quad (3)$$

$$y_{ijt} = \alpha_{ij} + \lambda_{st} + \beta_1 \text{bridge} + GDP_{jt} + R_{jt} + \kappa_{it} + \epsilon_{jt} \quad (4)$$

The specification is similar to before, and y_{ijt} can take three different variables, X , P , and \bar{x} . Observations in the panel are at the firm-destination level. α_{ij} is a firm-destination fixed effect, λ_{st} a 2-digit sector-year fixed effect, and ϵ_{jt} is an error term. Errors are clustered at the municipality-destination level.²⁸ The treatment effect, *bridge* is defined the same way as before,

difference setting over states (or regions, towns, cities) then errors should be clustered at the state level. Both advise against clustering at the state-year level. This stems from the fact that observations are likely to be serially correlated within a city between years. Note that if one clusters on city-year, then errors are assumed to be independent across states.

²⁵An additional concern is that the number of clusters in the preliminary specification is limited, which makes the inclusion of multiple control variables, lags or leads problematic.

²⁶One could argue that the trade costs to e.g. Germany would decrease, as the bridge opens up a pathway on land to western Europe. Even if that is the case, the relative decrease in bilateral trade costs should be larger for Denmark than for other destinations. Note also that if trade costs are reduced to other destinations it will reduce the estimated impact.

²⁷The destination control countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the United Kingdom. Norway is added as an adjacent country. Note that only Sweden, Denmark, Norway and the UK of the sample countries did not adopt the Euro in 1999. Greece was pegged to the Euro until 2001, and Denmark has been pegged to the Euro/ECU since 1996.

²⁸Moulton (1990) highlighted the importance of considering the grouping structure of the data; otherwise, the standard error may be biased downward. Angrist and Pischke (2008) suggest that 42 clusters are needed for a reliable estimate of the standard errors. This is a concern for the preliminary specification (using trade flows to Denmark only) as the standard errors are only clustered at the municipality level (3 clusters). In the baseline specification however the standard errors are clustered on municipality-destination pairs which results in

equals 1 if the firm is located in Malmö, the destination is Denmark and the year is 2001 or later (zero otherwise). Now firm level controls (κ_{it}) and country level macroeconomic controls (R_{jt}) are added to control for firm and destination specific effects. See appendix C for a discussion about the destination and firm specific control variables. As before, the year 2000 is dropped.

Lastly, the effect on the propensity to export (firm-extensive margin, M) is estimated with a linear model specification.

$$M_{it} = \alpha_i + \lambda_t + \beta_1 \text{bridge} + \epsilon_t \quad (5)$$

Here the dependent variable M is binary. It takes the value 1 if a firm exports to Denmark and 0 otherwise. The treatment, *bridge*, is defined the same way as before. The sample includes all firms that are in the three municipalities and founded in 1997 or earlier. For the identification, only firms that switched export status are used.²⁹ Errors are clustered on municipality.

6 Results

The results from estimating the *preliminary specification* in equation 2 show that there is a sizeable and significant effect on trade flows (see table 3). For the preliminary analysis we use firms located in Malmö, Gothenburg and Stockholm and only use trade flows to Denmark. The results show that aggregate firm exports (X) increased by 23% ($e^{0.208} - 1$), and average trade value per product (\bar{x}) within a firm by 18% ($e^{0.166} - 1$). For the change in the number of products (P) by firm, the point estimate is positive but only weakly statistically significant (at the 10% level). Note that all results are relative to the control group of firms in Gothenburg and Stockholm.³⁰

The construction of the Öresund bridge was observed, and therefore there may have been some anticipatory effects. In table 3, a lead for the bridge variable is added that equals 1 for the year being 1999 and the firm being located in Malmö (0 otherwise). This lead will pick up anticipatory effects (if any) as firms increased their trade the year before opening of the bridge. I also investigated if there was evidence of a lagged effect by interacting the bridge dummy and

42 clusters (3 municipalities \times 14 destinations). Coincidentally, this is the same number of clusters suggested by Angrist and Pischke (2008).

²⁹Note that the export status of all firms with less than 4.5 mkr. in yearly trade to Denmark is changed to 0 to keep the sample consistent over time.

³⁰The results are also robust when including only firms in *either* Gothenburg or Stockholm as a control. Results available on request.

Table 3: Preliminary specification for firms in all sectors: Trade flows to Denmark only by firms in Malmö, Gothenburg and Stockholm.

