**Master Thesis**

Master in Economics & Business – International Economics

# The Impact of Trade Liberalization on the Aggregate Financial Performance of Firms

A Theoretical and an Empirical Analysis of the Role of Resource, Market Share and Profit Reallocations in Eastern Europe and Central Asia


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Submitted on: 20th of July 2012

**Abstract**

This research paper theoretically and empirically investigates the role of resource, market share and profit reallocations in explaining the impact of trade liberalization on the aggregate performance of firms. A theoretical model, which is largely based on the model by Melitz (2003) and incorporates firm heterogeneity in the total factor productivity parameter, argues that the financial performance of firms can be used as an accurate proxy for productivity. The theoretical results suggest a positive impact of trade liberalization on the sector-wide aggregate financial performance of all firms active in an industry, but an insignificant impact of trade liberalization on the average performance of exporters. The empirical analysis, employing firm level data on 27 Eastern European and Central Asian countries over the period 2002-2009, confirms the theoretical predictions. In particular, it is shown that, independent of the different dependent variables used and the econometric estimation procedures followed, trade liberalization has a significantly positive impact on the sector-wide average financial performance of firms. Additionally, it is proven that among exporters, trade liberalization does not have a significant impact on aggregate performance.

*JEL Classification:* F12, F15, F41, F43, O11, O41

*Keywords:* Trade Liberalization, Productivity, Economic Growth, Imperfect Competition, Firm Heterogeneity in the Total Factor Productivity Parameter

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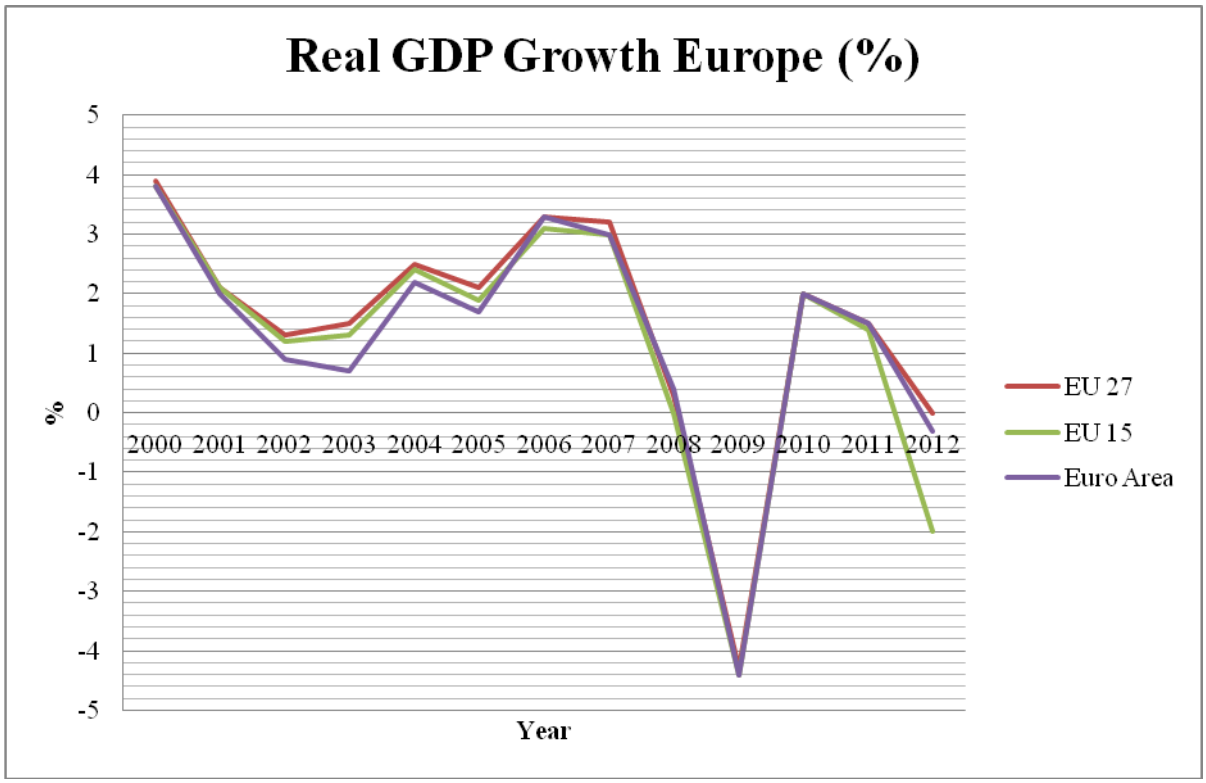
## 1 Introduction

Europe is in a financial and a political crisis. Financially, Europe is suffering from the large fiscal deficits encountered by Southern European countries and a highly fragile international financial system, which both put the stability of the common currency, the Euro (€), at risk. Politically, Europe is suffering from many conflicts of interest due to the high degree of economic, financial and political heterogeneity across European Union (EU) member states. Countries have their own strengths and weaknesses and, accordingly, their own economic and political problems and priorities. Discontent over Europe's economic performance, with an average real economic growth rate close to only half a percent, is the biggest factor hampering the implementation of an effective solution for the current financial and political crisis. Graph 1.1 displays the economic development of Europe over the period 2000-2012 (European Commission, 2012).

**Graph 1.1: Economic Development in Europe over the period 2000-2012**




Source: The Eurostat Database published by the European Commission (2012).

To overcome the financial and political crisis, European leaders must improve the EU economic performance. However, the problem is that nobody can agree on how this should be done. Some countries, in particular Southern European countries, are in favour of protectionist reforms, which reduce competition, prevent company reorganisations and layoffs, trigger investments in Research and Development (R&D) and allow the maintenance of Europe's current social security system. However, in a quantitative study on six major EU economies, Baily and Farrell (2005), two researchers at the McKinsey Global Institute (MGI), report that the poor economic performance in Europe, the EU and the Euro Area is not so much the result of a lack of technology and innovation, but rather is due to a lack of competition, which hampers the necessary increase in productivity. Baily and

Farrell (2005) emphasize the necessity of regulatory reforms, which boost competition, as they can improve productivity by triggering firms to make smart and innovative investments. Firms that do so successfully manage to perform better, expand their market shares and employ more workers. Less productive firms are confronted with a dilemma of either improving their businesses, which is costly, or exiting the market. Trade liberalization and the elimination of artificial protectionist laws and trade barriers are considered as important steps towards a market increasingly determined by competitive forces. Baily and Farrell (2005) conclude that classic, open economy and competitive market mechanisms have a positive and structural impact on European economies by boosting the main drivers of economic growth and allow Europe to overcome the current financial and political crisis without abandoning its well-developed social security system.

The suggestion that classic, open economy and competitive market mechanisms have a positive impact on firm and aggregate productivity serves as the main motivation for formally studying and quantifying the impact of trade liberalization on the sector-wide average performance of firms. There are many channels through which trade liberalization can affect productivity and performance, including economies of scale, knowledge spillovers and innovative incentives. This research paper will, in line with the quantitative assertions by Baily and Farrell (2005), primarily investigate the role of resource, market share and profit reallocations from less to more productive firms in explaining the influence of trade liberalization on aggregate performance. To this end, this paper presents a theoretical and an empirical analysis of the aforementioned relationship.

The theoretical analysis largely builds upon the model by Melitz (2003), which assesses the role of trade liberalization as a catalyst for inter-firm resource, market share and profit reallocations within an industry. The theoretical model developed in this paper incorporates many of the features of the model by Melitz (2003) and, in addition to Melitz (2003), argues that firm productivity can objectively be proxied by indicators of financial performance. In particular, it is shown that there is a direct positive relationship between the sector-wide average financial performance of firms and the aggregate productivity, which supports the idea that financial performance is a reliable, objective and accurately measurable proxy of productivity. The theoretical results in this paper suggest that trade liberalization has a positive influence on the industry-wide average productivity and financial performance level through processes of resource, market share and profit reallocations from less to more productive firms. Among exporting firms, it is shown that trade liberalization does not have a significant impact on the sector-wide average financial performance.

The theoretical results are used to formulate two hypotheses, which are tested empirically in this paper. The empirical analysis employs firm level data on 27 Eastern European and Central Asian countries over the period 2002-2009, provided by the Business Environment and Enterprise Performance Surveys (BEEPS) and constructed by the joint effort of the World Bank and the European Bank for Reconstruction and Development. The information gathered covers many different aspects of a firm, including general information, infrastructure and services, sales and supplies, the degree of competition, capacity, land and permits, crime, finance, business-government relations, labour, the business environment, and performance. The panel regression results, based on different model specifications and the implementation of various fixed effects estimation techniques, confirm the hypotheses formulated on the basis of the theoretical analysis. In particular, the outcomes reveal a stable, robust and significantly positive impact of the sector-wide export intensity on the industry-wide

average financial performance, which suggests that trade liberalization has a positive influence on the aggregate performance of firms. Additionally, it is shown that there is an insignificant relationship between the sector-wide average export intensity and the aggregate financial performance of exporters, which supports the theoretical hypothesis that trade liberalization has no impact on the average performance of exporters. These two outcomes support the idea that sector-wide improvements in financial performance are the result of inter-firm resource, market share and profit reallocations towards more efficient, mainly exporting firms within an industry. Overall, the results prove the significant importance of resource, market share and profit reallocations from less to more productive firms in explaining the positive influence of trade liberalization on the industry-wide average performance of firms and, accordingly, country-wide welfare.

The remainder of this paper is structured as follows. An overview of the existing theoretical and empirical literature on the impact of trade liberalization on productivity is presented in section 2. Attention is also paid to the underlying mechanisms explaining the relationship. Section 3 presents a theoretical analysis of the link between trade liberalization and the sector-wide average productivity and financial performance, using a model that largely builds upon the pioneering research by Melitz (2003) and serving as a framework for the formulation of empirical hypotheses. The model focuses on the role of resource, market share and profit reallocations in explaining the influence of trade liberalization on the industry-wide average performance of firms. Section 4 deals with the empirical analysis, employing a panel regression setup and a sample of 27 Eastern European and Central Asian countries to study the importance of resource, market share and profit reallocations in explaining the impact of trade liberalization on the aggregate financial performance. Section 5 concludes.

## 2 Literature Review

Many economists have studied the impact of trade liberalization on firm performance, both from a theoretical and an empirical point of view. In most cases, performance is assessed and estimated on the basis of plant-level total factor productivity.

### 2.1 Theoretical Literature

Theoretically, economists have stressed the positive impact of trade liberalization on firm productivity through a variety of channels. Grossman and Helpman (1991, 1993) analytically emphasize the importance of knowledge spillover effects resulting from international trade of final and intermediate products by means of a very simple and intuitive model. Production of different products takes place with the help of land, labour, and knowledge capital, which is a public input factor. It is assumed that knowledge accumulates as a by-product of production experience and is completely external to an individual manufacturing firm. The general equilibrium outcome indicates that trade liberalization improves plant-specific productivity through triggering innovations and access to a wider variety of more advanced intermediate inputs and capital goods. Using these products and absorbing the more advanced knowledge required to produce these kind of goods constitutes a process of technology diffusion, allowing firms to update their production processes and capital stock. This, logically, has a positive influence on plant performance, productivity, and economic growth.

Aghion *et al*. (2005) focus on a firm's response in terms of innovative investments to the entry threat of foreign firms imposed by trade liberalization. The researchers develop an adjusted version of the Schumpeterian discrete-time model, assuming that a final good is manufactured by a competitive industry using a continuum of intermediate goods, which are transformed by a technology and productivity parameter. This technology and productivity parameter measures the quality of the inputs and, thus, determines how much of these inputs needs to be used in production. The equilibrium innovation investment level is determined on the basis of a relatively simple and straightforward profit maximization exercise. The solution indicates that more advanced domestic firms will be encouraged to invest more in innovation following the increased entry threat of foreign firms due to trade liberalization. Less advanced firms, though, will be disincentivized to innovate, as their chance of outperforming the foreign entrant is minimal. The consequently lower profits and market shares will force these firms to exit the market. Overall, the model indicates that trade liberalization has a positive effect on the surviving firms in the market through increased incentives to invest in innovation.

Goh (2000) emphasizes the importance of a fairly similar mechanism in explaining the economic impacts of trade liberalization as the mechanism presented by Aghion *et al*. (2005). The researcher explains the positive influence of trade liberalization on firm productivity through the concepts of technological effort and opportunity costs. In particular, it is assumed that adopting new, more efficient technologies is a time-consuming process, yielding forgone profits and thus an opportunity cost. The model is based on an inverse relationship between the time spent on technological search and the cost of production and follows a two-stage maximization setup. In the first stage, the firm determines the optimal time spent on technological search. In the second stage, the firm decides upon the optimal production level, given the technological search time and the accompanying cost of production. The model is solved by backward induction. In particular, the firm's

optimal time spent on technological search is based on a trade-off between marginal benefits, consisting of a strategic effect and an efficiency effect, and marginal costs, being the opportunity cost effect of technological effort. The researcher shows that international protection in the form of tariffs and quota unambiguously reduces technological search effort due to higher opportunity costs. Namely, in a protected environment, firms will always be able to serve a larger share of the market and earn higher profits. Trade liberalization, however, tends to reduce this opportunity cost and to increase technological effort, efficiency, and productivity under the commonly made assumptions of linear marginal costs and demand functions.

Holmes and Schmitz (2001) assess the link between trade liberalization and firm productivity by developing a theoretical model used to evaluate the time firms devote to productive and unproductive entrepreneurial activities. The researchers develop an adjusted version of the model by Grossman and Helpman (1991), described earlier. It assumes the existence of two firms, competing in a technology ladder setup. The firms can divide their available time between two activities, determining their ladder positions, namely research and attempts to block the innovative practices of rivals. Solving the model, which is characterized by various scenarios in terms of technology ladder positions, is based on a three step procedure. The main result derived indicates that trade liberalization, *i.e.* 'an improvement in the state of trade' as it is referred to in the article, shifts the time spent on unproductive activities towards productive activities as the relative returns change in favour of research. This conclusion indicates a clear firm productivity improvement and holds for reductions in domestic as well as foreign tariffs.

Trade is often said to give rise to scale economies, improving productivity of firms. Tybout and Westbrook (1995) provide an overview of the sources of economies of scale that, through increased openness to trade, improve efficiency. Increased production due to foreign sales opportunities give rise to increasing returns to scale by spreading sunk costs, such as costs relating to Research & Development (R&D) and training new workers to operate in new production lines. Additionally, the increased sales potential may give rise to lower marginal costs due to specialization, learning effects, and the use of larger, more efficient machines.

A final channel through which trade liberalization can positively influence productivity and performance works via a process of resource, market share and profit reallocations from less to more efficient firms. The mechanism has extensively been analysed by Melitz (2003) and will into detail be discussed in section 3. The general idea is as follows. Opening up to trade and trade liberalization lead to a firm selection process, in which the more productive firms are able to survive and to remain active in the market due to increased foreign profit opportunities, whereas the less productive firms are forced to quit production due to increased competition in the final goods market. Accordingly, the process of resource, market share and profit reallocations from less to more productive firms causes an improvement in the industry-wide productivity and performance level. This paper incorporates many of the features of the model by Melitz (2003) and, in addition to Melitz (2003), argues that firm productivity can objectively be proxied by indicators of financial performance, such as the profit ratio or market share.

## 2.2 Empirical Literature

The empirical literature studying the impact of trade liberalization on firm productivity mainly considers developing countries that abandoned their inward-looking development strategies in exchange for drastic liberalization programmes during the 1980s. The implementation of these economic reforms largely relied upon the idea that the additional import competition and easier access to foreign technologies would positively influence domestic firm productivity. Popular cases considered include Chile, Indonesia, Mexico, Cote d'Ivoire, Colombia, and India.

Tybout *et al*. (1991) were among the first to examine the intra-industry productivity effects of the liberal trade reforms in Chile in the late 1970s and the early 1980s by making 'before and after' comparisons of a large sample of manufacturing plants. During the 1974 to 1979 period, Chile implemented a substantial trade liberalization programme, eliminating most non-tariff barriers and significantly reducing tariff rates. With a 10% *ad valorem* tariff in 1979, Chile had achieved one of the lowest and most uniform economic protection structures in the world (Dornbusch and Edwards, 1994). A glance at the data, comparing 1967, *i.e.* the pre-liberalization period, to 1979, *i.e.* the post-liberalization period, indicates a clear positive influence of the drastic reduction in protection on import shares, export shares, and intra-industry trade, and a negative impact of the reforms on total factor productivity for the manufacturing sector as a whole. However, it is important to take into account the major macroeconomic shocks Chile experienced over the period considered, including hyperinflation, a two-year recession, a significant exchange rate appreciation, and a considerably higher real interest rate, which could easily have masked the true effects of the trade reforms. To more formally study and isolate the impact of the trade liberalization on the manufacturing industry performance, measured according to different industry-specific proxies for productivity including changes in returns to scale, average efficiency levels and the industry-wide dispersion in efficiency levels, the researchers use Spearman rank correlations. The results indicate that the relatively large reductions in protection are linked to significant increases in returns to scale, declines in variations in efficiency levels among firms and substantial increases in average efficiency. Additionally, it is shown that the reforms led to an increase in production of small firms towards a minimum efficient scale, a reduction in labour input, a higher production level, and, accordingly, an increase in value-added and labour efficiency. Overall, the researchers conclude that the drastic trade liberalization process forced small inefficient plants to either improve their productivity towards a more efficient level or to drop out, resulting in a higher industry-wide productivity level. The wide range of surviving firms, accordingly, made use of on average more efficient technologies.

Pavcnik (2002) provides a more formal and accurate analysis of the impact of trade liberalization on Chilean manufacturing plant productivity over the period 1979-1986, overcoming the methodological drawbacks of pre- and post-liberalization comparisons due to macroeconomic confounding factors. In particular, the study contributes to the existing literature by identifying the trade effects through tracking productivity variation over time and across sectors, accurately measuring plant-specific productivity, and incorporating plant exit and resource, market share and profit reallocations among firms. Pavcnik (2002) employs the semiparametric estimation procedure developed by Olley and Pakes (1996) to obtain a consistent measure of plant-level productivity. This approach is focused on accurately measuring the parameters of a plant's production function, free of the econometric selection and simultaneity problems resulting from the unobserved character of plant-

specific efficiency. The procedure does not require a specific functional form, is tractable enough to estimate, and allows market structure dynamics like plant exit to be incorporated. Productivity, then, is simply modelled as the difference between a plant's actual output level and a plant's predicted output level based on the consistent production function parameter estimates. Using a detailed plant-level panel data set, Pavcnik (2002) reports three main results. Firstly, it is shown that the methodological aspects of the analysis are important. The Olley and Pakes (1996) semiparametric procedure provides more accurate estimates for the coefficients of a plant's production function, reporting significantly lower estimates for the labour input coefficient and significantly higher estimates for the capital input coefficient in comparison with, for example, the simpler OLS estimation procedure. Secondly, the results suggest a significantly positive impact of trade liberalization on plant productivity. In particular, the regression analysis indicates that the productivity of import-competing firms increases by, on average, 3% to 10% more than the productivity of non-trading firms. This finding points at a firm's efficiency-based reaction to increased foreign competition and decreased domestic market concentration and is consistent with the results by Blundell *et al*. (1999). Thirdly, Pavcnik (2002) concludes that channels other than scale economies produce intra-industry productivity improvements following trade liberalization. In particular, an analysis of the Chilean market structure indicates that a process of plant exit, with exiting plants being roughly 8% less productive than surviving plants, and resource reallocations from less productive to more productive plants contributed to the aggregate, industry-wide productivity gains.

Amiti and Konings (2007) manage to disentangle the productivity gains resulting from a reduction of tariffs on final goods and of tariffs on intermediate goods, using Indonesian plant-level data from 1991 to 2001. Production functions and, accordingly, plant-specific productivity levels are again estimated by means of the Olley and Pakes (1996) semiparametric methodology. The empirical results indicate that the largest productivity gains are due to reductions in input tariffs. Namely, a 10 percentage point decline in input tariffs produces a 12% increase in importing firm productivity, being twice as high as the productivity improvement experienced by a similar reduction in final goods tariffs. The impact of lower input tariffs is shown to be robust across different econometric specifications and significant both for competitive and concentrated industries. The productivity improvement due to a reduction in final goods tariffs can be attributed to an import-competition effect. The substantial impact of the reduction of input tariffs on plant productivity can be explained by a variety of mechanisms, including better access to a wider variety of higher quality intermediate products, learning effects, and reallocation effects. However, due to the unavailability of appropriate analytical measures, Amiti and Konings (2007) are not able to quantify the importance of these different channels.

By using a plant-level panel data set, Fernandes (2007) reports a strong positive impact of tariff liberalization on Colombian manufacturing plant productivity. Over the period 1977-1991, Colombia experienced significant changes in its trade policy. Broadly speaking, three regimes can be distinguished. The period 1977-1981 is referred to as the first liberalization period, with a significant reduction in import tariffs. From 1982-1984, Colombia pursued a more protectionist regime, increasing tariffs again. However, during the late 1980s and the early 1990s, the government switched again towards a more liberal trade policy, significantly and persistently reducing tariffs. To determine a plant's production function and productivity, Fernandes (2007) employs an adjusted version of the

methodology developed by Levinsohn and Petrin (2003) and Olley and Pakes (1996). The results suggest that tariffs negatively influence the total factor productivity of Colombian manufacturing plants, even after taking into account the possible confounding impacts of plant and industry heterogeneity, real exchange rate changes and industry-level cyclical effects. Additionally, Fernandes (2007) is able to distinguish between the impacts of liberalized trade among different types of plants. In particular, the researcher concludes that a reduction in import tariffs has a more significant impact on larger plants and plants operating in less competitive industries. The channels that contribute to the productivity improvement experienced by Colombian plants are linked to increased imports of foreign inputs, being of a higher quality, changes in skill intensity, machinery investments, updating technologies and market share reallocations from less to more productive firms.

