Processing Trade and Firm Performance
The Case of Hungary

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Abstract

Using Hungarian firm level data for the years 1994 and 1999, this paper investigates the effect of processing trading activity on firm performance. I find that employment premia, followed by gains in capital per worker, average wage, total factor productivity and value added are higher for firms doing this type of trade for both years. For some performance measures, processers are better than other firms even before they start assembling so I show that there is self-selection into processing. Evidence on learning-by-processing can also be identified: processing firms grow faster than others (in terms of employment, value added, labor productivity and average wage) after the start of processing. Finally, processers have higher probability of survival. In comparison with other types of traders, processers have higher employment, total factor productivity, wage per value added and value added per sales.

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1 Introduction

There is a broad literature on how trading activities (mainly exporting) enhance firm productivity: many recent empirical (e.g. Bernard and Jensen, 2007; Clerides, Lach and Tybout, 1996; Biesebroeck, 2003) and theoretical (e.g. Melitz, 2003) papers highlighted the heterogeneity of firms in international trade. The two most important hypotheses in the firms in international trade literature are related to self-selection and learning-by-exporting effects: on the one hand exporters should supposedly perform better than non-exporting counterparts even before starting their activity, so that they can bear the sunk costs of exporting; on the other hand, as these firms start to export and enter the foreign markets, they are exposed to more competition which should determine them to raise their productivity in order to survive (Bernard and Jensen, 1999). Importing behavior and firm performance was documented to a lesser extent (e.g. Castellani, Serti and Tomasi, 2008; Kasahara and Rodrigue, 2005; Halpern, Koren and Szeidl, 2009) although the two central questions of firm performance and trader status prevail in case of importers as well: first, because of sunk costs of importing, they might need to have better performance even before importing in which case there is self-selection of better firms into importing; second, firms might learn from importing and develop further as they have access to better inputs (Kasahara and Rodrigue, 2005).

The main goal of this paper is to contribute to the existing literature by investigating the relationship between processing trading activity and firm performance on a sample of Hungarian manufacturing firms for the years 1994 and 1999. Processing trade is a combination of importing and exporting when inputs and outputs flow between the procurer and the processer without changing owners. The value of the final good contains the inputs provided by the owner and the value added by the processer, that is the labor cost and the cost of other components (Csizmazia, 2005, p. 14). In my analysis I focus on *active* processing

trade, involving the importation and domestic processing of inputs, followed by the transportation of goods outside the country.

The studied period is especially important as it represents the first years after the transition when firms started to open up to trade. Although some of the firms were doing processing trade as an auxiliary activity starting from the 70's, as documented by Szanyi (2001), the breakthrough came in the beginning of the '90s when due to the changes in the economic environment firms lost their procurers and physical and human capital was left unused (Páldi, 1998). In this setting, processing trade helped many firms on a low level of technological development (compared to Western plants) to further continue their activities by completing the labor-intensive production processes of firms mainly from Western Europe (Antalóczy, Sass, 1998).

Mechanisms through which productivity might be increased can be identified for processing traders as well. First of all, processers should benefit from using better inputs, shipped from abroad. According to Andersson, Lööf and Johansson (2008) the possibility to import some of the commodities gives firms a broader choice in terms of inputs and allows them to specialize in activities where they have advantage. The qualitative aspects of imported inputs should not be neglected either (Halpern, Koren and Szeidl, 2009). In addition, the higher reliability of foreign input suppliers compared to domestic ones (especially in transition economies) gives certain advantages to input importers (Antalóczy, Sass, 1998). Second, processing firms are given instructions (e.g. description of how assembling should be done) to be followed throughout the production process which can be associated with a knowledge infusion; managerial, marketing and organizational knowledge might also be transferred (Antalóczy, Sass, 1998). Third, advanced types of processing trade (especially in the machinery industry) demand already capital investments from the part of the contractor in which case processers benefit from a technological transfer through the installation of more

advanced plant machinery (Éltető, 1999). Still, processers do not have to undertake the financing risks of the investments as long as machinery is provided by contractors (Antalóczy, Sass, 1998). Fourth, goods manufactured by processing traders are sold on foreign and mostly developed countries' markets where a higher quality of products is required. Competition is usually much stronger on foreign markets and firms selling abroad need to outperform non-trading firms (Bernard and Jensen, 1999).

So far, very few papers were focusing on how exactly and to what extent does processing trade influence firm performance although it was a prevalent way of trading in Central and Eastern Europe[1]. Antalóczy and Sass (1998) offer an overview of the evolution of Hungarian processing trade between the year 1992 and 1997. Another paper by Szanyi (2001) performs an investigation that relates processer status and different measures of firm performance based on an interpretation of questionnaire answers given by firms.

In my thesis, I answer processer status and performance related questions, following closely the methodology developed by Bernard and Jensen (1999) and testing the above mentioned mechanisms. In the first step, I identify processer premia for performance related measures such as total factor productivity, labor productivity, value added per worker, average wage, capital per worker, employment, value added to sales, wage to value added and wage to export sales ratios. Then I test whether there is self-selection into processing, i.e. do ex-ante better firms become processers. I next investigate whether firms do become better after they start processing. If learning-by-processing effects are present, then processing firms should grow faster in terms of performance indicators. In addition, controlling for firm characteristics, I test whether processers outlive their non-processer counterparts. Finally, I provide some performance comparison between processing firms and firms doing conventional types of trade.

[1] Egger and Egger (2005) investigate the factors that contributed to the increase in European processing trade.

The main findings of the thesis are as follows. Differences in performance measures are significant for processers, the highest premia being the one for employment, followed by capital per worker, average wage, value added per sales, total factor productivity and value added. Results are robust for both years and in most of the cases, with different control variables in the regressions as well. Moreover, processers perform better than other firms along some productivity measures even before and after they start this type of trade. I show that those firms self-select into processing which employ more workers, give higher wages and are more capital intensive ex-ante. Learning-by-processing effects can be identified for employment, value added, labor productivity and average wage. Moreover, processers have higher probability of survival. In comparison with other types of traders, processers are better along four performance measures for 1994 and 1999 according to the results from the baseline regression: employment, total factor productivity, wage per value added and value added per sales.

The paper is organized as follows. In Section 2, I review the international trade and firm performance literature in more detail. As processing trade is a combination of exporting and importing, I present the main performance-related findings for both trading activities. This part is followed by a section that offers insight into the evolution of processing trade in Hungary. In Section 4, I present the methodology used for the analysis. Next, I describe the data used, focusing mainly on some stylized facts concerning processing firms. In section 6, I present the results concerning processers and also a comparison of processer and other traders' performance. Section 7 concludes.

2 Related Literature

Earlier works related to the firms in international trade literature document broad evidence on better performance for firms that engage in trading activities. At first, most of the papers were investigating the relationship between exporting and performance, but later research showed that even importing (sometimes together with exporting) has a positive effect on firm productivity and other measures of performance. Beside these, there are only a few papers dealing with other types of international activities that became prevalent with firms' globalization (e.g. outsourcing, offshoring, processing).

The paper by Bernard and Jensen (1999) can be considered a cornerstone in assessing exporter performance. On a sample of US manufacturing firms, beyond identifying exporter premia for different productivity measures, they ask two other important questions related to firm performance. First, the authors investigate whether firms are better in each dimension already before exporting, which might trigger exporting, as better performing firms are more able to bear the costs of exporting (Bernard, Jensen, 1999). Results show clear evidence of exporters being ex-ante better than non-exporters: exporters are larger in terms of employment, they have more shipments and their value added is larger as well, compared to non-exporters. Second, Bernard and Jensen (1999) ask in their paper whether firms become better by exporting, which would be an expected outcome, considering that firms are exposed to higher competition on international markets and as a consequence they need to become more productive. The evidence on learning-by-exporting is mixed: employment and shipment growth are higher, whereas value added per worker and total factor productivity grow slower in case of exporters. They also find evidence on higher plant survival probability in case of exporters.