	All sectors				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	0.208 ^a (0.0166)	0.230 ^a (0.0156)	0.195 ^b (0.0213)	0.166 ^a (0.00635)	0.0418 ^c (0.0122)
Bridge lead		0.0631 (0.0267)			
Bridge 1-lag			0.0749 (0.0327)		
N	7003	7003	7003	7003	7003
R^2	0.779	0.779	0.779	0.773	0.871
Within R^2	0.0007	0.0007	0.0007	0.0005	0.0001
Firm-FE	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products.

a dummy for the year 2001. Neither the lead or the lag is significant in the preliminary analysis.

6.1 Baseline Results

In the baseline specification, equation 4, the control group is extended to include the trade flows to all adjacent and EU-15 countries for all firms in Malmö, Gothenburg and Stockholm. From table 4, we see that the aggregate main effect (X) is somewhat smaller than in the preliminary estimation, and only the impact on the product intensive margin is found significant. As before, we test for anticipatory effects using a lead that equals 1 for trade flows from Malmö to Denmark in 1999 and zero otherwise, and find a weakly significant effect prior to the introduction of the bridge. This suggests that firms in Malmö increased their trade intensity with Denmark even a year before the introduction of the Öresund Bridge. Note that this effect will tend to reduce the significance of the estimated effects from above, as part of the “bridge” effect is realised prior to the actual opening of the bridge.

As discussed earlier, there are two main sectors in the data, manufacturing and wholesalers (see table A1 in appendix A for the sectoral composition). By looking separately at the two main sectors, a heterogeneous sectoral effect is found. The positive effect observed is solely driven by firms in manufacturing, see table 5. For manufacturing firms the impact on all three margins

Table 4: Baseline specification for firms in all sectors: Includes firms in Malmö, Gothenburg and Stockholm and trade flows to Denmark, adjacent and EU-15 countries.

	All Sectors				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	0.0979 ^b (0.0383)	0.118 ^a (0.0373)	0.115 ^b (0.0516)	0.0223 (0.0358)	0.0756 ^a (0.0203)
Log GDP	0.584 (0.558)	0.584 (0.558)	0.592 (0.561)	0.564 (0.452)	0.0197 (0.163)
Log Real FX	-0.221 (0.235)	-0.221 (0.235)	-0.222 (0.235)	-0.0148 (0.240)	-0.206 ^b (0.0772)
Bridge lead		0.0412 ^c (0.0206)			
Bridge 1-lag			-0.00999 (0.0467)		
Bridge 2-lag			-0.0974 ^b (0.0375)		
Bridge 3-lag			-0.00996 (0.0336)		
N	55876	55876	55876	55876	55876
R^2	0.797	0.797	0.797	0.780	0.853
Within R^2	0.0102	0.0102	0.0102	0.0053	0.0084
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Adjacent countries are Norway and Finland. Controls for lagged TFP and lagged firm size are included (see appendix C).

is now positive and significant, with larger respective semi-elasticities for aggregate exports X , ($e^{0.261} - 1 = 35\%$), average export per product \bar{x} , ($e^{0.187} - 1 = 21\%$), and the product extensive margin P , ($e^{0.074} - 1 = 8\%$). For wholesalers the main effect on aggregate exports is insignificant, and only a redistribution, from the average trade value per product to the number of products exported, is found (see table 6).

Table 5: Baseline specification for manufacturing firms: Includes firms in Malmö, Gothenburg and Stockholm and trade flows to Denmark, adjacent and EU-15 countries.

	Manufacturing				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	0.261 ^a (0.0493)	0.287 ^a (0.0548)	0.295 ^a (0.0599)	0.187 ^a (0.0420)	0.0740 ^a (0.0184)
Bridge lead		0.0533 (0.0345)			
Log GDP	1.219 ^c (0.720)	1.219 ^c (0.720)	1.236 ^c (0.724)	1.255 ^b (0.589)	-0.0362 (0.187)
Log Real FX	-0.369 (0.255)	-0.369 (0.255)	-0.374 (0.256)	-0.177 (0.250)	-0.192 ^b (0.0933)
Bridge 1-lag			-0.0848 ^c (0.0447)		
Bridge 2-lag			-0.123 ^b (0.0457)		
Bridge 3-lag			-0.0385 (0.0415)		
N	21518	21518	21518	21518	21518
R^2	0.835	0.835	0.835	0.790	0.877
Within R^2	0.0154	0.0154	0.0155	0.0114	0.0051
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Controls for lagged TFP and lagged firm size are included (see appendix C).

