Exporting and Wages: an Analysis Using Linked Employer-Employee Data for Hungary, 2002-2011

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Abstract

This thesis investigates the relationship between trade and the labor market. In particular, it examines whether workers employed by firms which export receive higher wages than those employed by firms which sell only domestically. The literature up to date shows a small but significant exporter wage premium.

The data for the empirical estimation comes from a large linked employer-employee dataset for Hungary for the years 2002-2011. Applied to this rich dataset, the estimation procedure can account for a large set of firm and worker characteristics, as well as to look for a differential effect across worker types. In addition, the paper attempts to address the issue of self-selection of firms into trade, using panel data methods and a matching approach.

The study finds that, on average, exporters pay substantially higher wages. When firms and worker characteristics are taken into consideration, the difference remains positive and significant, but it declines markedly. The premium differs across workers: women are paid less, and workers with high education and skill – more, by exporters. When self-selection is also taken into account, the effect of exporting on wages becomes negative, but its magnitude is very small.

Overall, the paper fails to find evidence in support of the existence of an exporter wage premium.

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1. Introduction

The present thesis is part of a growing body of research on the wages paid by firms that export as opposed to those that always sell domestically. The identification and understanding of such differentials is important in view of the rising trade volumes throughout the world over the past decades, and the increasing internationalization of production and jobs. As a result of the global liberalization of trade, policies affecting the export behavior of firms have strong implications for the domestic labor market. If an exporter wage premium exists, and it is the result of export activity, domestic policies which encourage companies to sell abroad may have a positive effect on labor productivity and wages throughout the economy. If such a premium exists, but it is the result of self-selection, then encouraging exporting will simply reward firms that over-perform in any case, and it will have little bearing on long-term labor productivity (Bernard and Jensen, 1995). If no exporter wage premium exists, then trade liberalization policies will have little effect on wages (although they may still influence the labor market through employment). Furthermore, it is likely that if an exporter premium (or discount) exists, it will differ across groups of workers. Thus, the export activity of a firm may have implications on the gender wage gap, the returns to education and on the skilled-unskilled wage differential. In this context, trade-related policies may also alter the composition of the labor market.

With the empirical work of Bernard and Jensen (1995), it has been recognized that exporters pay, on average, higher wages. Additional research using more detailed data and various methodologies has followed; the evidence to date has been focused on Western economies, for the years prior to the Great Recession. The results confirm the existence of a small wage premium even after controlling for disparities in firm characteristics and worker attributes. However, there is no consensus whether the higher compensation is a result of exporting per se, or it is a consequence of self-selection of more productive firms into trade.

The purpose of the present research is to check for the existence of a differential between the wages paid by firms that export and those that sell only domestically in an Central European country – Hungary. The thesis will complement existing research in analyzing a time period which includes the recent financial crisis. Special attention will be paid to addressing the role of self-selection in examining the exporter wage premium.

As an additional note, a growing body of literature has recognized that the effect of international trade on labor productivity and wages is not channeled solely through exports. Imports are found to be at least as important (Martins and Opromolla, 2009; Koren and Toth, 2013). Furthermore, off-shoring is considered to bring about considerable benefits for firms (Hummels et al., 2011). These areas of research are outside the scope of the present paper. Despite the high correlation between exports, imports and off-shoring, this study will focus on the implications of export activity only.

The analysis will be based on a large linked employer-employee dataset (LEED) for the period 2002-2011. The paper will first ask if, on average, exporters pay significantly more. Then, a set of equations will explore a number of firm and worker characteristics so as to distinguish the effect of exports from that of other wage determinants. The thesis will additionally outline the dynamics of the exporter wage premium throughout the period, and it will ensure that the results are robust to other variable definitions and specifications. The analysis will also check whether the exporting activity of the firm has a different effect across groups of workers defined by gender, education and occupation.

The methodology will first use simple Ordinary Least Squares (OLS) regression techniques. Then, the econometric procedure will attempt to account for unobservable firm heterogeneity and self-selection of more productive firms into exporting. Since firms can be followed in the dataset, fixed effect regressions will demonstrate the effect of a change in the exporter status for workers within the same firm. In addition, a matching approach will be

used to generate two sets of firms, export starters and non-exporters, with similar initial characteristic. The non-exporters will be used as a control group for their peers that enter the foreign market. This approach will give tentative evidence on the causal effect of exporting on wages.

The paper will be organized as follows. Chapter 2 will summarize the theoretical and empirical arguments underpinning the exporter wage premium. Chapter 3 will give a brief overview of aggregate trade data for Hungary for the period of observation. Chapter 4 will provide information on the LEED for Hungary, on the variables of interest and on the sample used. Chapter 5 will show summary statistics for firm- and worker-level data. In Chapter 6, the core methodology of the paper will be explained. Chapter 7 will report basic regression results, robustness checks, and estimates for different groups of workers. Chapter 8 will focus on the application of propensity score matching, outlining the procedure and findings. Chapter 9 will conclude.

2. The exporter Wage Premium. Theory and Evidence

This chapter will summarize the theory and evidence behind the existence of an exporter wage premium. First, the main theoretical arguments predicting the existence of a wage differential will be outlined. Then, the chapter will continue with an overview of existing empirical studies, their use of data and their main findings. The chapter will conclude with methods for treating self-selection used in the literature.

2.1. Why do exporting firms pay higher wages

Research has established that exporters pay, on average, higher wages than firms that produce only for the domestic market. The reasons for the difference, however, are subject to discussion. In the literature, there are two basic lines of argument as regards the exporter wage premium.

One concerns **firm characteristics**, arguing that exporters are also "better" firms – they are larger, more productive and more capital and skill-intensive. As a result, and on the condition of rent-sharing, they can afford to pay higher wages. Even when a correlation between a firm's export activity and productivity (and thus – wages) can be established, the causality may run in both directions. Exporting may be the reason for a firm to be "better", or a symptom of it being more productive.

According to the causality argument, there are direct gains accrued from starting to export. Exporting firms have access to wider markets. They consequently have the incentive to invest more in capital and research along their comparative advantage, increasing the returns to labor (Schank, Schnabel and Wagner, 2007). Furthermore, the wider market allows firms to grow and expand their activity, as well as to utilize capacity more efficiently. As firms grow, they are more likely to provide for better job matching, to pay efficiency wages (so as to deter shrinking) and to share rents (accrued as a result of economies of scale in the

presence of fixed costs of production) (Oi and Idson, 1999). Additionally, the fiercer competition on the international scene compels firms to perform better so as to survive (Bertrand and Wagner, 1997). Intensive competition in this sense raises the threshold for firm exit. As less efficient firms drop out faster among non-exporters, the productivity of the average firm increases (Sampson, 2012).

Another explanation rests on the assumption that firms face an upward sloping labor supply curve. It has been established that exporters are larger, grow faster and are more productive. To attract the necessary amount of additional labor as demand increases, they need to pay higher wages (Schank et al., 2007). For example, in an analysis of the US economy, Bernard and Jensen (1995) establish that employment in exporting plants increases the demand for skilled labor, thus contributing to the gap between high- and low-skilled workers.

According to the alternative, self-selection argument, exporting may be a symptom, and not a cause of higher productivity. Thus, the observed differential stems from the choice of high-productivity firms to engage in trade. A leading theory, developed theoretically by Melitz (2013), is that establishing an export activity is costly. It is only the most productive firms that can afford to pay the fixed costs of exporting, and thus they self-select themselves into trade. These costs are incurred while researching the foreign market, adapting products to new regulations, overcoming language barriers (substantial in the case of Hungary) and setting up new distribution channels. Self-selection is a major issue regarding the estimation of the exporter wage premium. It is possible that the observed higher wages, together with exporting activity, are both simply an expression of better performance for other, unrelated reasons. Therefore, it is essential that theories and empirical studies in the area account for observable and unobservable heterogeneity among firms as much as possible.

In addition to firm characteristics, an exporter wage differential may be related to **labor composition.** Thus, the higher wages result from the returns to the observable and unobservable characteristics of workers employed in exporting firms. Employees may experience higher productivity or benefit from rent sharing with exporting; alternatively, it may be that more productive workers that self-select themselves into exporting firms.

Similar to the case of firms, one line of argument emphasizes the direct effect of exporting on worker productivity and compensation. Schank et al. (2007) suggest that the wage premium can be understood in the framework of the efficiency wage theory. In order to be competitive on the international market, firms (at least in countries where skill-intensive industries export) need workers with expertise, experience and firm-specific know-how. To lower employee turnover, these enterprises are therefore willing to voluntarily pay higher wages. Better compensation is also projected to increase the effort and motivation of employees, thus raising their productivity. A similar mechanism, proposed by Verhoogen (2008), is product quality. If the foreign market has a preference for products of higher quality than required for the domestic one, exporters need to pay higher wages so as to induce effort compatible with the superior standards. In a related theory, Sampson (2012) argues that while exporting, firms move up the technology ladder. The shift increases both the demand for and the return to skill, thus raising wages. In addition, firms that export may provide more on-the-job training so as to increase employee performance, which is likely to, over time, be reflected in wages.

In addition, exporting may change the composition of the workforce. If exporters employ on average more educated and skilled workers, then the estimated wage premium (when controlling for firm characteristics only) could, at least partially, be explained by worker attributes. It would not follow that exporters pay more for human capital, education or skill. In this line of argument, Munch and Skaksen (2006) theorize that exporters in advanced

economies are able to escape strong international competition posed by low-wage countries by employing more skilled workers and producing skill-intensive products.

Finally, similarly to firm-related theories, the existence of an exporter premium may be the result of self-selection of more productive workers into exporting firms based on unobservable factors (Baumgarten, 2010). Methods to try to overcome issues of firm and worker heterogeneity will be discussed after the overview of empirical literature which follows.

2.2. Empirical studies

Traditionally, the theory of international trade has focused on its implications for the aggregate economy or for specific industries. Since the seminal study of Bernard and Jensen (1995), it was recognized that it is firms, rather than states that trade. In their study, the authors look into differences between exporting and non-exporting firms, taking into account heterogeneity in terms of industry, location and other relevant characteristics. Using US **firm-level data** they establish that higher wages are paid by exporting firms even within the same industry. Since then, a large body of literature has documented that higher average wages are paid by firms that engage in international trade (Verhoogen, 2003; Alvarez and Lopez, 2005; Schlank et al., 2007).

However, firm-level analyses do not allow for controls reflecting the features of the labor force in trading versus non-trading firms.[1] Consequently, it is possible that the differential between firm-average wages is driven by worker heterogeneity. Furthermore, it is possible that exporting has a disparate effect on wages across different groups of workers. Therefore, in order to go a step further in understanding the exporter wages premium, recent

[1] Except for firm-level summary variables, such as the share of females, share of high-skill workers, etc.

analyses have taken advantage of the availability of linked employer-employee datasets. With such data it is possible to simultaneously control for both **firm and worker characteristics**.

Most empirical studies to date find a substantial raw wage premium for exporting firms. After controlling for a broad range of worker and firm attributes, the differential declines significantly, but in most cases it remains positive and significant. For example, using Norwegian data, Munch and Skaksen (2006) find that the wage premium exists for exporting firms, although it only accrues to the employees of companies with high skill intensities. For Germany, Schlank et al. (2007) estimate a small but significant premium. In another study on Germany, Baumgarten (2010) establishes the existence and growth of a wage premium for exporters, which can only partly be attributed to human capital endowments. Also for Germany, Klein, Moser and Urban (2010) find a substantial exporter premium for high-skilled workers, and a wage discount for low-skilled ones. Based on Italian data, Macis and Schivardi (2012) find a significant premium for exporters, attributable partly to rent sharing and partly to worker skills, in particular export-related experience.

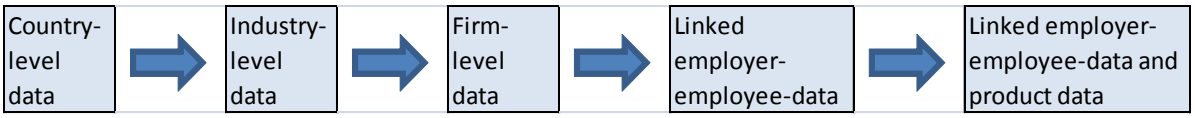
Conversely, after controlling for firm and worker specifics, several studies, fail to find even a small significant wage premium. These include Fafchamps (2008) for a sample of Moroccan firms and Breau and Rigby (2006) for a panel of Los Angeles companies[2].

Finally, a recent strand of literature has taken advantage of rich datasets that allow for disaggregation by the **characteristics of exports**. Looking at product destination countries, Schmillen (2011) finds a significant wage premium for German exporters. However, only shipments over a relatively long distance and to specific countries are associated with higher wages. In a study on Portugal, Martins and Opromolla (2009) analyze the type of product exported. They find that it is firms which increase the production of high-technology items

[2] For an overview of recent studies using linked employer-employee data, see Wagner (2012).

that also pay higher salaries. A table summarizing selected studies on the exporter wage premium using linked data is available in **Appendix A**.

Figure 1. Use of data in empirical studies on the wages paid by exporters



The present paper will focus on the case of Hungary as a small open Central European economy for which detailed data at the firm and worker level is available. There is already some empirical evidence on the labor market implications of trade for this country. Toth (2013) examines how wages are affected by exports, imports and foreign ownership with a focus on different occupational groups for the period 1994-2003. He finds that exporters pay, on average, higher wages. However, when he controls for firm fixed effects, foreign ownership and capital imports, the estimated effect becomes insignificant. For the same period, Koren and Toth (2013) show that firms engaged in international trade are more productive and pay higher wages; furthermore, imports are at least as important as exports. The results vary by occupational group and industry.

2.3. Studies addressing self-selection

As previously mentioned, self-selection is a major issue when analyzing the exporter wage premium. Due to the possibility that firms which are already more productive enter the international market it is not feasible to assume random assignment of the status of an exporter. If indeed exporting is not random, standard regression results will be biased. Due to the observational nature of the data, it is also not possible to compare exporters with a proper control group or to observe counterfactuals (i.e. what would have happened with wages if firms had not started to export). As a result, researchers have devised alternative statistical methods to treat the issue.