The two main mechanisms through which productivity might be enhanced suggested by Bernard and Jensen (1999) became the subject of investigation in many other papers[2] addressing exporter performance. Hansen (2010) investigates firm performance prior entry and productivity differences after entry into the export market between exporters and non-exporters for a merged sample of German and Austrian firms. The main finding is that better firms self-select into the export market and contrary to the finding in the Bernard and Jensen (1999) paper, their performance improves further after the start of exporting. The authors suggest that growth in productivity after exporting is due to economies of scale and there is no improvement due to technological changes but rather due to further investment incentives. On a sample of Spanish firms, Farinas and Martín-Marcos (2003) find that exporters are better in many dimensions than non-exporters and that there is evidence on better firms self-selecting into export markets. Considering entries to and exits from the export market, the authors show that firms which start exporting have higher performance measures before entering the export market. Similar to the Bernard and Jensen (1999) paper, for this sample of firms there is again no clear evidence for learning-by-exporting effect.

Baldwin and Gu (2003) investigate the relationship between exporting and firm performance for a sample of Canadian firms by addressing the two questions raised by Bernard and Jensen (1995) with three possible extensions. The authors consider that firm ownership, age and the intensity of exports might also influence productivity. They conclude that there is self-selection of more productive firms into the export market. Similar to Hansen (2010), for Canadian firms there is also clear evidence on learning-by-exporting: entrants in the export market grow faster than non-exporters. Concerning the extensions, Baldwin and Gu (2003) find that domestic and younger plants are more likely to benefit more from exporting. They also find evidence on productivity growth due to increased export intensity.

[2] For a summary of 45 studies concerning exports and productivity see Wagner (2005).

Other papers, still focusing on self-selection into export market and learning-by-exporting effects apply more advanced methodology to explain exporter performance but results do not change to a great extent compared to simple OLS estimations. Van Biesebroeck (2003), in order to detect the learning-by exporting-effects of firms and to control for self-selection into export market (decision of firm to export is endogenous), uses instrumental variables and semiparametric estimation. It turns out that in the case of the studied firms, both self-selection and learning-by-exporting effects are present. All methods support the idea that exporters increase their productivity as they enter the export market and the productivity gap is increasing between exporters and non-exporters. The explanation of the author for this effect is the presence of returns to scale (e.g. exploit scale economies by extending to foreign markets) and trader credit (e.g. increase sales through trader credits which can be relied on because of better contract enforceability in foreign markets).

De Loecker (2007) extends the analysis to a sample of firms from Slovenia and uses matching techniques to investigate the relationship between firm performance and exporting. The final conclusion is that by controlling for self-selection into export market exporters are better than their non-exporting counterparts and the performance gap between exporters and non-exporters is increasing over time. However, learning effects are different across sectors.

Álvarez and Fuentes (Forthcoming) use also matching techniques to document that Chilean firms that enter the export market increase their productivity after they start exporting. Clerides, Lach and Tybout (1996) introduce a new methodology to explain the relationship between performance and exporter status for Colombia, Mexico and Morocco: they estimate an autoregressive cost function and a dynamic discrete choice equation for export market participation decision but they find that exporting is not significantly shifting the cost function (e.g. there would be evidence on learning-by-exporting effect if, by entering the export market the firm faces a decrease in its costs of production).

Another less large set of papers considers importing activity as an explanation to differences in firm premia and identifies through which mechanisms productivity might be enhanced with this type of trading. Some other authors consider export and import together to explain exceptional firm performance.

For a sample of Swedish firms, using panel data methods, Andersson, Lööf and Johansson (2008) find out that firms that both import and export outperform those firms that either import or export. Moreover, productivity premium is increasing nonlinearly in the number of destination countries and number of products sold for each type of trader. Another paper by Muuls and Pisu (2007) for a sample of Belgian manufacturing firms finds out that all traders (exporters, importers, both way traders) are more productive (in terms of value added per worker) than non-traders. In addition, there seems to be self-selection not only to the export, but also to the import market, as both types of traders are larger (in terms of employment) and more productive (in terms of value added) before starting to trade. Castellani, Serti and Tomasi (2008), for a sample for Italian firms draw the same conclusions as Muuls and Pisu (2007) for the Belgian firms.

Altomonte and Békés (2010) investigate the relationship between exporting, importing or both way trading and firm performance on a sample of Hungarian firms with some possible extensions. Quantitative and qualitative indicators of traded goods as well as the technological aspect of production, called altogether complexity measures, are considered for explaining differences in performance for exporters and importers. The authors find evidence on productivity premia for all types of traders, including exporters-only, importers-only and both-way traders. Total factor productivity advantages prior trading can be documented for exporters and importers, the higher being for the last group, proving that there is self-selection into trading. Trade complexity indicators are also correlated with firm performance before

entry, but evidence on self-selection based on these measures can be found only for importers and not for exporters.

Kasahara and Rodrigue (2005) explore only the effect of importing on firm performance on a sample of Chilean firms and find evidence on importing intermediate inputs improving firm productivity. This effect is due to the fact that through importing, firms have access to more advanced foreign technology. There is also evidence on self-selection and learning-by-importing: better firms are more likely to start importing (they are more likely able to cover the sunk costs) and after they start it, it is more likely that they will invest, grow further and do not exit. Goldberg et al. (2008) also find out for a sample of Indian manufacturing firms that importers have substantial productivity gains and they attribute this outcome to the fact that through importing, firms have access to new input varieties in addition to enjoying lower input prices. Halpern, Koren and Szeidl (2009) essentially test together the effects of importing on firm performance for a sample of Hungarian firms, investigated in the last two mentioned papers. The first mechanism through which imported intermediate goods affect productivity is quality, meaning that imported inputs are better than their domestic counterparts. The second mechanism is referred to as complementarity and it captures the effect of using a certain combination of inputs for production. Authors use a structural model to estimate these effects on importing and they find out that imported inputs affect productivity considerably and that this gain is due to a larger extent to the complementarity effect.

The evidence on other types of international activities and firm performance is meager: Farinas and Martín-Marcos (2010) investigate the relationship between foreign sourcing and productivity on a sample of Spanish firms, Wagner (2009) tests for self-selection and performance effects in case of offshoring of German firms and Yu (2010) relates processing trade and firm performance for a sample of Chinese firms.

Farinas and Martín-Marcos (2010) find evidence on increasing number of firms (extensive margin) and increasing intensity (intensive margin) in outsourcing activity for the years 1990-2002. The authors test for differences between distribution functions and conclude that firms with higher productivity are more likely to outsource. Firms engaged in this type of international activity are better than others already before outsourcing as the ex-ante productivity distribution of those which outsource stochastically dominates the distribution of those which do no outsource.

In the second paper, Wagner (2009) compares firms that did relocate across the borders their activities to the ones that did not and finds that offshoring firms are larger, more productive, more human capital intensive and have a higher share of export sales in total sales than firms that do not engage in offshoring. This is true even for the year before some firms started to do this activity, so there is evidence on better firms' self-selection. In order to answer whether there are any effects of offshoring after starting it, the author performs propensity score matching and concludes that there is positive and large effect on productivity, weaker and positive effect on wage per employee and no effect on human capital intensity.

Finally, the paper of Yu (2010) considers the effect of processing trade, together with tariff reductions, on firm performance. According to the author's arguments, processing trade should increase productivity because of spillover effects, whereas tariff reductions through increased competition. For a sample of Chinese firms, in case of state owned enterprises, it is shown that firms gain in productivity from tariff reductions and those firms which are engaged in processing trade, gain even more.

Processing trade spread quickly in the '90s between Western and Central and Eastern European countries as well. For Hungary, Antalóczy and Sass (1998) document the role and development of processing trade. They use statistical methods to analyze on the macro level

the evolution of processed products in total exports, the wage costs, main partner countries and the industries mostly involved in processing trade.