Nataraj (2011) conducts unique research focused on the impact of trade liberalization on small firms operating in the Indian informal sector, which account for about 80% of the Indian manufacturing employment, during the 1990s. Productivity is measured according to an index number method developed by Aw *et al*. (2001), which is different from the approach adopted by the papers discussed previously. The statistical results support the hypothesis that it is important to consider these small, informal firms when quantifying the productivity impact of trade liberalization. Namely, it is shown that a 10 percentage point fall in final goods tariffs improves average productivity by roughly 3.5% and that this tendency is largely attributable to positive developments in the informal sector. In accordance with the resource, market share and profit reallocation argument, productivity increases most dramatically in the lowest quantiles, indicating that the least efficient firms exit the market.

A final empirical study worth mentioning is paper by Harrison (1994), focused on the impact of liberal trade reforms on the nature of market competition in Cote d'Ivoire in the mid 1980s, which could bias the measured change in plant-level productivity. Changes in market competition are assessed on the basis of the price-cost margins characterizing firms and industries. Using a balanced panel data set of 246 industrial firms, the results suggest that a decline in the price-cost margin, and thus in market power, is present in only a few sectors following the trade liberalization process. Taking into account adjustments in the price-cost margins, however, increases the positive impact of trade liberalization on productivity growth. Harrison concludes that the automatic assumption of perfect competition and constant returns to scale may potentially lead to underestimating the productivity improvements as a result of liberal trade policy adjustments.

## 3 The Theoretical Analysis

In his paper 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity', Melitz (2003) develops a theoretical, dynamic industry model with Dixit-Stiglitz preferences, increasing returns to scale and firm heterogeneity in the total factor productivity parameter to assess the role of trade liberalization as a catalyst for inter-firm resource, market share and profit reallocations within an industry. The inclusion of firm heterogeneity enables the explanation of how industry-wide aggregate productivity is endogenously determined. The model illustrates how trade liberalization, and thus an increase in the industry's exposure to international trade, leads to production factor, market share and profit reallocations from less to more productive firms, increasing sector-wide productivity and contributing to a welfare gain which has not been examined theoretically before. The results are consistent with some of empirical findings related to trade liberalization reported in section 2, including the existence of firm selection and resource reallocation mechanisms.

The study by Melitz (2003) serves as an important platform for the theoretical model developed in this section. In particular, this model, used to assess the theoretical impact of trade liberalization on the aggregate financial performance, incorporates many of the features of the model by Melitz (2003) and, in addition to Meltiz (2003), proves that firm productivity can objectively be proxied by indicators of financial performance. As in the paper by Melitz (2003), this section starts with an outline of the setup of the model and a description of the firm entry and exit procedure. Consequently, two equilibria are derived, compared and discussed, namely one in a closed economy setting and one in an open economy setting. This discussion allows a critical and theoretical assessment of the impact of trade liberalization on the sector-wide financial performance of firms.

### 3.1 Setup of the Model

*3.1.1 Demand*

The representative consumer in the home country is characterized by so-called Dixit-Stiglitz preferences (Dixit and Stiglitz, 1977), indicating that utility increases by the availability of a wider variety of goods. With infinitely many varieties indexed by $\omega$, the representative consumer's utility function, incorporating the 'love of variety' component and a constant elasticity of substitution (C.E.S), is equal to:

$$U = \left[ \int_{\omega \in \Omega} q(\omega)^{\rho} \, d\omega \right]^{1/\rho}, \tag{3.1}$$

where $0 < \rho < 1$ and $\Omega$ is the mass of all available goods. Since $U$ depends on all available varieties, $U$ can be interpreted as an aggregate consumption good. The price of the aggregate consumption good $U$, or differently the price per unit utility $P$, can be derived by assuming cost-minimizing behaviour of households and is equal to[1]:

$$P = \left[ \int_{\omega \in \Omega} p(\omega)^{1-\sigma} \, d\omega \right]^{\frac{1}{1-\sigma}}, \tag{3.2}$$

[1] The derivation of equation 3.2 is included in the Appendix, Proof A1.

where $\sigma = 1/(1-\rho) > 1$ and stands for the elasticity of substitution between varieties. With only homogenous goods, equation 3.2 can be simplified by replacing the continuum of goods by the total number of homogenous varieties available, being $M$:

$$P = M^{\frac{1}{1-\sigma}} \cdot p. \tag{3.3}$$

Analyzing equation 3.3 indicates a clear negative relationship between $M$ and $P$ since $\sigma > 1$. This implies that as more varieties become available, the price per unit utility declines *ceteris paribus* since a representative consumer has to consume less of each variety to obtain a constant level of utility.

To determine the total demand for a single variety $\omega$, based on utility maximizing behaviour, which is theoretically similar to cost-minimizing behaviour, of customers, a two-step procedure is followed. Firstly, by applying Shephard's Lemma to equation 3.2, it can be shown that the demand for a single variety $\omega$ per unit utility is equal to:

$$\frac{\partial P}{\partial p(\omega)} = \frac{1}{1-\sigma} \cdot \left[ \int_{\omega \in \Omega} p(\omega)^{1-\sigma} \, d\omega \right]^{\frac{1}{1-\sigma}-1} \cdot (1-\sigma) \cdot p(\omega)^{-\sigma} = P^{\sigma} \cdot p(\omega)^{-\sigma}. \tag{3.4}$$

Secondly, the total demand for a single variety $q(\omega)$ is equal to the product of the total utility and the demand for a variety per unit utility. This yields:

$$q(\omega) = U \cdot P^{\sigma} \cdot p(\omega)^{-\sigma} = Q \cdot P^{\sigma} \cdot p(\omega)^{-\sigma} = I \cdot P^{\sigma-1} \cdot p(\omega)^{-\sigma}, \tag{3.5}$$

where $I = Q \cdot P$ and equals total expenditures. Again, by assuming the existence of only homogenous goods, one can assess how the total demand for a single variety responds to an increase in the total number of varieties available. With $M$ homogenous goods, equation 3.5 can be rewritten as:

$$q = I \cdot P^{\sigma-1} \cdot p^{-\sigma} = I \cdot \left[ M^{\frac{1}{1-\sigma}} \cdot p \right]^{\sigma-1} \cdot p^{-\sigma} = \frac{1}{M} \cdot \frac{I}{p}. \tag{3.6}$$

Since $\sigma > 1$, the price per unit utility decreases as the total number of homogenous varieties $M$ increases. Then, as more varieties are consumed, the demand for each single variety decreases.

Based on equation 3.5, total revenues per variety $r(\omega)$ are equal to the product of the price per variety and the total demand for that variety. Hence, analytically, this yields:

$$r(\omega) = p(\omega) \cdot q(\omega) = I \cdot P^{\sigma-1} \cdot p(\omega)^{1-\sigma} = I \cdot \left[ \frac{p(\omega)}{P} \right]^{1-\sigma}. \tag{3.7}$$

*3.1.2 Production*

The supply side of the economy is characterized by infinitely many firms, which each produce a unique variety. Firms, thus, operate in a monopolistically competitive market. Firm technology is represented by a cost function with constant marginal costs. Production only requires labour as an input factor, such that production is equal to $q = l \cdot \varphi$, with $\varphi > 0$ and representing a firm-specific productivity parameter. The higher is $\varphi$, the more productive is the firm and the lower are the marginal cost of production. The amount of labour used by a firm, accordingly, is equal to $l = q \cdot 1/\varphi$. In the remainder of this theoretical analysis, firms are indexed by a company-specific productivity parameter

$\varphi$ rather than by a product-specific parameter $\omega$. Labour is supplied inelastically to the market. The size of the economy is determined by the total labour endowment $L$. All firms share the same fixed production cost $f > 0$.

The optimal price charged by a firm selling its unique product can be derived by assuming profit maximizing behaviour and, thus, by equating marginal revenues and marginal costs (MR = MC). Using equation 3.5 and the amount of labour required for production, it can be shown that the marginal revenues and the marginal costs are equal to[2]:

$$MR = \frac{\partial r(\varphi)}{\partial q(\varphi)} = I^{1/\sigma} \cdot P^{(\sigma-1)/\sigma} \cdot q(\varphi)^{-1/\sigma} \cdot (1-1/\sigma) = p(\varphi) \cdot (1-1/\sigma) \tag{3.8}$$

and

$$MC = \frac{\partial TC}{\partial q} = w \cdot \frac{1}{\varphi}. \tag{3.9}$$

Equating equations 3.8 and 3.9 yields an optimal pricing rule, such that the profit maximizing price per firm is equal to a mark-up over marginal costs:

$$\begin{aligned} & MR = MC \rightarrow p \cdot \left[1 - \frac{1}{\sigma}\right] = \frac{w}{\varphi} \\ & \rightarrow p(\varphi) = \frac{\sigma}{\sigma - 1} \cdot \frac{w}{\varphi}. \end{aligned} \tag{3.10}$$

After choosing labour as the numéraire and normalizing the wage rate to one, the optimal price $p(\varphi)$ is equal to:

$$p(\varphi) = \frac{\sigma}{\sigma - 1} \cdot \frac{1}{\varphi}. \tag{3.11}$$

Carefully analyzing equations 3.10 and 3.11 shows that the profit maximizing price decreases in response to an increase in the elasticity of substitution $\sigma$[3]. Intuitively, this is perfectly reasonable since the higher is the elasticity of substitution $\sigma$, the less unique is a particular variety and, hence, the lower is the market power of a single firm. Accordingly, the mark-up charged over marginal costs is lower.

Optimal profits, assuming profit maximizing prices, are equal to the difference between total revenues and total costs, which consist of two components, namely marginal costs and fixed production costs. Using the inverted version of equation 3.11 to replace the marginal costs component in the profit function, the profit function $\pi(\varphi)$ can be written as follows[4]:

$$\pi(\varphi) = \frac{p(\varphi) \cdot q(\varphi)}{\sigma} - f = \frac{r(\varphi)}{\sigma} - f. \tag{3.12}$$

[2] The derivation of equations 3.8 and 3.9 is included in the Appendix, Proofs A2 and A3.

[3] The first-order derivative of the profit maximizing pricing with respect to the elasticity of substitution is strictly negative: $\frac{\partial p(\varphi)}{\partial \sigma} = \frac{-1}{(\sigma-1)^2} \cdot \frac{w}{\varphi} < 0.$

[4] The derivation of equation 3.12 is included in the Appendix, Proof A4.

Since the elasticity of substitution is assumed to be always larger than unity and total revenues depend positively on a firm's productivity parameter[5], profits also increase in response to an improvement in a firm's productivity. The first order derivative of a firm's profits with respect to the productivity parameter $\varphi$ is equal to:

$$\frac{\partial \pi(\varphi)}{\partial \varphi} = \frac{(\sigma - 1) \cdot \varphi^{\sigma-2} \cdot \left(\frac{\sigma}{\sigma-1}\right) \cdot I \cdot P^{\sigma-1}}{\sigma}. \tag{3.13}$$

For an elasticity of substitution larger than unity, the right-hand side of equation 3.13 is strictly positive. This is the first indication supporting the idea that financial performance can be used as an accurate proxy for productivity.

Using equation 3.6 for the total demand for a single variety and function 3.7 for total firm revenues, respectively, it is possible to determine the ratio of outputs between two firms and the ratio of revenues between two firms. Firstly, the ratio of firm outputs is equal to:

$$\frac{q(\varphi_1)}{q(\varphi_2)} = \frac{I \cdot P^{\sigma-1} \cdot p(\varphi_1)^{-\sigma}}{I \cdot P^{\sigma-1} \cdot p(\varphi_2)^{-\sigma}} = \left[\frac{p(\varphi_1)}{p(\varphi_2)}\right]^{-\sigma} = \left[\frac{\varphi_1}{\varphi_2}\right]^{\sigma}. \tag{3.14}$$

Secondly, the ratio of firm revenues is equal to:

$$\frac{r(\varphi_1)}{r(\varphi_2)} = \frac{I \cdot P^{\sigma-1} \cdot p(\varphi_1)^{1-\sigma}}{I \cdot P^{\sigma-1} \cdot p(\varphi_2)^{1-\sigma}} = \left[\frac{p(\varphi_1)}{p(\varphi_2)}\right]^{1-\sigma} = \left[\frac{\varphi_1}{\varphi_2}\right]^{\sigma-1}. \tag{3.15}$$

Carefully analyzing these equations shows that, since the elasticity of substitution $\sigma > 1$, both the ratio of outputs and the ratio of revenues between firm 1 and firm 2 increases as the productivity gap between the companies widens.

### *3.1.3 Aggregation*

In order to leave the model analytically solvable and tractable, it is important to derive the aggregate price $P$ and the average sector-wide productivity parameter $\tilde{\varphi}$. The aggregate price $P$ depends on four components, namely the profit maximizing price charged by an individual firm, the mass $M$ of firms active in the market (and, accordingly, the mass $M$ of goods sold in the market), a distribution $\mu(\varphi)$ of productivity levels over the interval $[\underline{\varphi}; \overline{\varphi}]$, representing the lower and upper bounds for productivity respectively, and the elasticity of substitution $\sigma$. The aggregate price $P$, then, is equal to:

$$P = \left[\int_{\underline{\varphi}}^{\overline{\varphi}} p(\varphi)^{1-\sigma} \cdot M \cdot \mu(\varphi) d\varphi\right]^{\frac{1}{1-\sigma}}. \tag{3.16}$$

By rearranging terms and substituting equation 3.11 for the optimal price charged, this function can further be simplified to:

$$P = M^{\frac{1}{1-\sigma}} \cdot \frac{\sigma}{\sigma-1} \cdot \left[\int_{\underline{\varphi}}^{\overline{\varphi}} \varphi^{\sigma-1} \cdot \mu(\varphi) d\varphi\right]^{\frac{1}{1-\sigma}} = M^{\frac{1}{1-\sigma}} \cdot \frac{\sigma}{\sigma-1} \cdot \frac{1}{\tilde{\varphi}}, \tag{3.17}$$

[5] Using equation 3.7 and 3.11 to substitute the profit maximizing price for $p(\varphi)$, the firm's revenues can be seen to depend positively on $\varphi$, by rewriting 3.7 as follows: $r(\varphi) = \varphi^{\sigma-1} \cdot \left(\frac{\sigma}{\sigma-1}\right) \cdot I \cdot P^{\sigma-1}$.

where $\tilde{\varphi}$ is equal to a weighted average of all productivity levels and can explicitly be written as:

$$\tilde{\varphi} = \left[ \int_{\underline{\varphi}}^{\bar{\varphi}} \varphi^{\sigma-1} \cdot \mu(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}}. \tag{3.18}$$

Equation 3.17, in essence, is exactly similar to the aggregate price level that would characterize an economy with *M* average firms, *i.e.* firms with productivity levels equal to $\varphi = \tilde{\varphi}$ . Using this logic, it can be inferred that changes in the composition of average firms in an average economy or changes in the interval of possible productivity parameters in an economy with many different productivity levels both give rise to similar changes in the aggregate productivity level $\tilde{\varphi}$. Based this reasoning, the total demand for and the total revenue generated by a product produced by an average firm are equal to:

$$q(\tilde{\varphi}) = I \cdot P^{\sigma-1} \cdot p(\tilde{\varphi})^{-\sigma} \tag{3.19}$$

and

$$r(\tilde{\varphi}) = I \cdot P^{\sigma-1} \cdot p(\tilde{\varphi})^{1-\sigma}. \tag{3.20}$$

### 3.2 Firm Entry and Exit

Prior to market entry, there are infinitely many potential entrants into an industry and all firms are identical. To enter the market, firms have to make a start-up investment in order to build up factories and a retail channel, proxied by a fixed sunk market entry cost $f_e$, which is strictly positive. Subsequently to paying $f_e$, firms randomly draw their specific productivity parameter $\varphi$ from an exogenous, common distribution $g(\varphi)$, which is characterized by the interval $[\underline{\varphi}; \bar{\varphi}]$. This is a reasonable specification, since firms cannot have any information on the productivity of their employees or the extent to which their unique products are accepted by the market. The existence of the fixed sunk market entry cost makes sure firms only enter the market once.

After having drawn a specific productivity parameter, a firm will decide whether it starts production or not. In case a firm has picked a low productivity parameter, it may decide to leave the market again. Firms with a sufficiently high productivity parameter, meaning a productivity parameter that allows a firm to earn non-negative profits, will decide to start producing. Hence, using equation 3.12, it is possible to derive a zero cut-off profit condition, which defines the minimum productivity parameter $\varphi^*$ characterizing the firms that are active in the market:

$$\pi(\varphi^*) = \frac{r(\varphi^*)}{\sigma} - f = 0. \tag{3.21}$$

The existence of this zero cut-off profit condition requires an adjustment of the distribution $\mu(\varphi)$ of productivity by focusing only on the firms active in the market. Hence, from now onwards, $\mu(\varphi)$ is the conditional distribution of $g(\varphi)$ and is characterized by productivity levels over the interval $[\varphi^*; \bar{\varphi}]$. Since firms are exposed to periodic fixed production costs, both good and bad technologies can coexist in equilibrium. Following the adjustment of the distribution of productivity levels, equation 3.18, used to determine the average productivity parameter $\tilde{\varphi}$, should be updated by taking into account only the productivity levels of active firms:

(3.22) $$\tilde{\varphi} = \left[ \int_{\varphi^*}^{\bar{\varphi}} \varphi^{\sigma-1} \cdot \mu(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}}.$$

To assess how the average productivity parameter reacts to a change in the cut-off productivity level and, accordingly, to a change in the composition of productivity parameters characterizing the firms active in the market, the Leibniz integral rule can be used to derive the first order derivative of equation 3.22. This first order derivative is equal to:

(3.23) $$\frac{\partial \tilde{\varphi}}{\partial \varphi^*} = \frac{g(\varphi^*)}{1 - G(\varphi^*)} \cdot \left[ \tilde{\varphi} - \varphi^* \right],$$

which is strictly positive. This proves that an increase in the cut-off productivity parameter has a positive impact on the sector-wide average productivity level.

Firms with a productivity parameter $\varphi > \varphi^*$ and which are certainly active in the market earn strictly positive profits used to recover the initial fixed sunk market entry cost $f_e$. During every period they produce, firms may be hit by a negative shock with a probability $\theta$, with forced exit from the market as a consequence. The existence of this bad shock allows modelling a continuous flow of market entrants that try to establish a profitable plant and to start producing.

Since the average productivity level $\tilde{\varphi}$ is completely determined by the cut-off productivity level $\varphi^*$, the average profit and revenue levels, both depending on the average productivity level, are also linked to the cut-off productivity level. Analytically, this can be expressed as follows:

(3.24) $$\bar{r} = r(\tilde{\varphi}) = \left[ \frac{\tilde{\varphi}}{\varphi^*} \right]^{\sigma-1} \cdot r(\varphi^*)$$

and

(3.25) $$\bar{\pi} = \pi(\tilde{\varphi}) = \left[ \frac{\tilde{\varphi}}{\varphi^*} \right]^{\sigma-1} \cdot \frac{r(\varphi^*)}{\sigma} - f.$$

Equations 3.24 and 3.25 are useful for the determination of the closed economy equilibrium.

Returning to the assumption that firms have to pay a fixed sunk market entry cost prior to entering the market, it is possible to make the analytical simplification that firms are indifferent between paying the complete fixed sunk market entry cost $f_e$ initially or the per period equivalent of $f_e$, *i.e.* $f_{PPE}$, in each period firms expect to survive and to earn positive profits. Accordingly, given the fact that (1- $\theta$) captures the probability that a firm will survive in case of a negative shock, this simplifying assumption implies[6]:

(3.26) $$f_{PPE} = \theta \cdot f_e.$$

Based on this definition of the per period equivalent of the fixed sunk market entry cost, it is possible to determine a free entry condition, capturing the dynamic process of market entry. It defines the situation in which a firm believes it is worth paying the market entry cost, and, thus, is willing to accept the gamble of randomly drawing a productivity parameter that determines whether production is profitable. In essence, a firm will only enter the market if the expected profits conditional on

[6] The derivation of the simplification in equation 3.26 is included in the Appendix, Proof A5.

successful market entry equal the per period equivalent of the fixed sunk market entry cost. Analytically, this yields:

$$\left[1-G\left(\varphi^*\right)\right]\cdot\pi\left(\tilde{\varphi}\right)=\theta\cdot f_e, \tag{3.27}$$

where the expected profits conditional on successful market entry are equal to the product of the probability of successful market entry and the profits earned by a firm with average productivity, being the best approximation a company can make of the profits earned in the future.