One possible technique is to analyze the **performance of firms before they start to trade**. For the US, Bernard and Jensen (1999) look at firm characteristics and find that the causality does not run from exports to productivity. Rather, they find that exporters have higher employment, shipments, labor productivity and wages 2-3 years prior to starting to export. As an alternative, Toth (2011) controls for the possibility of self-selection in the main regression equation by including lagged productivity. He similarly concludes that the wage premium is to a large extent a result of self-selection.

Another way to address the issue is to focus on **exogenous shocks to the incentives to export** using the dynamics of export activity. The idea is that entry into the export market in this case is triggered by an unpredictable event largely unrelated to firm characteristics. Such studies have explored the implications of trade liberalization episodes or sharp exchange rate movements. Examples include Frias at al. (2009), who uses the peso devaluation in Mexico, and Macis and Schivardi (2012), who examine the devaluation of the Italian lira.

As an alternative, researchers can use an **instrumental variable** approach, looking for features correlated with export status, but not with wages. For example, Bernard and Jensen (1995) use export-weighted exchange rates and the income of trade partners as an instrument. Their results show that a positive foreign demand shock leads to more exports by existing exporters, rather than more firms starting to export. In a similar line, Macis and Schivardi (2012) use foreign demand at the region-sector-year level as an instrument. They find a positive exporter wage premium as a result of rent-sharing. Instrumental variables for export and skill intensity are used by Munch and Skaksen (2006).

Rich datasets also allow for the use of **panel-data methods** to account for observed and unobserved heterogeneity. One such method is to compute difference-in-difference estimates (Frias, Kaplanz and Verhoogen, 2009). Regressions on changes, rather

than levels, give more evidence in favor of causality rather than simply correlation. Another option is to add firm or worker fixed effects when the units of observation can be followed over time. This method shows the effect of switching in and out of exporting, singling out the role of time-invariant factors. The method controls not only for observable but also for unobservable characteristics that may be correlated with wages and export status. Based on the available information, panel-data regressions at the firm level can include firm fixed effects (Bernard and Jensen, 1995; Alcala and Hernandez, 2007) or industry fixed effects (Klein et al., 2010). At the worker level, regressions can also include worker fixed effects (Frias et al. 2009; Munch and Skaksen, 2006) or occupation fixed effects (Breau and Rigby, 2006). Finally, spell fixed effects can be included to specify firm-worker matches (Schank et al., 2007; Klein et al., 2010).

As yet another method, researchers have used a **matching approach**, pairing up export-starters and non-exporters based on a propensity score. In this manner, Wagner (2002) finds a positive causal effect of export activity on the growth of employment and wages in Germany, while the effect on labor productivity is less pronounced. Schlank, Schnabel and Wagner (2010) find that it is simply more productive firms that participate in trade, and thus are able to pay more for labor. They establish that the wage premium exists prior to trade, and it does not increase afterwards.

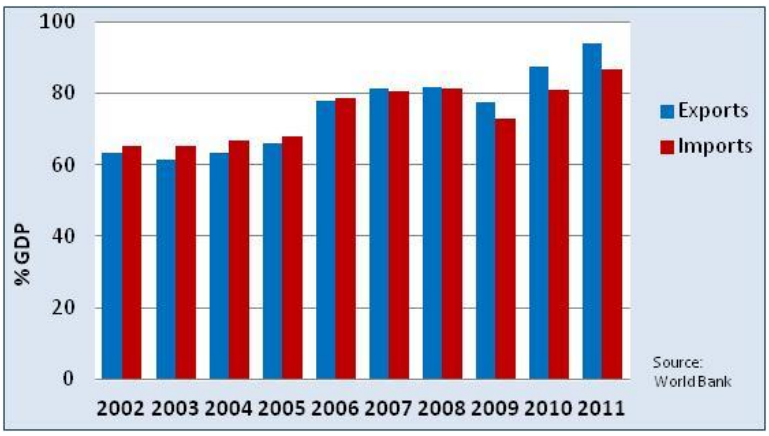
Due to the availability of a large linked employer-employee dataset for Hungary in which firms are linked, the last two solutions, namely panel-data regressions and matching, will be used in the present thesis.

3. Hungary: economy and trade

The present chapter will contextualize the purpose of the research by providing a brief overview of export activity in Hungary, the country of focus, throughout the period of interest, 2002-2011.

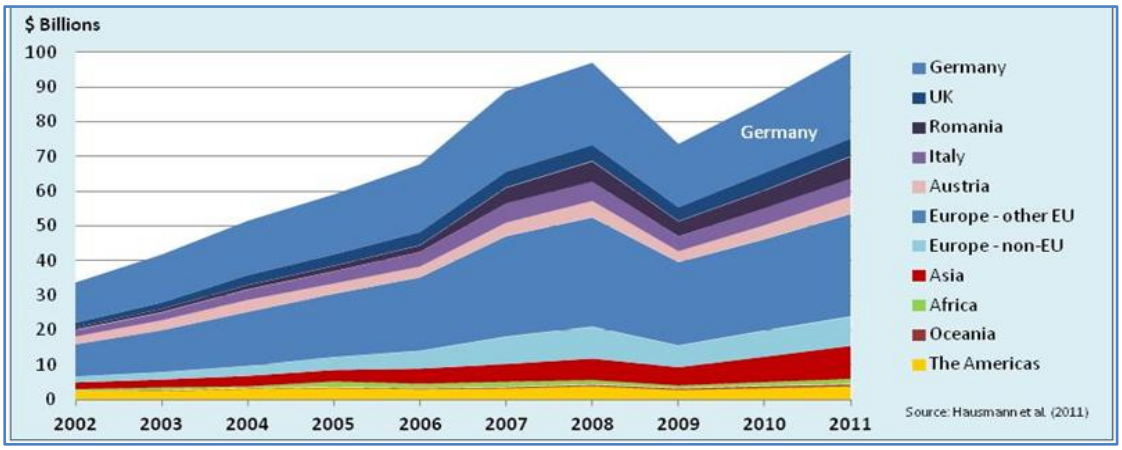
Hungary is a small open economy and a part of the European Union since 2004. Trade is a vital part of economic activity. The gross value of goods shipped outside of Hungary in 2011 was approximately $100 billion. In relative terms, both imports and exports reach over 60% of Gross Domestic Product in the year 2002, and the number has been continuously growing (**Figure 2**). For the period 2002-2008, the gross value of exports grew at an average rate of 18% annually. The year 2009 marked a steep decline of 23%. The years 2010 and 2011 saw a strong recovery, with exports reaching and slightly surpassing their pre-crisis levels (Hausmann et al., 2011). A similar trend: of strong growth, a steep decline in 2009 and a quick recovery afterwards, is observed when examining data on export volumes as well. This shows that the developments were not driven by price or exchange rate fluctuations, but by the Great Recession (World Bank, 2014). As regards net trade balance, at the beginning of the period Hungary is running a small trade deficit. From 2007 until the end of the period, exports exceed imports.

Figure 2. Trade in Goods and Services as % GDP



Hungary has specialized in exporting machines (which account for 47% of total exports), and transportation goods (10% of total exports). The leading products are broadcasting equipment (10%), cars (4.5%), video displays (4.2%), vehicle parts (4%), and packaged medicaments (3.3%) (Hausmann et al., 2011).

Figure 3. Value of Gross Exports from Hungary by Destination



In terms of product destination, the EU is by far the most important trading partner for Hungary (**Figure 3**). As of 2011, approximately 75% of Hungarian exports are sold on the common market. The second most important trading region spans other European states. The value of goods exported to the Americas and Asia is low and stable. For other destinations, the value of exports is very low. At the country level, Hungary's main trading partner is Germany, which is the destination of around 24% of Hungarian goods in 2011. It is followed by Romania (6.2%), Austria (5.1%), the United Kingdom (5%) and Italy (5%). Over the period 2002-2011, there was little change in the relative importance of trading parties, and the drop in 2009 was reflected across all major export markets for Hungary. Among the major trading partners, the hardest hit were the exports to Austria, which dropped by 32%. Least affected were firms exporting to the UK, as their shipments abroad declined by only 13%.

The above summary implies that exports are a vital part of the Hungarian economy. Therefore, from a domestic labor market perspective it is important to examine the role of external trade on the wages of workers.

4. Data

This chapter will describe the dataset used in the thesis. First, the sources and main features of the linked employer-employee dataset for Hungary will be reported. This is followed by an explanation of the construction and choice of an indicator for export activity. The third part will detail the contents and motivation for the firm-level variables that will be used in estimation. The fourth part will do the same for worker-level variables. The last part will comment on the choice of the final sample.

4.1. The dataset

This paper builds on a rich linked employer-employee data for Hungary for the years 2002-2011. The source for the firm-level data is the National Tax Administration of Hungary. It provides information on all enterprises operating in Hungary engaged in double-entry book-keeping. The dataset contains the balance sheet and income statement of companies, as well as basic indicators such as location, industry, employment and ownership. Each firm can be followed over time based on a unique identifier.

The source for the worker-lever data is the Hungarian Wage Survey. It covers a random sample of workers selected differently according to the size of the firm they work for. For companies with less than 20 employees, data on all workers are collected. For firms with more than 20 employees, data are collected based on the birthdates of people. Among production workers, the survey covers those born on the 5^{th} and 15^{th} of each month. Among non-production workers, those surveyed are born on the 5^{th}, 15^{th} and 25^{th} of each month. This selection procedure oversamples non-production workers. As a result, the survey covers around 7% of production and around 10% of non-production workers. Furthermore, due to this procedure, firms with more than 20 employees none of whom born on the respective

dates are also excluded from the data. Thus, the probability of a firm being included increases in the total number of employees. A firm is also not present if it chose not to respond to the survey. To adjust for these disparities and obtain results representative of the entire Hungarian economy, sampling weights, calculated by Earle, Telegdy and Antal (2012), will be used. They reflect the probability of each worker to be in the sample.

The two datasets are then linked to generate the linked employer-employee database used here. Since none of the surveys contains firm names, this is done on the basis of one-to-one matching on firm characteristics (county, detailed industry, employment, and financial indicators such as sales and profits). The dataset has then been cleaned from dubious changes, miscoding and spurious entry and exit (Earle et al., 2012).

4.2. Export variable

The variable for exports can either be continuous, showing the share of exports in sales, or it can be a dummy variable distinguishing between exporters and non-exporters. Bernard and Wagner's (1997) estimates show that the existence, rather than the magnitude, of export activity is associated with wage difference. Schank et al. (2007), on the other hand, find that the exporter/non-exporter status is not important for the wage differential, while the share of exports is. This paper will provide estimates using both variables.

First, the estimated equations will incorporate a dummy variable equal to 1 for firms that export and zero otherwise, in line with Melitz's (2003) theory that exporting entails fixed costs. The majority of studies surveyed classify a firm as an exporter when it exports any positive amount in a given year. This approach is used, for example, by Bernard and Jensen (1995) for the US and Frias et al. (2009) for Mexico. In the case of Hungary, 44% of firms have positive exports throughout the period 2002-2011, and the share of exports in total sales varies widely across firms and over the years. However, for 8% of all firm-years the share of

exports is below 1% of sales. The export activity of such firms can hardly be expected to have a significant impact on wages. Furthermore, such firms are likely to export sporadically and often change their exporter status. Therefore, the main results of the paper will be reported using a definition of an exporter as a firm which exports at least 5% of its sales in a given year (following Koenig, Mayneris & Poncet, 2009). The results will be replicated using alternative definitions of an exporter: a firm that exports over 0%, 1% and 20% of its sales, so as to check whether the conclusions are sensitive to the main definition.

Additionally, the regression equations will be re-estimated using the share of exports in total sales, so as to check whether export intensity has a different effect from that of the status of an exporter.

4.3. Firm-level variables

The data on firm characteristics include key indicators that have been found to be relevant for wage determination. In the database, each company is assigned an individual *identifier*, which allows for following firms over time.

A set of dummy variables is generated to account for which of Hungary's seven *regions* the company is based at.[3] *Industry* is defined by a standard 2-digit NACE Rev.1.1 code. The information is used to generate a set of industry dummy variables that will control for wage differences stemming from the different market in which firms operate.[4] In order to distinguish the effect of ownership structure from that of trade, a dummy variable indicates if a firm is majority *foreign owned*. As Earle et al. (2008) find foreign ownership in Hungary is associated with a significant wage and productivity premium, both as a result of selection and in terms of increased post-selection gains. Further, foreign owned firms are more likely to be

[3] Location is included following Bernard and Jensen (1995), who demonstrate a persistent inter-regional wage differential after controlling for other characteristics.

exporters, since they have more expertise related to international markets. *Firm age* is calculated as the year of observation minus the year of establishment. It is included in the estimation, because older firms have probably survived longer due to higher productivity. Moreover, their employees are likely to have longer tenure (by definition).[5]

The above variables are expected to be largely exogenous to the exporting-wage relationship, and they will enter the initial regression. At a second stage, the *size* of a company, measured as the natural logarithm the number of employees,[6] is included. With economies of scale, larger establishments are expected to be more productive and therefore to pay higher wages in the presence of rent-sharing (Oi and Idson, 1999). This variable, however, is likely to be endogenous – as firms export they grow and thus may be able to pay more for labor. If this is the case, the estimated coefficients will be biased, since they will in fact reflect a size-wage relationship. In order to mitigate this effect, three broad size classes are defined: *small* (less than 50 employees), *medium* (50-249 employees) and *large* (above 250 employees).[7]

Other variables which have been used in studies include enterprise revenue, profits, and capital (Breau and Rigby, 2006; Schank et al, 2007). However, these are likely to be some of the key mechanisms through which exporting activity affects wages. Therefore, these indicators are not included as controls.

4.4. Worker-level variables

The worker characteristics are defined as follows. *Wage* is the worker's monthly base compensation, plus overtime pay and allowances paid in May of the respective year. The

[4] Krueger and Summers (1988) show that even after controlling for worker traits and unobserved ability, there is a large and significant wage differential across industries.
[5] For a discussion, see Brown and Medoff (2001).
[6] Following the methodology of Schank et al. (2007).
[7] The classification is based on OECD's (2002) Frascati Manual.

variable also incorporates end-of-year bonuses adjusted for the date of entry of the worker. The natural logarithm of the resulting compensation indicator is used as the dependent variable in the regression analysis.

