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# **Import Intensity and Firm Productivity**

**An Empirical Analysis Based on Swedish Firm-Level Data**

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## **Abstract**

Most exporting firms in the world also import foreign inputs in production. Recent findings elucidate the importance of imports as a driver of firm productivity on the amount of goods exported. This study aims at investigating the correlation between imports and firm productivity, not the causality. It will add to previous research by shifting focus from import participation to import intensity and outline if trading firms may increase their import intensity to gain productivity effects. Based on a firm-level survey in the Swedish manufacturing sector during 2014, a (Pseudo) Poisson Maximum Likelihood estimator is used in the empirical analysis. We find a positive correlation between import intensity and firm productivity. This finding is in line with heterogeneous firm theory, from which we argue, that these productivity effects are mainly benefiting high productive firms. Policies acting to decrease trade restrictions might help low productive domestic firms surpass the productivity verge, enter the import market and benefit from increasing import intensity.

Keywords: Import Intensity, Firm Productivity, Sweden

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## 1 Introduction

For many years, discussions regarding exports as a way of increasing economic growth and productivity have focused on aggregate national data. In 1995, Bernard and Jensen published a paper that came to change the perspective of the entire research area (Wagner, 2007). They used firm-level data in the US manufacturing sector between 1976-1987 to investigate why exporters could be more productive than non-exporters and found that exporting is associated with success. It is beneficial for the entire economy (see Bernard and Jensen, 1995). Since 1995, explanations of firm participation in international trade have shifted toward these firm-level studies where firms differ in terms of characteristics. In this heterogeneous firm setting, most firms do not export, even though exporters are larger and more productive before entering the export market (Melitz, 2003).

To explain this heterogeneous firm approach, where most firms are non-exporters, two hypotheses are commonly used. First, trade stimulate a learning effect where firms gain knowledge about market characteristics and market demands in the international sector. This, in turn, increases firm productivity and makes firms more efficiently gain access to the export market. Second, high productive firms self-select into exporting (Jienwatcharamongkhol, 2014). There is an issue of causality present. Does trade generate a productivity enhancing effect from learning or does high productive firms simply self-select into exporting?

There is a large amount of research examining firm productivity and export participation, most of which conclude that productivity is higher for exporters than non-exporters and causality goes in both directions (See for example Wagner, 2007; De Loecker, 2007; Berthou et al, 2015). However, since most of the exporting firms are so called “two-way traders”, i.e. they also import inputs in production, recent research elucidate the importance of import participation as a way of increasing firm productivity on the amount of goods exported, most of which find that importers are more productive than non-importers but mixed evidence in terms of causality (see for example Vogel and Wagner, 2008; Kasahara and Rodriguez, 2005; Jienwatcharamongkhol, 2014).

This paper will add to previous research by shifting focus from import participation to import intensity (amount of imported goods in production) and outline if trading firms may increase their import intensity to gain productivity effects. Based on a firm-level survey from 275 firms in the Swedish manufacturing sector in 2014, a Pseudo-Poisson Maximum Likelihood

estimator is used in the empirical analysis. Since this survey feature unilateral trade flows during a one-year period, i.e. imports destined to- and exports originate from one country only, I will simply investigate the correlation between import intensity and firm productivity, not the direction of causality. My hypothesis is that this correlation will be positive.

It will be organized as follows. Chapter 2 presents our conceptual framework regarding heterogeneous firm theory and the interaction between firm productivity, exports and imports. Chapter 3 outlines our theoretical model of choice and motivates the estimation strategy while Chapter 4 presents the data. Chapter 5 discusses our estimation results and Chapter 6 concludes the paper.

## **2 Conceptual Framework**

*This chapter presents some important concepts used in this paper and provides empirical results from previous research.*

### **2.1 Heterogeneous Firm Theory**

Helpman and Krugman (1985) published a homogenous trade approach based on comparative advantage where firm productivity is constant for all firms and when trade liberalization increases, either all or no firms export. It came to be one of the most influential approaches to trade research during the 90's.

As the amount of firm-level data increased during late 90's, Melitz (2003) published a heterogeneous firm approach where he argued that international trade participation might be explained from firm behaviour, which in turn, is not well represented by the original neoclassical models. He argues that there is an entry cost associated with selling at the international market, consisting of per-unit costs (such as tariffs) and fixed costs (such as acquiring information). When a low productive firm decides to sell at the international market, they pay an entry fee and can then decide to exit immediately or continue to sell and be forced to exit with probability  $\delta$  when a negative shock occurs in the future. Thus, there is a productivity verge firms need to surpass to stay at the international market; otherwise they are forced to exit. Nevertheless, average profits within the economy will be positive, since all firms above the productivity verge earn positive profits.

In a closed economy, when there is no additional cost of trade, firms are identical and firm size have no effect on firm productivity, as in the homogenous approach by Helpman and Krugman (1985). When an economy opens up to trade, on the other hand, the entry costs presented above will make the amount of domestic firms decrease and be replaced by foreign exporting firms. The overall welfare effect, however, will be positive since the productivity level in the economy increases by more than its decrease from low productive domestic firms exiting.