Another paper by Szanyi (2001) performs a micro-level analysis based on two small samples[3] of Hungarian firms for 1996 and 1999, relating processing trade to a wide array of performance measures. The interpretation of firm level questionnaires shows that firms involved in processing trade produce higher quality output, use more advanced technology and have higher profit to sales ratio and return on equity. Further analysis illustrates that bigger, foreign owned and machinery industry processers perform better than small, domestically owned and light industry processers. Firms doing this type of trade are in advantage even when the change in these variables between 1996 and 1999 is considered, compared to non-processers.

Thus, these results suggest that the methodology used for exporters and importers could be implemented for processers as well by analyzing the same questions as for other types of traders. In the next section, I provide a description of the evolution of processing trade in Hungary to motivate that this type of trade had indeed an important role in firms' international activities.

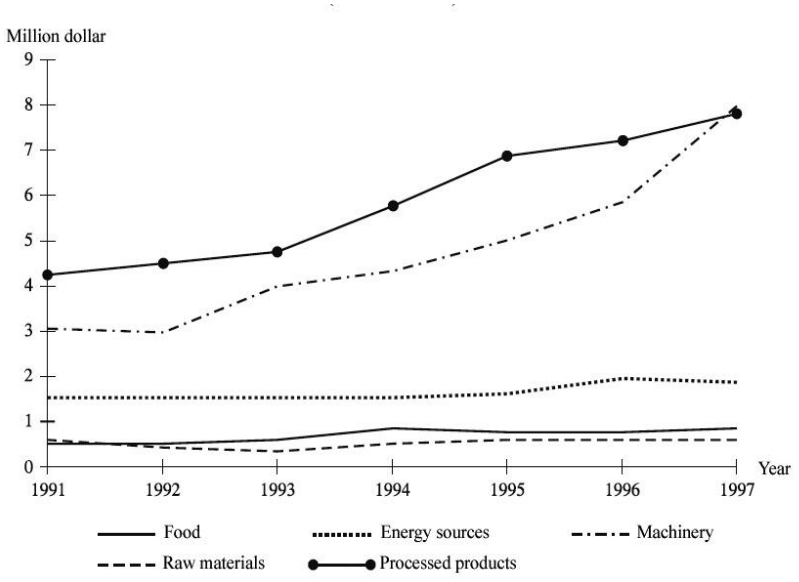
[3] Two samples with more than 300 observations for each year (1996 and 1999) were considered with 50 processers in the first and 65 processers in the second sample. See Szanyi (2001).

3 Processing trade in Hungary

Already from the beginning of the 1970's, processing trade was present in Hungary and it meant the only way of cooperation with Western countries (Antalóczy, Sass, 1998). Still, in this period, the processing of goods is mainly an auxiliary activity of firms (20-30% of sales according to Antalóczy, Sass (1998)), enabling them to use labor more efficiently, to generate additional revenue and to access better techonology (Szanyi, 2001).

Starting with the 1990s, processing became a question of survival for many Hungarian firms as they lost their Soviet procurers and consequently the major part of the orders (Páldi, 1998). Hungary became attractive as a processing partner for Western European countries and even firms from Japan and the United States were interested in doing processing trade in the region (Antalóczy, Sass, 1998). Figure 1 shows that for each year between 1991-1997 the main component of Hungarian import is given by processed products and their share is increasing in the studies period.

Figure 1: Hungarian import by main components, 1991-1997 (million dollar)

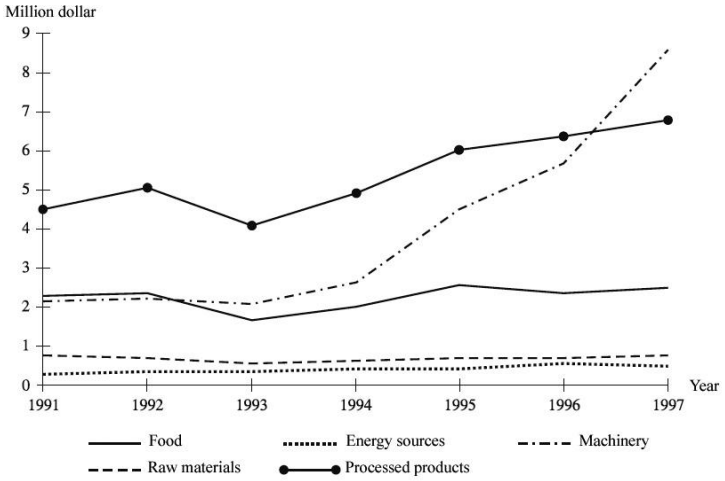


Source: Páldi (1998), p. 1021

Developed countries become interested in doing processing trade with countries in transition, Hungary being one of them, mostly because in these countries labor costs are low compared even to developing countries within the European Union region. There are still remarkable differences in labor productivity in comparision to developed countries, but these are outweighted by differences in wages (Antalóczy, Sass, 1998).

Low distance (through lower transportation costs) from main processing trade contractors of the European Union (Austria, Germany, Italy) also contributed to the increase in Hungarian processing trade. Between 1993-1997 the share of processing trade in country's export was around 25%, for each year, in which Germany, as a destination country counted for around 50%, followed by Austria with 15% and Italy with 10% (Antalóczy, Sass 1998). Figure 2 shows that for the years 1991-1997, except for 1993, processed products were increasing within export, being its largest component until 1996.

Figure 2: Hungarian export by main components, 1991-1997 (million dollar)



Source: Páldi (1998), p. 1021

For most of the countries, including Hungary, we can make a distinction between two main types of processing trade: the first type is concerning textile, leather, clothes and shoe

manufacturing and the second type is prevalent in machinery industry. The major difference between these two ways of doing processing trade is that the machinery industry requires usually more sophisticated technology and fixed assets investments from the part of contractor (Éltető, 1999). Starting from 1993, Hungary, similar to other countries from the region, was doing mostly the second type of processing trade. Throughout the years, the highest shares of processing trade were represented in the following machinery producer industries: manufacture of electrical machinery and apparatus, radio, television and communication equipment and transportation equipment (Éltető, 1999).

Another important aspect of processing trade is the evolution of wages, as the value added of the processing firm is labor. Between the years 1992-1997, wages represented around 30% of exports from processing trade, placing Hungary well ahead developing countries in terms of value added (Antalóczy, Sass, 1998). In the last years of the 1990's, processing trade wages shoould have declined as other countries from Eastern Europe entered the processing market. Still, the fact that Hungarian firms started processing trade relatively early and were exposed to learning spillovers from the 1970's, gives them a comparative advantage in quality processing trade (Antalóczy, Sass, 1998).

4 Methodology

In this section I provide an overview of the methodology used to estimate processer premia along various productivity measures, self-selection and learning-by-processing effect, and processer survival. For assessing other trader premia used later on with comparison purposes, I reestimate the same regressions with a dummy variable indicating other types of trading activity. In the following I detail the estimation of total factor productivity as well.

4.1 Identifying processer premia

In order to show the differences in characteristics between processers and non-processers I follow the methodology of Bernard and Jensen (1999) and other authors used before to detect exporter premia. This preliminary analysis is based on the following OLS regression:

$$x_{i,t} = \beta_0 + \beta_1 PROC_{i,t} + \beta_2 IND_i + \varepsilon_{i,t} \quad (1)$$

where x_i stands for the log of firm i, period t characteristic. The productivity measures used in the analysis are the following: total employment, value added per worker, labor productivity, average wage, TFP, capital per worker, wage per value added, wage per exportsales and value added per sales. PROC is a dummy variable and is equal to one if the firm is doing processing trade, zero otherwise. The β_1 coefficient from equation (1) shows the average percentage differentials in performance between processers and non-processers.

Additionally, I include industry dummies in the regressions (IND) with the motivation that sectors are very different in capital requirements, entry, exit and other conditions. As an extension, equation (1) is reestimated by controlling for firm size (log total number of employees) and foreign ownership. It is important to control for the total number of workers as firms are very heterogeneous in terms of employment and higher premia might be correlated with firm size. In addition, firm performance might also be correlated with the ownership structure of the firm. Majority foreign ownership can add additional gains to the

productivity effects of international trading activities (e.g. beyond foreign intermediate inputs and guaranteed foreign market for products, the processer might benefit from foreign management as well if it is owned by others from abroad). By omitting this variable from the regression, point estimates might be upward biased.