In line with the standard Mincer (1974) equation, *experience* (and its square, due to diminishing returns) and *education* will enter the regression. Years of potential market *experience* are expressed as age minus years of education minus 7. *Education* is defined via four dummy variables for each level of education. The categories included are: vocational education, high school diploma, and university degree. The omitted category is elementary school. *Gender* is accounted for, since women are expected to have lower earnings, even controlling for observable human capital (Becker, 1985). It is defined as a dummy variable that takes on the value of 1 of the individual is a female. While the sample covers only full-time employees, *working hours* are used to account for overtime work.

As a next step, the regression will control for the *occupation* of a worker, as a proxy for ability and returns to skills. *Occupation* is indicated by nine broad groups. The ones included in regression analysis are managers, professionals, technicians, office workers, services workers, agricultural workers, employees in industry and construction, and machine operators. The base group covers occupations for which no special skills are required. However, this variable is likely to be endogenous to the exports-wage relationship if the skill structure of labor in exporting firms is different. Therefore, occupation will first be accounted for by dividing workers into two broad skill classes. Following Riker (2010), *white-collar* workers are those classified under the first two occupational groups: managers and professionals. All the rest of the workers will be considered *blue-collar*. Finally, dummy variables for each occupational group will enter the analysis in a separate regression, together with other endogenous indicators.

4.5. Final sample

The total number of worker-years is 1,388,575. However, a number of them have been excluded as a result of sample selection or due to missing data.

First of all, the present topic will be restricted to firms operating in industries corresponding to codes 15-74 of NACE Rev.1.1. Firms in agriculture, mining, public administration and defense, education, and health and social work are dropped out of the analysis, since the mechanisms through which exports may impact wages are different. Excluded are also observations with no data on location, size (employment) and ownership (foreign vs. domestic). As regards worker data, observations with missing information on wage and experience were disregarded. The sample is restricted to full-time workers only. Further, workers with wages below the minimum wage for Hungary in any given year were deleted.[8] Finally, very small firms with one or no employees are excluded. After minor additional adjustments, the final sample is an unbalanced panel dataset with 1,107,664 worker-years, for workers employed in a total of 24,398 firms.

[8] Historical data on minimum wages were obtained from the OECD (2014) database.

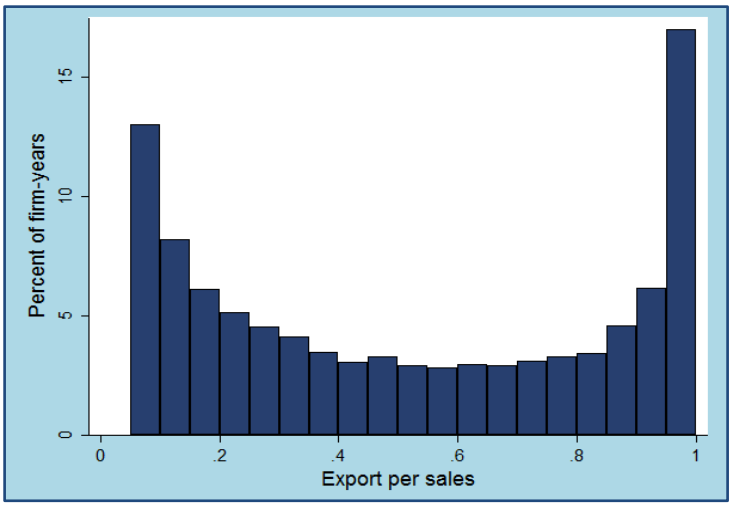
5. Summary statistics

After the dataset was introduced, and the content of main variables – explained, this chapter will provide summary statistics. First, descriptive statistics on export status and activity will be presented. Next, the key firm and worker characteristics will be compared for exporting versus non-exporting enterprises, using the main definition of an exporter.

5.1. Export variable

As previously mentioned, in the main analysis exporter status has been assigned to firms which export at least 5% of sales on a given year. Thus, the sample is divided into non-exporters and exporters. The share of exports in sales for the former is close to zero, despite the 5% condition, suggesting there are not many firms below but close to that threshold. For exporters, the average share of exports in total sales is 52%. The share is rather stable over time, with a minimum of 50% and a maximum of 54% in a given year. The histogram in **Figure 4** shows the distribution of firm-years based on the share of exports, looking at exporters only.

Figure 4. Histogram: Export share for exporting firms



As regards the exporter variable, it is important for the estimation procedure that there is enough variation among companies, i.e. that there are enough firms assigned to each exporting status. In order to use the longitudinal structure of the data, it is also essential that there is a sufficient number of companies switching their export status over the years. **Table 1** shows summary data for the dynamics of export status.

Table 1. Firms' export status

	Started exporting	Stopped exporting	Always exported	Never exported
2002	-	-	1595	4195
2003	122	145	1467	3900
2004	96	96	1551	4430
2005	204	135	1574	4633
2006	202	118	1462	4223
2007	202	118	1493	4074
2008	188	151	1472	3992
2009	202	156	1471	3848
2010	221	200	1630	5036
2011	213	128	1601	3813
Number of firm-years	**1650**	**1247**	**15316**	**42144**

Throughout the period, 23% of firm-years are accounted for by enterprises which export in every year of observation, and their share is stable over the period. A total of 62% of firm-years correspond to firms that never sold abroad. In each of the years, between 2% and 3% of firms in the sample switch into exporting. The same is true for firms that switch out of exporting. The share of firms that stop exporting is somewhat higher (by 0.6%) than that of firms which enter the foreign market. Among firms that switch between selling abroad and not, the average number of switches is 1.5. The maximum number of switches in and out of exporting is 5, but this is the case for only a few firms. For the firms that switch between exporting and non-exporting, the average length of exporting is 3.1 years, while they remain in the sample for an average of 3.7 years.

5.2. Firm-level data

The final sample contains data on 67,650 firm-years, for 24,398 unique firms. On average, a firm spends 2.9 years in the sample. The firm-years when a firm had the status of an exporter are 20,339, or 30% of the sample.

Table 2. Summary Statistics, Firm-Level Data

		Non-exporter	Exporter
Sales (1000 Huf)		3,003,567	8,934,890
Employment		107	213
Pretax Profit (1000 Huf)		138,705	423,184
Tangible assets (1000 Huf)		1,222,095	2,162,190
Firm Age		12	13
Foreign owned		11%	44%
State owned		5%	1%
Region	**Central Hungary**	44%	37%
	Central Transdanubia	9%	12%
	Western Transdanubia	9%	13%
	Southern Transdanubia	8%	7%
	Northern Hungary	8%	8%
	Northern Great Plain	11%	11%
	Southern Great Plain	11%	12%
Year	**2002**	10%	10%
	2003	9%	9%
	2004	11%	10%
	2005	11%	10%
	2006	10%	10%
	2007	10%	10%
	2008	9%	10%
	2009	9%	10%
	2010	12%	11%
	2011	9%	11%
Number of firm-years		47,311	20,339

The summary statistics presented in **Table 2** confirm the findings regarding exporters that the literature has established. Exporting companies are larger, in terms of both sales and employment. Mean sales are over twice as high for exporters, and they employ, on average, twice as many workers in Hungary. Exporting firms appear to also be more successful, as their average profits are three times higher than those of non-exporters. As an indicator for labor productivity, sales per worker are about 50% higher for exporters.

Exporters also have higher average value of capital (tangible assets). Counter to what is observed in empirical analyses, however, the amount of capital per worker is not higher for exporters (thus not supporting the theory that exporters have more incentives to make capital investments). On the contrary, capital per worker is 11% lower for firms that export. Consistent with the literature, firms engaged in trade are older, although the difference is small – on average one year. As expected, there is a high correlation between exporter status and ownership, as foreign-owned firms would have the knowledge, expertise and established distribution channels to export. Only 11% of non-exporters are foreign owned, as opposed to 44% of exporters. Not surprisingly, state ownership is negatively correlated with exports. Five percent of firms selling only domestically are state owned, as opposed to 1% for those selling abroad.

The largest percentage of firms from both groups is located in Central Hungary. For exporters, there is a larger percentage of firms in the regions close to Austria: Central and Western Transdanubia. In terms of industrial distribution (not reported), several industries have a large number of exporters as a share of all firms in the industry. These are firms manufacturing coke and petroleum products; motor vehicles; and communication equipment. A low number of exporting firms as a percentage of the total are found in publishing; tobacco products; and food and beverage. In terms of the share of exports in total sales for the industry, the leading industries are motor vehicles and communication equipment. The industries which export the smallest share of their production are publishing and tobacco products. Finally, for each year there is a roughly equal share of observations in each group, suggesting a relatively stable ratio between exporters and non-exporters over time.

5.3. Worker-level data

The sample selected from the linked employer-employee dataset provides information on 1,107,664 worker-years. Out of those, 391,322 worker-years, or 35% of the total are linked to exporting firms. **Table 3** provides summary statistics for the main characteristics of employees based on the exporter status of the firms.

Table 3. Summary Statistics: Worker-Level Data

		Non-exporter	Exporter
Age		40.1	39.7
Female (%)		40%	39%
Education	**Elementary**	11.1%	14.9%
	Vocational	33%	33%
	High school	39%	32%
	University	17%	20%
Blue-collar (%)		82%	82%
Working hours		39.8	39.8
Year	**2002**	9%	10%
	2003	10%	8%
	2004	11%	10%
	2005	11%	10%
	2006	11%	9%
	2007	10%	10%
	2008	9%	10%
	2009	10%	10%
	2010	10%	11%
	2011	9%	11%
Wage		171,579	207,893
Number of worker-years		716,342	391,322

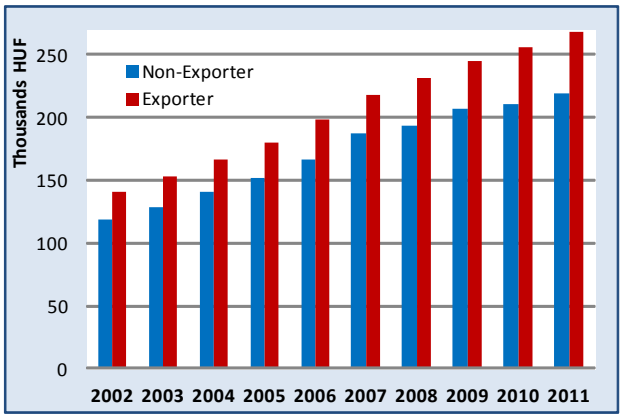
Interestingly, the means of the variables do not differ significantly across the two groups. Employees working for exporters are marginally younger and the share of women is just one percentage point lower. In terms of educational level, exporters employ a higher percentage of people with low educational attainment (elementary school). The share of people with vocational training is the same and that of high-school graduates is lower for exporters. They employ a higher share of university graduates.

The share of blue-collar workers is the same for exporters and non-exporters, suggesting little differentiation in terms of skill level. Further disaggregation show that blue-collar

workers in non-exporting firms are more often workers engaged in commercial and service occupations. Non-exporters, on the other hand, have more industry and construction workers, machine operators and assembly workers. In terms of white-collar workers, exporters have a similar share of managers and professionals (close to 9%), while non-exporters have a much higher share of managers (11%) than professionals (6%). Mean working hours are the same for both groups. Around 10% of the observations fall into each of the years surveyed, suggesting a stable ratio between surveyed employees in exporting and non-exporting firms.

Finally, the average wage differs significantly between the two groups. Exporters pay 21% higher wages in the sample. The standard deviation is also larger for that group. However, the relative standard error (standard error divided by the mean) is slightly lower for exporters: 1.12 as opposed to 1.17 for non-exporters, showing that in relative terms the wages paid by exporters are less volatile. The bar chart in **Figure 5** further demonstrates that the exporter versus non-exporter difference in average wages is persistent throughout the period. Thus, it is not driven by a specific year or period of time.

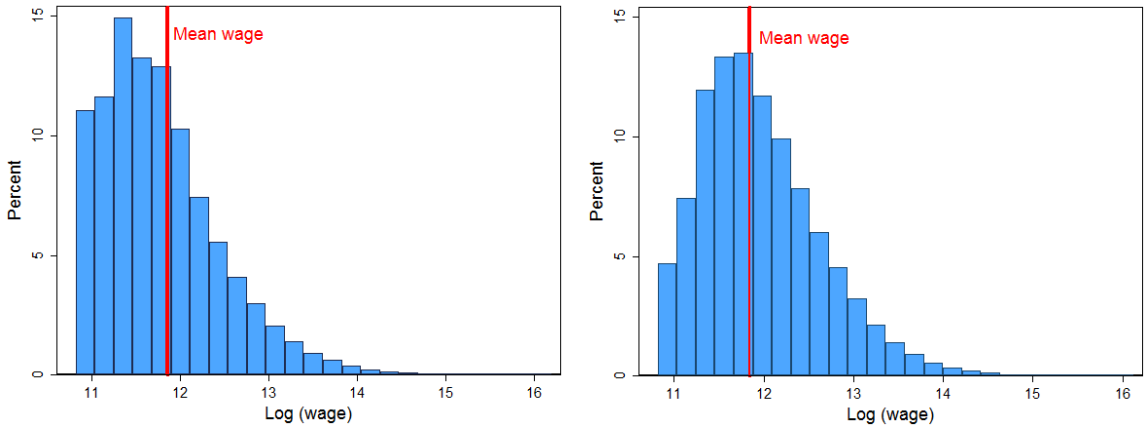
Figure 5. Wages For Non-Exporters vs. Exporters; Summary Statistics



Summary statistics for wages			
	All	Non-Exporter	Exporter
Mean	184,409	171,579	207,893
SD	214,101	201,561	233,512

The histogram in **Figure 6** plots the distribution of the natural logarithm of wage for exporters and non-exporters. It becomes evident that for non-exporters, a larger proportion of the wage distribution lies to the left of the sample mean (vertical line). Therefore, the possibility that the wage difference is driven by a few outliers can be ruled out.

Figure 6. Wages for Non-Exporters vs. Exporters. Histogram



Given that, as the summary statistics presented above demonstrated, basic worker characteristics do not differ significantly between exporting and non-exporting firms, the difference in average wages is an interesting case to analyze further. The methodology that will be used for this purpose is presented in the next chapter.