At firm-level, all domestic firms experiences loss in profits and market shares. Exporting firms, on the other hand, increase their market share and profits as trade liberalization increases. This is only true for high productive firms (i.e. firms above the productivity verge), however, since low productive firms loose market shares until they are forced to exit the international sector. This, in turn, leads to resource reallocation from low productive firms to high productive firms, making them expand and grow even further (Melitz , 2003)

Summing up, when an economy opens up to trade, there are some entry cost of selling at the international market, making overall welfare increase in the economy since resources reallocate between firms. However, only firms above the productivity verge are able to exploit these resources and increase in size and profits. Melitz (2003) argues that that this might be due to learning from importing or self-selection. Thus, trade restrictions might prevent low productive firms from fully taking advantage of the benefits from trade.

As the focus of trade research have shifted towards a heterogeneous firm setting, where trade is beneficial for the entire economy and decisions of trade participation depend on firm behaviour, how can firm productivity act as a driver of trade?

## **2.2 Firm Productivity and Export Participation**

In a heterogeneous firm setting, most firms do not export, and those that do are typically large and highly productive (Melitz, 2003). Wagner (2007) made an effort to explain this concept in 2007 when he compared 54 of the main empirical papers published since 1995. He found a positive correlation between engaging in exports and high productivity but that high productive firms self-select into exporting, leaving low productive firms behind. Building on these papers, Hansen (2010) put numerical values on his results. He found that exporters are 40% more productive than non-exporters in Germany and Austria during 1994-2003 and that

average firm productivity is 1% higher for exporters. This was also due to high productive firms self-selecting into exporting.

De Loecker (2007), on the other hand, argues that self-selection has been shown in the past by several authors and, instead, shows that exporting manufacturing firms in Slovenia between 1994-2004 became more productive than non-exporters due to a learning effect from engaging in exports. Hence, firms engaged in exports acquired knowledge about the characteristics and demands in the international market, which in turn, generated a productivity enhancing effect on the amount of exports. Furthermore, he found that firms exporting to high-income regions experience a larger productivity effect and that the productivity gap between exporters and non-exporters increases over time. Similarly, by investigating 23 European countries during the 2000's, Berthou et al (2015) also found that exporters are more productive than non-exporters due to a learning effect from engaging in exports.

Summing up, previous findings clearly follow a heterogeneous firm approach where exporters are more productive than non-exporters and in the case of causality, there is evidence for high productivity firms self-selecting (see for example Wagner, 2007; Hansen, 2010) into exporting as well as firms getting more productive due to a learning effect from engaging in exports (see for example De Loecker, 2007; Berthou et al, 2015). Does engaging in imports generate the same results?

### **2.3 Firm Productivity and Import Participation**

In a heterogeneous firm setting, most exporters are two-way traders, meaning that they both import and export (Jienwatcharamongkhol, 2014). In the past, researchers have focused solely on the relationship between exports and firm productivity. Recent findings, however, elucidate the importance of engaging in imports as a way of increasing firm productivity on the amount of exports.

As mentioned above, Wagner (2007) found evidence for high productivity firms self-selecting into exports. However, he also found that high productive firms self-select into imports but no evidence for a learning effect, since imports did not improve productivity for all firms. Similarly, Vogel and Wagner (2008) found that importing firms are more productive than non-importing firms in the German manufacturing sector due to self-selection but there is no

evidence for a learning effect. Continuing, Kasahara and Rodriguez (2005) found that plants importing intermediates in production in Chile are 20% more productive than non-importing plants during 1979-1997 due to self-selection. Also, importing plants have a higher probability of not being forced to exit the export market, as argued in chapter 2 by Melitz (2003).

In the Swedish manufacturing sector, on the other hand, Andersson, Johansson and Lööf (2007) found that importing firms have 9% higher productivity than non-importers between 1997-2004 in the manufacturing sector. Building on this finding, to determine direction of causality, Jienwatcharamongkhol (2014) found a productivity enhancing effect from engaging in imports on the amount of exports during 1997-2006 in the Swedish manufacturing sector due to a learning effect where imports stimulate learning and lead to firms exporting more. He argues that import experience might be a good proxy for current exports as more imports in the past usually imply a larger amount of exported goods in the future. Also, in terms of policy reforms, firms with previous import experience can exploit benefits from productivity reforms more efficiently and have an easier time entering the export market when trade restrictions are decreased, as mentioned in chapter 2 by Melitz (2003).

Summing up, previous findings clearly follow a heterogeneous firm approach where importers are more productive than non-importers. There is evidence for self-selection (see for example Wagner 2007; Vogel and Wagner 2008; Kasahara and Rodriguez, 2005) and a learning effect from engaging in imports (see for example Jienwatcharamongkhol, 2014).

Continuing, since most trading firms are two-way traders, are firms engaged in both exports and imports more productive than firms only engaged in imports or exports?