4.2 Identifying self-selection

Further on I analyze whether firms that became processers by the end of the period had different characteristics before they started processing, compared to those firms that are not involved in this type of trading in the final year. In order to perform this investigation I follow again Bernard and Jensen (1999) and I limit the sample only to those firms which did not do processing trade in the first year (1994). They may or may not be doing processing in the last year (1999). By estimating equation (2) by simple OLS, I can identify advantages in processer performance before entry (start of processing):

$$x_{i,1994} = \beta_0 + \beta_1 PROC_{i,1999} + \beta_2 IND_i + \varepsilon_{i,t} \qquad (2)$$

In the left hand side of equation (2) I include ex-ante (1994) performance measures as detailed earlier in logarithm and in the right hand side I use the dummy variable indicating processer status for 1999 and industry dummy. In addition, based on the same motivation as before, I extend equation (2) by controlling for size.

4.3 Identifying learning-by-processing

In order to show that firms become better by processing, I apply the methodology used for detecting learning-by-exporting effects by Bernard and Jensen (1999), Farinas and Martín-Marcos (2003) and other authors. Using OLS estimation, I regress the growth rate of log performance measures (between 1999 and 1994) on initial processer status (1994) according to the following equation:

$$\%\Delta x_{i,t} = x_{i,1999} - x_{i,1994} = \beta_0 + \beta_1 PROC_{i,1994} + \beta_2 IND_i + \varepsilon_{i,t} \qquad (3)$$

By including industry dummies, I control here as well for cross industry differences and as an extension I will again report results with a control for firm size due to the same motivation as before.

4.4 Estimating processer survival

In the last step I analyze how processer status in 1994 influences firm survival by estimating a probit model similar to the one used by Bernard and Jensen (1999) for assessing the relationship between exporting and firm survival. A firm is considered to be a survivor if it exists in both years, 1994 and 1999, given initial plant characteristics. The probit is defined in the following way:

$$S_{i,1999} = \begin{cases} 1 \; if & \beta x_{i,1994} + \beta_p PROC_{i,1994} + \varepsilon_{i,t} > 0 \\ 0 & otherwise \end{cases} \quad (4)$$

In the above specification, $x_{i,1994}$ is a set of initial plant level variables, including total employment, average wage, labor productivity and capital per worker. A dummy variable for 1994 processer status is also included and in addition I control for industries when I estimate the probit regression.

4.5 Estimating total factor productivity

One of the performance measures used throughout the analysis is total factor productivity. I assume that the firm has a Cobb-Douglas production function in the following form:

$$Y_{it} = A_{it} K_{it}^{\beta_k} L_{it}^{\beta_l} M_{it}^{\beta_m} \quad (5)$$

where Y_{it} represents output measured in sales revenue, K_{it}, L_{it} and M_{it} are capital, labor and intermediate material inputs and A_{it} is the firm level total factor productivity.

Taking logarithms of (5) yields:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \varepsilon_{it} \quad (6)$$

where lower case letters indicate log values of variables.

From (5) and (6) it follows that:

$$\log(A_{it}) = \beta_0 + \varepsilon_{it} \quad (7)$$

From the above equations the logarithm of total factor productivity can be obtained as the residual of equation (6):

$$\hat{a}_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} \quad (8)$$

I estimate equation (6) by OLS and use the residual as total factor productivity in my regressions. Although I am aware of the econometric problems[4] that might cause OLS estimates to be biased, it is beyond the purposes of this thesis to reestimate total factor productivity by other methods and to report the differences in results throughout the analysis. In addition, some papers using GMM approach or semiparametric estimation developed by Olley and Pakes (1996) find that there is no significant change in the results (e.g. De Loecker, 2007; Farinas and Martín-Marcos, 2003; Van Biesebroeck, 2003).

[4] Simultaneity bias might arise if firms can observe their total factor productivity in advance and subsequently adjust their input decision. Selection and attrition bias might cause problems if firms are not selected randomly in the sample for instance because they stop producing (Van Beveren, 2007).

5 Data

I analyze the relationship between processing trade and firm performance on the IEHAS-CEFIG Hungary dataset covering the period from 1992 to 2003. The database was obtained by merging customs data on international transactions (Hungarian Customs Statistics) and firm's balance sheets and earnings statements obtained from the Hungarian Tax Authority[5].

My sample is limited to firms from the manufacturing sector, identified by their 2-digit NACE revision one code (see Table A2, Appendix for the list of included industries). By trade volume, this sector has the most important exporting and importing activity (Békés, Harasztosi, Muraközy, 2009).

The main variables indicate trade flows (net value of exportsales, imports of intermediate inputs) and balance sheet and earnings statement entries: net value of sales, capital, equity, fixed assets, total wage bill, employment and cost of intermediate inputs. I have information on firm ownership structure as well. In each regression I control for industries for which I define dummies based on the NACE2 revision one codes. In addition, I generate a variable for processer status according to the definition of the Statistical Office (Csizmazia 2005, p. 14). Firms doing this type of trade are all importers (getting intermediate inputs from abroad) and exporters, shipping the final goods to foreign countries. Processing trade is inferred from the difference between Customs Statistics export value and export value declared to the Hungarian Tax Authority. For processers, the actual export is the value added (output less imported inputs) and this is reported to the Tax Authority. In the Customs Statistics, the value of the export shipment is registered, which leads to a difference between the two types of export entries[6]. I specify another group of traders as well that I will use later

[5] For a complete description of the database see Békés, Harasztosi, Muraközy (2009).

[6] The proxy defined in this way for processes might have measurement errors due to time differences between reporting and other noises in the data.

for comparing processer and other firm's performance involved in international trade. In order to simplify the comparison, the trader dummy indicates exporter-only, importer-only or both way trader status. A description of the used variables is provided in Table A1, Appendix.

Two years from the original database, 1994 and 1999, were included in my analysis with the following motivation. By 1994, I suppose that the majority of transition related changes had taken place. According to Hamar (2000) 90% of imports were liberalized by 1992. In Hungary, starting from 1994 processing trade related export tariffs for textiles and clothes manufacturing were completely abolished. Processing trade procurers from EU member countries only had to obtain a license for doing this type of trading activity in the country. As a consequence, many Western European firms were interested in doing processing trade in Hungary. By 1998, it became easier for any foreign country to produce in Hungary and customs related procedures and payments were no longer different for processing trade or other types of trade so EU countries lost their interest in moving assembling activity to Hungary. After 1999, just a few firms doing processing trade remain in the sample. This can be interpreted as a consequence of the customs regulation but it can also mean that these firms became better after some years of processing, and with the knowledge acquired from their partners they could have started producing their own products or they could have been integrated in the chain of the procurer firm as suppliers (Szanyi, 2001).

Out of the 30,840 firms in the used dataset, 2,637 were doing *active* processing trade. Table 1 shows that processing firms outperform non-processers in many aspects according to a mean value comparison of the variables. These firms employ on average almost four times more workers than non-processers, that is firms doing this type of trade are larger. On plant level, processing firms are able to generate more sales than their non-processing counterparts. Processers are also more capital intensive than non-processers: they have more fixed assets or their fixed assets are more valuable. Employees at processing firms have slightly higher

wages than employees at other firms. On firm level, processers have also higher value added and the major component of this item is labor (as seen from wage per value added indicator). One can also notice that more than half of these firms have foreigners as main owners.

Table 1: Descriptive statistics by processer status

	Total	Non-processer	Processer
Employment	48.179	39.973	145.438
Sales (ml. HUF)	174.971	162.945	346.102
Capital (ml. HUF)	59.462	53.786	132.369
Capital per worker	0.931	0.848	1.063
Exp. sales (ml. HUF)	79.631	68.821	213.203
Wage per worker	0.332	0.334	0.362
Labor productivity	3.364	3.540	2.408
Value added (V.A.)	48.761	43.825	113.045
V.A. per worker	0.835	0.868	0.740
Wage per V.A.	0.540	0.799	0.772
V.A. per sales	0.159	0.463	0.130
Importer dummy	0.380	0.329	1
Foreign owned	0.179	0.143	0.528
Firms	30,840	27,515	2,637

Mean values of firm level variables are included in the table.