6. Methodology

This chapter will provide an overview of the basic set of regressions and econometric methods to be used in the analysis. These equations will be estimated at the firm level as a starting point. Then, more detailed analysis will be performed using LEED data.

6.1. Firm-level regression

As a standard approach in the literature, the analysis will begin with a regression at the firm level. The equation to be estimated is:

$$\mathbf{lnW}_{jt} = \beta_0 + \beta_3 \mathbf{EXPORT}_{jt} + \mathbf{YEAR}_t + \varepsilon_{jt}$$

where j is an index for firm, and t – for time
W is the natural logarithm of the average wage per worker
EXPORT is the indicator for export activity (variable of interest)
YEAR is vector of year dummies
and ε is the error term

To control for observed firm characteristics, the same equation will also be estimated with the inclusion of exogenous features: age, ownership (foreign vs. domestic), and a full set of dummy variables for industry and location. In another specification, broad indicators for firm size will be included. A continuous variable for size will enter the regression at a next step. Finally, firm fixed effects will be included to account for firm unobservable heterogeneity. More details and motivation for the choice of specification follow below in the methodology concerning the LEED dataset.

6.2. Benchmark LEED regression

After the average difference between exporters and non-exporters is estimated for the firm-level sample, the analysis will focus on the LEED dataset. The initial equation to be estimated is:

$$\mathbf{lnW}_{ijt} = \beta_0 + \beta_3\mathbf{EXPORT}_{jt} + \mathbf{YEAR}_t + \varepsilon_{ijt}$$

where *i* is an index for individual, *j* – for firm, and *t* – for time
W is the natural logarithm of the wage
EXPORT is the indicator for export activity (variable of interest)
YEAR is vector of year dummies
and ε is the error term

This initial equation will show the raw differential between exporters and exporters, controlling only for time fixed effects. The set of dummy variables for each year will absorb the impact of country-specific and year-specific shocks which affect all companies. It will also eliminate the effect of trends in wage growth. Thus, the equation will report the average wage difference, while the error term will include observed and unobserved firm and worker heterogeneity.

6.3. LEED regression with firm and worker characteristics

The next stage will exploit the rich information provided by the Linked Employer-Employee Dataset so as to control for firm and worker observed heterogeneity. The following equation will be estimated:

$$\mathbf{lnW}_{ijt} = \beta_0 + \beta_1\mathbf{WORKER}_{it} + \beta_2\mathbf{FIRM}_{jt} + \beta_3\mathbf{EXPORT}_{jt} + \mathbf{YEAR}_t + \varepsilon_{ijt}$$

where *i* is an index for individual, *j* – for firm, and *t* – for time
W is the natural logarithm of the wage
WORKER is a set of worker characteristics
FIRM is a set of worker characteristics
EXPORT is the indicator for export activity (variable of interest)
YEAR is vector of year dummies
and ε is the error term

Here, the right-hand side includes two sets of control variables. The vector of FIRM characteristics will include controls on firm variables exogenous to the export-wage relationship, which are likely to play a role in determining the wage. These include firm age,

location, industry and ownership (foreign vs. domestics). The vector of WORKER characteristics will, analogously, include a set of employee-level indicators that are likely to be important for wage setting, while unrelated to exports. These are age, experience, gender and working hours.

As a next step, the same equation will be re-estimated with the inclusion of variables that may be correlated with both exports and wages: firm size and worker occupation. These variables will first enter as broad groups. Firm size will be classified as small, medium and large; workers will be divided into blue-collar and white-collar. In another equation, all the information encoded in the variables will be used. Firm size will enter as the logarithm of the number of employees, and a full set of occupation dummies will be included.

6.4. LEED regression with firm fixed effects and worker characteristics

The above regression, while controlling for a set of observed characteristics, does not solve the problem of self-selection outlined earlier. If more productive firms are the ones that become exporters, the observed differential will reflect the selection of more productive firms into exporting, and not necessarily any benefits derived from exporting that get translated into higher wages.

Therefore, since the data allow for following plants over time, firm fixed effects are added next. The coefficient on the export dummy will, in this case, show the change in wages for companies that change their export status in the period (Wooldridge, 2002). Firm-level characteristics are not included as they are either time-invariant (industry, location, ownership) or likely to be endogenous (size). The error term accounts only for time-varying worker unobserved heterogeneity.

$$\mathbf{lnW}_{ijt} = \beta_0 + \beta_1 \mathbf{WORKER}_{ijt} + \beta_2 \mathbf{EXPORT}_{jt} + \mathbf{YEAR}_t + \mathbf{J} + \varepsilon_{ijt}$$

where *i* is an index for individual, *j* – for firm, and *t* – for time

W is the natural logarithm of the wage
WORKER is a set of worker characteristics
EXPORT is the indicator for export activity (variable of interest)
YEAR is vector of year dummies
J stands for firm fixed effects
and ε is the error term

With firm fixed effects, the regression can control for time-invariant unobservable heterogeneity among companies. If a specific firm characteristic makes it more likely to be an exporter, raises wages and is not caused by exporting, it will be controlled for in this regression. A likely example for such a characteristic is firm technology to the extent that it can be considered time-invariant. Firms with better technology will be more productive, pay higher wages and be more likely to become exporters. If technological advantages do not change over time, the fixed effects regression will be able to partial out their effect. However, if technology changes together with, or as a result of exporting, then the fixed effects estimator will still be biased, suggesting potential limitations of this approach. Another drawback is that the method does not account for the effects of time-variant observable characteristics correlated with exports. Additionally, a problem may arise if there are not enough firms in the sample which switch between being an exporter and not. Similarly, the results will be noisy if many firms enter and exit the export market too often. For the Hungarian linked data, the selected sample and the choice of an exporter definition ensure that there are enough, but not too many switches (see **Table 1** in Summary statistics).

Ideally, the last step will be to add worker fixed effects so as to control for unobservable employee heterogeneity. Unfortunately the dataset does not allow following individuals over time. Yet it is likely that the error term contains worker characteristics that command a higher wage in exporting firms. These may be omitted variables, on which no data are available. For example, there are no data on the language skills of people. Foreign language knowledge is likely to increase labor productivity and thus compensation for a job

in an exporting firm, while it will tend to have a smaller effect for one at a non-exporting firm. Rather importantly, there are also no data on workers' tenure with the firm. If a worker has more experience with the particular employer, then his/her productivity will be higher. So, if exporting firms have a lower labor turnover, then it will be expected that they would also pay higher wages. In addition, workers at exporting firms may receive more on-the-job training, which raises productivity but on which no data are available.

The unobserved heterogeneity may also be the result of variables that cannot be directly measured, such as the level of ability among workers. Exporting firms may be able to systematically hire high-ability employees even within the same educational group, in which case their productivity and thus wages will be higher. Further, the unobserved ability may be match-specific, in which case the ability of more productive workers may be demonstrated only when they are employed by exporters (Helpman et al., 2010). Other potentially relevant but difficult to measure indicators are intelligence and motivation. There is, however, little opportunity to control for such factors, unless the same individual is followed over time.

7. Regression results

This chapter will present the results obtained by applying the above methods. The initial section will present firm-levels results, while the following sections will use the full set of firm and worker characteristics available from the linked dataset. For each of the tables of estimates, the regression analysis will first show the average OLS differential, including year fixed effects only. A number of exogenous firm and worker characteristics will then be added. The results will be re-estimated including variables that are likely to be endogenous. In order to try to distinguish between self-selection and causality, firm fixed effects will finally be added. All regressions will be calculated using sampling weights, so as to make the results representative for the entire Hungarian labor market.

7.1. Firm-level results

The firm-level regression analysis demonstrates the relationship between exporter status and the average wage paid by a firm. Regression [1] shows the average difference between exporters and non-exporters, including firm fixed effects only. Regression [2] adds exogenous firm characteristics, namely age, ownership, industry and location. Regression [3] includes broad indicators for firm size. Regression [4] replaces those with a continuous variable for size. Regression [5] displays fixed effects estimates. All results are presented in **Table 4**.

In line with previous studies, the results show that exporting firms pay an average wage which is around 5% higher than that for domestically oriented firms. The difference persists even when firm observable characteristics are controlled for. However, in the fixed effects specification the premium disappears. This suggests that the positive premium for average wages is largely accounted for by unobservable indicators.

Table 4. Regression Results: Firm-Level

	Dependent Variable: Log (average wage)				
	[1]	**[2]**	**[3]**	**[4]**	**[5]**
Exporter	**0.055*** [0.007]**	**0.033*** [0.007]**	**0.050*** [0.007]**	**0.015*** [0.003]**	**-0.127*** [0.019]**
Firm Age		0.011*** [0.001]	0.014*** [0.001]	0.039*** [0.001]	
Medium			-0.352*** [0.007]		
Large			-0.920*** [0.014]		
Log (size)				-0.900*** [0.002]	
Foreign owned		0.356*** [0.011]	0.402*** [0.011]	0.074*** [0.005]	
Firm variables	NO	YES	YES	YES	NO
Industry dummies	NO	YES	YES	YES	NO
Region dummies	NO	YES	YES	YES	NO
Year FE	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES
Observations	52,037	52,037	52,037	52,037	45,072
Number of firms	18,977	18,977	18,977	18,977	12,012

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1;

7.2. Main regression results

The previous chapter already pointed that there is a positive wage premium for exporters; however, it appears to be the result of self-selection of better firms into trade. To examine the question in more detail, the present section will show results using LEED data. This will give the opportunity to account not only for firm, but also for worker heterogeneity in wage determination.

Table 5 presents the results of the main regression on the LEED sample. The first equation reports the mean wage differential between exporters and non-exporters, controlling for time fixed effects only. The coefficient on the exporter variable is small – exporters pay on average only 1.4% more than non-exporters. The difference is significant at the 1% confidence level. Equation [2] reports the results of a regression that takes into account a wide set of firm and worker characteristics relevant for wage determination and exogenous to the wage-exports relationship. All variables have the expected signs. In view of firm-level variables, older firms pay marginally more to workers. Consistent with Earle et al. (2012),

foreign owned enterprises pay significantly higher wages, 18% higher on average, and the coefficient is highly significant. There are large differences in the wages paid in different industries (coefficients not reported). The highest wages are paid in insurance, financial services and petroleum products, and the lowest – in hotels and restaurants, and publishing. Wages also differ across regions, with the highest wages paid in Central Hungary, and the lowest – in Southern Transdanubia.

Table 5. Regression Results: Benchmark Regression

	Dependent Variable: Log (wage)						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Exporter	**0.014*** [0.002]**	**0.016*** [0.002]**	**0.012*** [0.002]**	**0.004** [0.002]**	**-0.015*** [0.002]**	**-0.014*** [0.002]**	**-0.016*** [0.002]**
Firm Age		0.004*** [0.000]	0.004*** [0.000]	0.003*** [0.000]			
Medium			0.098*** [0.002]				
Large			0.113*** [0.003]				
Log (size)				0.062*** [0.001]			
Foreign owned		0.179*** [0.003]	0.171*** [0.003]	0.160*** [0.003]			
Experience		0.021*** [0.000]	0.018*** [0.000]	0.016*** [0.000]	0.022*** [0.000]	0.018*** [0.000]	0.017*** [0.000]
Experience^2		-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]
Female		-0.148*** [0.001]	-0.120*** [0.001]	-0.137*** [0.001]	-0.152*** [0.001]	-0.122*** [0.001]	-0.139*** [0.001]
Education: Vocational		0.120*** [0.001]	0.117*** [0.001]	0.079*** [0.001]	0.121*** [0.002]	0.118*** [0.002]	0.079*** [0.001]
Education: High School		0.302*** [0.001]	0.254*** [0.001]	0.152*** [0.001]	0.304*** [0.002]	0.254*** [0.002]	0.150*** [0.002]
Education: University		0.780*** [0.001]	0.519*** [0.002]	0.441*** [0.002]	0.780*** [0.003]	0.509*** [0.003]	0.432*** [0.003]
White collar			0.364*** [0.001]			0.375*** [0.003]	
Working hours		0.008*** [0.000]	0.008*** [0.000]	0.007*** [0.000]	0.008*** [0.001]	0.007*** [0.001]	0.007*** [0.001]
Industry	NO	YES	YES	YES	NO	NO	NO
Region	NO	YES	YES	YES	NO	NO	NO
Occupation	NO	NO	NO	YES	NO	NO	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Constant	11.192*** [0.002]	10.419*** [0.015]	10.423*** [0.015]	10.228*** [0.015]			
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) For education, the omitted category is <12years 4) All regressions are weighed

The coefficients on worker characteristics also have the expected coefficients. Potential market experience has a positive impact on wages: each additional year contributes, on average, 2% to the wage. The effect is non-linear – the returns to experience decline over time. The gender wage differential is rather large and significant. Controlling for a wide range of additional variables, women are paid on average 12% less than men. Education contributes significantly to the wage of a worker. Compared to people with elementary education, those with a high-school diploma get 25% higher salaries, and those with a university degree – 52% higher. More detailed results are presented in Appendix B, **Table B1.** The coefficient on the export variable does not change significantly in magnitude. It remains small, positive, and highly significant.

Equation [3] includes, additionally, a set of variables that may be endogenous to the export-wage relationship. These are size and occupation, initially defined in terms of broad categories. The results indicate a significant and large firm size premium on wages. Companies classified as medium pay, on average, 10% more than the small ones, and those labeled large – 11% more. White collar occupations command, on average, 36% higher wages than blue-collar ones. The coefficient on exporter status remains positive and significant, although it declines slightly.

Regression [4] repeats the same estimation but replaces the size groups with a continuous size variable. In addition, a set of ten occupation classes replaces the white-collar indicator. In this regression, the coefficient on exporter becomes insignificant and close to zero. This result confirms that there is a high correlation between size, skill structure and export status.

The next set of regressions use a fixed effects estimator in order to partial out the impact of time-invariant unobserved heterogeneity at the firm level. In these equations, 688 observations are not used. These are singletons or firm-year pairs with only one observation.

As there is no within-group variation, they cannot be used in the analysis. Firm characteristics are not included. The worker characteristics enter in same pattern as in the previous regressions – equation [5] has only exogenous worker variables, equation [6] distinguishes white- from blue-collar occupations and equation [7] has a full set of occupational dummies.