### 3.3 Equilibrium in a Closed Economy

*3.3.1 The Equilibrium*

The zero cut-off profit condition and the free entry condition outlined in equations 3.21, 3.24, 3.25 and 3.27 are the equations which are useful for the determination of a unique closed economy equilibrium, linking and defining the average profit level with the cut-off and average productivity level. Rewriting these equations as to relate average profits to the cut-off productivity level yields the following zero cut-off profit condition and the free entry condition:

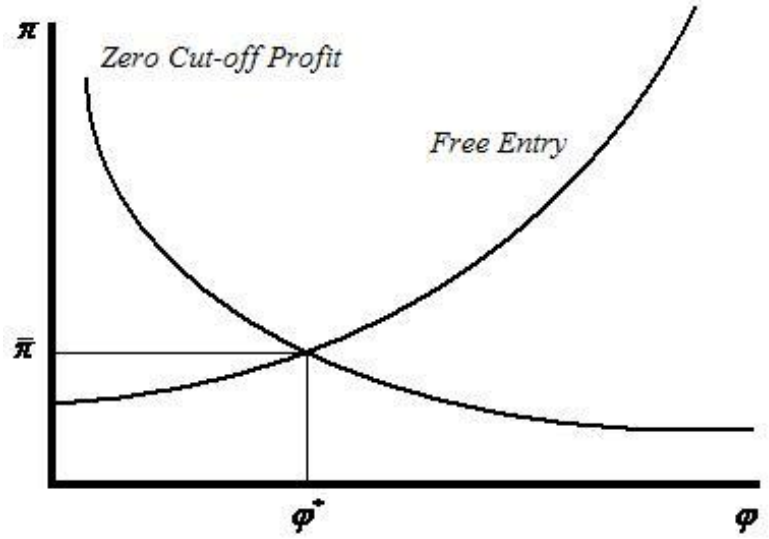
$$\bar{\pi}=fk\left(\varphi^*\right) \tag{3.28}$$

and

$$\bar{\pi}=\frac{\theta\cdot f_e}{\left[1-G\left(\varphi^*\right)\right]}. \tag{3.29}$$

where $k\left(\varphi^*\right)=\left[\frac{\tilde{\varphi}}{\varphi^*}\right]^{\sigma-1}-1$. Graphically, these equilibrium conditions look as follows:

**Figure 3.1: Determination of the Equilibrium Cut-off Productivity Parameter and the Average Profit Level**




The intersection of the zero profit cut-off condition and the free entry condition determines the equilibrium levels of $\bar{\pi}$ and $\varphi^*$. Analytically, the model can be solved by simplifying both the zero profit cut-off condition and the free entry condition. Firstly, by using a rewritten version of equation

3.15 to substitute for the cut-off revenue level in equation 3.21, the following transformed zero cut-off profit condition can be derived[7]:

$$r(\tilde{\varphi}) = \sigma \cdot f \cdot \left[\frac{\tilde{\varphi}}{\varphi^*}\right]^{\sigma-1}. \tag{3.30}$$

Secondly, using equation 3.30 to rewrite the average profit component in the free entry condition, the free entry condition can be transformed into[8]:

$$\left[1-G(\varphi^*)\right]\cdot\left[\left(\frac{\tilde{\varphi}}{\varphi^*}\right)^{\sigma-1}-1\right]\cdot f = \theta \cdot f_e. \tag{3.31}$$

Since the average productivity level $\tilde{\varphi}$ depends on the cut-off productivity parameter $\varphi^*$ as in equation 3.22, this model can be solved for both $\tilde{\varphi}$ and $\varphi^*$. These firm-level variables are independent of the country size *L*. A simplified example illustrating the derivation of the equilibrium is included in the Appendix, Proof A10.

*3.3.2 Comparative Statics Exercises*

To assess the dynamics of the model in a closed economy setting, it is worth to perform some comparative statics exercises and analytically check how the cut-off and average productivity levels react to changes in exogenous variables. Three types of shocks can occur. Firstly, the fixed sunk market entry costs $f_e$ can increase. In case this happens, the right-hand side of equation 3.31 increases. To maintain balance in the rewritten free entry condition, the left-hand side in the equation needs to increase, which requires the cut-off productivity level to decline. A lower cut-off productivity level automatically yields a lower industry-wide average productivity level. Graphically, this shock moves the upward-sloping free entry condition further up. Intuitively, an increase in $f_e$ makes it less attractive for potential market entrants to enter the market, as each firm has to earn higher profits to recover the increased fixed sunk market entry costs. Accordingly, fewer firms will enter the market, which reduces the competitive pressure on existing firms active in the market. The existing active firms will *ceteris paribus* earn higher average profits, independent of their productivity level. Thus, even initially less productive firms are able to survive in the market, reducing the cut-off and industry-wide average productivity levels.

Secondly, fixed production costs *f* can rise. In case this happens, the per period profits earned by each firm *ceteris paribus* decline. This affects the zero cut-off profit condition by increasing the productivity level necessary to earn non-negative profits, characterizing the productivity level that makes it attractive to be active in the market. It yields a situation in which only firms with a productivity parameter significantly higher than the initial cut-off productivity level are able to survive in the market. Firms that can no longer cover their production costs and, thus, earn negative profits are forced to exit the market. This selection mechanism has a positive impact on both the cut-off productivity level and the industry-wide average productive level. Graphically, this result can be understood by shifting the zero cut-off profit condition upward.

[7] The derivation of equation 3.30 is included in the Appendix, Proof A6.
[8] The derivation of equation 3.31 is included in the Appendix, Proof A7.

Thirdly, firms can be confronted with a lower death probability $\theta$. This has exactly opposite effects relative to an increase in the fixed sunk market entry costs. In this case, the right-hand side of equation 3.31 declines. To maintain balance in the free entry condition, the left-hand side of the equation needs to decrease, which requires the cut-off productivity level to increase. A higher cut-off productivity level automatically yields a higher industry-wide average productivity level. Graphically, this decline in the death probability moves the upward-sloping free entry condition down. Intuitively, a lower $\theta$ makes it more attractive for potential market entrants to enter the market, as the chances of survival in the market and earning positive profits are higher. Accordingly, more firms will enter the market, which increases the competitive pressure on existing firms active in the market. The existing active firms will *ceteris paribus* be confronted with lower market shares and lower profits. It will force some initially active, less productive firms to exit the market, increasing the cut-off and industry-wide average productivity levels. Only very productive firms are able to be active in the market.

## 3.4 Equilibrium in an Open Economy

### *3.4.1 Assumptions*

In an open economy setting, it is assumed that $n > 0$ other identical countries exist, such that the world consists of at least 2 very similar countries. Introducing trade to the model requires the inclusion three types of export costs. Firstly, each firm exporting its product to a foreign market is confronted with iceberg transportation costs $\tau$, meaning that $\tau > 1$ units of a good must be shipped in order for 1 unit to arrive at the destination. In essence, the iceberg transportation costs cause the marginal costs of a firm for supplying goods abroad to increase. Secondly, each firm has to pay periodic, fixed production costs $f_x$ to produce goods for the foreign market. It is assumed that these foreign fixed production costs are higher than the domestic fixed production costs, *i.e.* $f_x > f$. Thirdly, each firm is required to pay a fixed investment cost $f_{ex} > 0$ to be able to enter a foreign export market.

Defining these export costs is crucial for the development of a realistic theoretical, open economy model. Omission would create an equilibrium outcome in which the introduction of trade in an open economy setting has similar effects to an increase in the country size in an autarky setting. In particular, the introduction of trade would not have effects on any of the firm level variables, including the number of firms producing in each country, the levels of production, and the profits earned. The existence of firm heterogeneity would not alter the impact of trade liberalization. Only consumers would gain from the introduction of trade through the wider variety of products available in an open economy setting.

Since the countries are identical to each other, all countries are characterized by the same wage rate, which is still normalized to one, and country-wide aggregate variables. The profit maximizing price for firms serving the domestic market $p_d(\varphi)$ is similar to one in the closed economy setting and, hence, is equal to equation 3.11. Firms exporting goods set a profit maximizing price in excess of the optimal domestic price, incorporating the higher marginal cost $\tau$ for serving foreign markets. The optimal foreign price is equal to:

$$p_x(\varphi) = \frac{\sigma}{\sigma - 1} \cdot \frac{\tau}{\varphi} = \tau \cdot p_d(\varphi). \tag{3.32}$$

*3.4.2 Firm Entry, Exit and Export Status*

The firm entry and exit procedure described in section 3.2 remains unchanged in an open economy setting. Prior to entering the domestic market, firms have to pay an initial fixed sunk market entry cost. Subsequently, they discover their firm-specific productivity level and determine whether it is profitable to start production. Firms that start production are subject to a periodic negative shock, forcing them to exit the market immediately with probability $\theta$.

The decision to export occurs only after firms know their productivity level and, thus, is not subject to any export market uncertainty. Therefore, firms will only decide to export in case the profits from serving the foreign market are non-negative. The profits earned from serving the foreign market are equal to:

$$\pi_x(\varphi) = p_x(\varphi)\cdot q_x(\varphi) - c(\varphi)\cdot q_x(\varphi) - f_x = \frac{r_x(\varphi)}{\sigma} - f_x. \tag{3.33}$$

Using equations 3.7 and 3.32 to substitute for the revenues earned from exporting to the foreign market, this equation can be simplified to:

$$\pi_x(\varphi) = \frac{\left[p(\varphi)\cdot\tau\right]^{1-\sigma}\cdot P_F{}^{\sigma-1}\cdot I_F}{\sigma} - f_x. \tag{3.34}$$

Only firms with a productivity level high enough to earn non-negative profits from serving the foreign market will decide to produce for the domestic market and to export. Hence, as in the closed economy setting, it is possible to derive an adjusted zero cut-off profit condition, defining the minimum productivity parameter $\varphi_x^*$ characterizing the firms that will be active in the foreign market. This zero profit cut-off condition for serving the foreign market is equal to:

$$\frac{p\left(\varphi_x^*\right)^{1-\sigma}\cdot\tau^{1-\sigma}\cdot P_F^{\sigma-1}\cdot I_F}{\sigma} = f_x. \tag{3.35}$$

If $\varphi_x^* = \varphi^*$, all firms in the industry export. In case $\varphi_x^* > \varphi^*$, there is a number of firms that solely focuses on the domestic market. These firms, characterized by a productivity parameter $\varphi^* < \varphi < \varphi_x^*$, earn non-negative profits from selling their products domestically, but earn negative profits from serving the foreign market. Firms with a productivity parameter in excess of $\varphi_x^*$ will earn profits to sell goods both domestically and abroad.

Prior to entering the foreign market and exporting goods, firms have to assess whether it is actually profitable to do so, given the upfront investment they have to make. As in the closed economy setting, the dynamic process of market entry is defined by a free market entry condition. Firms will decide to enter the foreign market in case the expected profits are sufficient to cover the per period equivalent of the fixed sunk market entry cost. Compared to a closed economy setting, the expected profits with trade consist of two components, namely the expected profits from serving the domestic market and the expected profits from serving the foreign market. Again, conditional on successful market entry, a firm's best approximation of the future profits earned is the expected average profit level in both the domestic and foreign market. The per period equivalent of the fixed sunk market entry cost in the open economy setting can be derived similarly to the procedure followed in the closed

economy setting and, accordingly, is equal to equation 3.26. Then, the adjusted free entry condition in an open economy setting is as follows:

$$\left[1-G\left(\varphi^*\right)\right]\cdot\pi\left(\tilde{\varphi}\right)+\left[1-G\left(\varphi_x^*\right)\right]\cdot\pi\left(\tilde{\varphi}_x\right)=\theta\cdot f_e, \tag{3.36}$$

where $\tilde{\varphi}_x$ equals the average productivity parameter over all the exporting firms. Using equations 3.12 and 3.33 to substitute for the average profit levels, equation 3.36 can be simplified to:

$$\left[1-G\left(\varphi^*\right)\right]\cdot\left[\frac{r\left(\tilde{\varphi}\right)}{\sigma}-f\right]+\left[1-G\left(\varphi_x^*\right)\right]\cdot\left[\frac{r\left(\tilde{\varphi}_x\right)}{\sigma}-f_x\right]=\theta\cdot f_e. \tag{3.37}$$

*3.4.3 The Link between Productivity and the Financial Performance of Firms*

Before deriving, describing and discussing the open economy equilibrium, it can be proven that there is a positive relationship between a firm's productivity and its financial performance, supporting the idea that financial performance is an accurate proxy for unobservable productivity in the empirical analysis. Using equation 3.20, the sector-wide average profits earned by a firm with an average productivity parameter, being the difference between revenues and costs, are equal to:

$$\pi\left(\tilde{\varphi}\right)=\frac{I}{P^{1-\sigma}}\cdot p\left(\tilde{\varphi}\right)^{1-\sigma}-\frac{I}{P^{1-\sigma}}\cdot p\left(\tilde{\varphi}\right)^{-\sigma}\cdot c\left(\tilde{\varphi}\right), \tag{3.38}$$

where $P$ equals the aggregate price level in the domestic country, which in an open economy setting depends on both the price level domestically and abroad. Foreign countries, namely, have access to and can sell products in the domestic market. Accordingly, the foreign aggregate price level, which is exogenous, should also be taken into account when determining the aggregate price level. Using the inverse of equation 3.11 to substitute for the cost component in the profit function, equation 3.38 can be rewritten as:

$$\pi\left(\tilde{\varphi}\right)=\frac{I}{P^{1-\sigma}}\cdot p\left(\tilde{\varphi}\right)^{1-\sigma}\cdot\left[1-\frac{\sigma-1}{\sigma}\right]. \tag{3.39}$$

As in equations 3.16 and 3.17, the domestic aggregate sub-price index, here denoted by $P_D$, is equal to:

$$P_D=M^{\frac{1}{1-\sigma}}\cdot p\left(\tilde{\varphi}\right). \tag{3.40}$$

Using the same logic, the aggregate foreign sub-price index, denoted by $P_F$ and being equal to the sum of the individual foreign country price levels, can be expressed as follows:

$$P_F=\sum_{i=1}^{N}M_i^{\frac{1}{1-\sigma}}\cdot\tau\cdot p\left(\tilde{\varphi}_i\right), \tag{3.41}$$

where τ stands for the iceberg transportation costs and captures the difference between the prices domestically and abroad. Combining equations 3.40 and 3.41 to replace for the aggregate price $P$, equation 3.39 can be simplified to:

$$\pi(\tilde{\varphi}) = \frac{I \cdot p(\tilde{\varphi})^{1-\sigma}}{\left( M \cdot p(\tilde{\varphi})^{1-\sigma} + \sum_{i=1}^{N} M_i \cdot \tau \cdot p(\tilde{\varphi}_i)^{1-\sigma} \right) \cdot \sigma}. \tag{3.42}$$

Assuming that in an open economy setting the domestic country trades with a sufficiently large number of different foreign countries, the domestic aggregate price component can be removed from equation 3.42 as it is dominated by the exogenous, aggregate foreign price level. Accordingly, equation 3.42 can be approximated by:

$$\pi(\tilde{\varphi}) = \frac{I \cdot p(\tilde{\varphi})^{1-\sigma}}{\left( \sum_{i=1}^{N} M_i \cdot \tau \cdot p(\tilde{\varphi}_i)^{1-\sigma} \right) \cdot \sigma}. \tag{3.43}$$

Using equation 3.11 to substitute for the optimal average price level, equation 3.43 can further be simplified to:

$$\pi(\tilde{\varphi}) = \frac{I \cdot \left[ \frac{\sigma}{\sigma - 1} \cdot \frac{1}{\tilde{\varphi}} \right]^{1-\sigma}}{\left( \sum_{i=1}^{N} M_i \cdot \tau \cdot p(\tilde{\varphi}_i)^{1-\sigma} \right) \cdot \sigma}. \tag{3.44}$$

The first order derivative of equation 3.44 with respect to the sector-wide average productivity parameter, which is useful to assess the link between the financial performance of firms and their productivity level, is equal to:

$$\frac{\partial \pi(\tilde{\varphi})}{\partial \tilde{\varphi}} = (1-\sigma) \cdot \left[ \frac{\sigma}{\sigma - 1} \cdot \frac{1}{\tilde{\varphi}} \right]^{-\sigma} \cdot -\frac{1}{\tilde{\varphi}^2} \cdot \frac{I}{\left( \sum_{i=1}^{N} M_i \cdot p(\tilde{\varphi}_i)^{1-\sigma} \right) \cdot \sigma} > 0. \tag{3.45}$$

The first order derivative of the sector-wide average profits with respect to the average productivity parameter is strictly positive, indicating that in a setting as described above, the industry-wide average profits earned by a firm with average efficiency react positively to a change in the average productivity level. Intuitively, this relationship can be explained as follows. In case the sector-wide average productivity level improves, the average profit maximizing price charged by a firm with an average productivity level declines, as can be seen by analyzing the price specification incorporated in equation 3.44. However, since the elasticity of substitution $\sigma$ is greater than one, the decline in the optimal price has a positive impact on the industry-wide average profit level. The combination of higher average productivity and a lower profit maximizing price has an overall positive impact on the sales potential of the average firm, improving the industry-wide average profitability. Hence, this positive relationship supports the idea that the financial performance of firms can be used as an accurate and objectively measurable proxy of productivity.

### *3.4.4 The Equilibrium*

In equilibrium, two zero cut-off profit conditions, linking the average profits earned by firms active in the market to the cut-off productivity level, need to hold. Firstly, as in the closed economy setting, the

zero cut-off profit condition determining the production status in the domestic market and derived in equation 3.21 needs to be satisfied. Secondly, the zero cut-off profit condition determining the export status and derived in equation 3.35 needs to hold. Analytically, the simplified, rewritten versions of these zero profit cut-off conditions, linking the average profits earned to the cut-off productivity parameter, look as follows[9]:

$$\pi_d(\tilde{\varphi}) = fk(\varphi^*) \tag{3.46}$$

and

$$\pi_x(\tilde{\varphi}_x) = f_x k(\varphi_x^*), \tag{3.47}$$

Where $k(\varphi) = \left[\frac{\tilde{\varphi}}{\varphi}\right]^{\sigma-1} - 1$ . Combining equations 3.46 and 3.47 yields an overall zero cut-off profit condition characterizing the open economy setting:

$$\bar{\pi} = \pi_d(\tilde{\varphi}) + p_x n \pi_x(\varphi_x) = fk(\varphi^*) + p_x n f_x k(\varphi_x^*), \tag{3.48}$$

where *n* stands for the total number of trading partners.

To check whether the cut-off productivity parameter defining the firms that serve both the foreign market and the domestic market is higher than the minimum productivity parameter defining the firms that are only active in the domestic market, it is possible to express $\varphi_x^*$ as a function of $\varphi^*$. Namely, dividing the zero cut-off profit conditions derived in equations 3.21 and 3.35 and incorporating the symmetry condition outlined in section 3.4.1 yields[10]:

$$\left[\frac{p(\varphi_x^*)}{p(\varphi^*)}\right]^{1-\sigma} = \tau^{\sigma-1} \cdot \left[\frac{f_x}{f}\right]. \tag{3.49}$$

After substituting the optimal pricing rules derived in equations 3.11 and 3.32 for the optimal prices charged by firms exporting goods and firms only serving the domestic market and rearranging terms, equation 3.49 can be simplified to[11]:

$$\varphi_x^* = \varphi^* \cdot \tau \cdot \left[\frac{f_x}{f}\right]^{\frac{1}{\sigma-1}}. \tag{3.50}$$

Since the assumptions are made that $\tau > 1$ and $f_x > f$, it can be concluded that $\varphi_x^* > \varphi^*$, indicating that not all firms export. Only the firms with a sufficiently high productivity parameter are able to produce goods for the foreign market in a profitable way. Additionally, by carefully analyzing equation 3.50, it can be inferred that the higher is $\tau$ or $f_x$, the fewer firms are, apart from producing goods for the domestic market, also serving the foreign market.

The procedure followed to determine a unique open economy equilibrium is similar to the one followed in an autarky setting. Firstly, by using a rewritten version of equation 3.15 to substitute for

[9] These simplifications are similar to the procedure followed in the closed economy setting and applied to equation 3.28.

[10] The derivation of equation 3.49 is included in the Appendix, Proof A8.

[11] The derivation of equation 3.50 is included in the Appendix, Proof A8.

the domestic cut-off revenue level in equation 3.21, the following transformed zero cut-off profit condition for the domestic market can be derived[12]:

$$r(\tilde{\varphi}) = \sigma \cdot f \cdot \left[\frac{\tilde{\varphi}}{\varphi^*}\right]^{\sigma-1}. \tag{3.51}$$

The zero cut-off profit condition for the foreign market can be adjusted in a similar way. The transformed zero cut-off profit condition, then, looks as follows[13]:

$$r(\tilde{\varphi}_x) = \sigma \cdot f_x \cdot \left[\frac{\tilde{\varphi}_x}{\varphi_x^*}\right]^{\sigma-1}. \tag{3.52}$$

Secondly, using equations 3.51 and 3.52 to rewrite the average profit component in the free entry condition, the free entry condition can be transformed into:

$$\begin{aligned} &\left[1-G(\varphi^*)\right]\cdot\left[\frac{\sigma \cdot f \cdot \left(\tilde{\varphi}/\varphi^*\right)^{\sigma-1}}{\sigma} - f\right] + \\ &\left[1-G(\varphi_x^*)\right]\cdot\left[\frac{\sigma \cdot f_x \cdot \left(\tilde{\varphi}_x/\varphi_x^*\right)^{\sigma-1}}{\sigma} - f_x\right] = \theta \cdot f_e. \end{aligned} \tag{3.53}$$

This adjusted free entry condition, incorporating the zero cut-off profit conditions for both the domestic and the foreign market, can solved for the domestic cut-off productivity parameter $\varphi^*$, the domestic average productivity parameter $\tilde{\varphi}$, the export cut-off productivity parameter $\varphi_x^*$, and the exporter-specific average productivity parameter $\tilde{\varphi}_x$. A simplified example illustrating the derivation of the open economy equilibrium and comparing the outcome with the closed economy equilibrium is included in the Appendix, Proof A10.