#### **2.4 Firm Productivity and Two-Way Trading**

Aristei, Castellani and Franco (2011) investigated a pattern of two-way trading in 27 Eastern European and Central Asian countries. They argue that firms are forced to become two-way traders when they have to pay an entry fee to sell at the international market since engaging in imports increase knowledge about the international market, which in turn, might decrease these entry costs. Hence, there is a learning effect from importing that makes firms enter the export market more efficiently and make two-way traders more productive than firms only



exporting, only importing or non-trading. Firms have an incentive to engage in both imports and exports.

Summing up, previous findings clearly follow a heterogeneous firm approach where two-way traders are more productive than only exporters, only importers and non-traders (see for example Aristei, Castellani and Franco, 2011; Jienwatcharamongkhon, 2014), incentivizing all trading firms to engage in both imports and exports.

Continuing, we may conclude that trading firms are more productive than non-trading firms no matter if they are two-way traders, only exporters or only importers. Can these trading firms increase their productivity further by increasing intensity of trade (i.e. amount of trade)?

### **2.5 Firm Productivity and Trade Intensity**

Since previous research targeting the relationship between firm productivity and trade intensity is fairly limited, we will provide findings from both import- and export intensity as a comparison point. In the former case, Forlani (2012) made an empirical analysis in the Irish manufacturing sector. He found a positive correlation between import intensity and firm productivity and that a 1% increase in import intensity generated a 1,2% increase in firm productivity. He argues, however, that this productivity effect is only benefitting high productive firms. Building on this finding, to distinguish direction of causality again, Jienwatcharamongkhon (2014) found that, as previously mentioned, there is a productivity enhancing effect on amount of goods exported from engaging in imports in Sweden during 1997-2006. He found that this, in turn, depends on past import intensity. Hence, when a firm engages in trade, higher import intensity generates a learning effect where firm productivity increases on amount of goods exported. Similarly, Anderson (2013) found a positive relationship between import intensity and firm productivity in the Swedish agrifood sector.

In the latter case, there are similar findings. Iyer (2010) found that there are productivity-enhancing effects from increasing export intensity in the agricultural sector in New Zealand during 2000-2006. He found that firm productivity and firm characteristics are the drivers of export intensity and an increasing firm size will lower export intensity. There was also a positive correlation between number of markets and exports intensity. A new market implied a 1,3% increase in average firm export intensity in the entire economy. Continuing, Reis and Forte (2014) made an empirical analysis in Portugal during 2008-2010 with a sample of 1425

firms. They found a positive correlation between export intensity and firm productivity. Also, firm- and industry characteristics were seen to be drivers of export intensity. In contrast, Crino and Epifani (2008) found, in a sample of Italian manufacturing firms during 2001-2003, that export intensity and firm productivity is negatively correlated towards low-income countries and not correlated at all towards high-income countries.

Summing up, previous findings clearly follow a heterogeneous firm approach where more trade increase firm productivity (see for example Forlani, 2012; Jienwatcharamongkhon, 2014, Andersson, 2013; Iyer, 2010; Reis and Forte, 2014) towards both import- and export intensity. Furthermore, increased trade intensity generates a positive overall wealth effect in the economy while evidence of causality is mixed.

In the next chapter we outline our theoretical model of choice and motivate the estimation strategy used in the empirical analysis. Finally, we present the model specification.

### 3 Methodology

*This chapter presents The Gravity Models and motivates the choice of using a (Pseudo) Poisson Maximum Likelihood Estimator in the empirical analysis. Furthermore, it outlines a specification of the estimation model.*

#### 3.1 The Gravity Models

In trade research, the gravity models have gained a lot of popularity and can be thought of as a baseline model to understand bilateral trade (United Nations ESCAP, 2013). In an extended gravity model, following the heterogeneous approach presented by Melitz (2003), Anderson and Van Wincoop (2003) argued that entry costs to sell at the international market are heterogeneous, in contrast to a standard gravity model. Even though the survey used in the empirical analysis feature unilateral trade flows, we will derive the extended gravity model based on heterogeneous trade costs to use its implications in the empirical analysis.

First, standard gravity models assume homogenous firms with equal levels of productivity and profits, formally;

$$X_{ij} = GS_i M_j \phi_{ij} \tag{1}$$

Where level of bilateral exports,  $X_{ij}$ , are modelled as a function of importer characteristics,  $M_j$ , and exporter characteristics,  $S_j$ . To account for amount of trade in the world,  $G$  reflects trade liberalization and to control for homogenous trade costs (as argued by Helpman and Krugman, 1985),  $\phi_{ij}$  is the efficiency from which an exporter can access the international market. Hence,  $\phi_{ij}$ , is the inverse of trade costs and is often used as a proxy of trade costs. The standard gravity model result in two stylized facts; larger countries trade more and countries with high trade costs trade less (United Nations ESCAP, 2013).