Between the two years included in the analysis, there were even some positive changes in the variables (Table A4 and Table A5, Appendix). Processers in 1999 employed on average even more workers than in 1994 and the value added per worker, showing performance increase, also changed positively between the two years. Even more firms are under the control of foreign owners in 1999 compared to the first year.

Processing is a temporary trading status for almost half of the firms doing this type of trade (Table 2). By 1999, one fourth of original processers became traders, so not only did they survive in the changed economic environment, but also adapted to international trends and further developed in their trading activities (became importers-only, exporters-only or both way traders no longer depending on processing contract). Some of them (6%) also switched to non-trading. Around one fourth of initial processers exit the market by 1999, but processing still seems to be the best way of trading as it assures the highest rate of survival among all groups (26.7% of initial processers, 27.45% of initial traders and 36.43% of initial

non-traders exit). A small percentage of initial traders also choose to become processers, probably due to some positive changes in tariff regulations for processers.

Table 2: Transition matrix

1994/1999	Processer	Trader	Non-trader	Exit
Processer	506	311	68	312
	42.27%	25.98%	5.68%	26.07%
Trader	240	2,315	643	1,210
	5.44%	52.52%	14.59%	27.45%
Non-trader	50	788	3,161	2,292
	0.79%	12.53%	50.25%	36.43%

The table contains the number and percentage of firms that changed status between 1994 and 1999. Non traders are not involved in any kind of international trading activities.

The highest share of firms doing processing trade in both years is in the following industries: textiles (8.5%), dressing (24.2%), leather and footwear (8.6%), metal products (10.3%), machinery (7.5%) and electrical machinery (5.04%) (Table A3, Appendix). For the two most important groups of processing industries in Hungary (wearing apparel and shoes-industry group 1, and machinery-industry group 2) the changes in the main variables are as follows. Processers belonging to the first group of industries increased their employment from 1994 to 1999. Value added per worker and capital per worker have slightly decreased, but this might be due only to the increase in the number of workers (Table A7, Appendix). In addition, between the years 1994 and 1999 more than half of industry group 1 firms kept their processer status and slightly more than one fourth of processers did not survive. Others started doing different types of trade or simply stopped trading, but did not stop their activities. It seems that for firms from these industries it is again processing trade that helps to survive and continue maybe with other activities most frequently (Table A9, Appendix). Processing firms belonging to the second group of industries (and which are keeping their initial status until 1999) improve in employment, value added per worker and capital per worker as well (Table A8, Appendix). They are initially much less than processers from the first group of industries,

but around half of them are still processing in 1999, less than one fourth are exiting and the rest are continuing their activities in another way. If one considers trading status and the percentage of exitors for traders or non-traders, it is the processer status for which the lowest percentage of firms stop their activity (Table A10, Appendix).

6 Results

6.1 Processer premia

I start my analysis by showing that processers have different characteristics than non-processing firms. Results by year are reported in Table 3 for different performance measures, controlling for industries, size and ownership structure.

From columns (a) and (d) one can see that processers have the highest premia for size measured as employment. Bernard and Jensen (1999) obtain similar results for a sample of American exporter firms and Baldvin and Gu (2003) for Canadian manufacturers. Compared to gains in employment, value added per worker premia is already much lower for processers in 1994 (around 10%) but it increased to 28% by 1999. As processers' main input to the final product is labor, employer wages should reflect the value added. Wage premia and wage per value added premia (wage is on average around 70% of value added) are in line with this finding for the years included in the analysis. Both value added per worker and wage premia increase over time. Processing firms seems to be even more capital intensive than non-processing ones, although capital per worker premia decreased from 1994 to 1999. This finding shows that processers might be using more high technology and more valuable machinery for production than others. These firms also have a higher total factor productivity with similar values for both years so probably there are other effects that influence firm productivity differential beyond the inputs that I accounted for.

I include in the analysis two more variables indicating the value added content of sales. First I look at the wage content of export but this turns out to be negative for processers and the sign remains unchanged across years. Second, I take the actual value added content of operating revenues, calculated as the difference between final output and intermediate inputs over sales, and this is already 20 to 30% higher for processing firms. All the differences in the above mentioned performance measures are significant, although a small percentage of firms

are doing processing trade, compared to the whole sample. The only non-significant variable which indicated no advantage for processers is labor productivity calculated as output per worker.

In the next step, when I control for firm size (Table 3, columns b and e), processer premia decreases in some cases but remains still very significant for both years. For value added per worker, premia for 1994 even increases compared to the value from column (a). Total factor productivity is quite stable across the years even with this second specification. Processer advantages in average wage, value added per worker, capital per worker and value added per sales diminish, especially for the first year. After controlling for employment, wage per value added premia disappears for processers. In fact, for 1994 in column (b) processers have the highest premia for capital per worker. For 1999, processers still have the highest premia for capital per worker, after controlling for employment (column e).

Table 3: Processer premia

Log of firm level variables	1994			1999		
	(a)	(b)	(c)	(d)	(e)	(f)
Total employment	1.377***	-	-	1.666***	-	-
	(0.054)			(0.046)		
Value added per worker	0.108***	0.162***	-0.002	0.277***	0.181***	-0.028
	(0.031)	(0.033)	(0.033)	(0.027)	(0.006)	(0.030)
Labor productivity	-0.057	0.021	-0.124***	-0.023	-0.068**	-0.235***
	(0.035)	(0.036)	(0.038)	(0.030)	(0.032)	(0.034)
Average wage	0.243***	0.114***	0.020	0.385***	0.103***	-0.057***
	(0.019)	(0.021)	(0.022)	(0.017)	(0.018)	(0.018)
TFP	0.121***	0.128***	0.113***	0.164***	0.159***	0.098***
	(0.016)	(0.017)	(0.015)	(0.014)	(0.014)	(0.017)
Capital per worker	0.511***	0.484***	0.206***	0.328***	0.256***	-0.033
	(0.049)	(0.052)	(0.052)	(0.042)	(0.044)	(0.045)
Wage per value added	0.105***	-0.065**	0.007	0.095***	-0.091**	-0.041*
	(0.025)	(0.025)	(0.026)	(0.022)	(0.035)	(0.023)
Wage per export sales	-0.628***	-0.747***	-0.609***	-0.829***	-0.955***	-0.736***
	(0.058)	(0.058)	(0.059)	(0.051)	(0.053)	(0.055)
Value added per sales	0.219***	0.139***	0.139***	0.336***	0.235***	0.216***
	(0.022)	(0.023)	(0.023)	(0.019)	(0.019)	(0.020)

Robust standard errors in the paranthesis. Industry dummies included. In columns (b) and (d) size measured in employment is controlled for. In columns (c) and (f) I control for foreign ownership as well. A firm has foreign ownership if more than 50% of shares belong to foreigners. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.

In columns (c) and (f), Table 3, I also control for foreign ownership. More than 50% of processers from the sample have owners from abroad that hold more than 50% of total shares. Compared to columns (b) and (e), significant coefficients do not change a lot when I control for foreign ownership, except for capital per worker. For both years, there is still no premia for labor productivity. Value added per sales premia does not change with this specification. The same is true for total factor productivity in the first year, but it decreases in 1999 when I compare columns (b)-(c) and (e)-(f). In the second year, there is no more premia for processers for average wage and again there is almost no change in the value added content of sales. As there are no major changes in results caused by ownership, I will not report regression coefficient when controlling for foreign shareholding in further analysis.

6.2 Processer performance before entry

In this part I analyze the differences in productivity measures between those firms which became processers by the end of the period and those which did not, limiting the sample to only those firms that did not do processing in the beginning (1994). With this specification I can identify processer premia before the start of doing this type of trading. If there is evidence on future processers performing better before starting their activity, it can be interpreted as self-selection.