### *3.4.5 The Impact of Trade & Trade Liberalization*

The introduction of trade to the model has important consequences for various variables of interest, including the cut-off productivity parameter, the industry-wide average productivity parameter, and the nation-wide welfare level. Comparing the free entry conditions in a closed economy setting and in an open economy setting derived in equations 3.31 and 3.53, respectively, shows that an additional term is included in the open economy function. This additional term captures the expected profits earned from serving the foreign market, conditional on successful market entry, and is strictly positive. The inclusion of this additional term increases the left-hand side of the free-entry condition. To maintain balance, the cut-off productivity parameter $\varphi^*$ has to increase. Accordingly, the increase in $\varphi^*$ makes sure that only the most productive firms export their goods to the foreign market, since $\varphi_x^* > \varphi^*$, that the industry-wide aggregate productivity level increases, and that the industry-wide average profits earned per firm rise.

Intuitively, these dynamics can be explained by two mechanisms. Firstly, there is a domestic market selection effect. Since exposure to trade increases the expected profits conditional on

[12] The derivation of equation 3.51 is included in the Appendix, Proof A6.
[13] The derivation of equation 3.52 is included in the Appendix, Proof A9.

successful market entry, more firms (both domestic new entrants and foreign competitors) enter the domestic market, which intensifies competition in the market. Firms will serve smaller market shares and earn lower profits. Additionally, the increased entrance of firms increases competition for resources such as labour, which positively influences the costs of the factors of production. Accordingly, only the firms with a relatively high productivity parameter $\varphi$ can survive in the market. The less productive firms, which used to be able to survive in a closed economy setting, can no longer cover their costs and, thus, are forced to exit the market. Secondly, there is an export market selection effect. Only firms with a productivity parameter greater than or equal to $\varphi_x^*$ enter the export markets and experience an increase in overall market share. Firms with a productivity parameter in between $\varphi^*$ and $\varphi_x^*$ will only be active in the domestic market. The combination of these two selection effects causes only the more productive firms be active in the market and to produce.

Focusing on the financial performance of individual firms, it can be concluded that the aforementioned domestic and export market selection effects cause a type of Darwinian evolution to take place within an industry. Only the most efficient firms experience higher market shares and higher profits by serving both the domestic market and the foreign market. Some less efficient firms are productive enough to export and, accordingly, experience an increase in market share, but at the same time suffer a profit loss. Combined, it can be inferred that the impact of trade on the financial performance of exporters is ambiguous and insignificant. Firms only serving the domestic market suffer both a loss in market share and in profits. The least productive firms, experiencing severe losses, are driven out of the market. The industry-wide average financial performance, though, will improve due to the fact that only the more productive firms continue to be active in the market. This result is supported by the earlier discussed positive relationship between productivity and financial performance.

On a nation-wide level, the reallocation of resources, market shares and profits from less to more efficient firms and the increase in the product variety due to trade relationships with the rest of the world contribute to an aggregate welfare gain.

To assess the economic impact of trade liberalization rather than to compare the open economy setting with the autarky setting, two comparative statics exercises can be performed. Firstly, trade liberalization can be modelled as an increase in the number of trading partners. The domestic and export cut-off productivity levels both increase, leading to a reallocation of resources, market shares and profits towards more efficient firms and forcing the least productive firms to exit the market. The most efficient firms experience an increase in both market shares and profits by being able to cover the fixed production costs for serving the foreign market. Some less efficient firms, for which it is still profitable to enter the export market, suffer a loss in profits. Firms serving only the domestic market certainly experience a loss in both market shares and profits. On a nation-wide level, the reallocation of resources, market shares and profits causes aggregate productivity to rise and welfare to increase.

Secondly, trade liberalization can be modelled as a decrease in trade costs, either in iceberg transportation costs $\tau$ or in fixed costs for serving the foreign market $f_x$. In both cases, the least productive firms are forced to exit the market, which positively influences the domestic cut-off productivity parameter. However, contradictory to the increase in the number of trading partners, the decrease in trade costs causes the threshold productivity parameter to enter the export market to decline. Hence, in this case, it also generates entry of new firms into the export market. Finally, in line

with the previous comparative statics exercise, trade liberalization modelled as a decrease in trade costs generates an aggregate, nation-wide welfare gain.

### 3.5 Overview of the Theoretical Results

The main theoretical results based on the analysis in this section can be summarized as follows:

- Trade liberalization has a positive influence on the cut-off productivity level and the industry-wide average productivity level through processes of resource, market share and profit reallocations. The least productive firms are forced to leave the market due to increased competition in production factors and final goods markets. The more productive firms remain active in the market, leading to the just mentioned higher threshold and industry-wide productivity parameters.
- Trade liberalization has a positive influence on the industry-wide average financial performance through the aforementioned reallocation mechanisms and the direct, positive relationship between productivity and financial performance. This theoretical result supports the idea that financial performance is a reliable, objective and accurately measurable proxy of productivity.
- Trade liberalization has an ambiguous and insignificant impact influence on the average productivity and financial performance of exporters. Among the group of exporters, the most productive firms gain both in market share and profitability due to increased exposure to trade. Some other firms, for which it is still attractive to sell goods in the foreign market, will only experience the benefits of serving a higher market share, but suffer from a loss in profitability. Combined, the impact of trade liberalization on the productivity and financial performance of exporters is ambiguous and insignificant. Trade liberalization can have either a positive or a negative impact on the threshold productivity level determining the export status of a firm, depending on the way trade liberalization is modelled.

# 4 The Empirical Analysis

## 4.1 Hypotheses

The theoretical model derived and discussed in the previous section serves as a framework for empirically analyzing the influence of trade liberalization on the industry-wide average performance of firms due to a process of resource, market share and profit reallocations. Two central null-hypotheses ($H_0$) can be framed to assess the role of resource, market share and profit reallocations in explaining the influence of trade liberalization on the industry-wide average performance of firms:

1. Trade liberalization has a positive influence on the industry-wide average performance of firms.
2. Trade liberalization has an ambiguous and insignificant influence on the industry-wide average performance of exporters.

The alternative hypotheses ($H_a$), accordingly, can be formulated as follows:

1. Trade liberalization has no influence on the industry-wide average performance of firms.
2. Trade liberalization has a significant influence on the industry-wide average performance of exporters.

Significant evidence in favour of the two null-hypotheses supports the importance of resource, market share and profit reallocation mechanisms, a channel which has not been analyzed intensively empirically, in explaining how trade liberalization contributes to firm productivity and nation-wide welfare improvements.

## 4.2 Data

### *4.2.1 Firm-Level Data & Sample*

By construction, the empirical analysis requires data on the level of the firm, due to the existence of firm heterogeneity in the total factor productivity parameter in the theoretical analysis, and over a sufficiently long time period to facilitate the performance of a panel data analysis, the preferred methodology. To this end, the empirical analysis employs a detailed, harmonized panel dataset with comprehensive company-level data on the characteristics and performance of firms active in Eastern European and Central Asian countries, gathered by the implementation of the Business Environment and Enterprise Performance Surveys (BEEPS) and constructed by the joint effort of the World Bank and the European Bank for Reconstruction and Development (2012).

The complete Enterprise Surveys dataset incorporates data on in total 27 countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia, Bulgaria, Croatia, Czech Republic, Estonia, the Former Yugoslav Republic of Macedonia (FYROM), Georgia, Hungary, Kazakhstan, Kyrgyz, Latvia, Lithuania, the Republic of Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Tajikistan, Ukraine and Uzbekistan. With information collected on the basis of 150-1800 interviews per country, depending on the size of each country, and over a period of 4 years, in particular 2002, 2005, 2007 and 2009[14], the dataset constitutes a representative sample of an economy's private sector. In total, data on 23,570 firms has been collected.

[14] The Enterprise Survey was published in 2002, 2005, 2007 and 2009, but reports information on one year before the publishing year, *i.e.* 2001, 2004, 2006 and 2008.

The information gathered covers many different aspects of a firm, including general information, infrastructure and services, sales and supplies, the degree of competition, capacity, land and permits, crime, finance, business-government relations, labour, the business environment, and performance. Relevant indicators required for the empirical analysis include total sales revenue, total costs, the direct export intensity, firm age, foreign ownership shares, the use of foreign inputs, the number of skilled employees, total employment, the use of foreign technologies, and 4-digit sector affiliation (ISIC-Rev 3.1). Generally speaking, the sectors considered include both manufacturing and services. The ISIC codes allow a more specific definition of the different sectors included in the survey and indicate that the main activities considered are activities related to the processing of food, textiles, garments, chemicals, plastics and rubber, non-metallic mineral products, basic metals, fabricate metal products, machinery and equipment, electronics, other manufacturing, construction services, other services, wholesale, retail, hotel and restaurants, transportation, and IT services. In total, the sample includes 503 sectors, each defined by a unique 4-digit ISIC code (World Bank, 2012).

*4.2.2 Sector-Level Variables*

The empirical analysis extracts from the Enterprise Survey the firm-level information specified above to construct country-specific, sector-level variables. The construction of sector-level variables is necessary to investigate the role of resource, market share and profit reallocations in explaining the influence of trade liberalization on the industry-wide average performance of firms. Namely, as discussed earlier, theory suggests that trade liberalization has a positive influence on the sector-wide cut-off productivity level and, accordingly, on the sector-wide average productivity level. To empirically investigate this relationship, it is necessary to work with sector-wide average variables. Hence, the unit of observation in the empirical analysis is the average firm active in an industry. Taking the average firm as the unit of observation and analysis enables the elimination of any structural differences in firm characteristics within a sector.

Eight country-specific, sector-level variables are constructed. Firstly, annual sector-wide average productivity is assessed on the basis of the sector-wide average financial performance of firms. The use of financial performance as a proxy of productivity is supported by the theoretical proof outlined in section 3.4.3, which suggests that there is a positive relationship between productivity and financial performance. The advantage of using financial performance instead of productivity is that financial performance, specified in line with conventional finance literature (Berk and DeMarzo, 2007), is objectively and accurately measurable. Several researchers have attempted to accurately measure productivity by estimating a firm's production function. However, as discussed in section 2.2, the estimation procedure is often problematic due to the existence of econometric selection and simultaneity problems (Levinsohn and Petrin, 2002). In the analysis, two measures of financial performance are constructed. The most common financial performance measure is the profit ratio. Yearly firm-level profits are calculated by subtracting from the sales revenue the costs of labour, costs of electricity, costs of fuel, costs of water, costs of finished goods and materials, costs of raw materials and other intermediate goods, costs related to the purchases of fixed assets, and other costs not yet specified. Firm-specific profit ratios are calculated by dividing the obtained profit levels by the total annual sales revenues. The yearly sector-wide average profit over sales ratio is constructed by averaging the firm-specific profit ratios of all firms active in a sector in a particular year, weighted by

each firm's share in total sectoral employment. Employment is measured by means of the total number of full-time workers hired by a particular firm. Using employment shares as a method for determining weighted averages is a common procedure applied in many economic empirical studies, including Aitken and Harrison (1999). The firm's share in total sectoral employment, $ES_{jct}$, is calculated as follows:

$$ES_{jct} = \frac{FTE_{ijct}}{\sum_{i} FTE_{ijct}}, \tag{4.1}$$

where $ES_{jct}$ is the sectoral employment share characterizing sector *j* in country *c* at time *t* and $FTE_{ijct}$ stands for the number of full-time employees working at firm *i* active in sector *j* in country *c* at time *t*. As mentioned earlier, sectors are characterized by 4-digit ISIC codes, allowing a highly specific definition of different sectors. The annual profit over sales ratio is always in between -1 and +1. Firms with a ratio outside this range are deleted from the dataset, as chances are high that the information reported on these firms is subject to severe inaccuracies. Another widely used measure of financial performance is the market share, quantifying the part of the market that is served by a firm. Since the empirical analysis relies upon sector-wide average values, annual sector-wide average market shares are constructed by determining the yearly sector-wide average sales revenues, and dividing these revenue levels by the annual country-wide average sales. Again, sectors are characterized by 4-digit ISIC codes, allowing a highly specific definition of different sectors. The calculated annual sector-wide average market shares are by definition in between 0 and +1.

Secondly, yearly sector-wide export intensities are used to model the process of trade liberalization and, thus, represent a crucial sector-level variable in the model. An increase in the sector-wide export intensity over the period 2002-2009 is a clear indication of an economy opening up to trade, with sectors trying to exploit the increased sales potential by selling products in foreign markets. The yearly sector-wide export intensities are determined with the help of the survey information on firm-specific direct export intensities. The assumption that the survey information on export intensities is a representative basis for calculating sector-wide export intensities is supported by a simple comparison exercise. Comparing the sector-wide export shares, calculated by dividing the sector-wide export values by the country-wide export values, determined for a random subsample of 2-digit ISIC code specified sectors and countries in the Enterprise Survey with the official country-specific export shares of the corresponding 2-digit HTS code specified sectors reported by the International Trade Centre provides sufficient evidence for assuming that the Enterprise Survey is a representative basis for estimating sector-wide export intensities. The Enterprise Survey defines the firm-specific direct export intensity as the total value of goods directly exported to foreign markets as a percentage of overall sales. The direct export intensities are used to determine the total annual firm-specific export values. Using the 4-digit ISIC code sector definition, the firm-specific export values are used as inputs to calculate the annual sector-wide export values. By dividing these export values by the yearly nation-wide sales values, being the sum of the sector-wide sales values in a particular year, the annual sector-wide average export intensities can be determined. By definition, the yearly sector-wide export intensities are in between 0 and +1, with a value of +1 indicating that 100% of a sector's sales are exported to foreign markets.

Thirdly, the natural logarithm of the average age of firms active in 4-digit ISIC code specified sectors is determined to control for structural differences between firms and industries that can possibly bias the relationship between trade liberalization and performance. It may be argued that more mature firms have established a dominant position in the market, are producing a unique product and are using production, marketing and sales strategies that have proven to be efficient. These firms may perform structurally better compared to less mature firms. Since the empirical analysis uses the average firm active in a sector as the unit of observation, sector-wide average ages are used rather than the firm-specific ages. The Enterprise Survey reports information on the year that a firm started its operations, which can be used to calculate the firm-specific age. By taking the difference between the survey year[15] and the year a firm started its operations, the firm-specific age can be determined. Accordingly, as in the case of the sector-wide profit ratio, the yearly sector-wide average age of firms is constructed by averaging the firm-specific ages of all firms active in a 4-digit ISIC code defined sector in a particular year, weighted by each firm's share in total sectoral employment. Employment shares are calculated as defined in equation 4.1.

Fourthly, since firm size might be a firm-specific characteristic that has a structural impact on the financial performance, the natural logarithm of the average size of firms active in 4-digit ISIC code defined sectors is calculated and included in the empirical analysis. In particular, it may be argued that smaller firms are more flexible and have greater potential to grow, which allows them to fully benefit from trade liberalization via entering new markets. In case this is true, firm size may have a structurally positive impact on the performance of smaller companies in an open economy setting, which can bias the empirical link between trade liberalization and performance. Firm size is assessed on the basis of the total number of full-time employees hired by a company. A full-time employee is defined as a worker who is contracted for a term of one or more fiscal years, who has a guaranteed renewal of his or her employment contract and who works 8 or more hours per day (World Bank, 2012). As in the case of the sector-wide profit ratio and the average age, the sector-wide average firm size is determined by averaging the firm-specific sizes of all firms active in a particular sector in a specific year, weighted by each firm's share in total sectoral employment. Employment shares are calculated as defined in equation 4.1.

Fifthly, the share of foreign ownership, measured according to a sector-wide average percentage, is determined. The reason for calculating this variable is that many researchers have shown that there is a statistically significant and positive relationship between foreign direct investments, which are often proxied by the share of foreign ownership, and the performance of firms in emerging markets. In particular, Aitken and Harrison (1999) show that production plants clearly benefit from the productive advantages of foreign owners through a process of technology diffusion and learning effects, using a sample of Venezuelan firms. Therefore, firms and sectors receiving significant amounts of foreign direct investments may structurally perform better, which can possibly bias the relationship between trade liberalization and performance. Sector-wide average shares of foreign ownership rather than firm-specific foreign ownership stakes are used since the empirical analysis uses the average firm active in a sector as the unit of observation. The Enterprise Survey provides information on the percentage of the firm that is owned by private foreign individuals,

[15] The Enterprise Survey was published in 2002, 2005, 2007 and 2009, but reports information on one year before the publishing year, *i.e.* 2001, 2004, 2006 and 2008.

companies or organisations. The yearly sector-wide average shares of foreign ownership are constructed by averaging the firm-specific foreign ownership stakes of all firms active in a 4-digit ISIC code defined sector in a particular year, weighted by each firm's share in total sectoral employment. Employment shares are calculated as defined in equation 4.1. By definition, the yearly sector-wide average shares of foreign ownership are in between 0 and +1. A value of +1 indicates that, on average, the companies active in a particular sector are completely owned by private foreign individuals, companies or organisations.

Sixthly, the sector-wide average skill intensity is determined with the help of the information on the number of skilled workers employed by a firm. Skill intensity is a relevant variable to include as a control variable in the empirical analysis since factor market competition is an important feature influencing a company's ability to survive in an open economy market. Firms with good financial performance can attract more skilled and talented workers, resulting in a relatively higher proportion of skilled workers employed and having a positive influence on productivity and performance. However, hiring more skilled workers also comes at the cost of paying higher wages. The Enterprise Survey reports information on each firm's number of skilled workers hired. Skilled workers are defined as 'workers engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping, maintenance, repair, product development, auxiliary production for the plant's own use, recordkeeping, and other services closely associated with these production operations'. Workers with functions above the supervisory level are excluded from this definition. Skilled workers are also workers that have some special knowledge or skill in their work. In terms of education, a skilled worker attended a college, university or technical school (World Bank, 2012). Dividing the number of skilled workers by the total number of full-time workers employed by a firm yields a firm-specific measure of skill intensity. This skill intensity measure is a ratio on the interval [0, 1]. The closer is the ratio to 1, the higher is the proportion of skilled workers within the complete firm-specific workforce. The yearly sector-wide average skill intensities are calculated by averaging the firm-specific skill intensities of all firms active in a 4-digit ISIC code specified sector in a particular year, weighted by each firm's share in total sectoral employment. Employment shares are calculated as defined in equation 4.1.

Seventhly, related to the share of foreign ownership, sector-wide average foreign technology dummies are calculated. The idea behind inclusion of a foreign technology variable is essentially similar to the one behind the inclusion of the earlier described foreign ownership variable. Again, the use of sophisticated foreign technologies may have a positive influence on a firm's performance. Additionally, a process of technology diffusion and learning effects may boost technological development in the foreign direct investment receiving country, enhancing economic growth and, accordingly, also allowing firms that do not use foreign technologies to benefit. The Enterprise Survey provides firm-specific foreign technology dummies, with a value 0 referring to firms not using any foreign technologies and a value 1 defining firms that have implemented foreign technologies in their production processes. Firm-specific dummies are converted into sector-wide average foreign technology dummies by averaging the firm-specific foreign technology dummies of all firms active in a 4-digit ISIC code specified sector in a particular year, weighted by each firm's share in total sectoral employment. Again, employment shares are calculated as defined in equation 4.1.

The final sector-level variable included in the analysis is the sector-wide average foreign input share, measuring the average proportion of foreign supplies used in the production process by firms active in a particular 4-digit ISIC code defined sector. The Enterprise Survey gives an overview of firm-specific imports of foreign supplies. Constructing the sector-wide average foreign input shares follows the exact same procedure as the one followed for the construction of all the other sector-level variables and, accordingly, is done by averaging the firm-specific foreign input proportions of all firms active in a 4-digit ISIC code specified sector in a particular year, weighted by each firm's share in total sectoral employment. Again, employment shares are calculated as defined in equation 4.1.

### *4.2.3 Macro-Level Variables*

Two macro-level variables are included in the empirical analysis to control for the influence of structural country-wide differences which can bias the relationship between trade liberalization and the performance of firms. Additionally, these macro-level, country-specific variables can be used as a fixed effects specification, partly due to their time invariability.

The first macro-level variable constructed is the country-specific inflation difference. Inflation is an important determinant of a country's competitiveness. A high inflation rate in a country, measured according to the GDP deflator, relative to the inflation rate characterizing its trading partners has negative consequences for a country's real exchange rate and worsens its competitive position in international trade markets, which adversely influences a firm's financial performance in an open economy setting. Likewise, countries with a lower inflation rate relative to their trading partners enjoy a favourable competitive position, which has a positive impact on a firm's ability to compete in international trade markets. The World Bank Databank in general and the World Development Indicators in particular provide a comprehensive overview of annual, country-specific inflation rates (World Bank, 2012). Country-specific inflation differences are constructed by taking the difference between a country's inflation rate and the average inflation rate characterizing its five main trading partners, weighted by the each trading partner's share in the country's exports. The International Trade Centre, summarizing the data reported by the United Nations Commercial Trade Database and providing information on a country's trade flows and export destinations, has been used to determine the five major trading partners of each of the 27 countries in the Enterprise Survey. A country's major trading partner is defined as a nation that receives that highest share of goods and services exported by a country of interest (International Trade Centre, 2012).