Several robustness checks are performed for the baseline specification. First the sample is limited to a short period before and after the introduction of the bridge to see if the effect is driven by the time horizon of the data. Tables B1 and B2 in appendix B, display the results if we use only two years before and after the opening of the bridge (1998-1999 as a pre-period and 2001-2002 as a post-period). The main effect on aggregate firm exports (X) is slightly lower than before but is highly significant. For the other margins, a similar effect is found on the product extensive margin while, a less significant effect is now found for the average trade per product.

Table 6: Baseline specification for wholesale firms: Includes firms in Malmö, Gothenburg and Stockholm and trade flows to Denmark, adjacent and EU-15 countries.

	Wholesale				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	-0.0493 (0.0615)	0.0257 (0.0599)	-0.0247 (0.0874)	-0.185 ^a (0.0562)	0.136 ^a (0.0282)
Bridge lead		0.152 ^a (0.0334)			
Log GDP	0.250 (0.781)	0.252 (0.781)	0.261 (0.788)	0.136 (0.637)	0.114 (0.253)
Log Real FX	-0.0188 (0.386)	-0.0188 (0.386)	-0.0190 (0.387)	0.191 (0.342)	-0.210 ^b (0.102)
Bridge 1-lag			0.0707 (0.0854)		
Bridge 2-lag			-0.206 ^a (0.0543)		
Bridge 3-lag			-0.0909 (0.0543)		
N	27642	27642	27642	27642	27642
R^2	0.764	0.764	0.764	0.751	0.838
Within R^2	0.0101	0.0101	0.0101	0.0039	0.0127
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Controls for lagged TFP and lagged firm size are included (see appendix C).

A second robustness check is to exclude products that have marginally positive trade values. Table B3 shows the results when the regressions are re-estimated to include only products with more than 1000 SEK and 10000 SEK in yearly export sales.³¹ The point estimates are similar for manufacturing firms and are all significant at the 1% level. In general, the robustness checks on the sample of wholesalers are less consistent, and show either an insignificant or a negative effect. A third robustness check is to limit the group of destinations to adjacent countries only instead of to both adjacent and EU-15 countries. The results are stronger for the firms in the manufacturing sector; see table B4. See table B5 for the results on the wholesale sector and a discussion in the following section.³²

Table 7: Extensive margin - Firms in Malmö, Gothenburg and Stockholm

	All Sectors		Manufacturing		Wholesale	
	M	M_{logit}	M	M_{logit}	M	M_{logit}
Bridge	0.301 ^a (0.00519)	1.554 ^a (0.201)	0.343 ^a (0.0101)	2.000 ^a (0.441)	0.252 ^a (0.00349)	1.249 ^a (0.243)
Constant	0.338 ^a (0.00921)		0.361 ^a (0.0117)		0.321 ^a (0.0118)	
N	12816	12746	2583	2563	7898	7863
R^2	0.0127		0.0262		0.0167	
Year-FE	Yes	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality.

The extensive margin, i.e. the impact on the propensity (probability) of firms in all sectors to export to Denmark, is sizeable, and we find that firms in Malmö are 35% ($e^{0.301} - 1$) more likely to export to Denmark than the control group using a linear specification. See table 7. For robustness, a logit model is estimated, and I find somewhat stronger effect.³³ Looking separately at manufacturing and the wholesale firms, the impact is positive and significant in both sectors. The magnitude varies, and is stronger for manufacturing firms when using both the linear and

³¹Equivalent to roughly €100 and €1000.

³²Other robustness checks include limiting the sample of firms to single plant firms to avoid the possible redistribution of activities within a firm. The results are similar for the manufacturing sector. The results are also robust when limiting the sample to firms founded before 1991, before a decision to build the bridge was made. I argue that it is highly-unlikely that firms anticipated a bridge between Malmö and Copenhagen in the near future before 1991. At that point, the political decision process regarding a possible connection was informal, and with the history of such negotiations not materialising, the probability of a bridge was low. The results using this sub-sample are similar to the baseline (available on request). Note that for this robustness check, the firms are assumed to be in the same municipality as they were in 1997. Lastly, the results are robust when dropping the control variables lagged TFP and lagged firm sales.