In all three of the fixed effects regressions, the coefficient on the exporter dummy remains small and highly significant. However, it enters with a negative sign. Thus, there is no support for the theory of an exporter wage premium using this method. The result is interesting in not only showing that wages paid by exporters are not higher, which is what most of the literature to date finds. The fixed effects regression shows that for comparable workers, exporter wages may, in fact, be lower compared to firms selling domestically in Hungary.

7.3. Robustness checks

The current section will outline potential issues related to the sample, methodology and variable definition, and try to address them using alternative estimates.

First, it has to be noted that the above results may potentially suffer from bias due to the definition of an exporter variable chosen. The threshold of 5% may be too high, and exclude a lot of exporters just below the limit. Alternatively, it may be too low, and not fully account for the effect of occasional exporting and sporadic shipment of goods across the border. Therefore, the benchmark estimation will be re-produced with three different definitions of the exporter variables. One of them will define exporters as firms with any amount of positive exports, in line with the standard practice in the literature. For the other two alternative indicators, a threshold of 1% and 20% is be used to define the exporter dummy. A table with the number of firms falling into each category in each of the years can

be found in Appendix B, **Table B2.** The regression results for the variables of interest are shown below, in **Table 6**.

Table 6. Regression Results: Different Exporter Definitions

	Dependent Variable: Log (wage)						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Exporter	0.047***	0.047***	0.035***	0.024***	-0.003	-0.001	-0.003
0% definition	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Exporter	0.029***	0.028***	0.024***	0.015***	-0.007***	-0.007***	-0.009***
1 % definition	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Exporter	0.014***	0.016***	0.012***	0.004**	-0.015***	-0.014***	-0.016***
5% definition	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Exporter	0.0333***	0.0293***	0.019***	0.0124***	-0.0061*	-0.004	-0.0033
20% definition	[0.0025]	[0.0024]	[0.002]	[0.0020]	[0.0032]	[0.003]	[0.0029]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

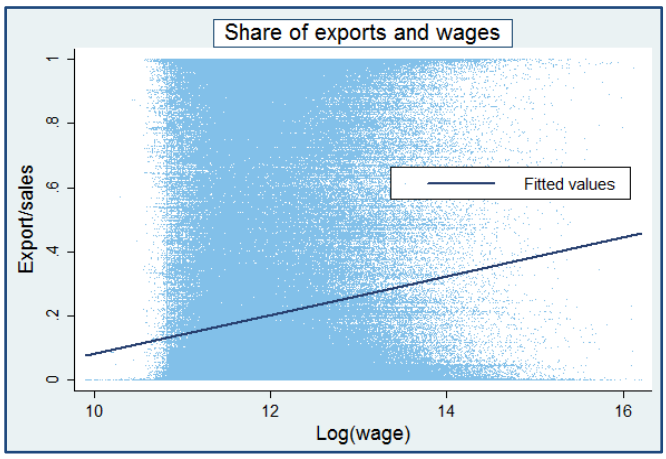
1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) All regressions are weighed with worker weights

The use of rather different definitions of an exporter does not materially change the conclusions from the previous section. The average wage differential obtained via OLS is small, but positive and significant. It is the largest for firms that export any positive amount, followed by those exporting over 20% of their production. With the addition of firm and worker controls, in each of the cases the differential declines further, although it mostly remains significant. When firm fixed effects are added, the effect of exports remains very small and it turns negative in all equations. It is highly significant in most cases. The persistence of the results demonstrates that the estimated coefficients are robust to the choice of an exporter variable.

In addition, as noted in the literature overview, there is still no consensus on whether it is the status of an exporter or the magnitude of export activity that is correlated with wages. Therefore, a different trade indicator, the share of exports in total sales, will be considered. The scatter-plot in **Figure 7** depicts the logarithm of wage of each worker against the share of

exports in the firm he/she is employed in. The upward slope of the fitted line shows an overall positive relationship between the two indicators.

Figure 7. Correlation between the share of exports and wages



In order to obtain more precise results, the basic regressions are estimated using the share of exports instead of the status of an exporter. The results are presented in **Table 7**.

Table 7. Regression Results: Share of Exports

	Dependent Variable: Log (wage)						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Export / Sales	**0.070***** [0.004]	**0.064***** [0.004]	**0.052***** [0.004]	**0.028***** [0.004]	**-0.017***** [0.006]	**-0.014**** [0.006]	**-0.016***** [0.006]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1;
3) All regressions are weighed with worker weights

These regressions will have somewhat different implications. The idea behind them is to see the effect of the magnitude of exports on the wage, with the expectation that firms which trade more may be able to benefit to a larger extent from exporting, and thus pay higher wages. Although the magnitude of the reported coefficients is somewhat higher, the basic conclusions are surprisingly similar to those reached using dichotomous variables. There is a positive exporter premium which declines with the addition of control variables in

the OLS regressions. The incorporation of firm fixed effects results in a low but significant negative correlation between exporting and wages.

One characteristic of the status of an exporter which was not yet explored is switching between being an exporter and a non-exporter. The interpretation of the results above is not as straightforward when multiple entries and exits from the export market are possible.

First of all, some firms have exports above 5% for only one year, and then return to being non-exporters. It is difficult to believe that a single year on the export market can bring about tangible benefits to be translated into higher salaries. Therefore, the calculations are repeated using a variable which assigns exporter status only to firms which export for at least two years in a row. The results, presented in **Table 8**, are in line with those seen previously.

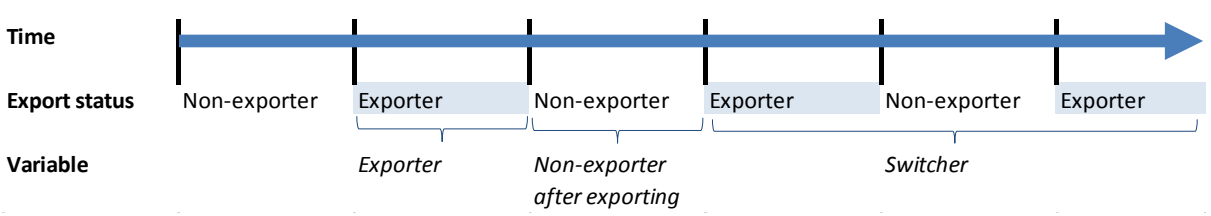
Table 8. Regression Results: Exporters For Two Years

	Dependent Variable: Log (wage)						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Exporter for two years	**0.016***** [0.002]	**0.027***** [0.002]	**0.021***** [0.002]	**0.012***** [0.002]	**-0.007***** [0.003]	**-0.006**** [0.003]	**-0.008***** [0.003]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	No	NO	NO	NO	YES	YES	YES
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

1) Standard errors in brackets below the coefficients; 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1;
3) All regressions are weighed with worker weights

The fact that companies switch in and out of exporting provides further opportunities for analysis. Two new variables have been added, and their meaning – illustrated in **Figure 8**. The first one is *non-exporter after exporting*. It applies only to firms which were not exporting for a period of time, then exported, and stopped exporting again. The variable is equal to one for the second period of non-exporting.

Figure 8. Exporter status switches



The second variable, *switcher*, is equal to one for all firm-years when a firms switches in and out of exporting more than twice. It is included to capture the effect of sporadic exporting activity.

Table 9. Regression Results: Export Switches

	Dependent Variable: Log (wage)						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Exporter	**0.018*** [0.002]**	**0.016*** [0.002]**	**0.013*** [0.002]**	**0.004*** [0.002]**	**-0.014*** [0.002]**	**-0.012*** [0.002]**	**-0.014*** [0.002]**
Non-exporter After exporting	**0.039*** [0.010]**	**0.017** [0.008]**	**0.021*** [0.008]**	**0.019** [0.008]**	**0.011 [0.010]**	**0.016* [0.010]**	**0.016* [0.009]**
Switcher	0.036*** [0.004]	-0.002 [0.004]	-0.000 [0.004]	0.014*** [0.004]	0.010** [0.004]	0.014*** [0.004]	0.018*** [0.004]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Endogenous	NO	NO	SOME	YES	NO	SOME	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Observations	1 107 664	1 107 664	1 107 664	1 107 664	1 106 976	1 106 976	1 106 976
Number of firms	24 398	24 398	24 398	24 398	23 710	23 710	23 710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) All regressions are weighed with worker weights

The benchmark regressions are estimated with these two new variables and shown in **Table 9**. The results for the main exporter dummy do not change substantially. The coefficient on the dummy variable for non-exporter after exporting is small, positive, and, in the OLS regressions, it is highly significant. This implies that when firms revert to selling on the domestic market after exporting, the wages they pay increase. The coefficient on switcher, for the cases when it is significant, is small but positive. This implies that intermittent export activity has a small positive effect (if any) on the wages of workers.

The above estimates show that the main results are not sensitive to the definition of an exporter chosen initially. A potential measurement problem, however, may still exist as regards the wage variable. During the process of data cleaning, all cases where the reported wage was below the minimum wage were dropped out. Still, the results may be affected if there are unrealistically high values for wages, as a result of incorrect reporting, miscoding or simply unusual cases. Due to the possibility that extreme high values will seriously affect the

main results, observations that fall above the 99th percentile in the wage distribution are dropped out (follwong Barsky, 2000).[9] The results are presented in **Table 10**.

Table 10. Regression Results: Potential Outliers Removed

	Dependent Variable: Log (wage)						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Export / Sales	0.016***	0.017***	0.014***	0.006***	-0.011***	-0.011***	-0.012***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	No	NO	NO	NO	YES	YES	YES
Observations	1,096,587	1,096,587	1,096,587	1,096,587	1,095,895	1,095,895	1,095,895
Number of firms	24,396	24,396	24,396	24,396	23,704	23,704	23,704

1) Standard errors in brackets below the coefficients. 2) Confidence level: *** p<0.01, ** p<0.05, * p<0.1;
3) All regressions are weighed with worker weights; 4) Wages above the 99th percentile are removed

A comparison with the benchmark regression shows that the main conclusions remain valid. In addition, the magnitude of the coefficients changes only marginally. This implies that the main results obtained so far are not driven by few unusually high wage values.

Since this section demonstrated the robustness of the estimation procedure to different variable definitions, specifications and the treatment of outliers, the next section will provide more detailed results for the wage differential across worker types.

7.4. Regression by groups of workers

The following sets of regressions will show whether the exporting status of a firm has a different effect on different types of workers, as defined by gender, education and occupation. This will be done by including an interaction term between the characteristic of interest and the exporter dummy.

First, the analysis will examine whether there is a different gender wage differential for exporters and for non-exporters. The reason why this may happen is that exporting leads to increased product competition. By the implications of Becker's (1957) model of

[9] As a result, 11,077 observations above 1,010,834 HUF are dropped out.

employers' taste for discrimination, more intensive competition should decrease or eliminate the male-female wage differential in the long-run, if that differential is not the result of differential productivity for the two genders.

Table 11. Regression Results: By Gender

	Dependent Variable: Log (wage)						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Exporter	**0.060*** **	**0.039*** **	**0.039*** **	**0.029*** **	**0.016*** **	**0.011*** **	**0.007*** **
	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]
Female*Exporter	**-0.087*** **	**-0.066*** **	**-0.074*** **	**-0.071*** **	**-0.068*** **	**-0.072*** **	**-0.068*** **
	[0.002]	[0.002]	[0.002]	[0.001]	[0.003]	[0.003]	[0.003]
Female	**-0.107*** **	**-0.124*** **	**-0.092*** **	**-0.109*** **	**-0.127*** **	**-0.094*** **	**-0.112*** **
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Endogenous	NO	NO	SOME	YES	NO	SOME	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	No	NO	NO	NO	YES	YES	YES
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) All regressions are weighed with worker weights; 4) Female is a dummy variable equal to 1 for females

Therefore, the set of equations used so far has been estimated with an interaction term between the gender dummy (taking the value of 1 for females) and exporter status. As **Table 11** shows, the coefficient on the interaction term is negative – females in exporting firms are paid significantly less than males, controlling for a wide range of worker and firm characteristics. In addition, they are paid less than females in firms that sell domestically. Interestingly, the coefficient on exporter status in the fixed effects regression remains small but positive for males for this specification (as opposed to the general case). The finding is contrary to that of previous studies. Examining Hungarian data, Lovasz (2008) finds that in industries with higher export share, the male-female wage gap is significantly lower. Similarly, Klein at al. (2010) find that exporting mitigates the male-female wage inequality.

Second, the regressions are estimated with the inclusion of interaction terms between exporter status and the separate levels of education and skill. Theory suggests that exporters would pay higher wages to workers with more human capital or better skills. The Stolper-Samuleson theorem (1941) implies that when a country liberalizes trade, it specializes in

production using its relatively most abundant factor. Hungary, being a developed economy, is therefore expected to specialize in more skill-intensive industries. Consequently, the demand for, and returns to, skill and education are to increase. Another set of theories, formalized by Pissarides (1997) argues that trade increases the skill premium even if the products exported are not skill intensive. The reason is that trade facilitates the transfer and upgrade of technology which is skill-biased. Since high-skilled workers and technology are complements, the returns to skill increase.

Table 12. Regression Results: By Education

	Dependent Variable: Log (wage)						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Exporter	**-0.033*****	**-0.032*****	**-0.048*****	**-0.076*****	**-0.060*****	**-0.073*****	**-0.094*****
	[0.003]	[0.003]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]
Education (Vocational)	**0.026*****	**0.018*****	**0.023*****	**0.043*****	**0.016*****	**0.021*****	**0.041*****
*Exporter	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]
Education (High school)	**0.051*****	**0.037*****	**0.063*****	**0.089*****	**0.035*****	**0.062*****	**0.087*****
*Exporter	[0.002]	[0.002]	[0.002]	[0.002]	[0.004]	[0.003]	[0.003]
Education (University)	**0.149*****	**0.151*****	**0.160*****	**0.177*****	**0.149*****	**0.159*****	**0.176*****
*Exporter	[0.003]	[0.003]	[0.003]	[0.003]	[0.005]	[0.005]	[0.005]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Endogenous	NO	NO	SOME	YES	NO	SOME	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	No	NO	NO	NO	YES	YES	YES
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1;
3) All regressions are weighed with worker weights; 4) The omitted group for education is elementary education

To test for the existence of higher returns to human capital, the estimates presented in **Table 12** include interaction terms between exporter status and three educational levels. Their coefficients will show if more (or less) educated workers benefit disproportionately from the export activity of a firm. The base category is workers with elementary education. The results show that in exporting firms, workers with low educational attainment are paid less than in domestically oriented firms. For vocational education, there is also a discount, although it is lower. For workers with high school education, the sum of the coefficients on exporter and the interaction terms is small and positive in the OLS regressions, and small and negative in the fixed effects regressions. Workers with a university degree, by contrast,

receive significantly higher wages from exporters than from domestic firms – by 8-12 percent, depending on the specification. The positive wage premium is robust to the addition of control variables and firm fixed effects. Once again, the results are not the ones found in previous empirical studies. Fafchamps (2008) for example concludes that jobs in exporting firms do not bring about higher returns to education.