As already discussed, there is broad evidence in firms in international trade literature that better firms self- select into exporting (e.g. Bernard and Jensen, 1999; Aw, Chung and Roberts 2000; Baldwin and Gu 2003; Clerides, Lach and Tybout, 1996; Van Biesebroeck, 2003). Exporters should perform ex-ante better than non-exporters in order to be able to cover transportation costs and the expenses of finding the consumers and adapting their products to foreign markets (Bernard and Jensen, 1999). Muuls and Pisu (2007), for a sample of firms from Belgium and Castellani, Serti and Tomasi (2008) for Italian firms find evidence on self-selection into importing as well. Entry barriers to import market can also be identified: firms

might have to search for a certain input or a certain supplier (Kraay et al., 2002) or in many cases they are importing expensive high technology capital goods for the production processes and they should be able to cover these costs (Castellani, Serti and Tomasi, 2008).

Processers, doing both-way trading according to a special contract, might also have to overcome some of these barriers. For them, the costly part is probably to integrate into a chain of production (find a processing partner and the inputs) and to adapt to the expectations of the procurer and through that to the foreign market where processed products will be sold.

Results in Table 4 show that there is indeed self-selection into processing in case of Hungarian firms as positive ex-ante productivity differences for future processers are significant for three measures of performance.

Table 4: Ex-ante performance for future processers

Log of firm level variables	1994	
	(a)	(b)
Total employment	1.232***	-
	(0.068)	
Value added per worker	0.088	0.128*
	(0.067)	(0.067)
Labor productivity	-0.002	0.067
	(0.073)	(0.074)
Average wage	0.131***	0.026
	(0.048)	(0.048)
TFP	-0.017	-0.006
	(0.034)	(0.034)
Capital per worker	0.675***	0.650***
	(0.093)	(0.094)
Wage per value added	0.075	-0.064
	(0.053)	(0.052)
Wage per export sales	-0.845***	-0.978***
	(0.117)	(0.115)
Value added per sales	0.046	-0.026
	(0.045)	(0.045)

Robust standard errors in the paranthesis. Industry dummies included. In column (b) size measured in employment is controlled for. Those firms were included which were not processers in 1994. They may or may not be processers in 1999. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.

Processers are more than twice larger than non-processing firms in terms of employment which is in line with the fact that more workers are needed to complete the labor-intensive production processes of firms from abroad. Workers are also better paid ex-ante at those firms which will become processers later (13% wage premia). Processers are also almost 70% more capital intensive than other firms. It might be the case that their fixed assets are more valuable and can be used to produce more advanced products later on with the know-how provided by the procurer. Processers have a significant disadvantage only in the case of wage per export sales but many of these firms do not have export sales before they start processing and consequently exporting.

When I control for size with the same motivation as before, significant ex-ante processer advantages do not change to a great extent. From column (b) one can see that value added per worker premia becomes higher (significant at 10%). If the most important input of processers is labor, then it is probably this characteristic that gives advantage to processers in entering the marker. Antalóczy and Sass (1998) mention in their paper that Hungarian firms had an advantage in doing quality processing trade which is driven by the quality of the laborforce. After controlling for size, advantages in average wage are no longer significant. Ex-ante capital intensity of processers is not changing in the second specification and there is still no advantage in terms of wage per export sales. These results suggest that firms that become processers in the subsequent period, have better performance along some productivity measures already before starting to do this type of trading activity.

6.3 Processer performance after entry

So far I showed that firms doing processing trade in 1999 had better performance ex-ante than those firms which were not involved in processing in the last year. The second question that relates processing trade and firm performance asks whether processing improves performance measures for later years.

Evidence on learning-by-trading is less clear in the literature, but for some countries, exporters or importers develop even after they start their trading activity (e.g. Hansen, 2010; Van Biesebroeck, 2003; Baldvin and Gu, 2003 identify learning effects for exporters; Kasahara and Rodrique, 2005 find learning effect for importers). Firms should increase their productivity after they enter foreign markets due to increased competition (to which they should adapt to survive) and knowledge and techological spillovers (Bernard and Jensen, 1999).

I would expect processers to have an increase in performance measures after they start doing this type of trade because of access to better inputs, production technology and in some cases even access to higher technology machinery provided by the processer partner. Especially at more advanced levels of processing trade like machinery production, the processing partner will have to set up a plant and provide the fixed assets for assembling (Éltető, 1999).

Results in Table 5 show that on average, processers have higher growth rates than non-processers for five productivity measures. After the start of this type of trading activity, the growth in employment is higher at these firms. It seems that these firms reach their objectives by hiring more employees and producing even more output that is sold on foreign markets. This is confirmed by higher labor productivity and value added per worker growth at processing firms. They are likely to improve their efficiency (and bear the higher costs of employment) by implementing the more advanced production processes of the procurers (assembling according to the standards of the processing partner). Changes in average wage are also in line with the changes in productivity: wage growth at processers is on average 0.13 percentage points higher. Processing trade, which is less appreciated because of the assymetry in the relationship between assembler and procurer (Szanyi, 2001), turns out to make these firms better off, even if they have a low bargaining power regarding wages (labor-intensive

production phases can be relocated to even cheaper labor regions). Processers also have a small, but significant advantage in total factor productivity growth rate. For capital per worker, processers have a 0.11 percentage point lower growth rate than other firms (significant at 5%). Investment in capital at these firms was probably not in line with the increase in employment and processing partners could make use of the existing fixed assets and machinery at the firms that started doing processing trade.

Table 5: Processer performance after the start of processing trade

Growth rates of log firm level variables	1994	
	(a)	(b)
Total employment	0.097***	0.408***
	(0.039)	(0.039)
Value added per worker	0.158***	0.053
	(0.033)	(0.034)
Labor productivity	0.126***	0.014
	(0.035)	(0.036)
Average wage	0.129***	0.062***
	(0.020)	(0.020)
TFP	0.040**	0.028
	(0.018)	(0.019)
Capital per worker	-0.108**	-0.206***
	(0.051)	(0.051)
Wage per value added	-0.015	0.009
	(0.029)	(0.030)
Wage per export sales	0.024	0.070
	(0.068)	(0.068)
Value added per sales	0.009	0.041
	(0.024)	(0.025)

Robust standard errors in the paranthesis. Industry dummies included. In column (b) size measured in employment is controlled for. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.

When I control for size (column b) learning-by-processing effects are still significant for some performance measures. Processers still grow faster in employment and the growth rate is even higher in column (b). They have higher growth rate for average wage as well, but compared to column (a) it decreased. The growth rate of wage per value added, wage content of export sales and value added share of sales remain insignificant when controlling for employment.

These findings suggest that firms learn from processing, further develop and grow faster than other firm along some performance measures. Processers have the highest growth advantage in value added per worker (column a) which is most likely due to knowledge spillovers from the partner firms from abroad. Employees at these firms probably gain the most: not only the workforce growth is faster at processers, but also wage growth (column a and b).

6.4 Processer survival

From previous results it became clear that processers are better than non-processing firms in performance, that they have many of the desired characteristics already before starting processing trade and that they develop faster than non-processers after starting this type of trade. In this part I continue my analysis and show that processers have also higher probabilities to stay in the market and continue their activities.

According to previous findings in the literature, firms involved in international trade have higher survival probabilities (e.g. Bernard and Jensen, 1999 analyzes survival probability for exporters; Kasahara and Rodrique, 2005 find higher survival probability for importers). In Table 6 I show that processers, involved in both-way trading are also more likely to survive than non-processing firms.

Table 6: Survival probability of processers

	Probit coefficient	Change in probability (%)
Intercept	0.276***	-
	(0.062)	
Processer dummy	0.145***	78.09
	(0.048)	
Total employment	0.072***	72.23
	(0.009)	
Average wage	-0.095***	-67.12
	(0.021)	
Labor productivity	0.189***	79.08
	(0.014)	
Capital per worker	0.009	74.94
	(0.009)	

Robust standard errors in the paranthesis. Industry dummies included in the regression. For calculating the changes in probabilities, the standard deviation or change from 0 to 1 in case of dummy variable were considered, while for the non-changing variables means were taken. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.