As trade research has evolved towards a heterogeneous firm setting, some issues in regards to this standard approach have emerged (see for example United Nations ESCAP, 2013; Andersson and Van Wincoop, 2003). When trade costs decrease between bilateral trading partners in the model above, it will not affect trade with other partners, contradicting heterogeneous firm theory. Also, if this decrease is equal among trading partners, including domestic markets, trade increases for everyone. This implies that trade increases in the domestic market even if relative prices remain unchanged; this is not realistic (United Nations ESCAP, 2013).

To solve these issues, Anderson and Van Wincoop (2003) presented an extended gravity model where trade costs are heterogeneous across suppliers and markets. In this model, countries may produce different kinds of goods and trade costs are usually higher in the international sector, since there is more cost associated with international trade (such as transportation costs) (United Nations ESCAP, 2013), formally;

$$X_{ij} = \frac{Y_i Y_j}{Y} \left( \frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (2)$$

The most notable difference is the inclusion of two new variables,  $\Pi_i$  and  $P_j$ , in a non-linear gravity model where the former is capturing heterogeneous trade costs across markets and the latter is capturing heterogeneous trade costs across suppliers. Further,  $t_{ij}$ , reflect overall trade costs instead of the inverse, as in the standard gravity model. Since trade costs are hard to measure, distance between bilateral trading partners is often used as a proxy. The extended gravity model result in one key implication; changes in trade costs affect trade with all trading

partners due to its effect on relative prices within each market (United Nations ESCAP, 2013).

Summing up, the extended gravity model outlined by Anderson and Van Wincoop (2003) follow the heterogeneous approach outlined by Melitz (2003). We will use its implications in the empirical analysis.

Continuing, we present the estimation strategy used in the empirical analysis and outline our model specification.

### 3.2 Estimation

In a gravity equation, the usual approach is to take logarithms of all variables in its non-linear form and acquire a log-linear model, which is simply estimated by an OLS, formally;

$$\ln X_{ij} = a_0 + a_1 \ln Y_i + a_2 \ln Y_j + a_3 \ln t_{ij} + a_4 \ln \prod_i + a_5 P_j + \varepsilon_{ij} \quad (3)$$

Where, the logarithmic value of bilateral trade,  $X_{ij}$ , is modelled as a function of size,  $Y_i Y_j$ , trade costs,  $t_{ij}$  and heterogeneous trade costs- across suppliers,  $\prod_i$ , and producers,  $P_j$ . Since the survey used in the empirical analysis feature unilateral trade flows, i will re-specify a gravity equation to fit my research question and sample, as several researchers have done in the past (see for example Jienwatcharamongkhol, 2014; Bourdet and Persson, 2010).

A heavily debated issue when estimating gravity equations is how to handle zero trade flows in a given year. It is not unusual in firm-level datasets that some firms have positive trade values in a given year but zero trade values in another year. In a standard linear estimation, as presented above, we take logarithms on the non-linear gravity model, and achieve a log-linear gravity equation. Thus, zero trade values will be dropped since the logarithm of zero is not defined. In trade research, three different approaches have been used to deal with this issue.

First, by simply using a linearized estimation model and drop the zero trade values. This might be correct if the zero trade values are randomly distributed, i.e. if they do not provide any extra information needed in the empirical analysis. If they instead, do contain important information, this approach will generate inconsistent estimates. Second, by adding a constant to these zero trade values before taking logarithms. If these constants do not reflect the

expected values, however, this approach will generate inconsistent estimates. Third, by estimating the gravity equation in levels. Hence, by keeping the dependent variable in its non-logarithmic form we may avoid these zero trade values from dropping out (UNCTAD and WTO, 2012). Which approach might fit our dataset?

Since the survey used in the empirical analysis feature unilateral trade flows in a given year, zero trade values simply reflect missing answers, with an unknown causality. Nevertheless, they might contain important information needed to acquire consistent estimates. Therefore, we will estimate a gravity model in levels to avoid the zero trade values from getting dropped. What estimation strategy might fit this approach?

In *table 5* in appendix, it can be seen through a Bresuch-Pagan test that heteroskedasticity is present in our dataset, which is likely in trade data. To still achieve robust estimates, we will use a (Pseudo) Poisson Maximum Likelihood (PPML) estimation presented by Silva and Tenreyro (2006). It is an estimation strategy, which can be used on levels of trade, directly on the non-linear form of the gravity model where zero trade values are not dropped and independent variables may still be interpreted as elasticity's. They argue that even if heteroskedasticity is present in our data, it will still generate robust estimates. So, with heteroskedastic data within our dataset, PPML estimation might not be optimal, but it will still be efficient. Furthermore, it is used by a large amount of researchers to deal with zero trade flows (see for example Bourdot and Persson, 2006; Westerlund and Wilhelmsson, 2006), formally;

$$\sum_{i=1}^n [y_i - \exp(x_i\beta)]x_i = 0 \quad (4)$$

It is assumed that the variance of the dependent variable,  $y_i$ , for a given value of the explanatory variable,  $x_i$ , is constant and the PPML estimator give the same weight to all observations rather than focusing on observations where the expected value of  $x_i$  is large, since observations with a large expected value is compensated by a larger variance. So, all that is needed for this estimator to be consistent is a correct specification of the conditional mean. Thus, it will work for all various types of data distributions (Silva and Tenreyro, 2006)