³³The odds ratio, from the logit estimation, equals 4.7 ($e^{1.547}$) which means that the odds of exporting to Denmark increase almost fivefold with treatment.

the logit specification. Manufacturers and wholesalers in Malmö are 41% ($e^{0.343} - 1$) and 29% ($e^{0.252} - 1$) more likely to export to Denmark than the control group.³⁴ This suggests that the fixed costs barrier of exporting to Denmark decreased with the bridge, with the decrease being greater among manufacturing firms.

6.2 Evaluating Models of Multi-Product Exporters

The main objective of this paper is to evaluate empirically the theoretical validity of the predictions provided by MPE models. The nature of wholesalers differs substantially from that of manufacturing firms, as they do not generally produce the products they export themselves but rather serve as a channel to redistribute goods produced by other firms.³⁵ Therefore, as the MPE models are mostly constructed to explain the behaviour of manufacturing firms rather than of wholesalers, the discussion below will focus on that sector.

Theoretically, we expect that following a decrease in trade costs, there will be an increase in the propensity of firms to export (M), and both the trade intensity of firms (X) and the number of products (P) exported will also increase. For manufacturing firms a theoretically consistent and robust effect is found on these three margins. See table 8 for an overview of the predictions and a comparison to the results.

Table 8: Comparison of results and predictions for manufacturing firms

Margin	Definition	Prediction	Result
M , Firm Extensive Margin	Probability of exporting	+	+
X , Firm Intensive Margin	Amount Exported	+	+
P , Prod. Extensive Margin	Nr. of products exported	+	+
\bar{x} , Prod. Intensive Margin	Ave. trade value per product	+/-	+

The MPE models do not provide a prediction for the product intensive margin (\bar{x}), since it is assumed that new products are exported less intensively than older products. In this paper, the sizeable impact on aggregate exports (X) for manufacturing firms is driven by an increase in

³⁴From the logit specification, the odds ratio also shows the differing sectoral effects in participation, with the odds of manufacturing and wholesaler exporting around 7.4 (e^2) higher and 3.5 ($e^{1.249}$) times higher compared to the respective control groups.

³⁵The results for the wholesale sector are either insignificant or negative in some cases. A possible reason for this is that wholesalers may be more global in nature and less impacted by changes in distance (such as by the Öresund Bridge). This is important as all results are relative to the control group. Hence, if remote wholesalers benefit equally compared to wholesalers in Malmö from the Öresund bridge, the specification of treatment and control groups becomes less applicable in that specific case.

the average value per product (\bar{x}) and to a smaller degree by the number of products (P).

The overall impact on aggregate firm exports (X) can be decomposed into sub-margins of average exports per product (\bar{x}) and number of products (P). For manufacturing firms, I find that around 70-80% of the increase in aggregate firm exports (X) can be attributed to increases in the average trade value per product (\bar{x}), while the rest is due to a greater number of products (P) exported (20-30%). This result suggests that firms respond mostly by increasing the trade value of the existing products rather than increasing their product scope following a drop in trade costs. This relates to the findings of [Arnarson \(2016\)](#), who showed that firms mainly focus on a limited number of “superstar” (core) products that have a very large weight in terms of export value to a destination. He argues that other, more peripheral products may be exported to support the “superstars” of the firm. Firms may therefore respond to a decrease in trade costs by increasing the intensity of already exported products rather than on the product extensive margin.³⁶

This paper relates most closely to [Berthou and Fontagné \(2013\)](#), who evaluated the theoretical predictions of the multi-product exporter model by [Bernard, Redding, and Schott \(2011\)](#) using the introduction of the Euro for identification. Looking only at manufacturing firms, they found a 5% weakly significant³⁷ effect on aggregate firm exports (X), with the main effect coming from increased average value per product (\bar{x}). After controlling for general equilibrium effects,³⁸ the main result strengthened and they found that aggregate exports increased by 7%, driven by an increase in average exports per product (\bar{x}). Comparing the results for manufacturing firms, we see that both papers find a significant increase in aggregate trade per firm, average value exported per product, and a relatively small increase in the number of products exported. Unlike [Berthou and Fontagné \(2013\)](#), I find a large and significant effect on the firm’s decision to export.

³⁶Hence, firms are likely to base their export decisions on products that have a sizeable impact on their aggregate trade and a reduction in trade costs need not impact to the same extent the decisions to enter a market with new and/or (highly) peripheral products.