Increase in employment and labor productivity and processer status increase the predicted probability of survival, whereas the increase of average wage decreases the survival probability. If a firm becomes processer, then it has 78% higher probability to stay in the market and continue its activity.

It seems that processing firms benefit from the permanent and usually longer term contracts with foreign partners that help processers not only to survive but also to do more complicated steps of assembling later on and to develop their own product lines and find additional trading partners in the future (Szanyi, 2001).

6.5 Processer vs. other trader performance

So far I showed that processers are better than non-processing firms in many aspects: their performance is better even before they start doing this type of trade, they further improve with processing and survive with higher probability than non-processers. In this section I ask how much better processers are than other traders and I provide a comparison between the two groups.

I consider processer premia from Table 3 and the results in Table 7, and conclude that processers outperform traders in total employment, so firms doing processing trade are the largest. Processers have also a larger premia in total factor productivity, wage per value added and value added content of sales. Traders have a clear advantage in labor productivity and value added per worker which is not changing over the years and which is probably due to the lower size in terms of labor of traders compared to processers. Their premia is also higher for wage per export sales and it even increases by 1999. In terms of capital per worker, processers have very similar premia (around 50%) for the first year, but for the second year premia is twice as large for traders. For both years, traders have higher premia for average wage as well, although the difference is much less for 1999.

Table 7: Trader premia

Log of firm level variables	1994		1999	
	(a)	(b)	(c)	(d)
Total employment	0.824***	-	0.924***	-
	(0.032)		(0.023)	
Value added per worker	0.503***	0.553***	0.597***	0.583***
	(0.021)	(0.021)	(0.016)	(0.017)
Labor productivity	0.717***	0.800***	0.744***	0.782***
	(0.022)	(0.023)	(0.017)	(0.018)
Average wage	0.393***	0.324***	0.445***	0.305***
	(0.015)	(0.016)	(0.012)	(0.011)
TFP	0.049***	0.052***	0.049***	0.043***
	(0.009)	(0.009)	(0.007)	(0.007)
Capital per worker	0.525***	0.532***	0.602***	0.602***
	(0.029)	(0.031)	(0.023)	(0.024)
Wage per value added	-0.146***	-0.245***	-0.169***	-0.284***
	(0.017)	(0.017)	(0.014)	(0.014)
Wage per export sales	0.628***	0.747***	0.828***	0.955***
	(0.058)	(0.059)	(0.051)	(0.053)
Value added per sales	-0.157***	-0.214***	-0.116***	-0.193***
	(0.014)	(0.014)	(0.012)	(0.012)

Robust standard errors in the paranthesis. Industry dummies included. In columns (b) and (d) size measured in employment is controlled for. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.

By controlling for firm size, premia even increases for some performance measures for both groups, but differences between the two groups are still present. The premia for total factor productivity and value added per sales remains higher for processers. Capital per worker advantages are similar for the first year in the second specification, but for 1999 traders have much higher premia for this performance measure. Traders have their advantage in value added per worker, labor productivity and average wage, similar for both years and almost unchanged compared to the results from the baseline regression.

In order to have a complete analysis, I document performance differences among processers and traders before and after entry and well (Table A11 and Table A12, Appendix). The most interesting finding is that processers have more employees and higher capital per worker premia than other traders even before entry. Ex-ante average wage premia is similar for both groups. Surprisingly, traders do not grow further after they start their activity, except for value added per sales and employment in the second specification.

7 Conclusion

The aim of this paper was to investigate the performance of firms engaged in processing activity, that is a combination of importing and exporting according to a special contract. I used a Hungarian dataset obtained by merging Customs Statistics and firm's balance sheets and earnings statements to answer four performance related questions. First, I investigated whether processing firms have better performance along different productivity measures. I then identified the source of exceptional processer performance: if those firms that start processing are ex-ante better than non-processers, then there is evidence on self-selection; if processers grow faster than their counterparts after they start this type of trading activity, then learning-by-processing effects are present. I also asked whether processers have higher probability to avoid exit and continue their activity. In addition, I provided a comparison between processers' and other traders' performance.

The empirical methodology that I implemented in this thesis was widely used so far to investigate the performance of firms doing other types of trade like exporting, importing or both way trading. In fact, the firms in international trade literature is focused on documenting mainly the exceptional performance of exporters and importers.

I contributed to the existing research by showing that similar mechanisms through which productivity is increased in case of other types of traders can be identified for processers as well. Because of importing, processers might have access to better and different types of inputs from reliable suppliers from abroad (Andersson, Lööf and Johansson, 2008; Antalóczy, Sass, 1998). Moreover, through the processing agreement with the procurer, processers are given instructions describing how assembling should be done which is equivalent to a knowledge infusion. In addition, outputs are sold on foreign markets where competition is fiercer and processers should adapt to foreign tastes (Bernard and Jensen, 1999).

These arguments are confirmed by the results that show that processers are indeed better than non-processing firms along many performance measures. They have the highest premia for employment, capital per worker, average wage and value added. Future processers have higher employment, average wage and capital per worker even before they start processing confirming self-selection into processing. Higher employment and higher value of fixed assets are probably demanded by future processing partners. They grow further after the start of processing in terms of employment, value added, average wage and labor productivity due to learning spillovers. Processers have also higher probability of survival due to the more reliable, longer term contracts with the procurer. In comparison with other types of traders, processers still have superior performance along some productivity measures.

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Appendix

Table A1: Firm level variables

Total employment	Average number of employees in year t.
Sales	Net operating revenues earned by the firm in year t.
Wages	Total wagebill of a firm in a given year.
Average wage	Defined as total wagebill over total employment.
Fixed assets	Revenue generating non-current assets.
Capital per worker	Fixed assets over total employment.
Intermediate	Total material and cost of inputs.
Value added per worker	The difference between sales and intermediate inputs over total employment.
Labor productivity	Unit output, defined as sales over total employment.
Wage per value added	Wages over the difference between sales and intermediate inputs.
Exportsales	Net income from selling abroad.
Wage per exportsales	Defined as wages over exportsales.
Value added per sales	The difference between sales and intermediate inputs over total sales.
Foreign ownership	The dummy variable takes the value 1 if more than 50% of the shares of the firm are owned foreign firms.
Industry dummy (i18, i19, …, i35)	Defined based on the NACE2 revision one classification of firms.
Processer	The dummy variable takes the value 1 if (Customs Statistics Export-Hungarian Tax Authority Export)>0.025*sales. In Customs Statistics all exports are registered which cross the border. The Hungarian Tax Authority export is based on the firms' declaration.
Trader	The dummy variable takes the value 1 if the firm is exporter-only or importer-only or both way trader. Exporters have positive export sales, importers have positive value of intermediate inputs, exporter-importers have both.