### 3.2 Model Specification

I will model import intensity of firm  $i$  to country  $j$  as a function of firm productivity in a gravity equation, while controlling for various firm- and industry characteristics to acknowledge that trade costs vary across suppliers and markets in a heterogeneous firm setting (as outlined by Melitz, 2003; Andersson and Van Wincoop, 2003), formally;

$$IMP_i = \gamma_1(Firmprod_i) + \gamma_2(EXP_i) + \gamma_3(Firmsize_i) + \delta_i + \varepsilon_i \quad (5)$$

The dependent variable,  $IMP_i$ , reflects import intensity and is included in levels. The main independent variable,  $Firmprod_i$ , reflects firm productivity and is included in logarithms. To control for heterogeneous firms we include various firm-characteristics. The size of the firm,  $Firmsize_i$ , is included in logarithms while export intensity,  $EXP_i$ , is included in levels to avoid zero trade values from dropping out.

Since this model feature unilateral trade flows, and trade costs are different across suppliers, aggregating import activities over suppliers might yield biased results. Therefore, we include industry-specific dummies,  $\delta_i$ . Furthermore, since trade costs also differ across markets, aggregating import activities over markets might also generate biased results. However, due to lack of information regarding trading partners, we do not have the possibility to include country-specific dummies. We will keep this in mind when we interpret the estimation results (UNCTAD and WTO, 2012).

Continuing, we present the dataset and variables used in the empirical analysis.

## 4 Data

*This chapter provides a detailed description of our survey and variables used in the empirical analysis.*

Data for the empirical analysis are taken from the World Bank Enterprise Surveys that contain survey data at firm-level in different locations and at different times (The World Bank, 2014).

### 4.1 World Bank Enterprise Survey

The surveys created by (The World Bank, 2014) contain various country-specific questions and collect information regarding business environment, firm characteristics and firm constraints. It uses a standard questionnaire that is sent out to a chosen sample and is usually

answered by the business owners. To determine what sample to include they use a stratified random sample where all firms are divided into groups and random samples are drawn from each group. By using a random sample, it corrects for selection issues of regions, size of the firm and industries.

The purpose of this paper is to investigate the relationship between import intensity and firm productivity in the Swedish manufacturing sector. The World Bank (2014) only has one survey available at firm-level in the Swedish manufacturing sector. Hence, we will use this survey obtained during 2014 where they questioned 313 manufacturing firms in Sweden with a wide variety of questions regarding firm characteristics and business environment. In 38 of these firms, however, one or more questions needed in the empirical analysis were left unanswered, forcing us to drop these firms. Hence, in the empirical analysis we have a total of 275 manufacturing firms.

To account for an unbiased sample, we investigate the composition of firm size and engagement in trade. In *table 2* in appendix it can be seen that 73 firms in the sample are small, with less than 20 employees. 136 firms are of medium size and have between 20-99 employees while 66 firms are large and have above 100 employees. This, together with the fact that 76% of the firms are engaged in two-way trading (as can be seen in *table 1* in appendix), imply that most of the chosen manufacturing firms in the sample follow heterogeneous firm theory where traders should be large and high productive (as argued by Melitz, 2003).

## **4.2 Variable Description**

Here, we outline a detailed description of all variables used in the empirical analysis.

### **4.2.1 Import Intensity**

As mentioned in the introduction, there is a limited amount of research investigating the relationship between import intensity and firm productivity. Nevertheless, recent findings elucidate the importance of import intensity as a driver of firm productivity on the amount of goods exported. Therefore, as previous studies have done in the past (see for example Jienwatcharamongkhol, 2014) we will use it as the dependent variable. It is calculated as amount of imports to firm  $i$ . To calculate this variable, we made a ratio of the question “Costs of materials and inputs used in production” in annual total SEK and “Percentage of material and inputs used in production of foreign origin”, annually. Thus, this ratio gives us the total

value of imported materials and inputs used in production of foreign origin and will be used as a proxy for import intensity in a given firm. This will be included in the main estimation in levels to control for zero trade flows.

#### **4.2.2 Firm Productivity**

Since the purpose of this paper is to investigate the correlation between import intensity and firm productivity, we will use firm productivity as our main independent variable in the empirical analysis. In previous research, many different measurements of firm productivity have been used. In this paper, it will be estimated as labour productivity (i.e. total sales as a ratio of total number of employees). This may be simplified way of expressing firm productivity but due to lack of data we cannot use more advanced measures of firm productivity, such as value added per employee, total factor productivity (TFP) or gross-value added per employee. To calculate this variable, we made a ratio of the question “total annual sales” in SEK and “total number of employees”, annually. It is included in logarithms in all estimations.