The GDP per capita difference is the second macro-level variable constructed and included in the empirical analysis. The evolution of the GDP per capita can be used as a proxy for country-specific economic development, which may be a driver of improved firm performance independent of the process of trade liberalization. Additionally, Heckscher-Ohlin theory suggests that comparative advantage is the major factor in explaining why countries specialize in an open economy setting. In particular, the theory states that countries export goods that use production factors intensively that are abundantly available. Imports consist of goods that use production factors intensively that are rather scarcely available. This specialization tendency allows firms to focus on their core competence and improve productivity, which in turn has a positive impact on the financial performance. To control for these structural country-specific influences, possibly biasing the statistical link between trade liberalization and performance and to include country fixed effects in the empirical analysis, the GDP

per capita difference is constructed. The World Bank Databank in general and the World Development Indicators in particular provide all the necessary information for calculating this macro-level variable (World Bank, 2012). To eliminate the influence of price changes, the GDP per capita is measured in US Dollars specific for the year 2000. Again, as in the case of the inflation difference, the GDP per capita difference is constructed by subtracting from the GDP per capita a country in the Enterprise Survey sample the average GDP per capita characterizing its five main trading partners, weighted by the each trading partner's share in the country's exports. The five major trading partners are determined on the basis of the export values and destination data provided by the International Trade Centre (2012).

*4.2.4 Descriptive Statistics*

The data obtained and described are characterized by some interesting descriptive features. Table 4.1 presents a comprehensive overview of the descriptive statistics of the overall sample, providing information on sector-wide sales, profits, aggregate financial performance, export intensities, shares of foreign ownership, the use of foreign technologies, the use of foreign supplies, firm size, firm age, the number of full-time workers employed and the two macro-level variables.

The average sales value for all countries considered, after deleting sales values that give rise to profit ratios smaller than -1 or greater than +1, is approximately equal to $4.6 billion, with a maximum of $100 trillion for a firm in Uzbekistan. The average profits earned, only taking into account profits that produce reasonable profit ratios, are equal to $3.7 billion.

The mean of the sector-wide average profit ratio, a variable which is highly relevant for the empirical analysis, is 0.410. The corresponding standard deviation of 0.335 indicates that there is quite some dispersion among sectors and firms in terms of their financial performance. Out of the sample of 27 countries, fifteen countries are characterized by a higher profit ratio. These countries include Belarus, Bosnia, Bulgaria, Croatia, Czech Republic, Estonia, Kyrgyz, Latvia, Lithuania, Romania, Russia, Slovakia, Slovenia, Ukraine and Uzbekistan. The lowest aggregate profit ratio, equal to the earlier defined lower bound of -1, is characterizing Azerbaijan, the Former Yugoslav Republic of Macedonia, Lithuania and Russia.

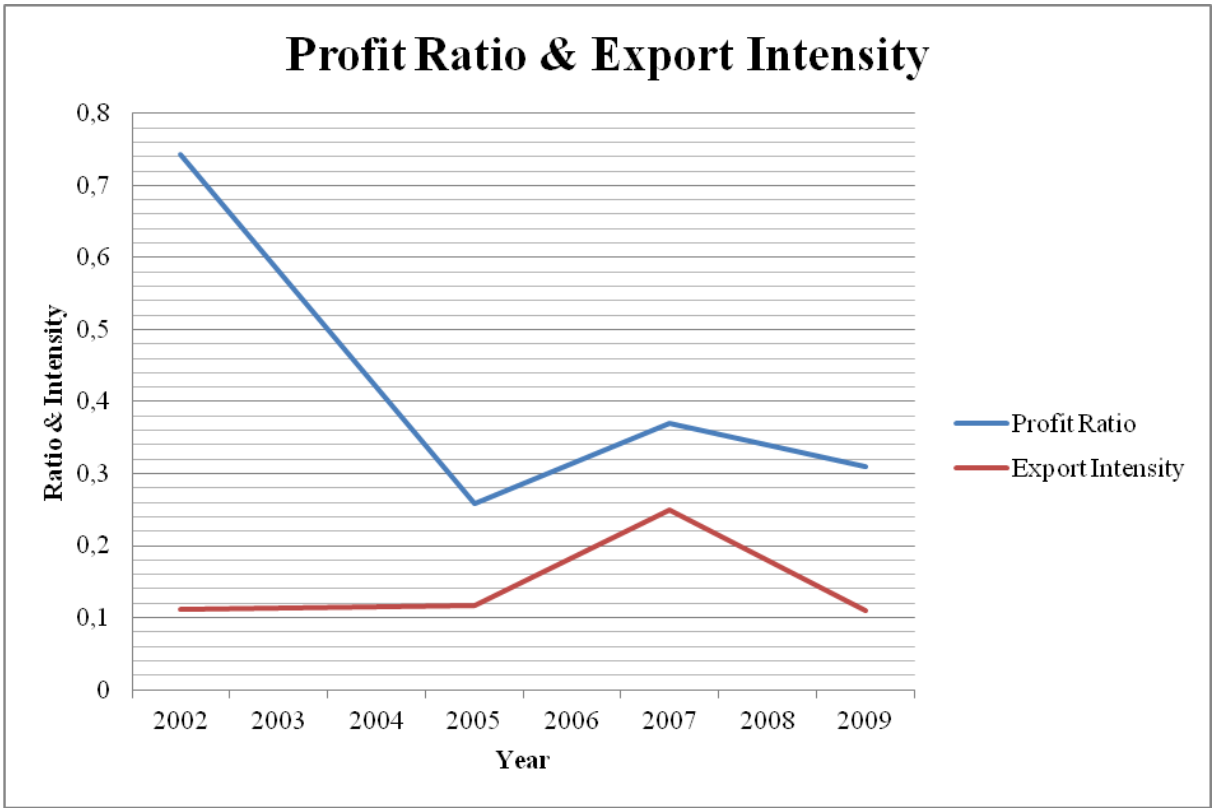
Sector-wide exports vary widely among different industries. The mean of the sector-wide average exports equals $429 million with a standard deviation of $43.8 billion. Again, sectors and countries differ considerably in terms of average export values. The country with the largest sector-wide exports is Uzbekistan, with an average industry-wide export value of $13.4 billion. Looking at the sector-wide export intensity, the overall sample is characterized by an average export intensity of 0.124. Only sector-wide export intensities in between 0 and +1 are taken into account. Countries with a higher sector-wide export intensity are Albania, Bosnia, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Romania, Slovakia, Slovenia and Ukraine. The most open economies are Bulgaria and Slovenia, with average sector-wide export intensities of 0.221 and 0.227, respectively. Graph 4.1 on page 35 plots the development of the sector-wide average profit ratio and the sector-wide average export intensity for the overall sample over the period 2002-2009.

Graph 4.1 shows that the sector-wide average profit ratio and the sector-wide average export intensity follow a very similar trend, which possibly indicates a positive relationship between the sector-wide export intensity and the aggregate financial performance. Both the profit ratio and the

**Table 4.1: Descriptive Statistics of the Overall Sample**

| | Mean | Median | Maximum | Minimum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 4630000000 | 500000 | 100000000000000 | 0 | 671000000000 | 26911 |
| **Sector-Wide Profit Ratio** | 0.410 | 0.332 | 1 | -1 | 0.335 | 20692 |
| **Profit ($)** | 3730000000 | 57056 | 100000000000000 | -399000000000 | 610000000000 | 26911 |
| **Sector-Wide Export Intensity** | 0.124 | 0.001 | 1 | 0 | 0.228 | 25009 |
| **Sector-Wide Exports ($)** | 492000000 | 308 | 4000000000000 | 0 | 43800000000 | 25009 |
| **Share of Foreign Ownership** | 0.132 | 0 | 1 | 0 | 0.240 | 26897 |
| **Sector-Wide Skill Intensity** | 0.366 | 0.400 | 1 | 0 | 0.293 | 26903 |
| **Sector-Wide Firm Age** | 2.413 | 2.368 | 5.246 | 0 | 0.778 | 26477 |
| **Sector-Wide Firm Size** | 4.313 | 4.468 | 10.483 | 0 | 1.617 | 26911 |
| **Number of Full-Time Workers** | 115 | 22 | 37772 | 0 | 468 | 26788 |
| **Sector-Wide Foreign Inputs** | 0.246 | 0.103 | 1 | 0 | 0.301 | 26903 |
| **Sector-Wide Foreign Technology** | 0.053 | 0 | 1 | 0 | 0.172 | 26910 |
| **Inflation (GDP Deflator, %)** | 11.869 | 7.261 | 88.383 | -0.370 | 14.243 | 26911 |
| **GDP per Capita (Const. 2000 $)** | 3030.365 | 1848.777 | 13836.189 | 152.156 | 2751.188 | 26911 |

**Graph 4.1: The Development of the Sector-Wide Average Profit Ratio and the Sector-Wide Average Export Intensity for the Complete Enterprise Survey Sample over the Period 2002-2009**




export intensity reach a peak in 2007, one year before the fall of Lehman Brothers and the start of the heaviest financial and economic crisis since the Great Depression in the 1920s and 1930s. Since 2008, developed Western countries in general and European counties in particular have been subject to a severe economic downturn, with country-specific fiscal problems and significantly lower economic growth rates as a consequence. Consumer confidence fell considerable and, accordingly, firms have experienced a decline in sales and profits, both domestically and abroad. The combination of these developments can explain the decreasing trend in the sector-wide average profit ratio and the sector-wide average export intensity over the period 2007-2009.

Focusing on the control variables that capture the influence of private foreign individuals, companies or organisations on firms and sectors reviewed in the Enterprise Survey, the overall sample is characterized by an average foreign ownership percentage of approximately 14% and an average foreign inputs percentage of almost 27.5%. These statistics indicate that private foreign individuals, companies or organisations indeed play a substantial role in the businesses in Eastern European and Central Asian markets and can affect the financial performance. Countries with very high foreign participation and, accordingly, recipients of higher than average foreign direct investments are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Moldova and Serbia. Albania, Belarus, Bosnia, Estonia, the Former Yugoslav Republic of Macedonia, Kyrgyz and Latvia are the countries importing a higher than average proportion of foreign supplies for usage in the production process. Looking at the foreign technology dummy, the sector-wide average value, after taking into account all foreign technology dummies for all sectors in all 27 countries in the Enterprise Survey, is equal to 0.05, which is relatively low and indicates that foreign ownership does not necessarily imply the implementation of

foreign technologies. Still, the foreign influence can work via a variety of other channels, including learning effects.

In the average sector, approximately 115 full-time workers are employed by each firm. Firm size differs quite significantly, with the smallest firm active in the average sector employing no full-time employee and the largest firm in the average sector employing more than 37,000 workers. There are eleven countries where the average firm employs more than 115 full-time workers: Croatia, Czech Republic, Estonia, Hungary, Latvia, Romania, Russia, Serbia, Slovakia, Ukraine and Uzbekistan. The Russian average firm is the largest in the overall sample, employing approximately 211 full-time workers. The overall average sector-wide firm age equals slightly more than 11 years, indicating the most of the firms started their business after the collapse of the former Soviet Union and during the transition phase towards a capitalist, market-oriented economy. The most mature firms are found in Croatia, Poland, Serbia and Slovenia, with a sector-wide firm age of, on average, approximately 17 years.

The overall sample is characterized by an average inflation rate of 11.9%, being a fairly high percentage. Out of the sample, there are nine countries with a higher average inflation rate. Belarus is characterized by the highest average inflation rate. Serbia is characterized by the highest annual inflation rate of more than 88% in 2002. The lowest average inflation rate is achieved by Poland, with an inflation rate of 3.5%. The country-specific inflation difference variable is both positive and negative, indicating that the countries studied trade with countries with both higher and lower inflation rates. The average GDP per capita in the sample of Eastern European and Central Asian countries is equal to $3030, measured in US Dollars specific for the year 2000. In total, there are nine countries with a higher average GDP per capita. The poorest country is Tajikistan, with an average GDP per capita of slightly more than $200. The richest country is Slovenia, with an average GDP per capita of close to $12000. Focusing on the GDP per capita difference, capturing the difference between the GDP per capita in one of the countries in the sample and the average GDP per capita characterizing a country's most important trading partners, it can be concluded that this variable is always negative. This indicates that all of the Eastern European and Central Asian countries studied trade with Western, more developed countries. The difference in the levels of economic development between the countries included in the sample and their main trading partners gives rise to trading patterns which are based on the principles of comparative advantages and specialization. A comprehensive overview of country-specific descriptive statistics can be found in the Appendix, Tables A1 to A27.

### 4.3 Methodology

To empirically assess the role of resource, market share and profit reallocations in explaining the influence of trade liberalization on the industry-wide average performance of firms and test the hypotheses formulated in section 4.1, a panel regression analysis is conducted using the data described in section 4.2. Firm-level data over a long period of time is required to investigate the relationship between trade liberalization and performance due to the importance of the firm heterogeneity assumption in the theoretical analysis. The dataset described in section 4.2 facilitates the performance of a panel regression analysis, as the dataset includes information on 23,570 firms, active in 503 4-digit ISIC code specified sectors and 27 countries and over the period 2002-2009. Generally speaking, the following regression is estimated:

$$FP_{ijt} = \alpha + \beta_1 Exp_{ijt} + \beta x'_{ijt} + \delta_i + \delta_j + \delta_t + \varepsilon_{ijt}, \quad (4.2)$$

where $FP_{ijt}$ is the average financial performance of firms active in sector $i$ in country $j$ at time $t$, $Exp_{ijt}$ is the sector-wide export intensity for sector $i$ in country $j$ at time $t$, and $x'_{ijt}$ is a vector of control variables, including the sector-wide average firm age, the sector-wide average firm size, the sector-wide average skill intensity, the sector-wide average foreign ownership share, sector-wide foreign technology dummies, and the sector-wide average foreign input share. A significant and positive coefficient $\beta_1$ supports the hypothesis that trade liberalization has a positive impact on the performance of firms through a process of resource, market share and profit reallocations from less to more productive firms. An important assumption underlying the empirical analysis of equation 4.2 is the independence of the sector-specific intercepts, the country-specific intercepts, the time-specific intercepts and the sector-, country- and time-specific error term, resulting from the estimation. To account for this, it is essential to model different sector-specific, country-specific and time-specific intercepts rather than a general constant. Econometrically, this can be achieved via the fixed effects estimation procedure (Verbeek, 2008). $\delta_i$, $\delta_j$ and $\delta_t$ are dummies for the different 4-digit ISIC code specified sectors, the 27 Eastern European and Central Asian countries studied and the 4 years considered and are used to apply the fixed effects specification. Firm fixed effects are not necessary, since all structural differences between firms are eliminated by taking the average firm as the unit of observation and analysis.

Five different empirical specifications of the model outlined in equation 4.2 are estimated to investigate the empirical link between trade liberalization and performance and to test the hypotheses formulated in section 4.1. Firstly, a model is constructed that regresses the sector-wide average profit ratio on the sector-wide export intensity, the sector-wide average firm age, the sector-wide average firm size, the sector-wide average skill intensity, the sector-wide average foreign ownership share, the sector-wide foreign technology dummies, and the sector-wide average foreign input share. Formally, this regression model looks as follows:

$$PR_{ijt} = \alpha + \beta_1 Exp_{ijt} + \beta x'_{ijt} + \delta_i + \delta_j + \delta_t + \varepsilon_{ijt}, \quad (4.3)$$

where $PR_{ijt}$ is the average profit ratio of firms active in sector $i$ in country $j$ at time $t$, $Exp_{ijt}$ is the sector-wide export intensity for sector $i$ in country $j$ at time $t$, and $x'_{ijt}$ is a vector of control variables, including the control variables specified above and related to firm age, size, foreign participation and influence and skill intensity. The model is estimated using sector, country and time fixed effects by including the industry-specific, country-specific and time-specific dummies $\delta_i$, $\delta_j$ and $\delta_t$.

Secondly, a model is estimated using a different fixed effects specification. This model serves as a robustness check to the first model. Instead of including the country-specific dummies $\delta_j$, country fixed effects are applied by incorporating the two macro-level variables described in section 4.2.3, namely the inflation difference and the GDP per capita difference, into the empirical model. Since the inflation difference and GDP per capita difference are largely time invariant and country-specific, these two variables can be used as alternatives for the conventional country dummies. Sector and time fixed effects are captured by the conventional sector-specific and time-specific dummies $\delta_i$ and $\delta_t$. Formally, this regression model looks as follows:

$$(4.4) \quad PR_{ijt} = \alpha + \beta_1 Exp_{ijt} + \beta x'_{ijt} + \gamma_1 \Delta Inflation_{jt} + \gamma_2 \Delta GDPpc_{jt} + \delta_i + \delta_t + \varepsilon_{ijt},$$

where $PR_{ijt}$ is the average profit ratio of firms active in sector *i* in country *j* at time *t*, $Exp_{ijt}$ is the sector-wide export intensity for sector *i* in country *j* at time *t*, $x'_{ijt}$ is a vector of control variables, including the control variables related to firm age, size, foreign participation and influence and skill intensity, $\Delta Inflation_{jt}$ is the inflation difference between country *j* and five of its main trading partners at time *t*, and $\Delta GDPpc_{jt}$ is the GDP per capita difference between country *j* and five of its main trading partners at time *t*. $\delta_i$ and $\delta_t$ are sector-specific and time-specific dummies, capturing sector and time fixed effects.

Thirdly, a model in first differences is estimated. Estimating this model eliminates sector and country fixed effects, though still incorporates time fixed effects and allows the inclusion of the country-specific inflation difference and the GDP per capita difference as separate explanatory variables. Again, this model specification serves as a robustness check to the first model. Formally, this model looks as follows:

$$(4.5) \quad \Delta PR_{ijt} = \alpha + \beta_1 \Delta Exp_{ijt} + \beta \Delta x'_{ijt} + \gamma_1 \Delta\left(\Delta Inflation_{jt}\right) + \gamma_2 \Delta\left(\Delta GDPpc_{jt}\right) + \delta_t + \varepsilon_{ijt},$$

where $\Delta PR_{ijt}$ is the difference between the average profit ratio of firms active in sector *i* in country *j* at time *t* and time *t-1*, $\Delta Exp_{ijt}$ is the change in the sector-wide export intensity for sector *i* in country *j* from time *t-1* to time *t*, and $\Delta x'_{ijt}$ is a vector of control variables, specified in first differences and including the control variables related to firm age, size, foreign participation and influence and skill intensity. $\Delta(\Delta Inflation_{jt})$ is the change in the inflation difference between country *j* and five of its main trading partners from time *t-1* to time *t*, and $\Delta(\Delta GDPpc_{jt})$ is the change in the GDP per capita difference between country *j* and five of its main trading partners from time *t-1* to time *t*. $\delta_t$ is a time-specific dummy, capturing the time fixed effects. Due to the estimation in first differences, fewer observations are taken into account in the empirical analysis. Instead of four, only three time periods can be considered, namely the period 2002-2005, 2005-2007 and 2007-2009.

Fourthly, a model using the sector-wide average market share as the dependent variable is estimated. As described in section 4.2.2, the sector-wide average market share is a widely-used alternative for the profit ratio as a proxy of financial performance (Berk and DeMarzo, 2007) and quantifies the part of the market that is served by an average firm active in a 4-digit ISIC code specified sector. The use of an alternative dependent variable allows checking the stability and the robustness of the results produced by the first two model specifications. The independent and explanatory variables are similar to the ones employed in these two regression models. Formally, this model is specified as follows:

$$(4.6) \quad MS_{ijt} = \alpha + \beta_1 Exp_{ijt} + \beta x'_{ijt} + \delta_i + \delta_j + \delta_t + \varepsilon_{ijt},$$

where $MS_{ijt}$ is the average market share of firms active in sector *i* in country *j* at time *t*, $Exp_{ijt}$ is the sector-wide export intensity for sector *i* in country *j* at time *t*, and $x'_{ijt}$ is a vector of control variables, including the control variables specified earlier and related to firm age, size, foreign participation and influence and skill intensity. The model is estimated using sector, country and time fixed effects by

including the industry-specific, country-specific and time-specific dummies $\delta_i$, $\delta_j$ and $\delta_t$. The country-specific macro-level variables are not included.

Fifthly, a model is estimated using a subsample of only exporting firms. Exporters are defined as firms with strictly positive direct export intensities. Using the subsample of only exporters allows testing the hypothesis that trade liberalization has an ambiguous and insignificant impact on the aggregate performance of exporters. Supporting this hypothesis provides additional evidence for the importance of resource, market share and profit reallocations from less to more productive firms in explaining the relationship between trade liberalization and the sector-wide average performance. In this model, the sector-wide average profit ratio is again used as a proxy for performance and as the dependent variable. The independent variables are similar to the ones used in the first, the second and the fourth model specification. Formally, this model is specified as follows:

$$PR_{ijt} = \alpha + \beta_1 Exp_{ijt} + \beta x'_{ijt} + \delta_i + \delta_j + \delta_t + \varepsilon_{ijt}, \tag{4.7}$$

where $PR_{ijt}$ is the average profit ratio of exporting firms active in sector $i$ in country $j$ at time $t$, $Exp_{ijt}$ is the sector-wide export intensity for sector $i$ in country $j$ at time $t$, and $x'_{ijt}$ is a vector of control variables, including the control variables specified earlier and related to the exporter's age, size, foreign participation and influence and skill intensity. The model is estimated using sector, country and time fixed effects by including the industry-specific, country-specific and time-specific dummies $\delta_i$, $\delta_j$ and $\delta_t$. An insignificant coefficient $\beta_1$ supports the hypothesis that trade liberalization has an ambiguous and insignificant impact on the performance of exporters.