To further check for the existence of different returns to skill in exporting firms, the results presented in **Table 13** are estimated with an interaction term between occupation (as defined by 10 broad occupational classes) and exporter status. The base category for the estimation is unskilled workers. Among the fixed effects regressions, only equation [7] is estimated, as it is the one which includes occupational dummies.

Table 13. Regression Results: By Occupation

	Dependent Variable: Log (wage)				
	[1]	**[2]**	**[3]**	**[4]**	**[7]**
Exporter	**-0.050***** [0.003]	**-0.055***** [0.003]	**-0.060***** [0.003]	**-0.065***** [0.003]	**-0.084***** [0.004]
Managers*Exporter	**0.281***** [0.004]	**0.246***** [0.004]	**0.247***** [0.004]	**0.245***** [0.004]	**0.234***** [0.007]
Professionals*Exporter	**0.113***** [0.004]	**0.109***** [0.004]	**0.109***** [0.004]	**0.107***** [0.004]	**0.113***** [0.006]
Technicians*Exporter	**0.137***** [0.003]	**0.116***** [0.003]	**0.115***** [0.003]	**0.114***** [0.003]	**0.117***** [0.005]
Office & customer services*Exporter	**0.078***** [0.004]	**0.069***** [0.004]	**0.068***** [0.004]	**0.067***** [0.004]	**0.065***** [0.008]
Commercial & services*Exporter	**0.046***** [0.005]	**0.045***** [0.004]	**0.046***** [0.004]	**0.045***** [0.004]	**0.044***** [0.006]
Agricultural & forestry*Exporter	**0.037**** [0.016]	**0.036**** [0.015]	**0.038**** [0.015]	**0.033**** [0.015]	**0.022** [0.017]
Industry & construction*Exporter	**0.030***** [0.003]	**0.042***** [0.003]	**0.042***** [0.003]	**0.041***** [0.003]	**0.040***** [0.004]
Machine, assembly workers*Exporter	**-0.091***** [0.004]	**-0.049***** [0.003]	**-0.049***** [0.003]	**-0.050***** [0.003]	**-0.050***** [0.005]
Firm variables	NO	YES	YES	YES	NO
Worker variables	NO	YES	YES	YES	YES
Endogenous	NO	NO	SOME	YES	SOME
Year FE	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) All regressions are weighed with worker weights; 4) The base category is occupations that require no special skills

The results show a significant and economically important difference in pay across skill categories. Overall, low-skilled occupations are paid less, and high-skilled – more, by

exporters. There is a relatively high wage discount for *unskilled workers*: compared to domestic firms, exporters pay 5-8% less to employees with no special qualifications, depending on the specification. For the next category, *machine operators, assembly workers and drivers*, there is an even deeper wage discount: exporters pay more than 10% lower compensation than firms that sell domestically. The conclusion is valid across all specifications. *Agricultural and forestry workers* also receive lower wages from exporters, although the differential is smaller. The same is true of employees engaged in *commercial activities and services*. For *office and customer service* occupations, the difference is small and its sign changes between the OLS and the fixed effects regressions. The three groups with highest skills receive a significant premium when employed by exporters. *Technicians* and *professionals* earn on average 3-8% more at exporting firms. The differential is the highest for *managers*: for management jobs, exporters pay on average 15-23% more.

These findings are difficult to compare with previous studies, due to the wide variety of results obtained for different countries, periods of time and methods. For example, Bernard and Jensen (1995) show a wage premium for both production and non-production workers, but its magnitude is substantially larger for the latter. Schank et al. (2007) find a positive wage premium for both groups, but it is higher for blue-collar than for white-collar workers. For Hungary, Toth (2011) finds no significant impact of exporting activity on the wages of any occupational group. The conclusions here, finally, appear to agree with those of Klein et al. (2010). They find a significant exporter premium for high-skilled workers and an exporter discount for low-skilled workers. These results, however, need to be treated with caution since, as already noted, occupation may be determined endogenously with exporter status.

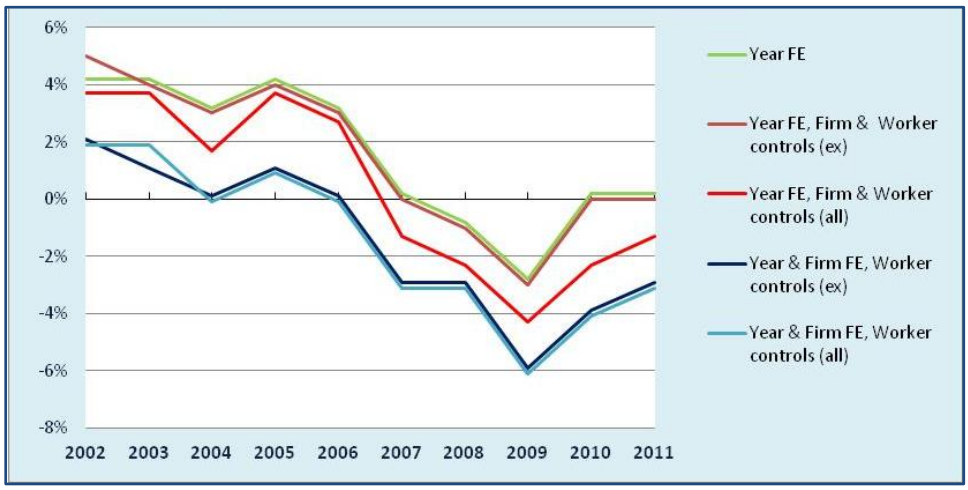
The estimates including interaction terms suggest that there is a wide variation in the exporter wage differential between genders, across educational levels, and for different occupational groups. Although the main regression shows no significant differences between

firms selling domestically and abroad, it may well be the case that this is the result of averaging. Further disaggregation shows that women are paid significantly less, and university graduates and high-skilled workers – significantly more by exporters. The estimated coefficients do not provide support for the hypothesis that higher competition on foreign markets mitigates wage discrimination. The numbers do, however, imply the presence of higher returns to human capital and skill-based technological change for exporting firms.

7.5. Change of the premium over time

This section looks into the change in the exporter wage differential over time. For this purpose, the main regressions were estimated together with interaction terms for each of the years of observation. **Figure 9** plots the estimation results. All coefficients are significant at the 1% level. A table with detailed regression output is available in Appendix B, **Table B3**. [10]

Figure 9. Wage differential change over time



The graph shows rather different values for the wage differential over time. At the beginning of the period, exporters pay higher wages, and this is true for each specification. Between 2004 and 2006, there still exists a wage premium using the OLS specification, but

[10] For simplicity, regressions [3] and [6], which include some but not all potentially endogenous factors, are not reported. The results from these specifications are similar to those presented in Figure 9.

not when firm fixed effects are included. The differential declines and turns negative across all specifications as early as 2007, prior to the onset of the Great Recession. In 2009, there is a large negative difference between wages paid by exporters as opposed to those of non-exporters. In the following two years there is a strong recovery, and exporter wages come closer to those of domestic firms. The finding that the wage differential has been decreasing throughout the period (down to negative values) is contrary to that obtained by Baumgarten (2010). For a period ending immediately prior to the crisis, the author finds a growing positive premium paid by exporters.

Appendix B, **Figure B1** additionally shows figures plotting the wage differential over time using the different definitions of exporter. The pattern is similar across firms that export any positive amount, more than 1% of sales and more than 20% of sales. The decline during the years of the crisis is the steepest for firms that fall under the narrowest definition of exporting (over 20% of sales). Further analysis of the impact of the crisis on the wages paid by employers is beyond the scope of this paper, as it will have to consider the adjustment of employment together with that of wages during deteriorating economic conditions.

7.6. Issues

The analysis thus presented has to acknowledge the possibility of some measurement and estimation issues. As regards measurement, one potential problem is the wage variable. Wages may be underreported, as some individuals may work informally for tax reasons. If there is a systematic difference between exporters and non-exporters in terms of underreporting, then the results will be biased. However, in view of the results so far, this seems unlikely to be an issue. The negative exporter coefficient would imply more underreporting by exporting firms, and there are few reasons to believe this is the case. Another potential issue is the measurement of exports. The financial statements of companies

record their trade receivables, i.e. the value of goods sold directly on the export market. However, to the extent that firms do not know the final destination of their products, reported exports will understate the true value of goods shipped abroad (Bernard and Jensen, 1995).

In terms of estimation, a potential problem already explained is the lack of controls for worker unobserved heterogeneity. Omitted variable bias, for both firm and worker characteristics, is also a potential problem, as there are numerous factors not used here that would be relevant for wage determination. If these factors, remaining in the error term, are correlated with the explanatory variables, the estimated coefficients will be biased. Finally, even with fixed effects it is possible that self-selection is not completely ruled out, since the method cannot control for time-variant unobserved firm characteristics. Therefore, the next chapter will use a matching approach as an additional mechanism to mitigate the issue. Initially similar firms differing in their future exporter status will be matched. Then, the difference in wages they pay after one group starts to export will be evaluated.

8. Matching

8.1. Matching sample and procedure

The above presented regression analysis on the full sample attempts to control for a large set of firms and worker characteristics. Yet, it is still possible and highly likely that if exporters pay higher wages, this is the result of the self-selection of more productive firms into trade, rather than a benefit from trade. To address this possibility, the present chapter will use a matching procedure, which will pair up firms that start to export to otherwise similar firms that always sell domestically. This will show the average effect of treatment (the start of export activity) between otherwise similar plants.

Matching between treated and non-treated firms is performed using a propensity score introduced by Rosenbaum and Rubin (1983) as the probability of being treated conditional on pre-treatment characteristics. Matching is done on the basis of firm, rather than worker characteristics, as it allows for the use of the firm identifier to follow companies through time. Furthermore, exporting activity is determined at the firm, rather than the employee level (Earle et al., 2012).

The model is estimated for a sample consisting of the treatment and the control group. The treatment group encompasses export starters. Thus, it excludes all firms that always export, and firms that export initially but stop afterwards. The group is additionally restricted only to firms for which there are data for at least two years prior to exporting, and at least two years after exporting. Thus, the treatment group is limited to those firms that became exporters in the years 2004-2010. Firms that change their exporter status more than twice are also excluded, so as to disregard the effect of sporadic exporting activity on wages. The control group is restricted only to firms which never export and remain in the sample for at

least 4 years. To ensure similarity between the treatment and control groups, several industries are dropped out of the analysis.[11]

In the subset that will be used to estimate a propensity score, observations in the treatment group are included only for the year in which they start to export. The treatment group is matched against firms that never export. Observations for non-exporters for each year are pooled together to form the control group. Due to the large disparity in the number of observations in the two groups, the control group is down-weighted in the propensity score estimation so that it has an impact equal to that of the treatment group (as in Earle et al., 2012).

The basis for matching is a propensity score obtained from a probit model, where the dependent variable is the probability of being an exporter at time *t*:

$$P(\mathbf{Exporter}_{jt}=1) = f(\mathbf{FIRM}_{jt-1}, \mathbf{INDUSTRY}_j, \mathbf{YEAR}_t)$$

Where $P(\mathbf{Exporter}_{it}=1)$ is the probability of starting to export in time t
$\mathbf{FIRM}_{it-1}$ is a set of lagged firm characteristics
$\mathbf{INDUSTRY}_j$ is a set of dummy variables for industry
$\mathbf{YEAR}_t$ is a vector of year dummies

The identified control group needs to be similar to the treatment group with regard to its predicted probability of exporting. The variables included in the probit are therefore lagged values of firm characteristics which do not influence the treatment. Following Earle et al. (2012), these include firm size and it square (measured as total employment), labor productivity and its square (measured as sales per employee), capital intensity and its square (measured as fixed assets per employee), and average firm wage and its square (measured as total labor cost divided by employment). An additional variable is a dummy for foreign

[11] In one industry there are no non-exporters (NACE code 23) within the sample. In four industries there are no export starters (NACE codes 34, 61, 62).

ownership in the previous year.[12] All of these variables are measured at the year prior to starting to export for exporters, and the year prior to observation for non-exporters. In addition, the equation includes the growth in total employment and average plant wage from two to one year prior to observation. These variables are included so as to account for unobservable factors that may cause an upward trend in firm size and wages before exporting. The estimates from the probit model are reported in **Table C1.1**.

The propensity score for each firm is the predicted probability from the estimated probit model. The common support condition is imposed, which requires an overlap between the matched and the control group. Therefore, all observations in the treatment group whose propensity score exceeds that of the control group are dropped. Likewise, control group observations whose score is lower than the lowest for the treatment group are dropped.[13] (Caliendo and Kopeinig, 2008). Afterwards, the score is used for nearest neighborhood matching. Each firm *i* from the treatment group is matched with a firm *j* that never exports which has the closest propensity score. This is done for firm pairs within the same year and industry.

$$\left| P_{it} - P_{jt} \right| = \min_{k \in \{\text{exporter } kt=0\}} \{ P_{it} - P_{jt} \}$$

Table 14 shows the number of firms in the matched sample that never exported and those that are export starters. Only 229 export starters were matched with 191 non-exporters eventually. Out of all export-starters, 50 firms return to non-exporting after being exporters for at least two years. Export starters in the sample export for an average of 3.8 years.

[12] In Earle at al. (2012), this is the dependent variable in the probit model, and thus not included. Since foreign ownership is likely to have a high predictive power for export activity, it is included here.
[13] Among export-starters, 1 firm drops out. Among non-exporters, 1495 observations drop out.