#### **4.2.3 Firm Size**

As mentioned in chapter 2, firms are heterogeneous and experience varying trade costs. To control for differences in firm size of the included manufacturing firms we include this as a control variable. Hence, it can be seen as a proxy for trade costs since large firms usually trade more, implying larger trade costs (Melitz, 2003) To calculate this variable, we included a question of “total number of employees”, annually. It is included in logarithms in all estimations.

#### **4.2.4 Export Intensity**

To further control for heterogeneous firms and varying trade costs we have chosen to include export intensity as well. It is often used as a proxy for firm size since countries exporting more are usually larger (Melitz, 2003). This variable is calculated as a ratio from the question “Total annual sales” in SEK and “% of direct exports”, annually. This is included in levels in the main estimation to control for zero trade flows.

### **4.3 Summary Statistics**

In *table 2* in appendix the summary statistics of the variables above are shown. Here, they are entered in non-logarithmic form. First, we may note that an average firm have approximately 156 employees, giving evidence to the assumption made in chapter 2, that the manufacturing firms within our sample are large and high productive in accordance with heterogeneous firm theory, since 76% of these are engaged in two-way trading. Furthermore, it may be interesting



to note that the main independent variable, Firm productivity, ranges from 492000 in total SEK to 200 000 008 in total SEK. The mean is around 35 000 006 in total SEK and standard deviation is 12 850 007 in total SEK. Hence, our standard deviation is smaller than our mean, indicating a dataset clustered around the mean.

#### 4.4 Correlation Matrix

In table 3 in appendix the correlation matrix of the variables above are shown. Here, the dependent variable indeed shows some correlation with both control variables. Which is not unexpected since they are measured from similar questions. Furthermore, the included control variables are strongly correlated with each other, leaving us to believe that one of these can be excluded in the estimation since both measure size of a firm with a different approach. We will include various robustness checks in the empirical analysis to control for this.

#### 4.5 Data-Related Issues

Since the survey used in the empirical analysis is very limited in terms of questions and/or answered questions it was not possible to include more control variables needed in the estimation. To further control for heterogeneous trade costs across markets we would like to include country-specific dummies and country-specific characteristics (such as GDP and population to capture differences in market size and market demands across trading partners). Furthermore, more control variables could be included to control for heterogeneous trade costs across suppliers (such as corporation). Hence, if a firm is part of a bigger corporation it is possible that it may decrease trade costs without engaging in trade. Also, to proxy trade costs in a more realistic way, in comparison with firm size and export intensity above, a variable of distance between trading partners could ideally have been used.

## 5 Results

*This chapter presents our estimation results. When appropriate we relate our results to previous findings and make suggestions for future research. To account for accuracy in these findings, we include various robustness checks.*

In table 6;column 1, the main findings in a PPML estimation are presented. For Import intensity, we notice that the main independent variable, Firm productivity, show positive and significant coefficient at the 1% level. This confirms our hypothesis and suggests that an increase in firm productivity will lead to a positive impact on import intensity. Hence, an increase in firm productivity by 1% would on average make import intensity increase by 1,189%. If we look at the control variables, all of them are significant. Firm size show a

positive sign and imply that larger countries import more, in line with heterogeneous firm theory. A 1% increase would on average make import intensity increase by 0,938%. Export intensity, on the other hand, show a negative sign and imply that an increase in the level of export intensity would decrease the level of import intensity, contradicting previous findings as export intensity is often included as a proxy for firm size and should yield similar results (see for example Jienwatcharamongkhon, 2014; Forlani, 2012). However, as confirmed by the correlation matrix in chapter 4, firm size and export intensity are highly correlated. Hence, they might include similar information. To control for this, we include an additional PPML estimation where export intensity is included independently. In *table 6; column 7* it can be seen that this changes the sign of the coefficient, now in line with previous findings. Furthermore, the correlation between import intensity and firm productivity is still positive and imply that a 1% increase in firm productivity would on average make import intensity increase by 0,762%.

Continuing, before making various robustness checks, we may relate our findings to previous research and make some suggestions for future research. Forlani (2012) found a similar correlation between import intensity and firm productivity in the Irish manufacturing sector, where a 1% increase in import intensity would on average make firm productivity increase by 1,2%. Therefore, by finding a positive and significant relationship of import intensity on firm productivity in this paper, and by arguing that the Irish manufacturing sector are similar to the Swedish one in terms of business environment and suppliers, we can make similar arguments as Forlani (2012).

Thus, an increase in import intensity generates a productivity enhancing effect on the amount of exports, but in line with Melitz (2003) and Forlani (2012), only benefits high productive firms. To show this within our sample, we include an additional PPML estimation with a re-specification of the model in line with Forlani (2012). In *table 6; column 4*, firm productivity is the dependent variable with import intensity as main independent variable. In this setting, the sign and significance of the coefficient remain unchanged in comparison with the main estimation. Hence, an increase in import intensity generates a productivity enhancing effect, giving evidence to the arguments outlined above.