## 4.4 Empirical Results

### *4.4.1 Regression Results for the Sector-Wide Profit Ratio*

The panel regressions as outlined in the previous section yield some very interesting results regarding the role of resource, market share and profit reallocations in explaining the influence of trade liberalization on the industry-wide average performance of firms. The results of the first regression model explaining the sector-wide average profit ratio by means of the sector-wide average export intensity and a group of control variables and applying sector-specific, country-specific and time-specific dummies to capture sector, country and time fixed effects are summarized in Table 4.2.

By studying the reported results, it can be concluded that the sector-wide export intensity has a significantly positive impact on the sector-wide average profit ratio, using both a 5% and a 10% significance level and independent of the type of control variables included. The regression excluding all control variables shows a positive relationship between the sector-wide export intensity and the sector-wide average profit ratio at a 5% significance level. The models including control variables related to the sector-wide average firm age, the sector-wide average firm size, the sector-wide average skill intensity, the sector-wide average shares of foreign ownership, the sector-wide average foreign technology variable and the sector-wide average foreign input shares reveal a positive impact of the sector-wide export intensity on the sector-wide average profit ratio at a 5% significance level. The most extensive model, including all control variables and being characterized by a high $R^2$ statistic of 0.47, shows the most significant positive impact of the sector-wide export intensity on the sector-wide

**Table 4.2: Regression Results for the Sector-Wide Average Profit Ratio, Overall Sample**

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| **Constant** | 0.486*** | 0.421*** | 0.426*** | 0.438*** | 0.488*** | 0.492*** | 0.493*** |
| | (0.010) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) |
| **Sector-Wide Export Intensity** | 0.015* | 0.014* | 0.017** | 0.019** | 0.015* | 0.017** | 0.019** |
| | (0.009) | (0.008) | (0.009) | (0.009) | (0.008) | (0.008) | (0.009) |
| **Sector-Wide Firm Age** | | 0.027*** | 0.029*** | 0.029*** | 0.027*** | 0.027*** | 0.027*** |
| | | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| **Sector-Wide Firm Size** | | | -0.002* | -0.002 | -0.010*** | -0.010*** | -0.010*** |
| | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| **Sector-Wide Skill Intensity** | | | | -0.124*** | -0.125*** | -0.118*** | -0.116*** |
| | | | | (0.008) | (0.008) | (0.008) | (0.008) |
| **Sector-Wide Foreign Ownership** | | | | | 0.011 | 0.014* | 0.018** |
| | | | | | (0.008) | (0.008) | (0.008) |
| **Sector-Wide Foreign Technology** | | | | | | -0.056*** | -0.053*** |
| | | | | | | (0.012) | (0.012) |
| **Sector-Wide Foreign Inputs** | | | | | | | -0.019*** |
| | | | | | | | (0.007) |
| **Adjusted R-Squared** | 0.41 | 0.41 | 0.42 | 0.42 | 0.46 | 0.47 | 0.47 |
| **Fixed Effects** | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year |
| **Number of Observations** | 18177 | 17957 | 17957 | 17949 | 17949 | 17949 | 17949 |

Dependent Variable: Sector-Wide Average Profit Ratio

*** indicates significance at a 1% significance level; ** at a 5% significance level, * at a 10% significance level

Note: 7 Model Specifications, depending using different regressors and control variables: (1) Direct effect of the sector-wide export intensity on the sector-wide profit ratio; (2) Model 1including sector-wide firm age; (3) Model 1including sector-wide firm age and size; (4) Model 1including sector-wide firm age, size and skill intensity; (5) Model 1including sector-wide firm age, size, skill intensity and share of foreign ownership; (6) Model 1including sector-wide firm age, size, skill intensity, share of foreign ownership and foreign technology; (7) Model 1including sector-wide firm age, size, skill intensity, share of foreign ownership, foreign technology and share of foreign inputs; Method Used: Panel Least Squares, with industry, country and period fixed effects; t-statistics are reported in between brackets.

average profit ratio. By calculating the point elasticity[16], using the coefficient of 0.019 for the aggregate export intensity in the most extensive model and the means of the sector-wide profit ratio and the sector-wide export intensity for the overall sample, it can be inferred that an increase in the aggregate export intensity of 1% gives rise to a significant improvement in the aggregate financial performance of firms of 0.006%.

These results indicate that trade liberalization has a positive impact on the sector-wide financial performance of firms and, since the financial performance is used as a proxy for productivity, on the sector-wide productivity level. This positive relationship proves that resource, market share and profit reallocations from less to more productive firms play an important role in open economies and may serve as drivers of productivity and nation-wide aggregate welfare improvements. The positive impact of trade liberalization on the sector-wide average performance suggests that increasing trade relationships and exports alter firm entry and exit dynamics, force the least productive firms to leave the market due to increasing competition in both factor and final goods markets, give rise to a pool of highly productive firms surviving and active in the market and produce aggregate efficiency improvements. Overall, the results provide significant and robust evidence not to reject the first null-hypothesis related to the complete sample and formulated in section 4.1[17].

The results in Table 4.2 indicate that the natural logarithm of the sector-wide average firm age has a robust and positive impact on the sector-wide financial performance of firms, significant at a 1% significance level and independent of the exact model specification. The high significance of this variable indicates that the sector-wide average firm age is an important control variable to be included in the model. However, inclusion of the natural logarithm of the sector-wide average firm age has no immediate effect on the explanatory power of the model, as the adjusted $R^2$ statistic does not change and still is equal to 0.41. The empirical outcome suggests that sectors with on average more mature firms tend to perform better. Firms that have on average been in operations for a longer period of time may have gained the expertise to produce and sell their products in an efficient and, accordingly, more profitable way. These kinds of firms may rely upon production techniques, distribution networks and marketing strategies that have proven to work in the past. Less mature firms may still be in a process of development, which comes at the cost of efficiency and productivity. This outcome is in line with the conclusions drawn by Hannan and Freeman (1984). They suggest that older firms tend to make use of more efficient techniques, which allows them to make a reliable and accountable impression on customers and, accordingly, to perform better.

The empirical results regarding the natural logarithm of the sector-wide average firm size are not as robust as the results regarding the natural logarithm of the sector-wide average firm age. The model including both the sector-wide firm age and the sector-wide firm size as the only control variables shows a negative impact of firm size on average performance, significant at a 10% significance level. The model that also includes sector-wide skill intensity as a control variable indicates an insignificant relationship between aggregate firm size and the sector-wide average financial performance. More extensive models, including control variables related to foreign participation, produce more stable and robust results, indicating that the sector-wide average firm size

[16] The point elasticity is calculated by means of the following formula: $\eta = \frac{\partial PR_{ijt}}{\delta Exp_{ijt}} \cdot \frac{Exp_{ijt}}{PR_{ijt}} = \beta_1 \cdot \frac{Exp_{ijt}}{PR_{ijt}}$.

[17] $H_0$: Trade liberalization has a positive influence on the industry-wide average performance of firms.

has a clear negative impact on aggregate performance, significant at a 1% level. Overall, it can be concluded that the sector-wide average firm size has a negative impact on the sector-wide average performance. Sectors with on average larger firms may be too inflexible to adjust to quickly changing market conditions in an open economy setting. In an open economy setting, many factors, both domestically and abroad, can influence an average firm's position in the market. An average firm that is relatively large may experience severe difficulties to adjust to changes in these factors, which negatively impacts the sector-wide average performance. Sectors with on average smaller firms may be much more flexible and, accordingly, can easily adjust to changing market conditions, which has a positive impact on aggregate productivity and performance. This supports the empirical finding by Tybout *et al*. (1991) that smaller establishments benefit the most from trade liberalization and reductions in protection.

The sector-wide average skill intensity has a highly robust, stable and negative impact on the sector-wide average profit ratio, significant at a 1% significance level and independent of the number of control variables included. The significance of this variable shows that it is a relevant variable to include in the analysis. In terms of explanatory power, however, the inclusion of the sector-wide average skill intensity contributes only to a marginal improvement of the model with an adjusted $R^2$ of 0.42. The negative coefficient indicates that a higher average proportion of skilled labour employed by firms active in a particular sector adversely affects the sector-wide performance. Although skilled labour tends to be more productive than unskilled labour, it can be such that the wages of skilled workers are so much higher than the wages of unskilled workers, so that the productivity and performance related benefits are outweighed by the costs. This can explain why the sector-wide average skill intensity has a highly significant and negative impact on the aggregate performance of firms in a sector. The negative impact of the aggregate skill intensity confirms the theoretical and empirical findings by Abowd *et al*. (1999), which suggest that skilled workers tend to be high wage recipients and, therefore, can negatively influence profitability.

Focusing on the participation of private foreign individuals, companies and organisations, Table 4.2 indicates that the sector-wide average share of foreign ownership has an ambiguous impact on the sector-wide average profit ratio. The inclusion of only the sector-wide average share of foreign ownership, without any other variables describing the impact of foreign investors, indicates an insignificantly positive relationship. The explanatory power of the model, however, increases considerably by including average foreign ownership share, as can be seen by an $R^2$ of 0.46. More extensive models, incorporating other control variables related to foreign participation, produce more significant, positive results for the sector-wide average share of foreign ownership. In particular, the most extensive model reveals a clear positive relationship between the sector-wide average share of foreign ownership and the sector-wide average financial performance, significant at a 5% significance level. Overall, it can be concluded that the sector-wide average share of foreign ownership has a marginally significant, positive impact on the sector-wide average profit ratio. This outcome is in line with previous literature on foreign participation, foreign direct investments and the productivity of firms. Most studies show productivity improvements following foreign participation and foreign direct investments due to a combination of technology diffusion, productivity spillovers and learning effects (Aitken and Harisson, 1999).

The sector-wide average foreign technology variable has a significantly negative impact on the sector-wide average profit ratio. It is significant at a 1% significance level. The inclusion of this variable shows that the sector-wide average share of foreign ownership has a significantly positive effect on the aggregate performance of firms. The explanation for the negative relationship between the implementation of foreign technologies and the sector-wide average profit ratio may be related to the length of the time dimension incorporated in the empirical analysis. The period studied runs from 2002 to 2009, which is a period of only seven years and might be too short to accurately capture the commonly documented productivity benefits from implementing sophisticated foreign technologies[18]. The implementation and adaptation of sophisticated foreign technologies is a costly and time-consuming process. Workers need to be trained and productive mistakes can be made. This can come at the cost of a lower profitability in the short run. Once correctly implemented, it can be the case that the sophisticated foreign technologies pay off over a longer period of time, with a positive impact on the average financial performance as a consequence. The reported result and the discussed explanation are in line with conclusions drawn by Liu (2006), which indicate that technology transfer is a costly process, where scarce resources must be devoted to learning, and that the actual productivity and performance benefits of implementing advanced foreign technologies are only experienced over a longer term.

The final control variable included, the sector-wide average share of foreign inputs, has a negative impact on the sector-wide average financial performance, significant at a 1% significance level. The inclusion of this variable contributes to a marginal increase in the explanatory power of the model, producing an $R^2$ of 0.47. The use of foreign inputs in the production process may have a negative impact on aggregate profitability due to the higher costs related to purchasing them. Purchasing foreign supplies requires additional expenses, related to for instance transportation and tariffs. The higher is the average proportion of foreign supplies used within a sector, the higher are the costs related to purchasing these supplies, and the lower is the sector-wide average profit ratio. This reasoning is also addressed by Liu (2006).

*4.4.2 Regression Results for the Sector-Wide Profit Ratio with the Macro-Level Variables*

The second regression model explains the sector-wide average profit ratio by means of the sector-wide average export intensity and a group of control variables and uses the country-specific inflation difference and the GDP per capita difference to capture country fixed effects. Conventional sector-specific and time-specific dummies are used to apply sector and time fixed effects. The results are reported in Table 4.3.

The results largely confirm the previously documented statistical findings and, thus, serve as evidence for the robustness of the aforementioned empirical conclusions. Most importantly, the sector-wide average export intensity has a clear positive impact on the sector-wide average profit ratio, significant at a 1% significance level and independent of the control variables included in the analysis. By calculating the point elasticity[19], using the coefficient of 0.042 for the aggregate export intensity in the most extensive model and the means of the sector-wide profit ratio and the sector-wide export

[18] See, among others, Aitken and Harisson (1999) and Borensztein *et al*. (1998) for the same argument.

[19] The point elasticity is calculated by means of the following formula: $\eta = \frac{\partial PR_{ijt}}{\delta Exp_{ijt}} \cdot \frac{Exp_{ijt}}{PR_{ijt}} = \beta_1 \cdot \frac{Exp_{ijt}}{PR_{ijt}}$.

**Table 4.3: Regression Results for the Sector-Wide Average Profit Ratio, Overall Sample, Including Macro-Level Variables**

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| **Constant** | 0.476*** | 0.407*** | 0.414*** | 0.441*** | 0.437*** | 0.437*** | 0.449*** |
| | (0.008) | (0.010) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) |
| **Sector-Wide Export Intensity** | 0.040*** | 0.036*** | 0.040*** | 0.042*** | 0.035*** | 0.037*** | 0.042*** |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.010) |
| **Sector-Wide Firm Age** | | 0.030*** | 0.033*** | 0.034*** | 0.036*** | 0.035*** | 0.035*** |
| | | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| **Sector-Wide Firm Size** | | | -0.004** | -0.003** | -0.004*** | -0.004*** | -0.005*** |
| | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) |
| **Sector-Wide Skill Intensity** | | | | -0.111*** | -0.109*** | -0.102*** | -0.099*** |
| | | | | (0.009) | (0.009) | (0.009) | (0.009) |
| **Sector-Wide Foreign Ownership** | | | | | 0.028*** | 0.031*** | 0.036*** |
| | | | | | (0.009) | (0.009) | (0.009) |
| **Sector-Wide Foreign Technology** | | | | | | -0.067*** | -0.059*** |
| | | | | | | (0.013) | (0.013) |
| **Sector-Wide Foreign Inputs** | | | | | | | -0.030*** |
| | | | | | | | (0.007) |
| **Inflation Difference** | 0.0003* | 0.0002 | 0.0002 | 0.0004** | 0.0004** | 0.0004** | 0.0004** |
| | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| **GDP per Capita Difference** | 0.000** | 0.000* | 0.000* | 0.000 | 0.000* | 0.000* | 0.000** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Adjusted R-Squared** | 0.37 | 0.38 | 0.38 | 0.38 | 0.39 | 0.39 | 0.39 |
| **Fixed Effects** | Industry, Year | Industry, Year | Industry, Year | Industry, Year | Industry, Year | Industry, Year | Industry, Year |
| **Number of Observations** | 18756 | 18536 | 18536 | 18528 | 18528 | 18528 | 18528 |

Dependent Variable: Sector-Wide Average Overall Profit Ratio

*** indicates significance at a 1% significance level; ** at a 5% significance level, * at a 10% significance level

Note: 7 Model Specifications, depending using different regressors and control variables: (1) Direct effect of the sector-wide export intensity on the sector-wide profit ratio; (2) Model 1 including sector-wide firm age; (3) Model 1 including sector-wide firm age and size; (4) Model 1 including sector-wide firm age, size and skill intensity; (5) Model 1 including sector-wide firm age, size, skill intensity and share of foreign ownership; (6) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership and foreign technology; (7) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership, foreign technology and share of foreign inputs; Method Used: Panel Least Squares, with industry and period fixed effects; Country fixed effects via the country-specific macro variables; t-statistics are reported in between brackets.

intensity for the overall sample, it can be inferred that an increase in the aggregate export intensity of 1% gives rise to a significant improvement in the aggregate financial performance of firms of 0.015%. This result again points at the importance of resource, market share and profit reallocations from less to more productive firms in explaining the positive impact of trade liberalization on the sector-wide average performance of firms. It suggests that increasing exports alter firm entry and exit dynamics, force the least productive firms to leave the market due to increasing competition in both factor and final goods markets, give rise to a pool of highly productive firms surviving and active in the market and produce aggregate efficiency improvements. Therefore, the results confirm the earlier conclusion that there is significant and robust evidence not to reject the first null-hypothesis related to the complete sample and formulated in section 4.1[20].

The empirical findings on the impact of the control variables on the sector-wide average profit ratio are similar to the earlier described results. The natural logarithm of the sector-wide average firm age has a significantly positive impact on the aggregate financial performance, which indicates that sectors with on average more mature firms tend to be more productive due to greater expertise and experience with respect to efficient production, distribution and marketing strategies. This confirms the earlier mentioned suggestions proposed by Hannan and Freeman (1984). The natural logarithm of the sector-wide average firm size has a significantly negative impact on the aggregate financial performance, which means that sectors with on average larger firms tend to be less productive. This finding can be explained by the greater difficulties larger firms experience with respect to adjusting to changing market conditions and supports the conclusions drawn by Tybout *et al*. (1991). This inflexibility may serve as a barrier to adapt quickly and efficiently and, therefore, may hamper improvements in performance. The sector-wide skill intensity has a significantly negative impact on the sector-wide average financial performance, which can be explained by the higher costs associated with hiring more skilled workers and confirms the findings by Abowd *et al*. (1999). In case the higher costs of hiring skilled workers outweigh the productivity benefits of hiring them, the impact of a higher sector-wide average skill intensity on the aggregate financial performance may be negative. The sector-wide average share of foreign ownership has a significantly positive effect on the industry-wide performance of firms, suggesting that foreign participation positively influences performance due to technology diffusion and learning effects and confirming earlier documented literature[21]. The impacts of the sector-wide average foreign technology variable and the sector-wide average share of foreign inputs used in production on the sector-wide average profit ratio are both significantly negative. These results can be explained by the long time required for efficiently implementing sophisticated foreign technologies and the higher costs associated with purchasing foreign inputs. Both these results confirm the findings by Liu (2006).

The macro-level variables included to capture country fixed effects perform well as an alternative to the conventional country-specific dummies. The explanatory power of the model including the macro-level variables, with an adjusted $R^2$ in between 0.37 and 0.39, is slightly lower than to the model including country-specific dummies. The influence of the country-specific inflation difference on the sector-wide profit ratio is ambiguous. The models that include the sector-wide export intensity as the regressor and the sector-wide average firm age and/or the sector-wide average firm

[20] $H_0$: Trade liberalization has a positive influence on the industry-wide average performance of firms.

[21] See, among others, Aitken and Harisson (1999) and Borensztein *et al*. (1998) for the same argument.

size as the control variables produce insignificant results for the country-specific inflation difference. The more extensive models, also including control variables related to skill intensity and foreign participation, provide more convincing evidence for a positive impact of the country-specific inflation difference on the sector-wide average profit ratio, significant at a 5% significance level. Overall, it is hard to conclude that the inflation difference has a stable and robust impact on the aggregate financial performance. The GDP per capita difference is positive and generally significant at a 10% significance level, which is in line with standard Heckscher-Ohlin economic theory. This result indicates that economic growth in the countries considered in the sample, relative to their main trading partners, has a positive influence on the sector-wide average performance. Sectors and firms benefit from increased economic growth by exploiting the increased sales potential and implementing more advanced technologies. The comparative advantage principle is the main determinant driving a process of specialization, which allows sectors and firms to focus on their core competence and, accordingly, to improve productivity and the financial performance.

*4.4.3 Regression Results for the Change in the Sector-Wide Profit Ratio*

The third regression model explains the change in the sector-wide average profit ratio by means of the change in the sector-wide average export intensity and a group of control variables. This model specification in first differences enables the removal of any sector and country fixed effects. Time fixed effects, though, are incorporated through conventional time-specific dummies. The macro-level variables can be included to check their added value in explaining the change in the aggregate performance. This model in first differences makes use of data on three time periods, namely 2002-2005, 2005-2007 and 2007-2009, and, accordingly, deals with fewer observations. Despite the fewer observations, the model does not suffer from a significantly lower explanatory power. The results are reported in Table 4.4.

The empirical outcomes largely confirm the previously documented empirical findings and, thus, again serve as evidence for the robustness of the aforementioned empirical conclusions. Most importantly, the results indicate that the change in the sector-wide average export intensity has a clear positive impact on the change in the sector-wide average profit ratio, generally significant at a 1% or 5% significance level and independent of the control variables included in the analysis. This result provides convincing evidence for the importance of resource, market share and profit reallocations from less to more productive firms in explaining the positive impact of trade liberalization on the sector-wide average performance of firms. It suggests that increasing trade relationships alter firm entry and exit dynamics, force the least productive firms to leave the market due to increasing competition in both factor and final goods markets, give rise to a pool of highly productive firms surviving and active in the market and produce aggregate efficiency improvements. Therefore, the results confirm the earlier conclusion that there is significant and robust evidence not to reject the first null-hypothesis related to the complete sample and formulated in section 4.1[22].

The results regarding the control variables are not completely similar to the ones reported in Tables 4.2 and 4.3. Similar results in comparison to the earlier presented outcomes are reported for the changes in the sector-wide average skill intensity, the foreign technology variable and the GDP per capita difference. The change in sector-wide skill intensity has a significantly negative impact on the

[22] $H_0$: Trade liberalization has a positive influence on the industry-wide average performance of firms.