Table 14. Matched sample composition		
	Firms	Firm-years
Non-exporters	191	1,270
Export-starters	229	1,662
Export-starters who stop exporting	50	72

It has to be noted that the method of matching entails some issues. First, it decreases the sample size significantly.[14] A second limitation to the approach is that it does not account for switching in and out of exporting. Furthermore, since it is not possible to follow individuals over time, the method does not allow for the effect of non-random hiring and separation. It cannot rule out the event in which after the start of export activity, firms systematically hire workers with higher unobserved ability. Thus the results of the matching approach may be biased (Schlank et al., 2010)

With these caveats in mind, the LEED sample is limited only to workers associated with the matched firms. Appendix C, **Table C1.2** compares the main characteristics of plants in the LEED and the matched sample. On average, the matched firms are larger, older, have higher sales and are more often foreign owned. The average share of exports in sales is significantly lower. This can be attributed to the fact that most firms which export a large share or all of their production do so throughout the period.

Summary statistics of firm characteristics can be found in Appendix C, **Table C2.1**. Exporters and export-starters in the matched sample have a similar average amount of total sales. Employment is lightly lower for exporters, and average profits are significantly below those of non-exporters. Export-starters are slightly younger, more often foreign owned and less often state owned. As in the full LEED sample, they surprisingly do not have more total tangible assets, and capital per worker is actually lower. As per the choice of a definition of an export-starter, no firms export in the first two years. The average share of exports in total sales is 11% for exporter-starters.

[14] Schalank et al.'s (2010) study is based on only 48 export-starters.

Overall, however, in the matched sample, exporter starters and non-exporters are more similar than exporters and non-exporters in the full LEED sample. To confirm the similarity between the two sets of firms, **Table C2.1** reports standardized mean differences between the key firm characteristics.[15] The smaller these differences are, the more similar the treatment and control group are, and the less likely it is that heterogeneity interferes with the estimates. The standardized differences are close to zero for sales, employment, profits and capital. Their values are somewhat higher, but still low, for age and ownership. These results confirm that the two groups of firms are similar in terms of features other than export activity.

Summary statistics of worker characteristics can be found in Appendix C, **Table C2.2**. In the matching sample, women are less represented in export-starters. Exporting firms have a significantly higher percentage of university graduates; other educational groups do not differ markedly between the treatment and control group. The percentage of blue-collar workers and average working hours are roughly the same. The mean wage, however, once again differs significantly in favor of exporters. Export-starters pay, on average, 13% higher wages. Therefore, the next section will use econometric techniques to check whether, after controlling for firm and worker characteristics and firm fixed effects, this difference persists.

8.2. Regression results on the matched sample

In this chapter the main regression is applied to the matched sample. The key results are presented in **Table 15** (full results are reported in Appendix C, **Table C3**).

[15] Standardized mean differences are calculated as $\frac{\Delta\, means}{\sqrt{\partial 1^2+\partial 2^2}}$, or the difference in means over the pooled standard deviation of the treatment and control group (Higgins and Green, 2011).

Table 15. Benchmark Regression Results: Matched Sample

	Dependent Variable: Log (wage)						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Exporter	-0.027***	-0.024***	-0.018***	-0.022***	-0.024***	-0.017***	-0.021***
	[0.007]	[0.006]	[0.005]	[0.005]	[0.006]	[0.005]	[0.005]
Region Dummies	NO	YES	YES	YES	NO	NO	NO
Industry dummies	NO	YES	YES	YES	NO	NO	NO
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Constant	11.528***	10.923***	10.954***	10.841***			
	[0.025]	[0.058]	[0.056]	[0.059]			
Observations	51,980	51,980	51,980	51,980	51,980	51,980	51,980
Number of Firms	420	420	420	420	420	420	420

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1;

The results obtained from the matched sample are similar to those shown in the fixed effects regressions on the entire LEED sample. The similarity is observed in sign, significance and magnitude of the estimated coefficient. The regression fails to find an exporter wage premium for Hungary for the respective period. On the contrary, there appears to be a small but robust wage discount for workers employed in plants selling abroad. The conclusions from the above procedure can be considered more conclusive that those applied to the LEED, since the matching procedure mitigates the effect of self selection into exporting. Among otherwise similar plants in the initial period, those that start to export paid, on average, between 1% and 2% lower wages to workers with comparable observable characteristics.

The results are also reproduced with the inclusion of an indicator for firms that start to export, but switch to a non-exporter status afterwards. The set of regressions in **Table 16** incorporates a dummy variable equal to one for the years in which an export starter has returned to selling domestically. The coefficient of an exporter in these equations does not change significantly from the one previously estimated. The coefficient on the variable denoting non-exporting after exporting is insignificant. This is again similar to the fixed effects result on the LEED sample. While the wages of export starters are lower in the period

during which they export, they do not appear to rise when a firm discontinues its export activity.

Table 16. Regression Results, Export Switches, Matched Sample

	Dependent Variable: Log (wage)						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
Exporter	**-0.028*** [0.007]**	**-0.027*** [0.006]**	**-0.019*** [0.006]**	**-0.024*** [0.005]**	**-0.027*** [0.006]**	**-0.019*** [0.006]**	**-0.023*** [0.005]**
Non-exporter After exporting	-0.005 [0.016]	-0.019 [0.014]	-0.007 [0.013]	-0.009 [0.012]	-0.023* [0.013]	-0.013 [0.013]	-0.013 [0.012]
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	No	NO	NO	NO	YES	YES	YES
Observations	60,874	60,874	60,874	48,315	60,874	60,874	75,013
Number of firms	586	586	586	574	586	586	586

1) Standard errors in brackets below the coefficients. 2) Confidence level: *** p<0.01, ** p<0.05, * p<0.1;

In summary, the matching approach confirms the existence of a small wage discount for plants that export. Comparing plants with initially similar characteristics, the method has attempted to mitigate the effect of self-selection into trade.

9. Conclusion

The purpose of this thesis was to establish whether the wages paid by firms engaged in international trade differ from those paid by firms selling domestically, since the literature to date has identified that a small wage premium is often paid by exporters. The analysis was based on a rich linked employer-employee dataset for Hungary for the years 2002 – 2011.

As expected, the raw average wage differential between exporters and non-exporters is positive and significant. After controlling for a wide range of observable firm and worker characteristics, the differential declines substantially. This implies that a large proportion of the unconditional premium can be explained by the attributes of firms and workers, and not by the export activity of firms per se. Nonetheless, a small positive difference between wages in exporting and non-exporting establishments remains.

However, the result cannot yet be interpreted as causality running from exporting to higher compensation. First of all, wages may still be partially determined by firm or workers characteristics that are either omitted from the regression or unobservable. Second, the premium may be the result of selection – if more productive firms self-select into trade, then both exporting and higher wages would simply be an expression of higher productivity, with no causal relationship between them.

In an attempt to mitigate the effect of self-selection, two methods were used. First, firm fixed effects were added to the regression analysis. Second, a matching procedure was used, where export-starters and non-exporting firms were matched based on pre-exporting characteristics. In both cases, the exporter wage premium not only disappears, it becomes negative and highly significant, although its magnitude is small. This reversal confirms the importance of addressing self-selection in interpreting the relationship between exporting and trade.

Several robustness checks were performed to ascertain the validity of the results. The use of different indicators for exporting activity, the treatment of outliers, and regressions accounting for frequent switches of exporting status confirm the initial findings. The regressions were then further disaggregated by worker types. It was shown that exporters offer lower compensation to women, and higher returns to skill and education.

The results presented here are difficult to reconcile with previous findings. The empirical evidence so far gravitates between a small positive premium and no premium at all, while the data for Hungary for 2002-2011 show a small exporter discount. A potential reason for the negative coefficient may be the fact that the time period surveyed includes the years of the financial crisis, since during the downturn the Hungarian exporting firms were particularly hard hit (Cseres-Gergely, Kátay & Szörfi, 2013). If rent sharing is the basis for higher wages in exporters, the negative coefficient may be expression of falling firm profits due to cyclical fluctuations. In this case, exporting would act to amplify the effect of the business cycle, rather than induce structural changes in firms.

The exact reason for and mechanism through which wages in exporting firms fell short of their domestic counterparts is beyond the scope of this paper. Such analyses need to address the role of worker unobserved heterogeneity, as well as the link between business cycles and wages, taking into account adjustments of both wages and employment. What the paper shows, however, is that there is no conclusive evidence that in Hungary exporters pay higher wages than non-exporters. While the estimated effect is, in fact, negative, its magnitude is too small to be considered relevant for policy making with regard to domestic wages.

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Appendix A. Literature overview

Table A. Empirical studies using LEED

Author	Year	Country, period	Data	Method	Basic result
Munch and Skaksen	2006	Denmark (1995–2002)	LEED	OLS, Worker FE; IVs for export and skill intensity	Positive wage premium, but only for workers in firms with high skill intensities
Breau and Rigby	2006	USA (1990 & 2000)	LEED	OLS, Industry FE, Occupation FE	No significant exporter premium after including worker variables
Schank, Schnabel and Wagner	2007	Germany (1993–1997)	LEED	OLS, Firm FE, Worker FE, Spell FE	Small but positive wage premium; larger for blue-collar workers
Alcalá and Hernández	2007	Spain (2002)	LEED + destinations	OLS, Firm FE	Positive wage premium, increasing in market remoteness
Fafchamps	2008	Morocco (1999 - 2000)	LEED	OLS, Firm FE, Worker FE	Positive premium only as a result of size and capital; no higher returns on education
Frias, Kaplanz and Verhoogen	2009	Mexico (1985-2005)	LEED	2SLS, Diff-in-diff, Worker FE	Positive wage premium; largely not the result of worker self-selection
Martins and Opromolla	2009	Portugal (1995-2005)	LEED + products	OLS, Firm FE, Worker FE, Spell FE	Salaries rise for firms that increase high-tech exports; imports are at least important
Schank, Schnabel and Wagner	2010	Germany (1994–2005)	LEED	OLS, Matching	Positive wage premium as a result of self-selection
Baumgarten	2010	Germany (1996-2007)	LEED	OLS, Decomposition of wage dispersion	Positive wage premiuml increasing over time
Klein, Moser and Urban	2010	Germany (1993–2007)	LEED	OLS, Firm FE, Firm-Occupation FE, Spell FE	Positive premium for high-skilled workers and discount for low-skilled workers
Schmillen	2011	Germany (2003-2006)	LEED + distances	OLS, Firm FE, Worker FE, Spell FE	Positive wage premium only for shipments over a long distance.
Toth	2011	Hungary (1994-2003)	LEED	OLS, Firm FE	No significant exporter premium;
Koren and Toth	2013	Hungary (1994-2003)	LEED	OLS, Firm FE	Trading firms pay higher wages; imports are at least as important as exports

Appendix B. Regression results, LEED sample

Table B1. Benchmark regression, detailed results

Table B1. Regression Results: Benchmark Regression

	Dependent Variable: Log (wage)						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Exporter	**0.014*** [0.002]**	**0.016*** [0.002]**	**0.012*** [0.002]**	**0.004** [0.002]**	**-0.015*** [0.002]**	**-0.014*** [0.002]**	**-0.016*** [0.002]**
Firm Age		0.004*** [0.000]	0.004*** [0.000]	0.003*** [0.000]			
Medium			0.098*** [0.002]				
Large			0.113*** [0.003]				
Log (size)				0.062*** [0.001]			
Foreign owned		0.179*** [0.003]	0.171*** [0.003]	0.160*** [0.003]			
Experience		0.021*** [0.000]	0.018*** [0.000]	0.016*** [0.000]	0.022*** [0.000]	0.018*** [0.000]	0.017*** [0.000]
Experience^2		-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]	-0.000*** [0.000]
Female		-0.148*** [0.001]	-0.120*** [0.001]	-0.137*** [0.001]	-0.152*** [0.001]	-0.122*** [0.001]	-0.139*** [0.001]
Education: Vocational		0.120*** [0.001]	0.117*** [0.001]	0.079*** [0.001]	0.121*** [0.002]	0.118*** [0.002]	0.079*** [0.001]
Education: High School		0.302*** [0.001]	0.254*** [0.001]	0.152*** [0.001]	0.304*** [0.002]	0.254*** [0.002]	0.150*** [0.002]
Education: University		0.780*** [0.001]	0.519*** [0.002]	0.441*** [0.002]	0.780*** [0.003]	0.509*** [0.003]	0.432*** [0.003]
White collar			0.364*** [0.001]			0.375*** [0.003]	
Occupation: Managers				0.607*** [0.002]			0.621*** [0.005]
Occupation: Professionals				0.417*** [0.002]			0.415*** [0.005]
Occupation: Technicians, associate professionals				0.282*** [0.002]			0.278*** [0.003]
Occupation: Office and customer services				0.199*** [0.002]			0.198*** [0.005]
Occupation: Commercial and services				0.124*** [0.002]			0.129*** [0.003]
Occupation: Agricultural and forestry				0.052*** [0.007]			0.057*** [0.009]
Occupation: Industry and construction				0.133*** [0.002]			0.132*** [0.002]
Occupation: Machine, assembly workers				0.092*** [0.002]			0.089*** [0.003]
Working hours		0.008*** [0.000]	0.008*** [0.000]	0.007*** [0.000]	0.008*** [0.001]	0.007*** [0.001]	0.007*** [0.001]
Industry & region dummies	NO	YES	YES	YES	NO	NO	NO
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Firm variables	NO	YES	YES	YES	NO	NO	NO
Worker variables	NO	YES	YES	YES	YES	YES	YES
Constant	11.192*** [0.002]	10.419*** [0.015]	10.423*** [0.015]	10.228*** [0.015]			
Observations	1,107,664	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	24,398	23,710	23,710	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) For education, the omitted category is <12years, for region - Central Hungary, for occupation - unskilled workers. 4) All regressions are weighed

Table B2. Number of firms and share of total for different definitions of exporter status