Table A2: Industries in the sample by 2-digit NACE revision 1 industry code

15-Manufacture of food products and beverages
16-Manufacture of tobacco products
17-Manufacture of textiles
18-Manufacture of wearing apparel; dressing and dyeing of fur
19-Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20-Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21-Manufacture of pulp, paper and paper products
22-Publishing, printing and reproduction of recorded media
23-Manufacture of coke, refined petroleum products and nuclear fuel
24-Manufacture of chemicals and chemical products
25-Manufacture of rubber and plastic products
26-Manufacture of other non-metallic mineral products
27-Manufacture of basic metals
28-Manufacture of fabricated metal products, except machinery and equipment
29-Manufacture of machinery and equipment n.e.c.
30-Manufacture of office machinery and computers
31-Manufacture of electrical machinery and apparatus n.e.c.
32-Manufacture of radio, television and communication equipment and apparatus
33-Manufacture of medical, precision and optical instruments, watches and clocks
34-Manufacture of motor vehicles, trailers and semi-trailers
35-Manufacture of other transport equipment

Table A3: Number and percentage of firms in the sample by 2-digit NACE revision 1 industry code and processer status

INDUSTRY	TOTAL	%	PROCESSER	%	NON-PROCESSER	%
15	4415	14.316	104	3.944	4145	15.065
16	13	0.042	4	0.152	9	0.033
17	1152	3.735	223	8.457	910	3.307
18	1805	5.853	640	24.270	1121	4.074
19	593	1.923	226	8.570	357	1.297
20	1863	6.041	83	3.148	1732	6.295
21	368	1.193	27	1.024	339	1.232
22	3623	11.748	22	0.834	3521	12.797
23	13	0.042	0	0.000	12	0.044
24	808	2.620	62	2.351	728	2.646
25	1633	5.295	138	5.233	1463	5.317
26	1196	3.878	53	2.010	1118	4.063
27	365	1.184	34	1.289	319	1.159
28	4078	13.223	272	10.315	3727	13.545
29	3256	10.558	198	7.509	3009	10.936
30	241	0.781	10	0.379	224	0.814
31	1108	3.593	133	5.044	959	3.485
32	797	2.584	103	3.906	678	2.464
33	1273	4.128	75	2.844	1180	4.289
34	386	1.252	77	2.920	300	1.090
35	184	0.597	20	0.758	161	0.585
Total	30,840	100%	2,637	100%	27,515	100%

Table A4: Descriptive statistics by year

IF YEAR=1994	**Total**	**Non-processer**	**Processer**
Employment	58.9407	50.76743	144.0426
Sales	153.8377	145.2365	268.6387
Capital	72.15275	67.53722	129.3956
Capital per worker	.9458834	.8296502	1.193176
Export sales	40.71224	32.82053	119.9484
Wage per worker	.3877301	.3952061	.3755124
Value added (V.A.)	47.81907	44.11015	92.58078
V.A. per worker	.8579815	.9069957	.6930701
Wage per V.A.	.6402831	.861566	.5972571
Importer dummy	.4066432	.3480891	1
Exporter dummy	.3267908	.2715575	.8922306
State owned	.0752391	.0727866	.1077694
Foreign owned	.2044959	.1686192	.4979114
Firms	11,922	10,414	1,197

Mean values of firm level variables are included in the table.

Table A5: Descriptive statistics by year

IF YEAR=1999	Total	Non-processer	Processer
Employment	41.39756	33.40021	146.5972
Sales	188.289	173.7291	410.4929
Capital-fixed assets	51.46359	45.41205	134.8397
Capital per worker	.9222793	.858415	.9554661
Export sales	104.1575	90.74403	290.7211
Wage per worker	.2965851	.2961657	.3516651
Value added	49.35493	43.65175	130.0559
Value added per worker	.8203994	.8441545	.7798785
Wage per value added	.4774576	.7614373	.9165119
Importer dummy	.3634634	.3167651	1
Exporter dummy	.3095465	.2671189	.8944444
State owned	.0188709	.0174844	.0388889
Foreign owned	.162385	.1277703	.5527778
Firms	18,918	17,101	1,440

Mean values of firm level variables are included in the table.

Table A6: Manufacturing industry statistics

Change in mean log employment between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	.3757921	.2325758	-.9290062	-
Trader	.4979808	.2154302	-.2734797	-
Nontrader	1.167457	.5586574	.0424504	-

Change in mean log value added per worker between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	.0004635	.1431337	-.292896	-
Trader	.0553129	-.0282425	-.2908292	-
Nontrader	.0544088	.1183104	-.1540003	-

Change in mean log capital per worker between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	-.1626558	-.0244874	-.3800997	-
Trader	-.1417333	.1047212	-.0648971	-
Nontrader	-.2811915	.347186	-.068101	-

Table A7: Wearing apparel and shoe industry statistics (NACE2 rev. 1 codes 18&19)

Change in mean log employment between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	.1819812	.0812983	-.7500428	-
Trader	.8724688	.1325629	-.3059072	-
Nontrader	1.116476	.6041846	.001501	-

Change in mean log value added per worker between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	-.2041758	-.0746727	-.3522777	-
Trader	-.2020603	-.1939685	-.5036976	-
Nontrader	-.1826193	.0563792	-.1185573	-

Change in mean log capital per worker between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	-.2137101	-.1165025	-.4479979	-
Trader	-.2522256	.3758523	-.5305396	-
Nontrader	-.1495219	-.0446182	-.476194	-

Table A8: Machinery industry statistics (NACE2 rev. 1 codes 30&31&32)

Change in mean log employment between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	.7546778	-.0277428	-1.260681	-
Trader	.8519955	.184999	-.3569062	-
Nontrader	.7837917	.5827906	-.0949712	-

Change in mean log value added per worker between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	.3746223	.4406509	-1.321622	-
Trader	-.0778748	.0426628	.0338062	-
Nontrader	.0882952	.3475362	.0670067	-

Change in mean log capital per worker between 1999-1994

1994/1999	Processer	Trader	Nontrader	Exit
Processer	.1509521	.3176021	-1.203608	-
Trader	-.4344044	.26248	.5733895	-
Nontrader	-1.68986	.6529777	.211973	-

Table A9: Transition matrix for wearing apparel and shoe industries (NACE2 codes 18&19)

1994/1999	Processer	Trader	Nontrader	Exit
Processer	236	30	35	111
	57.28%	7.28%	8.50%	26.94%
Trader	22	73	32	60
	11.76%	39.04%	17.11%	32.09%
Nontrader	15	30	159	166
	8.02%	16.04%	85.03%	88.77%

The table contains the number and percentage of firms that changed status between 1994 and 1999.

Table A10: Transition matrix for machinery industries (NACE2 codes 30&31&32)

1994/1999	Processer	Trader	Nontrader	Exit
Processer	47	25	4	22
	47.96%	25.51%	4.08%	22.45%
Trader	29	192	42	83
	8.38%	55.49%	12.14%	23.99%
Nontrader	216	3	55	111
	56.10%	0.78%	14.29%	28.83%

The table contains the number and percentage of firms that changed status between 1994 and 1999.

Table A11: Ex-ante performance for future traders

Log of firm level variables	1994	
	(a)	(b)
Total employment	0.474***	-
	(0.054)	
Value added per worker	0.216***	0.231***
	(0.034)	(0.035)
Labor productivity	0.312***	0.351***
	(0.038)	(0.038)
Average wage	0.133***	0.074***
	(0.028)	(0.028)
TFP	-0.037**	-0.047***
	(0.016)	(0.017)
Capital per worker	0.467***	0.491***
	(0.054)	(0.055)
Wage per value added	-0.057**	-0.120***
	(0.028)	(0.027)
Wage per export sales	0.210**	0.191**
	(0.095)	(0.094)
Value added per sales	-0.101***	-0.151***
	(0.024)	(0.024)

Robust standard errors in the paranthesis. Industry dummies included. In column (b) size measured in employment is controlled for. Those firms were included which were not processers in 1994. They may or may not be processers in 1999. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.

Table A12: Trader performance after the start of trading

Growth rates of log firm level variables	1994	
	(a)	(b)
Total employment	-0.046**	0.116***
	(0.023)	(0.022)
Value added per worker	-0.010	-0.066***
	(0.024)	(0.024)
Labor productivity	-0.084***	-0.146***
	(0.023)	(0.023)
Average wage	-0.029**	-0.062***
	(0.017)	(0.017)
TFP	0.010	0.003
	(0.011)	(0.011)
Capital per worker	0.050	0.002
	(0.034)	(0.034)
Wage per value added	0.005	0.018
	(0.020)	(0.021)
Wage per export sales	-0.024	-0.070
	(0.068)	(0.068)
Value added per sales	0.054***	0.071***
	(0.016)	(0.017)

Robust standard errors in the paranthesis. Industry dummies included. In column (b) size measured in employment is controlled for. *-significant at 10% level. **-significant at 5% level. ***-significant at 1% level.