**Table 4.4: Regression Results for the Change in the Sector-Wide Average Profit Ratio, Overall Sample, Including Macro-Level Variables**

| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 |
|---|---|---|---|---|---|---|---|---|---|
| **Constant** | -0.250*** | -0.254*** | -0.254*** | -0.263*** | -0.263*** | -0.254*** | -0.254*** | -0.272*** | -0.275*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.009) | (0.009) | (0.009) | (0.009) |
| **Δ Sector-Wide Export Intensity** | 0.092*** | 0.090*** | 0.078** | 0.082*** | 0.073** | 0.079** | 0.079** | 0.112*** | 0.111*** |
| | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.035) | (0.035) |
| **Δ Sector-Wide Firm Age** | | 0.020** | 0.012 | 0.012 | 0.015 | 0.015 | 0.015 | 0.014 | 0.015 |
| | | (0.009) | (0.010) | (0.010) | (0.010) | (0.010) | (0.010) | (0.011) | (0.011) |
| **Δ Sector-Wide Firm Size** | | | 0.013*** | 0.014*** | 0.013** | 0.012** | 0.012** | 0.009* | 0.009 |
| | | | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| **Δ Sector-Wide Skill Intensity** | | | | -0.077*** | -0.074*** | -0.055** | -0.056** | -0.043* | -0.041 |
| | | | | (0.024) | (0.024) | (0.025) | (0.025) | (0.027) | (0.027) |
| **Δ Sector-Wide Foreign Ownership** | | | | | 0.042 | 0.043* | 0.042 | 0.030 | 0.028 |
| | | | | | (0.026) | (0.026) | (0.027) | (0.028) | (0.028) |
| **Δ Sector-Wide Foreign Technology** | | | | | | -0.116*** | -0.117*** | -0.113** | -0.116*** |
| | | | | | | (0.038) | (0.038) | (0.044) | (0.044) |
| **Δ Sector-Wide Foreign Inputs** | | | | | | | 0.006 | 0.003 | 0.003 |
| | | | | | | | (0.022) | (0.024) | (0.024) |
| **Δ Inflation Difference** | | | | | | | | 0.000 | 0.000 |
| | | | | | | | | (0.001) | (0.001) |
| **Δ GDP per Capita Difference** | | | | | | | | | 0.000* |
| | | | | | | | | | (0.000) |
| **Adjusted R-Squared** | 0.40 | 0.40 | 0.40 | 0.41 | 0.41 | 0.41 | 0.41 | 0.39 | 0.39 |
| **Fixed Effects** | Year | Year | Year | Year | Year | Year | Year | Year | Year |
| **Number of Observations** | 2142 | 2142 | 2142 | 2142 | 2142 | 2142 | 2142 | 1931 | 1931 |

Dependent Variable: Change in the Sector-Wide Average Profit Ratio

*** indicates significance at a 1% significance level; ** at a 5% significance level, * at a 10% significance level

Note: 9 Model Specifications, depending using different regressors and control variables: (1) Direct effect of the sector-wide export intensity on the sector-wide profit ratio; (2) Model 1 including sector-wide firm age; (3) Model 1including sector-wide firm age and size; (4) Model 1including sector-wide firm age, size and skill intensity; (5) Model 1 including sector-wide firm age, size, skill intensity and share of foreign ownership; (6) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership and foreign technology; (7) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership, foreign technology and share of foreign inputs; (8) and (9) Including the two macro-level variables: the country-specific inflation difference and the country-specific GDP per capita difference; Method Used: Panel Least Squares, time fixed effects; t-statistics are reported in between brackets.

change in aggregate performance, which is in line with the idea that hiring a higher proportion of skilled workers can lead to a lower sector-wide average profit ratio due to higher wage costs. In case the wages paid to skilled workers are too high, the additional expenses resulting from hiring skilled workers can outweigh the productivity benefits. This, again, confirms the findings by Abowd *et al*. (1999). The change in the sector-wide average implementation of foreign technologies has a significantly negative impact on change in the aggregate financial performance, which is similar to the earlier presented results. This can be explained by the longer time it takes to efficiently implement and benefit from more advanced foreign technologies and, hence, confirms the findings by Liu (2006). The change in the GDP per capita difference has a significantly positive impact on the change in the sector-wide average profit ratio, which supports the Heckscher-Ohlin argument of comparative advantages and international specialization. The sector-wide average firm age, the share of foreign ownership, the proportion of foreign inputs used in production and the macro-level, inflation difference variable, all modelled in first differences, turn out to be insignificantly different from zero and, therefore, do not have any impact on the change in the aggregate performance. The impact of the change in the sector-wide share of foreign ownership is significantly positive and, accordingly, similar to previous findings only in case the sector-wide technology variable is included as a control variable. The variable that shows a completely different result from earlier presented outcomes is the change in the sector-wide average firm size. The change in the sector-wide average firm size has significantly positive impact on the change in aggregate performance.

*4.4.4 Regression Results for the Sector-Wide Market Share*

The fourth regression model employs a different dependent variable and explains the sector-wide average market share by means of the sector-wide average export intensity and the conventional control variables. Sector-specific, country-specific and time-specific dummies are used to capture sector, country and time fixed effects. Using the sector-wide average market share instead of the sector-wide average profit ratio as the dependent variable allows checking the robustness and stability of the earlier presented results. The results of this regression model are reported in Table 4.5. Since there is much more information on sales than on profits, this regression model incorporates more observations. Despite the inclusion of more observations, the explanatory power of the model is lower compared to the first regression model explaining the sector-wide average profit ratio. The adjusted $R^2$ is in between 0.05 and 0.13, depending on the kinds of control variables included. The results confirm the positive influence on the sector-wide export intensity on the sector-wide average market share and, thus, on the aggregate performance, producing highly significant and positive coefficients at a 1% significance levels and being independent of the kinds of control variables included.

These results indicate that trade liberalization has a positive impact on the sector-wide financial performance of and, since the financial performance is used as a proxy for productivity, on the sector-wide productivity level. This positive relationship proves that resource, market share and profit reallocations from less to more productive firms play an important role in open economies and may serve as a driver of productivity and nation-wide aggregate welfare improvements. The positive impact of trade liberalization on aggregate market shares suggests that increasing trade relationships and exports alter firm entry and exit dynamics, force the least productive firms to leave the market due

**Table 4.5: Regression Results for the Sector-Wide Average Market Share, Overall Sample**

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| **Constant** | 0.002*** | -0.004*** | -0.008*** | -0.008*** | -0.009*** | -0.009*** | -0.009*** |
| | (0.0004) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) | (0.0005) |
| **Sector-Wide Export Intensity** | 0.003*** | 0.003*** | 0.001*** | 0.001*** | 0.001** | 0.001* | 0.001* |
| | (0.0003) | (0.0003) | (0.0003) | (0.0003) | (0.0003) | (0.0003) | (0.0004) |
| **Sector-Wide Firm Age** | | 0.002*** | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001*** |
| | | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| **Sector-Wide Firm Size** | | | 0.002*** | 0.002*** | 0.002*** | 0.002*** | 0.002*** |
| | | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Sector-Wide Skill Intensity** | | | | -0.001** | -0.001*** | -0.001*** | -0.001*** |
| | | | | (0.0003) | (0.0003) | (0.0003) | (0.0003) |
| **Sector-Wide Foreign Ownership** | | | | | 0.001*** | 0.001*** | 0.001*** |
| | | | | | (0.0003) | (0.0003) | (0.0003) |
| **Sector-Wide Foreign Technology** | | | | | | 0.001*** | 0.001*** |
| | | | | | | (0.0004) | (0.0004) |
| **Sector-Wide Foreign Inputs** | | | | | | | 0.000 |
| | | | | | | | (0.0002) |
| **Adjusted R-Squared** | 0.05 | 0.07 | 0.11 | 0.12 | 0.13 | 0.13 | 0.13 |
| **Fixed Effects** | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year |
| **Number of Observations** | 25009 | 24582 | 24582 | 24574 | 24573 | 24573 | 24573 |

Dependent Variable: Sector-Wide Average Market Share

*** indicates significance at a 1% significance level; ** at a 5% significance level, * at a 10% significance level

Note: 7 Model Specifications, depending using different regressors and control variables: (1) Direct effect of the sector-wide export intensity on the sector-wide profit ratio; (2) Model 1 including sector-wide firm age; (3) Model 1 including sector-wide firm age and size; (4) Model 1 including sector-wide firm age, size and skill intensity; (5) Model 1 including sector-wide firm age, size, skill intensity and share of foreign ownership; (6) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership and foreign technology; (7) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership, foreign technology and share of foreign inputs; Method Used: Method Used: Panel Least Squares, with industry, country and period fixed effects; t-statistics are reported in between brackets.

to increasing competition in both factor and final goods markets, give rise to a pool of highly productive firms surviving and active in the market and produce aggregate efficiency improvements. Overall, the results provide significant and robust evidence not to reject the first null-hypothesis related to the complete sample and formulated in section 4.1[23].

The results regarding the control variables provide mixed results in comparison with earlier reported outcomes and conclusions. In line with the first and second regression model, the natural logarithm of the sector-wide average firm age has a positive impact on the aggregate financial performance, significant at a 1% significance level and independent of the control variables included. This result supports the idea that sectors with on average more mature firms tend to perform better than sectors with on average younger firms. Firms that have on average been in operations for a longer period of time may have gained the expertise to produce and sell their products in an efficient and, accordingly, more profitable way. These kinds of firms may rely upon production techniques, distribution networks and marketing strategies that have proven to work in the past. Less mature firms may still be in a process of development, which comes at the cost of efficiency and productivity. This outcome is line with the suggestions proposed by Hannan and Freeman (1984).

The significantly negative impact of the sector-wide average skill intensity on the aggregate financial performance confirms the results from the first two regression models. It indicates that, although skilled labour tends to be more productive than unskilled labour, it can be such that the productivity and performance related benefits are outweighed by the costs. This result is similar to the findings by Abowd *et al*. (1999). The sector-wide average share of foreign ownership has a significantly positive impact on the sector-wide average market share, which confirms the earlier described theory that foreign participation and foreign direct investments improve productivity due to a combination of technology diffusion, productivity spillovers and learning effects.

Contradictory to the outcomes of the first two regression models are the results regarding the sector-wide average firm size, the sector-wide foreign technology variable and the sector-wide average share of foreign inputs used in production. The sector-wide average firm size has a significantly positive impact on aggregate performance, which suggests that sector with on average larger firms tend to perform better. The sector-wide implementation of foreign technologies has a positive impact on the sector-wide average market share, which therefore provides additional evidence for the positive impact of the participation by private foreign individuals, companies or organisations on productivity already captured by the sector-wide average share of foreign ownership. The sector-wide average share of foreign supplies used on production turns out to have an insignificant impact on aggregate performance.

### *4.4.5 Regression Results for the Sector-Wide Profit Ratio of Exporters*

The fifth and final regression model employs a subsample of only exporting firms and explains the sector-wide average profit ratio by means of the sector-wide average export intensity and the conventional control variables. Sector-specific, country-specific and time-specific dummies are used to capture sector, country and time fixed effects. Using the subsample of only exporters instead of the overall sample as a basis for estimating the regression model allows testing the impact of trade liberalization on the sector-wide average financial performance of exporters, which according to the

[23] $H_0$: Trade liberalization has a positive influence on the industry-wide average performance of firms.

**Table 4.6: Regression Results for the Sector-Wide Average Profit Ratio, Only Exporters**

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| **Constant** | 0.483 | 0.457 | 0.467 | 0.505 | 0.507 | 0.510 | 0.510 |
| | (0.028) | (0.031) | (0.031) | (0.031) | (0.031) | (0.031) | (0.031) |
| **Sector-Wide Export Intensity** | 0.010 | 0.009 | 0.012 | 0.017 | 0.018 | 0.019 | 0.021 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) |
| **Sector-Wide Firm Age** | | 0.011** | 0.014*** | 0.012** | 0.011** | 0.011** | 0.011** |
| | | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| **Sector-Wide Firm Size** | | | -0.004 | -0.003 | -0.003 | -0.003 | -0.003 |
| | | | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| **Sector-Wide Skill Intensity** | | | | -0.183*** | -0.184*** | -0.181*** | -0.176*** |
| | | | | (0.016) | (0.016) | (0.016) | (0.016) |
| **Sector-Wide Foreign Ownership** | | | | | -0.007 | -0.006 | -0.001 |
| | | | | | (0.013) | (0.013) | (0.013) |
| **Sector-Wide Foreign Technology** | | | | | | -0.025 | -0.019 |
| | | | | | | (0.018) | (0.018) |
| **Sector-Wide Foreign Inputs** | | | | | | | -0.035*** |
| | | | | | | | (0.013) |
| **Adjusted R-Squared** | 0.49 | 0.49 | 0.49 | 0.50 | 0.50 | 0.50 | 0.51 |
| **Fixed Effects** | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year | Country, Industry, Year |
| **Number of Observations** | 5036 | 4953 | 4953 | 4951 | 4951 | 4951 | 4951 |

Dependent Variable: Sector-Wide Average Profit Ratio

*** indicates significance at a 1% significance level; ** at a 5% significance level, * at a 10% significance level

Note: 7 Model Specifications, depending using different regressors and control variables: (1) Direct effect of the sector-wide export intensity on the sector-wide profit ratio; (2) Model 1 including sector-wide firm age; (3) Model 1 including sector-wide firm age and size; (4) Model 1 including sector-wide firm age, size and skill intensity; (5) Model 1 including sector-wide firm age, size, skill intensity and share of foreign ownership; (6) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership and foreign technology; (7) Model 1 including sector-wide firm age, size, skill intensity, share of foreign ownership, foreign technology and share of foreign inputs; Method Used: Method Used: Panel Least Squares, with industry, country and period fixed effects; t-statistics are reported in between brackets.

second hypothesis formulated in section 4.1 should be ambiguous and insignificant[24]. The regression based on only exporters incorporates fewer observations. The explanatory power, though, is relatively high in comparison with the earlier discussed models, with an adjusted $R^2$ in between 0.49 and 0.51. The results of this regression model are reported in Table 4.6.

By studying the reported results, it can be concluded that the sector-wide export intensity has an insignificant impact on the sector-wide average profit ratio of exporters, independent of the type of control variables included. This result indicates that trade liberalization has an ambiguous and insignificant influence on the aggregate performance of exporters and, therefore, supports the theoretical predictions. Theoretically, it has been argued that in an open economy setting only the most productive firms, *i.e.* firms with a productive parameter that is equal to or greater than the cut-off productive parameter determining a firm's export status, enter the export market. This export market selection effect causes a type of Darwinian evolution to take place within an industry. Only the most efficient firms experience higher market shares and higher profits by serving both the domestic market and the foreign market. Some less efficient firms are productive enough to export and, accordingly, experience an increase in market share, but at the same time suffer a profit loss. Combined, it can be inferred that the impact of trade liberalization on the financial performance of exporters is ambiguous and insignificant. The insignificant relationship between the sector-wide average export intensity and the aggregate performance of exporters confirms this theoretical result. It can thus be concluded that there is significant and robust evidence not to reject the exporters-specific null-hypothesis formulated in section 4.1.

The results regarding the control variables are generally similar to the earlier reported outcomes and conclusions. The natural logarithm of the sector-wide average firm age has a significantly positive impact on the aggregate performance of exporters, which confirms the earlier formulated idea that sectors with on average more mature firms tend to perform better than sectors with on average younger firms and supports the suggestions by Hannan and Freeman (1984). Firms that have on average been in operations for a longer period of time may have gained the expertise to produce and sell their products in an efficient and, accordingly, more profitable way. These kinds of firms may rely upon production techniques, distribution networks and marketing strategies that have proven to work in the past. Less mature firms may still be in a process of development, which comes at the cost of efficiency and productivity. The natural logarithm of the sector-wide average firm size has an insignificant impact on the sector-wide average profit ratio of exporters, which contradicts earlier results. This may be due to a greater degree of homogeneity among exporters. The sector-wide average skill intensity has a significantly negative impact on the aggregate performance of exporters, which supports the idea that the costs of hiring a higher proportion of skilled labour can outweigh the benefits, negatively affecting the sector-wide average performance. This result is in line with the findings by Abowd *et al*. (1999). The results regarding the control variables capturing the influence of private foreign individuals are mixed. The sector-wide average share of foreign ownership and the sector-wide average foreign technology variable are both insignificantly different from zero, which contradicts the outcomes resulting from other regression models incorporating the complete dataset. The sector-wide average share of foreign inputs is significantly negative, which is in line with the

[24] $H_0$: Trade liberalization has an ambiguous and insignificant influence on the industry-wide average performance of exporters.

other regression models. This result may indicate that foreign inputs used in production can only be purchased at a higher cost due to for example transportation expenses and tariffs, which has a negative impact on the financial performance of exporters.

### 4.5 Trade Liberalization and Performance: A Different Perspective

The economic impact of trade liberalization cannot necessarily be explained by a single theory. The process of within industry resource, market share and profit reallocations from less to more productive firms is a useful theory in explaining the influence of trade liberalization on aggregate performance and identifying a unique contributor to country-wide welfare. As outlined in section 2.1, other theories focus on explaining the impact of trade liberalization through processes of within firm productivity improvements. In particular, Grossman and Helpman (1991, 1993) analytically emphasize the importance of knowledge spillover effects resulting from the international trade of final and intermediate products, whereas Aghion *et al*. (2005) argue that trade liberalization incentivizes firms to invest more in innovation. Goh (2000), related to Aghion *et al*. (2005), shows that trade liberalization tends to reduce the opportunity cost of technological effort and to increase the willingness to adopt new, more efficient technologies. This has a positive impact on firm efficiency and productivity. Holmes and Schmitz (2001) assess the link between trade liberalization and firm productivity by proving that increased exposure to trade makes firms spend more time on productive activities rather than unproductive activities. Tybout and Westbrook (1995) provide an overview of the sources of economies of scale that, through increased openness to trade, improve firm efficiency and productivity.

To empirically investigate the importance of within firm productivity changes in explaining the economic impacts of trade liberalization, a panel regression model is estimated, regressing the firm-specific financial performance on the sector-wide average export intensity and a series of control variables capturing firm characteristics. Analytically, the model looks as follows:

$$(4.8) \quad PR_{ijt} = \alpha + \beta_1 Exp_{sjt} + \beta x'_{ijt} + \gamma_1 \Delta Inflation_{jt} + \gamma_2 \Delta GDPpc_{jt} + \delta_i + \delta_t + \varepsilon_{ijt},$$

where $PR_{ijt}$ is the profit ratio of firm $i$ in country $j$ at time $t$ and $Exp_{ijt}$ is the sector-wide export intensity characterizing sector $s$ in which firm $i$ in country $j$ at time $t$ is active. Sector-wide, export intensities are used instead of firm-specific export intensities as trade liberalization is a macroeconomic phenomenon and, thus, is best captured by sector-wide economic developments. $x'_{ijt}$ is a vector of control variables, including the firm characteristics related to firm age, size, foreign participation and influence and skill intensity. $\Delta Inflation_{jt}$ is the inflation difference between country $j$ and five of its main trading partners at time $t$, and $\Delta GDPpc_{jt}$ is the GDP per capita difference between country $j$ and five of its main trading partners at time $t$. These two macro variables are used to capture country-specific fixed effects. $\delta_i$ and $\delta_t$ are firm-specific and time-specific dummies, capturing firm and time fixed effects.