³⁷Only at the 10% significance level.

³⁸They call this “phi-ness”. It is not needed in our setting since the Öresund bridge only benefited Swedish firms.

7 Conclusion

The main contribution of this paper is to evaluate empirically the theoretical predictions of several models of multi-product exporters when faced with a decrease in trade costs. Using the introduction of the Öresund bridge as a *quasi-natural experiment*, I identify how the export decisions of firms in Malmö ('treated') changed compared to firms in the more distant control municipalities of Gothenburg and Stockholm. The focus of this paper is on how the decision to export to Denmark was impacted as well as on the within-firm decisions regarding product scope and the intensity of trade. Looking at all sectors jointly I find a significant effect on aggregate exports (X) compared to Gothenburg and Stockholm. This result hides vast sectoral heterogeneity since firms in the manufacturing sector are driving the main results while I find mostly insignificant results for wholesalers.

For manufacturing firms³⁹ the baseline results of the paper are consistent with the [MPE](#) models on three of the margins tested. As predicted, a reduction in trade costs induces more firms to export (M) and increases their aggregate exports (X). Decomposing the impact on aggregate exports, we see that around 70-80% of the increase in aggregate firm trade can be attributed to increased average sales per product (\bar{x}), with the other 20-30% attributed to an increase in the number of products exported. This result is important, as the [MPE](#) models have an ambiguous prediction regarding how average sales per product (\bar{x}) should change following a change in trade costs. The results of this paper show, however, that increases in average sales per product (\bar{x}) is driving the increase in aggregate exports rather than increases in product scope (the number of products exported). To our knowledge, only [Berthou and Fontagné \(2013\)](#) have similarly evaluated a model of multi-product exporters when faced with a change in trade costs. This paper differs from theirs in the estimated size of the effects and, unlike their paper, I find a large and highly significant response in terms of the decision to export.

More broadly, the results of this paper highlight the value of infrastructure on market access. The large effect on the probability of exporting indicates that the Öresund was a barrier to trade, and even if the "great circle distance" was unchanged, the improved market access altered both the effective and the perceived distance, leading to a reduction in both variable and fixed costs of exporting.

³⁹The results for wholesalers are in general much weaker and often insignificant. See section 6.2. The discussion here focuses on manufacturing firms.

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Appendices

A Descriptive Statistics

Table A1: Sectoral decomposition of firms in sample.

Sector	Malmö	Gothenburg	Stockholm	Total
Agriculture	0.0	2.4	0.2	0.9
Mining	0.4	0.2	0.2	0.2
Manufacturing	33.0	25.6	17.7	22.9
Infrastructure	1.8	1.0	0.7	1.0
Construction	0.4	1.9	0.9	1.1
Wholesale	50.4	50.8	58.6	54.6
Transport/storage	2.1	6.0	3.3	4.0
Accommodation/food services	0.4	0.0	0.0	0.1
Information/communication	2.5	1.2	6.8	4.2
Finance/insurance	0.0	0.2	0.5	0.3
Real-estate	4.3	2.2	1.9	2.4
Professional activities	4.3	6.7	6.1	6.0
Other	0.7	1.9	3.0	2.2
Total	100.0	100.0	100.0	100.0
	(282)	(585)	(879)	(1746)

Table A2: Sectoral decomposition of firms in sample, only firms that trade to Denmark in some year.

Sector	Malmö	Gothenburg	Stockholm	Total
Agriculture	0.0	3.3	0.3	1.2
Mining	0.4	0.3	0.2	0.2
Manufacturing	35.9	26.8	20.5	25.4
Infrastructure	1.7	1.5	0.8	1.2
Construction	0.4	1.0	0.6	0.7
Wholesale	50.0	55.4	61.4	57.4
Transport/storage	1.3	1.5	1.1	1.3
Information/communication	1.3	0.8	5.3	3.1
Finance/insurance	0.0	0.3	0.3	0.2
Real-estate	4.7	2.5	1.6	2.5
Professional activities	3.8	5.3	5.8	5.2
Other	0.4	1.5	2.1	1.6
Total	100.0 (234)	100.0 (399)	100.0 (625)	100.0 (1258)

Table A3: Share (%) of firms exporting to each destination, for firms in Malmö, Gothenburg and Stockholm in 1999.