Building on this finding, Jienwatcharamongkhon (2014) and Aristei, Castellani and Franco (2011) argued that exporters are forced into importing due to trade costs at the international

market since importing may induce a learning effect, which, in turn, decrease trade costs (as argued by Melitz, 2003). Thus, our finding of a productivity enhancing effect from increasing import intensity might decrease these trade costs even further; making firms more efficiently gain access to the export market.

Summing up, my findings show a positive correlation between import intensity and firm productivity, confirming my initial hypothesis. Furthermore, in relation to previous research, we find that there is a productivity enhancing effect from increasing import intensity in the Swedish manufacturing sector during 2014 but only high productive firms may exploit this benefit. For low productivity firms to gain access to this benefit, they need to cross the productivity verge (Melitz, 2003) by improving their productivity through import participation. Thus, for future research, there is a need to investigate the direction of causality between trade intensity and firm productivity further to make any valid policy proposals. What is clear, on the other hand, is that a decrease in trade restrictions might help low productive firms get more competitive at the international market.

### 5.1 Robustness Checks

To assess the reliability in our estimates, we have made various robustness checks. First, we follow approach 1 outlined in chapter 3, to use an OLS estimation and let the zero trade values get dropped. Here, we include all variables in logarithms. In *table 6; column 2* it can be seen that the main independent variable, firm productivity, is still positive and significant and imply that a 1% increase in firm productivity would on average make import intensity increase by 0,933%. Looking at our control variables, firm size also show a positive and significant coefficient, where a 1% increase in firm size would on average make import intensity increase by 1,023 %. Export intensity, on the other hand, turns out to be insignificant. So, when we let 65 zero trade values get dropped in an OLS setting, estimation results are similar to our main findings, but generate a lower effect on imports intensity from firm productivity and a larger effect from firm size.

Second, we follow approach 2 outlined in chapter 3, to use an OLS estimation and add a constant of 1's to all zero trade values in it's non-logarithmic form to prevent them from being dropped. Here, we include all variables in logarithms. In *table 6; column 3* it can be seen that the main independent variable, firm productivity, still show a positive and significant coefficient, where a 1% increase in firm productivity would on average make

import intensity increase by 0,803%. Looking at our control variables, firm size also show a positive and significant coefficient, where a 1% increase in firm size would on average make import intensity increase by 1,171%. Export intensity is also positive and significant, where a 1% increase in export intensity would on average make import intensity increase by 0,203%. So, when we add a constant of 1's to avoid the zero trade values from getting dropped, estimation results are similar to our main findings, but generate a lower effect on import intensity from firm productivity, a higher effect from firm size and a change in sign from export intensity.

Third, as mentioned in the previous paragraph, we made three estimations with a re-specification from Forlani (2012) where firm productivity is the dependent variable and import intensity is the main independent variable. We base these estimations on the same zero trade approaches, as outlined in chapter 3. In *table 6; column 4-6* it can be seen that the relationship between import intensity and firm productivity is still positive and significant in all estimations, and imply that an increase in import intensity generates a productivity enhancing effect. However, the effect is lower in comparison with our main estimation.

Finally, we notice that the R2 value of the PPML estimation (*table 6; column 1*) seem to fit the data better than both OLS estimations (*table 6; column 2-3*) since it is approximately 80% in the first case, 71% in the second and 36% in the final case. Since we use the same specification of variables in these estimations, where the only difference is the inclusion of logarithms, it seems likely that a change in estimator strategy can be important to pick up as much information as possible from our data. When we change dependent variable in *column 4-6*, it can be seen that R2 are highest for the OLS setting where we let zero trade values get dropped.

## 6 Conclusion

This paper investigates the correlation between import intensity and firm productivity based on a sample of 275 manufacturing firms in Sweden in 2014 by using a Pseudo Poisson Maximum Likelihood estimation model. My findings imply that there is a positive and significant effect between import intensity and firm productivity, confirming my hypothesis, and findings from previous research (see for example Forlani, 2012; Jienwatcharamongkhol, 2014; Andersson, 2013).

As can be seen in the main estimation (*table 6;column 1*) a 1% increase in firm productivity would on average make import intensity increase by 1,189%. At first glance, these effects might seem small but since the Swedish manufacturing sector consists of around 50 800 manufacturing firms (SCB, 2015), an aggregation of the productivity effect on all trading firms would be large and significant for the entire economy.

By establishing a positive and significant correlation between import intensity, this paper does not further distinguish the direction of causality. Nevertheless, it argues, in line with previous findings and heterogeneous firm theory (see for example Forlani, 2012; Melitz, 2003) that there is a productivity enhancing effect from increasing import intensity (see *table 6;column 4-6*) but only high productive firms may exploit this benefit. For low productive firms to acquire this benefit, they need to increase their productivity through import participation.