Year	Export/Sales > 0		Export/Sales > 1%		Export/Sales > 5%		Export/Sales > 20%	
2002	2,872	43%	2,423	36%	1,991	30%	1,467	22%
2003	2,636	42%	2,216	35%	1,833	29%	1,369	22%
2004	3,015	43%	2,430	35%	1,939	28%	1,400	20%
2005	3,118	43%	2,540	35%	2,041	28%	1,441	20%
2006	2,988	44%	2,450	36%	2,009	30%	1,426	21%
2007	2,988	45%	2,521	38%	2,053	31%	1,475	22%
2008	3,013	46%	2,499	38%	2,054	31%	1,504	23%
2009	3,009	47%	2,480	39%	2,050	32%	1,493	23%
2010	3,299	43%	2,729	35%	2,202	29%	1,610	21%
2011	3,115	50%	2,668	42%	2,167	34%	1,606	26%
Total	**30,053**	**44%**	**24,956**	**37%**	**20,339**	**30%**	**14,791**	**22%**

Table B3. Year-dummy interactions, main regression

Table B3. Regression Results: Year Interactions					
	Dependent Variable: Log (wage)				
	[1]	[2]	[4]	[5]	[7]
Exporter	**0.042***** [0.003]	**0.050***** [0.003]	**0.037***** [0.003]	**0.021***** [0.004]	**0.019***** [0.004]
Exporter*2003	**-0.005** [0.004]	**-0.012***** [0.003]	**-0.008**** [0.003]	**-0.010**** [0.004]	**-0.008*** [0.004]
Exporter*2004	**-0.018***** [0.004]	**-0.021***** [0.003]	**-0.020***** [0.003]	**-0.026***** [0.005]	**-0.028***** [0.004]
Exporter*2005	**-0.005** [0.004]	**-0.011***** [0.003]	**-0.006**** [0.003]	**-0.017***** [0.004]	**-0.016***** [0.004]
Exporter*2006	**-0.011***** [0.004]	**-0.021***** [0.003]	**-0.017***** [0.003]	**-0.027***** [0.005]	**-0.024***** [0.004]
Exporter*2007	**-0.043***** [0.004]	**-0.054***** [0.003]	**-0.055***** [0.003]	**-0.055***** [0.009]	**-0.055***** [0.009]
Exporter*2008	**-0.055***** [0.004]	**-0.060***** [0.003]	**-0.063***** [0.003]	**-0.056***** [0.005]	**-0.056***** [0.005]
Exporter*2009	**-0.070***** [0.004]	**-0.083***** [0.004]	**-0.083***** [0.003]	**-0.081***** [0.005]	**-0.081***** [0.005]
Exporter*2010	**-0.048***** [0.004]	**-0.058***** [0.004]	**-0.063***** [0.003]	**-0.061***** [0.005]	**-0.064***** [0.005]
Exporter*2011	**-0.045***** [0.004]	**-0.054***** [0.004]	**-0.057***** [0.003]	**-0.052***** [0.005]	**-0.051***** [0.005]
Firm variables	NO	YES	YES	YES	NO
Worker variables	NO	YES	YES	YES	YES
Endogenous	NO	NO	YES	NO	YES
Year FE	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES
Observations	1,107,664	1,107,664	1,107,664	1,106,976	1,106,976
Number of firms	24,398	24,398	24,398	23,710	23,710

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1; 3) All regressions are weighed with worker weights

Figure B1. Year dummy interactions, different export intensity

Figure B 1.1. Wage differential change over time: firms which export > 0% of sales

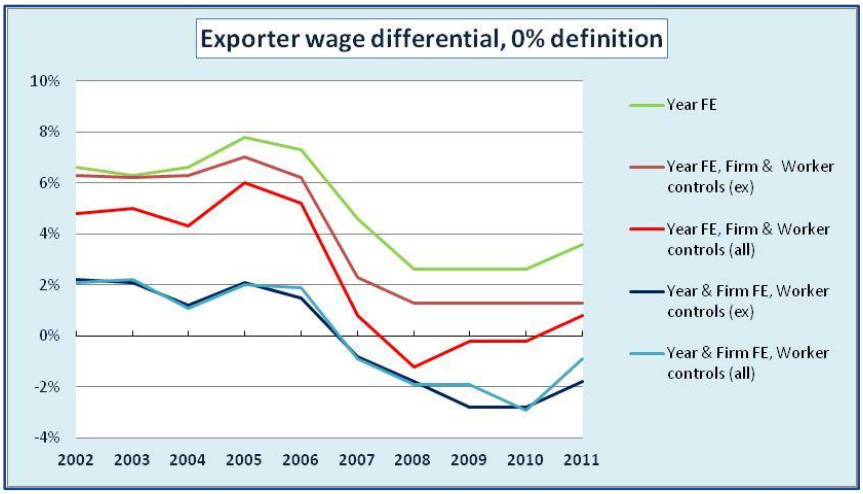


Figure B 1.2. Wage differential change over time: firms which export > 1% of sales

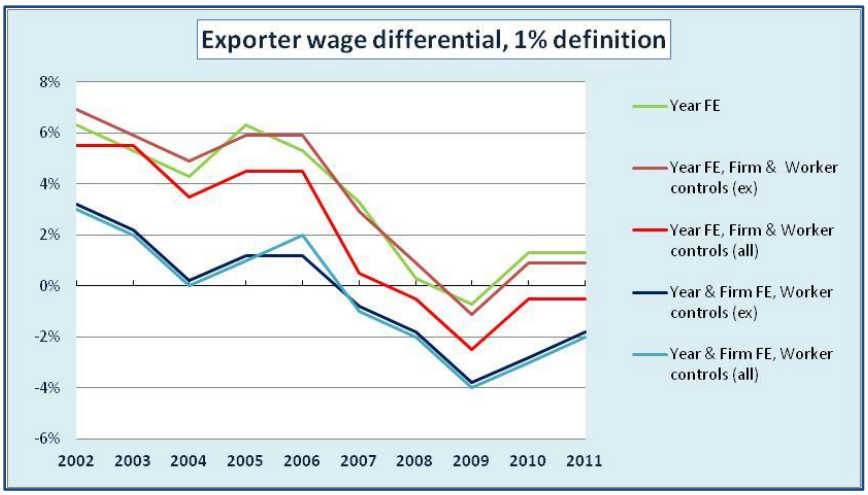
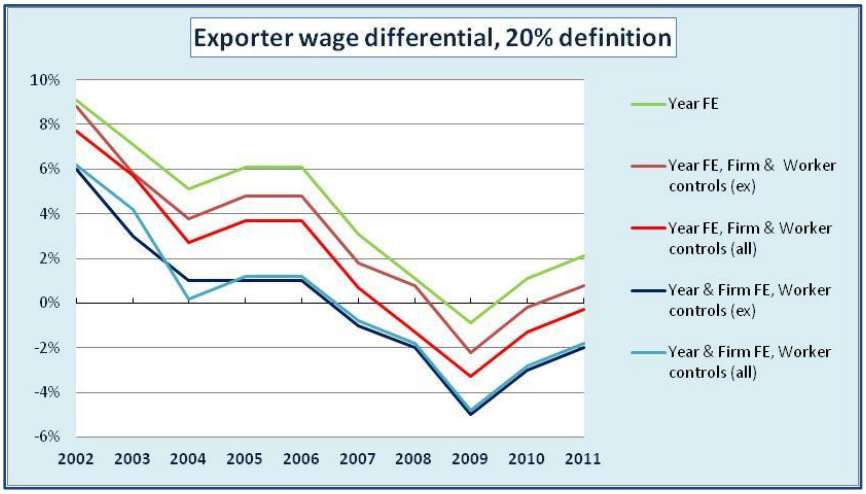


Figure B 1.3. Wage differential change over time: firms which export > 20% of sales



Appendix C: Matched sample

Table C1. Matching procedure

Table C1.1. Propensity score matching, probit regression

Table C1.1. Probit Results	
	Dependent Variable: Probability of being an exporter
Log (Total Employment $_{t-1}$) $^{\wedge 2}$	0.5882***
	[0.1962]
Log (Total Employment $_{t-1}$) $^{\wedge 2}$	-0.0353*
	[0.0196]
Log (Labor productivity $_{t-1}$)	2.1402***
	[0.5157]
Log (Labor productivity $_{t-1}$) $^{\wedge 2}$	-0.0965***
	[0.0259]
Log (Capital intensity $_{t-1}$)	-0.0907
	[0.1773]
Log (Capital intensity $_{t-1}$) $^{\wedge 2}$	0.0094
	[0.0114]
Log (Average wage $_{t-1}$)	0.0069
	[0.6746]
Log (Averarge wage $_{t-1}$) $^{\wedge 2}$	0.0002
	[0.0438]
Employment growth (from t-2 to t-1)	-0.0978
	[0.4141]
Wage growth (from t-2 to t-1)	0.1092
	[0.2428]
Foreign ownership $_{t-1}$	0.4328***
	[0.1219]
Year dummies	YES
Industry dummies	YES
Pseudo R^2	0.63
Observations	9,813

1) Standard errors in brackets below the coefficients. 2) Confidence level: ***p<0.01, ** p<0.05, * p<0.1;

Table C1.2. Comparison between the full LEED and the matched sample

Table C1.2. Comparison between LEED and matched sample		
	LEED	**Matched**
Sales (1000 Huf)	4,787,376	7,487,038
Employment	138.8	216.6
Pretax Profit (1000 Huf)	224,234	201,759
Tangible assets (1000HUF)	1,505,696	2,465,662
Firm age	12.0	13.4
Foreign owned	21%	23%
State owned	4%	3%
Exports / Sales	16%	7%
Number of firm-years	67,650	2,932

Table C2. Summary statistics for the matched sample

Table C2.1. Firm-level summary statistics for the matched sample

Table C2.1. Firm-level summary statistics, matched sample				
		Non-exporter	Exporter	Standardized mean difference
Sales (1000 Huf)		7,629,981	7,377,810	0.01
Employment		206.3	224.5	-0.04
Pretax Profit (1000 Huf)		250,596	164,441	0.04
Tangible assets (1000 Huf)		3,099,547	1,981,285	0.04
Firm age		13.9	12.9	0.10
Foreign owned		17%	28%	-0.18
State owned		5%	2%	0.13
Region	Central Hungary	48%	44%	
	Central Transdanubia	8%	10%	
	Western Transdanubia	6%	9%	
	Southern Transdanubia	5%	4%	
	Northern Hungary	10%	7%	
	Northern Great Plain	15%	11%	
	Southern Great Plain	8%	14%	
Year	2002	10%	10%	
	2003	10%	10%	
	2004	10%	10%	
	2005	12%	10%	
	2006	12%	11%	
	2007	11%	11%	
	2008	11%	11%	
	2009	10%	10%	
	2010	8%	9%	
	2011	7%	8%	
Exports / Sales		0%	11%	
Number of firm-years		1,270	1,662	

Table C2.2. Worker-level summary statistics for the matched sample

Table C2.2. Worker-level summary statistics, matched sample				
			Non-exporter	Exporter
Age			41.3	39.8
Female (%)			45%	38%
Education	Elementary		12%	13%
	Vocational		35%	30%
	High school		38%	38%
	University		16%	20%
Blue-collar (%)			82%	81%
Working hours			40.1	39.9
Year		2002	10%	9%
		2003	9%	9%
		2004	10%	9%
		2005	11%	9%
		2006	11%	12%
		2007	12%	11%
		2008	10%	10%
		2009	11%	10%
		2010	9%	10%
		2011	7%	10%
Wage			192,420	216,674
Total worker-years			22,132	29,848

Table C3. Regression results for the matched sample, main regression

Table C3. Benchmark Regression Results: Matched Sample							
	Dependent Variable: Log (wage)						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Exporter	-0.027***	-0.024***	-0.018***	-0.022***	-0.024***	-0.017***	-0.021***
	[0.007]	[0.006]	[0.005]	[0.005]	[0.006]	[0.005]	[0.005]
Experience		0.030***	0.025***	0.023***	0.030***	0.025***	0.022***
		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Experience^2		-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Female		-0.171***	-0.131***	-0.143***	-0.171***	-0.131***	-0.143***
		[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Education: Vocational		0.123***	0.113***	0.060***	0.123***	0.113***	0.059***
		[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Education: High School		0.335***	0.282***	0.144***	0.335***	0.282***	0.143***
		[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Education: University		0.849***	0.544***	0.462***	0.846***	0.541***	0.458***
		[0.007]	[0.008]	[0.008]	[0.007]	[0.008]	[0.008]
White collar			0.424***			0.424***	
			[0.005]			[0.005]	
Occupation: Managers				0.744***			0.745***
				[0.009]			[0.009]
Occupation: Professionals				0.405***			0.404***
				[0.011]			[0.011]
Occupation: Technicians, associate professionals				0.327***			0.327***
				[0.008]			[0.008]
Occupation: Office, customer services				0.200***			0.201***
				[0.009]			[0.009]
Occupation: Commercial, services				0.127***			0.129***
				[0.008]			[0.008]
Occupation: Agricultural, forestry				0.140**			0.140**
				[0.071]			[0.071]
Occupation: Industry , construction				0.156***			0.157***
				[0.007]			[0.007]
Occupation: Machine, assembly workers				0.129***			0.128***
				[0.008]			[0.008]
Working hours		-0.001	-0.001	-0.002**	0.001	0	-0.001
		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Firm Age		0.003	0.003	0.002			
		[0.002]	[0.002]	[0.002]			
Medium			0.046***				
			[0.010]				
Large			0.068***				
			[0.013]				
Log (size)				0.026***			
				[0.005]			
Foreign owned	11.528***	10.923***	10.954***	10.841***			
	[0.025]	[0.058]	[0.056]	[0.059]			
Region Dummies	NO	YES	YES	YES	NO	NO	NO
Industry dummies	NO	YES	YES	YES	NO	NO	NO
Year FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	YES	YES	YES
Constant	11.528***	10.923***	10.954***	10.841***			
	[0.025]	[0.058]	[0.056]	[0.059]			
Observations	51,980	51,980	51,980	51,980	51,980	51,980	51,980
Number of Firms	420	420	420	420	420	420	420

1) Standard errors in brackets below the coefficients. 2) Confidence level:*** p<0.01, ** p<0.05, * p<0.1; 3) For education, the omitted category is less than vocational. For region the omitted is Central Hungary. For occupation, the omitted is unskilled workers.