Destinations	Malmö	Gothenburg	Stockholm	Total
AT	5.00	4.28	4.74	4.62
BE	5.89	6.16	5.75	5.92
DE	10.20	9.78	9.52	9.73
DK	11.96	11.17	11.16	11.31
ES	5.67	6.28	6.09	6.08
FI	11.06	10.64	11.94	11.33
FR	7.01	7.18	6.91	7.02
GB	8.47	8.58	8.41	8.48
GR	3.05	3.59	3.22	3.32
IT	6.37	6.55	6.20	6.35
LU	0.95	0.77	0.93	0.88
NL	8.01	7.75	7.24	7.56
NO	13.06	13.66	14.56	13.97
PT	3.30	3.62	3.33	3.43
Total	100	100	100	100

B Results Appendix

Table B1: Robustness for baseline specification using only years 1998 to 2002 and firms in manufacturing sector. Includes firms in Malmö, Gothenburg and Stockholm and trade flows to Denmark, adjacent and EU-15 countries

	Manufacturing				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	0.168 ^a (0.0489)	0.178 ^a (0.0597)	0.161 ^a (0.0555)	0.0750 ^c (0.0437)	0.0929 ^a (0.0224)
Bridge lead		0.0204 (0.0332)			
Log GDP	0.844 (1.585)	0.847 (1.587)	0.842 (1.586)	0.453 (1.590)	0.390 (0.369)
Log Real FX	-1.161 ^b (0.458)	-1.161 ^b (0.458)	-1.160 ^b (0.459)	-1.330 ^a (0.396)	0.169 (0.277)
Bridge 1-lag			0.0120 (0.0299)		
N	7010	7010	7010	7010	7010
R^2	0.895	0.895	0.895	0.861	0.925
Within R^2	0.0116	0.0116	0.0116	0.0102	0.0026
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Controls for lagged TFP and lagged firm size are included (see appendix C).

Table B2: Robustness for baseline specification using only years 1998 to 2002 and firms in wholesale sector. Includes firms in Malmö, Gothenburg and Stockholm and trade flows to Denmark, adjacent and EU-15 countries

	Wholesale				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	-0.209 ^a (0.0536)	-0.119 ^c (0.0602)	-0.412 ^a (0.0657)	-0.190 ^a (0.0465)	-0.0192 (0.0315)
Bridge lead		0.180 ^a (0.0340)			
Log GDP	3.237 ^c (1.758)	3.265 ^c (1.761)	3.175 ^c (1.748)	2.270 (1.826)	0.939 (0.710)
Log Real FX	0.251 (0.526)	0.255 (0.526)	0.301 (0.530)	0.450 (0.564)	-0.165 (0.258)
Bridge 1-lag			0.365 ^a (0.0471)		
N	7830	7830	7830	7922	7830
R^2	0.843	0.843	0.843	0.832	0.902
Within R^2	0.0035	0.0036	0.0039	0.0009	0.0055
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Controls for lagged TFP and lagged firm size are included (see appendix C).

Table B3: Robustness for baseline specification using trade to adjacent and all EU-15 countries from firms in Malmö, Gothenburg and Stockholm.

	Bridge		TFP		N
<i>All Sectors</i>					
\bar{x}_1	0.0448	(0.0377)	-0.0502 ^a	(0.0133)	55876
\bar{x}_{10}	0.0861	(0.0598)	-0.0631 ^a	(0.0240)	55876
P_1	0.0671 ^a	(0.0151)	-0.0198 ^a	(0.00363)	55177
P_{10}	0.0705 ^a	(0.0144)	-0.0152 ^a	(0.00358)	51580
<i>Manufacturing</i>					
\bar{x}_1	0.201 ^a	(0.0510)	-0.0519 ^b	(0.0248)	21518
\bar{x}_{10}	0.211 ^a	(0.0796)	-0.0628	(0.0383)	21518
P_1	0.0621 ^a	(0.0152)	-0.00914	(0.00587)	21364
P_{10}	0.0831 ^a	(0.0139)	-0.00634	(0.00660)	20407
<i>Wholesale</i>					
\bar{x}_1	-0.159 ^a	(0.0597)	-0.0499 ^a	(0.0192)	27642
\bar{x}_{10}	-0.0688	(0.0957)	-0.0777 ^b	(0.0316)	27642
P_1	0.136 ^a	(0.0249)	-0.0337 ^a	(0.00609)	27194
P_{10}	0.129 ^a	(0.0218)	-0.0265 ^a	(0.00509)	25010

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. \bar{x} = average trade value within firm, per product. P =Number of products. Controls for lagged firm size for the destinations we include GDP and the real exchange rate (see appendix C). All regressions include firm-destination-FE and sector-year FE. The subscripts 1 and 10 refer to yearly minimum product value (in '000 SEK).