To assess the reliability in our estimates, we made several robustness checks. First, we let all zero trade values get dropped in an OLS setting (*table 6; column 2*). Second, we added a constant of 1's to the non-logarithmic value of our variables (*table 6; column 3*). Third, we made a re-specification of the estimation model in accordance with Forlani (2012) and estimated using the same approaches as above (*table 6;column 4-6*). Finally, we excluded firm size and included export intensity independently, since they were correlated, as a proxy of firm size (*table 6;column 7*). All different robustness checks provided positive and significant coefficients of the main independent variables.

For future research, a large comprehensive study stretching over several years in the Swedish manufacturing sector is needed to determine direction of causality from increasing import intensity on firm productivity to make reliable policy proposals. Nevertheless, I have provided some new evidence in the Swedish manufacturing sector during 2014. Even with such a small sample, it might be possible to argue that it reflects the entire sector, due to its similarities with other more comprehensive studies (see for example Jienwatcharamongkhol, 2014; Forlani, 2012).

Thereby, policy reforms should be directed at decreasing trade restrictions, especially towards imports. This might help low productive domestic markets increase their competitiveness at the international market, increasing firm productivity to the point where they cross the productivity verge and enter the export market. In aggregation, this might improve the

economic growth and overall wealth of the entire economy. Finally, all my findings need to be interpreted with caution since the survey used in the empirical analysis is fairly small and did not contain perfect information regarding firm productivity, firm characteristics and country characteristics. In most cases, various proxy's had to be constructed.

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## Appendix

**Table 1: Amount of manufacturing firms engaged in trade (2014)**

	Non-Importers		Importers	
	Firms	%	Firms	%
Non-Exporters	14	5,09	47	17,09
Exporters	4	1,45	210	76,36

**Note:** All columns with the label “%” are a percentage of 275 manufacturing firms in Sweden in 2014.

**Table 2: Composition of manufacturing firms in Sweden (2014)**

Size(employees)	Number of firms
Small(<20)	73
Medium(20-99)	136
Large(100 and over)	66

**Note:** In total, 275 manufacturing firms.

**Table 3: Summary Statistics**

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Firmsize	275	156.7	1,008	3	16,533
Firmprod	275	3.506e+06	1.285e+07	491,803	2.008e+08
EXP	275	5.276e+08	6.589e+09	0	1.093e+11
IMP	275	9.107e+07	2.887e+08	0	3.354e+09

**Note:** All variables are entered in non-logarithmic form.

**Table 4: Correlation Matrix**

	IMP	EXP	Firmprod	Firmsize
IMP	1.0000			
EXP	0.7079	1.0000		
Firmprod	0.1532	0.0197	1.0000	
Firmsize	0.7471	0.9877	0.0131	1.0000

**Note:** All variables are entered in non-logarithmic form

**Table 5: Breusch-Pagan Test for Heteroskedasticity**

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Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance  
 Variables: fitted values of IMP

chi2(1) = 159.33  
 Prob > chi2 = 0.0000

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**Note:** All variables are entered in non-logarithmic form

**Table 6: Estimation Results**

VARIABLES	(1) IMP	(2) lnIMP	(3) lnIMP	(4) Firmprod	(5) Firmprod	(6) Firmprod	(7) IMP
Firmprod	<b>1.189***</b> (0.116)	<b>0.933***</b> (0.317)	<b>0.803*</b> (0.416)				<b>0.762***</b> (0.155)
EXP	-1.84e-11*** (3.32e-12)			-2.34e-12*** (6.84e-13)			2.84e-11*** (1.81e-12)
Firmsize	0.938*** (0.0648)	1.023*** (0.107)	1.171*** (0.155)	0.00200 (0.00322)	-0.460*** (0.0860)	0.0762 (0.0530)	
lnEXP		0.0534 (0.0723)	0.203*** (0.0491)		0.237*** (0.0551)	0.00682 (0.00870)	
IMP				<b>9.93e-11***</b> (2.51e-11)			
lnIMP					<b>0.198***</b> (0.0419)	<b>0.0288*</b> (0.0163)	
Constant	-3.892** (1.790)	-1.771 (3.834)	-3.312 (5.806)	2.661*** (0.0125)	8.994*** (0.478)	13.71*** (0.189)	6.856*** (2.299)
Observations	275	210	275	275	210	275	275
R-squared	0.803	0.713	0.375	0.220	0.523	0.104	0.470

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Note:** Industry dummies are included but not reported. Coefficients of the main independent variables are in **bold**. Three different approaches are used: **First**; linearized estimation dropping zero trade values, **Second**; linearized estimation by adding a constant of 1's **Third**; PPML estimation in levels. The third approach, which is used in the main empirical analysis, can be seen in *column 1* with the main model specification and further in *column 4* with model specification outlined by Forlani (2012). To further control for robust estimates, the first and second approach to zero trade flows are also included. The first approach can be seen in *column 2* with the main model specification and *column 5* with the specification by Forlani (2012). The second approach can be seen in *column 3* with the main model specification and *column 6* with the specification by Forlani (2012). Finally, in *Column 7*, we excluded firm size due to correlation with export intensity, EXP, as a robustness check in the main model specification.