Table B4: Manufacturing firms, alternative control sample: Includes firms in Malmö, Gothenburg and Stockholm and only trade flows to Denmark and adjacent countries (Finland and Norway).

	Manufacturing				
	X	X_{lead}	X_{lag}	\bar{x}	P
Bridge	0.378 ^a (0.0612)	0.334 ^a (0.0636)	0.271 ^a (0.0659)	0.274 ^a (0.0635)	0.104 ^a (0.0280)
Bridge lead		0.137 ^b (0.0424)			
Log GDP	3.186 ^b (1.096)			3.133 ^a (0.930)	0.0528 (0.539)
Log Real FX	0.741 (0.483)			1.058 ^a (0.271)	-0.316 (0.290)
Bridge 1-lag			-0.0109 (0.0591)		
Bridge 2-lag			-0.0909 (0.0564)		
Bridge 3-lag			0.0761 (0.0673)		
N	6619	6619	6619	6619	6619
R^2	0.827	0.826	0.826	0.770	0.870
Within R^2	0.0203	0.0177	0.0178	0.0153	0.0066
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Controls for lagged TFP and lagged firm size are included (see appendix C).

Table B5: Wholesale firms, alternative control sample: Includes firms in Malmö, Gothenburg and Stockholm and only trade flows to Denmark and adjacent countries (Finland and Norway).

	Wholesale				
	X	X_{lead}	\bar{x}	P	X
Bridge	-0.203 ^a (0.0397)	-0.117 ^b (0.0486)	-0.260 ^a (0.0561)	-0.316 ^a (0.0481)	0.112 ^b (0.0455)
Bridge lead		0.174 ^b (0.0523)			
Log GDP	-0.772 (0.685)	-0.764 (0.687)	-0.866 (0.692)	-0.488 (0.499)	-0.284 (0.444)
Log Real FX	0.646 ^b (0.236)	0.650 ^b (0.237)	0.658 ^b (0.237)	0.958 ^a (0.233)	-0.313 (0.201)
Bridge 1-lag			0.281 ^a (0.0820)		
Bridge 2-lag			-0.0916 (0.0563)		
Bridge 3-lag			0.0966 ^b (0.0416)		
N	11411	11411	11411	11411	11411
R^2	0.754	0.754	0.754	0.748	0.838
Within R^2	0.0154	0.0155	0.0157	0.0072	0.0167
Firm-Dest-FE	Yes	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes	Yes

^c $p < .10$, ^b $p < .05$, ^a $p < .01$. Standard errors in parentheses, clustered on municipality and destination pairs. X = Total trade value, \bar{x} =average trade value within firm, per product. P =Number of products. Controls for lagged TFP and lagged firm size are included (see appendix C).

C Control Variables

The data used for GDP comes from the World Development Indicators of the World Bank and is measured in constant US dollars (2005) (in logs). The bilateral real exchange rate is calculated as follows:

$$R_{jt} = E_j * \frac{PPI_{jt}}{PPI_{se,t}} \quad (6)$$

Here R_{jt} is the bilateral real exchange rate between country j and Sweden. E_j is the yearly nominal exchange rate between Sweden and the destination j , (SEK per unit foreign currency). The data is from the Riksbanken website. PPI_{jt} is the producer price index for country j and $PPI_{se,t}$ is the PPI for Sweden in year t . The PPI is a country level series (B-E36) from Eurostat, measured in national currency.⁴⁰

The firm level control variables used are lagged firm sales and lagged total factor productivity (TFP), both in logs. TFP is calculated using the Olley-Pakes methodology at the 2-digit sectoral level and lagged by one year to avoid reverse causality. Note that TFP is calculated by using the whole dataset for Sweden. This is done so TFP can be calculated for as large a proportion of the sample as possible. There are restrictions on the minimum number of firms in a sector, which may make the calculations problematic for smaller samples.

⁴⁰See http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sts_inppd_a&lang=en.