The results are reported in Table 4.7 and provide some interesting outcomes. In particular, it can be seen that the sector-wide average export intensity has a positive impact on the firm-specific financial performance, significant at a 5% significance level and independent of the exact model

**Table 4.7: Regression Results for the Firm-Specific Profit Ratio, Overall Sample, Including Macro-Level Variables**

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
|---|---|---|---|---|---|---|---|---|
| **Constant** | 0.431*** | 0.382*** | 0.296*** | 0.376*** | 0.360*** | 0.188 | 0.245 | 0.390*** |
| | (0.034) | (0.046) | (0.057) | (0.064) | (0.065) | (0.149) | (0.149) | (0.067) |
| **Export Intensity** | 0.080** | 0.080** | 0.076** | 0.083** | 0.086** | 0.181** | 0.185** | 0.095** |
| | (0.039) | (0.039) | (0.039) | (0.038) | (0.039) | (0.070) | (0.073) | (0.041) |
| **Firm Age** | | 0.023* | 0.018 | -0.005 | -0.002 | -0.015 | -0.021 | -0,006 |
| | | (0.014) | (0.014) | (0.015) | (0.015) | (0.026) | (0.026) | (0.015) |
| **Firm Size** | | | 0.030** | 0.024* | 0.022 | 0.022 | 0.006 | 0.013 |
| | | | (0.012) | (0.013) | (0.013) | (0.027) | (0.027) | (0.014) |
| **Skill Intensity** | | | | 0.003 | 0.004 | 0.026 | 0.013 | -0.008 |
| | | | | (0.028) | (0.029) | (0.065) | (0.066) | (0.030) |
| **Foreign Ownership** | | | | | 0.091** | 0.027 | 0.025 | 0.086** |
| | | | | | (0.044) | (0.085) | (0.084) | (0.045) |
| **Foreign Technology** | | | | | | 0.063 | 0.080 | |
| | | | | | | (0.053) | (0.053) | |
| **Foreign Inputs** | | | | | | | 0.057 | -0.011 |
| | | | | | | | (0.054) | (0.025) |
| **Inflation Difference** | -0.0003 | -0.0003 | -0.0004 | -0.0005 | -0.0006 | 0.003 | 0.003 | -0.0006 |
| | (0.0007) | (0.0007) | (0.0007) | (0.0006) | (0.0007) | (0.004) | (0.004) | (0.0007) |
| **GDP per Capita Difference** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| **Adjusted R-Squared** | 0.53 | 0.53 | 0.53 | 0.61 | 0.60 | 0.02 | 0.04 | 0.61 |
| **Fixed Effects** | Firm, Year | Firm, Year | Firm, Year | Firm, Year | Firm, Year | Firm, Year | Firm, Year | Firm, Year |
| **Number of Observations** | 18040 | 17931 | 17895 | 13566 | 13269 | 9480 | 9241 | 12826 |

Dependent Variable: Firm-Specific Profit Ratio

*** indicates significance at a 1% significance level; ** at a 5% significance level, * at a 10% significance level

Note: 9 Model Specifications, depending using different regressors and control variables: (1) Direct effect of the sector-wide export intensity on the firm-specific profit ratio; (2) Model 1 including firm age; (3) Model 1including firm age and size; (4) Model 1including firm age, size and skill intensity; (5) Model 1 including firm age, size, skill intensity and share of foreign ownership; (6) Model 1 including firm age, size, skill intensity, share of foreign ownership and foreign technology; (7) Model 1 including firm age, size, skill intensity, share of foreign ownership, foreign technology and share of foreign inputs; (8) Model 1 including firm age, size, skill intensity, share of foreign ownership and share of foreign inputs; Method Used: Panel Least Squares, with industry and period fixed effects; Country fixed effects via the country-specific macro variables; t-statistics are reported in between brackets.

specification. This result indicates that trade liberalization positively influences firm productivity and performance through processes of within firm changes and confirms the general consensus among researchers. Possible explanations for this positive result include the exploitation of economies of scale, knowledge spillovers, learning effects, the implementation of more advanced foreign technologies, and increased incentives to innovate and to spend more time on productive activities instead of on unproductive activities. It can be concluded that trade liberalization, next to within industry reallocations that positively influence aggregate performance, also causes within firm changes that improve efficiency and productivity.

The results regarding the control variables are generally insignificant, which is contradictory to the earlier reported outcomes. Firm age, firm size, the firm-specific skill intensity, the foreign technology variable and the use of foreign inputs seem not to have a significant impact on the financial performance of a firm. A complete model specification either including or excluding the foreign technology variable, being models 7 and 8 respectively, is estimated to overcome the econometric problem of estimating a model with insufficient information on the firm-specific use of foreign technologies. The model excluding the foreign technology variable has a far greater explanatory power, as can be seen by the adjusted $R^2$ of 0.61, and provides more stable statistical outcomes compared to the model including the foreign technology variable. The only variable that has a fairly stable and significant impact on firm performance is the share of foreign ownership. The firm-specific share of foreign ownership has a positive impact on firm performance, significant at a 5% significance level. This outcome is in line with previous literature on foreign participation, foreign direct investments and the productivity of firms. Most studies show productivity improvements following foreign participation and foreign direct investments due to a combination of technology diffusion, productivity spillovers and learning effects (Aitken and Harisson, 1999).

### 4.6. Overview of the Empirical Results

The main empirical results, based on the different regression models, can be summarized as follows:

- There is a significantly positive relationship between the sector-wide average export intensity and the sector-wide average performance of firms, independent of the proxy used for financial performance. This result supports the hypothesis that trade liberalization has a positive influence on the industry-wide average performance of firms.
- There is an insignificant relationship between the sector-wide average export intensity and the aggregate financial performance of exporters. This result supports the hypothesis that trade liberalization has no impact on the average performance of exporters.
- Overall, these two results support the importance of resource, market share and profit reallocations from less to more productive firms in explaining the positive influence of trade liberalization on the industry-wide average performance of firms.

Regarding the control variables included in the empirical analysis, the overall results give rise to the following conclusions:

- Sectors with on average more mature firms tend to perform better and be more productive.
- The sector-wide average firm size has an ambiguous effect on aggregate performance.

- Sectors with on average a higher proportion on skilled workers being employed tend to perform worse, which can be the results of the higher wages of skilled workers that outweigh the productivity benefits.
- Sector-wide foreign ownership has a positive influence on aggregate performance, considering both the sample of all firms included in the dataset and the subsample of only exporters. This result is in line with previous literature, pointing at the positive impact of foreign ownership on performance through technology diffusion and spillover effects.
- The impact of the sector-wide implementation of foreign technologies is indeterminate, which can be the result of the relatively short time period considered.
- The sector-wide use of foreign supplies tends to have a negative impact on the sector-wide average financial performance, which may be due to the higher costs associated with purchasing foreign inputs.

## 5. Conclusion

Many researchers have attempted to specify the mechanisms that underlie the generally positive relationship between trade liberalization and firm and aggregate productivity. Suggested mechanisms include economies of scale, knowledge spillovers and increased incentives to devote more time to innovative and productive activities.

This research paper theoretically and empirically investigates the importance of resource, market share and profit reallocation mechanisms in explaining the impact of trade liberalization on the sector-wide average performance of firms. The theoretical analysis largely builds upon the pioneering research by Melitz (2003), which assesses the role of trade liberalization as a catalyst for inter-firm resource, market share and profit reallocations within an industry. Melitz (2003) is one of the first researchers to develop a theoretical, dynamic industry model that includes Dixit-Stiglitz preferences, increasing returns to scale and firm heterogeneity in the total factor productivity parameter. The theoretical model developed in this paper incorporates many of the features of the model by Melitz (2003) and, in addition to Melitz (2003), argues that firm productivity can objectively be proxied by indicators of financial performance. By comparing the market entry dynamics in a closed economy setting and in an open economy setting, the theoretical analysis gives rise to three clear results. Firstly, the theoretical results suggest that trade liberalization has a positive influence on the industry-wide average productivity and financial performance level through processes of resource, market share and profit reallocations from less to more productive firms. This result can be explained by the combination of a domestic market and an export market selection effect. Since exposure to trade increases the expected profits conditional on successful market entry, more firms (both domestic new entrants and foreign competitors) enter the domestic market, which intensifies competition in factor and final goods markets. Firms will serve smaller market shares and earn lower profits, which allows only the more productive firms to survive in the market and forces the less productive firms to exit. Successfully entering the foreign market is only achieved by the most productive firms, as exporting goods and services is characterized by additional transportation expenses and fixed costs for serving the foreign market. Secondly, it is shown that in an open economy setting there is a direct positive relationship between the sector-wide average financial performance of firms and the aggregate productivity level, which supports the idea that financial performance is a reliable, objective and accurately measurable proxy of productivity. Thirdly, the theoretical results suggest that trade liberalization has an ambiguous and insignificant impact on the sector-wide average productivity and financial performance of exports. In particular, trade liberalization has two contradictory effects among exporters. The most productive exporters gain in both market shares and profits. Some slightly less productive firms, though, will continue to export, but will experience financial difficulties. Overall, the impact of trade liberalization on the aggregate performance of exporters can be concluded to be ambiguous and insignificant. These theoretical results are used to formulate two hypotheses on the impact of trade liberalization on the sector-wide average performance of firms and exporters, respectively, which are tested empirically.

The empirical analysis employs firm-level data on 27 Eastern European and Central Asian countries over the period 2002-2009, provided by the Business Environment and Enterprise Performance Surveys (BEEPS) and constructed by the joint effort of the World Bank and the European Bank for Reconstruction and Development. The complete dataset consists of 23,570 firms,

active in 503 4-digit ISIC code specified sectors over the years 2002, 2005, 2007 and 2009. The information gathered covers many different aspects of a firm used to calculate the various sector-level variables, including general information, infrastructure and services, sales and supplies, the degree of competition, capacity, land and permits, crime, finance, business-government relations, labour, the business environment, and performance. Different econometric estimation procedures are followed, depending on the sample and the dependent variable used and the kind of fixed effects estimation technique employed. The panel regression results confirm the hypotheses formulated on the basis of the theoretical analysis. In particular, the outcomes reveal a stable, robust and significantly positive impact of the sector-wide export intensity on the industry-wide average financial performance of firms, measured by means of the aggregate profit ratio or the sector-wide market share. This result suggests that trade liberalization has a structurally positive influence on the aggregate financial performance of firms through processes of resource, market share and profit reallocations. Additionally, the outcomes of the panel regression model employing a subsample of only exporting firm show that there is an insignificant relationship between the sector-wide average export intensity and the aggregate financial performance of exporters. This result supports the theoretical hypothesis that trade liberalization has no impact on the average performance of exporters. Interesting results regarding the control variables include the fact that sectors with on average more mature firms tend to perform better possibly due to greater expertise and experience and that sectors with on average a higher proportion on skilled workers being employed tend to perform worse, which can be the result of the higher wages paid to skilled workers that outweigh the productivity benefits. Sectors with a high degree of foreign ownership tend to perform better possible due to technology diffusion, knowledge spillovers and learning effect, whereas sectors that use a high proportion of foreign supplies tend to perform worse possible due to the higher costs associated with purchasing foreign inputs. Overall, the empirical results prove the significant importance of resource, market share and profit reallocations from less to more productive firms in explaining the positive influence of trade liberalization on the industry-wide average performance of firms. This conclusion proves the effectiveness of classic, open economy market mechanisms in improving aggregate firm productivity and, accordingly, general economic performance through the creation of ‘healthy’ competitive pressures. Progressive reforms focused on further liberalization and increasing competition should therefore be embraced rather than be abandoned by policymakers in periods of crises.

Even though the results provide satisfactory insights into the overall effect of trade liberalization through firm heterogeneity in the total factor productivity parameter, there is plenty of room for further research and empirical refinements. Instead of using the survey information to estimate sector-wide export intensities, it is possible to calculate exact sector-wide export intensities using the information on total sector-wide exports and sales from the International Trade Centre. This allows a more specific definition of different sectors on the basis of highly disaggregated product and industry classifications and, thus, may give a more precise proxy for the macroeconomic process of trade liberalization. Additionally, instead of using data on just four years, more historical export data can be used to assess the longer term sector-wide, economic effects of trade liberalization. This is particularly relevant since the impacts of resource, market share and profit reallocations on the ecnomy occur over a long period of time.

## 6 References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# 7 Appendix

**Proof A1: Equation 3.2, The Price per Unit Utility *P***

The utility function, assuming Dixit-Sitglizt prefences, a constant elasticity of substitution and two varieties, equals:

$$U = \left(q_1^{\rho} + q_2^{\rho}\right)^{1/\rho}. \tag{7.1}$$

Optimizing utility is similar to minimizing the costs. Accordingly, to determine the optimal quantities of $q_1$ and $q_2$ consumed, the following Lagrangian can be formulated:

$$\Lambda = p_1 \cdot q_1 + p_2 \cdot q_2 + \lambda\left(1 - \left(q_1^{\rho} + q_2^{\rho}\right)^{1/\rho}\right). \tag{7.2}$$

The first order conditions of equation 7.2 with respect to $q_1$ and $q_2$ are equal to:

$$\frac{\partial \Lambda}{\partial q_1} = p_1 - \lambda \cdot \frac{1}{\rho}\left(q_1^{\rho} + q_2^{\rho}\right)^{1/\rho - 1} \cdot \rho \cdot q_1^{\rho - 1} = 0 \tag{7.3}$$

and

$$\frac{\partial \Lambda}{\partial q_2} = p_2 - \lambda \cdot \frac{1}{\rho}\left(q_1^{\rho} + q_2^{\rho}\right)^{1/\rho - 1} \cdot \rho \cdot q_2^{\rho - 1} = 0. \tag{7.4}$$

Dividing equation 7.3 by 7.4 and rewriting yields the following expression for $q_1$:

$$q_1 = \left[\frac{p_1}{p_2}\right]^{\frac{1}{\rho - 1}} \cdot q_2. \tag{7.5}$$

Plugging equation 7.5 into the side constraint of equation 7.2 allows deriving the optimal quantity consumed of variety $q_2$ as a function of $p_1$ and $p_2$:

$$q_2 = \left(p_1^{\frac{\rho}{\rho - 1}} + p_2^{\frac{\rho}{\rho - 1}}\right)^{-1/\rho} \cdot p_2^{\frac{1}{\rho - 1}}. \tag{7.6}$$

Similarly, the optimal quantity consumed of variety $q_1$ is equal to:

$$q_1 = \left(p_1^{\frac{\rho}{\rho - 1}} + p_2^{\frac{\rho}{\rho - 1}}\right)^{-1/\rho} \cdot p_1^{\frac{1}{\rho - 1}}. \tag{7.7}$$

Combining equations 7.6 and 7.7 yields a total expenditure function:

$$P = \left(p_1^{\frac{\rho}{\rho - 1}} + p_2^{\frac{\rho}{\rho - 1}}\right)^{-1/\rho} \cdot \left(p_2^{\frac{1}{\rho - 1} + 1} + p_1^{\frac{1}{\rho - 1} + 1}\right) = \left(p_1^{\frac{\rho}{\rho - 1}} + p_2^{\frac{\rho}{\rho - 1}}\right)^{-1/\rho + 1}. \tag{7.8}$$

By assuming that the elasticity of substitution between varieties is $\sigma = 1/(1-\rho) > 1$, equation 7.8 can be simplified to:

$$P = \left(p_1^{1-\sigma} + p_2^{1-\sigma}\right)^{\frac{1}{1-\sigma}}. \tag{7.9}$$

In case of infinitely many varieties, equation 7.9 is equal to:

(7.10) $$P = \left[ \int_{\omega \in \Omega} p(\omega)^{1-\sigma} \, d\omega \right]^{\frac{1}{1-\sigma}}.$$

**Proof A2: Equation 3.8, The Marginal Revenue Function**

The total demand for a single variety $\varphi$, as in equation 3.5, is equal to:

(7.11) $$q(\varphi) = I \cdot P^{\sigma-1} \cdot p(\varphi)^{-\sigma}.$$

Equation 7.11 can be used to determine a function for $p(\varphi)$. This function is equal to:

(7.12) $$p(\varphi) = I^{1/\sigma} \cdot P^{(\sigma-1)/\sigma} \cdot q(\varphi)^{-1/\sigma}.$$

The total revenues earned per firm, being the product of the price charged and the quantity sold, are equal to:

(7.13) $$r(\varphi) = I^{1/\sigma} \cdot P^{(\sigma-1)/\sigma} \cdot q(\varphi)^{1-1/\sigma}.$$

The marginal revenue function, defined as the first order derivative of a firm's revenues with respect to the quantity sold, then is equal to:

(7.14) $$MR = \frac{\partial r(\varphi)}{\partial q(\varphi)} = I^{1/\sigma} \cdot P^{(\sigma-1)/\sigma} \cdot q(\varphi)^{-1/\sigma} \cdot (1 - 1/\sigma) = p(\varphi) \cdot (1 - 1/\sigma).$$

**Proof A3: Equation 3.9, The Marginal Cost Function**

The total costs faced by a firm consist of fixed and variable production costs. Analytically, the total costs function can be expressed as follows:

(7.15) $$TC = w \cdot f + w \cdot \frac{1}{\varphi} \cdot q.$$

The marginal cost function, defined as the first order derivative of a firm's total costs with respect to the quantity sold, then is equal to:

(7.16) $$MC = \frac{\partial TC}{\partial q} = w \cdot \frac{1}{\varphi}.$$

**Proof A4: Equation 3.12, The Profit Function**

Total profits are equal to the difference between total revenues and total costs, consisting of variable and fixed costs. Analytically, total profits can be written as:

(7.17) $$\pi(\varphi) = p(\varphi) \cdot q(\varphi) - c(\varphi) \cdot q(\varphi) - f.$$

Since the optimal price charged is equal to a mark-up over marginal costs, the inverse of the optimal pricing rule, as in equation 3.11, can be used to rewrite equation 7.17 as follows:

(7.18) $$\pi(\varphi) = p(\varphi)\cdot q(\varphi) - \frac{\sigma-1}{\sigma}\cdot p(\varphi)\cdot q(\varphi) - f.$$

Rearranging terms yields:

(7.19) $$\pi(\varphi) = p(\varphi)\cdot q(\varphi)\cdot\left[1-\frac{\sigma-1}{\sigma}\right] - f.$$

Equation 7.19 can further be simplified so that the profit function as in equation 3.12 is obtained:

(7.20) $$\pi(\varphi) = \frac{p(\varphi)\cdot q(\varphi)}{\sigma} - f = \frac{r(\varphi)}{\sigma} - f.$$

**Proof A5: Equation 3.26, The Per Period Equivalent of the Fixed sunk Market Entry Cost**

A firm is indifferent between paying $f_e$ upon market entry or the per period equivalent of $f_e$ in each period the firm expects to survive. Analytically, this implies:

(7.21) $$f_e = f_{PPE} + (1-\theta)\cdot f_{PPE} + (1-\theta)^2\cdot f_{PPE} + (1-\theta)^3\cdot f_{PPE} + \ldots$$

Multiplying equation 7.21 by (1-$\theta$) yields:

(7.22) $$(1-\theta)\cdot f_e = (1-\theta)\cdot f_{PPE} + (1-\theta)^2\cdot f_{PPE} + (1-\theta)^3\cdot f_{PPE} + (1-\theta)^4\cdot f_{PPE} + \ldots$$

Taking the difference between 7.21 and 7.22 yields the relationship between $f_e$ and $f_{PPE}$:

(7.23) $$f_{PPE} = \theta\cdot f_e.$$

**Proof A6: Equation 3.30 and 3.51, The Transformed Zero Cut-off Profit Condition**

By using equation 3.15, the ratio of the revenues earned by a firm with the cut-off productivity level and the revenues earned by a firm with the average productivity level can be determined:

(7.24) $$\frac{r(\varphi^*)}{r(\tilde{\varphi})} = \left[\frac{\varphi^*}{\tilde{\varphi}}\right]^{\sigma-1}.$$

Equation 7.24 can be rearranged into a function for the cut-off revenue level:

(7.25) $$r(\varphi^*) = r(\tilde{\varphi})\cdot\left[\frac{\varphi^*}{\tilde{\varphi}}\right]^{\sigma-1}.$$

The equation for the cut-off revenue level can be plugged into the original zero cut-off profit condition. This yields:

(7.26) $$\frac{r(\tilde{\varphi})\cdot\left[\frac{\varphi^*}{\tilde{\varphi}}\right]^{\sigma-1}}{\sigma} = f.$$

Equation 7.26 can be rewritten into the transformed zero cut-off profit condition:

(7.27) $$r(\tilde{\varphi}) = \sigma \cdot f \cdot \left[\frac{\tilde{\varphi}}{\varphi^*}\right]^{\sigma-1}.$$

**Proof A7: Equation 3.31, The Transformed Free Entry Condition**

The average profit level is equal to:

(7.28) $$\pi(\tilde{\varphi}) = \frac{r(\tilde{\varphi})}{\sigma} - f.$$

The function for the average profit level can be plugged into the original free entry condition. This yields:

(7.29) $$\left[1 - G(\varphi^*)\right] \cdot \left[\frac{r(\tilde{\varphi})}{\sigma} - f\right] = \theta \cdot f_e.$$

Using the transformed zero cut-off profit condition to substitute for the average revenue level in equation 7.29 yields a more comprehensive free entry condition:

(7.30) $$\left[1 - G(\varphi^*)\right] \cdot \left[\frac{\sigma \cdot f \cdot \left(\frac{\tilde{\varphi}}{\varphi^*}\right)^{\sigma-1}}{\sigma} - f\right] = \theta \cdot f_e.$$

Equation 7.30 can further be simplified into the transformed free entry condition, which, as in equation 3.31, is equal to:

(7.31) $$\left[1 - G(\varphi^*)\right] \cdot \left[\left(\frac{\tilde{\varphi}}{\varphi^*}\right)^{\sigma-1} - 1\right] \cdot f = \theta \cdot f_e.$$

**Proof A8: Equation 3.49 and 3.50, The Export Market Cut-Off Productivity Level**

The ratio of the zero cut-off profit condition for the export and the domestic market is equal to:

(7.32) $$\frac{p(\varphi_x^*)^{1-\sigma} \cdot \tau^{1-\sigma} \cdot P_F^{\sigma-1} \cdot I_F}{p(\varphi^*)^{1-\sigma} \cdot P^{\sigma-1} \cdot I} = \frac{f_x}{f}.$$

The symmetry condition implies that all exogenous variables are similar, both domestically and abroad. Hence, $P = P_F$ and $I = I_F$. This means that these variables cancel out. Accordingly, equation 7.32 can be simplified to equation 3.49:

(7.33) $$\frac{p(\varphi_x^*)^{1-\sigma}}{p(\varphi^*)^{1-\sigma}} = \tau^{\sigma-1} \cdot \frac{f_x}{f}.$$

Substituting the optimal prices charged domestically and abroad, as in equations 3.11 and 3.32, into equation 7.33 yields:

(7.34) $$\left[\frac{\left(\frac{\sigma}{\sigma-1} \cdot \frac{1}{\varphi_x^*}\right)}{\left(\frac{\sigma}{\sigma-1} \cdot \frac{1}{\varphi^*}\right)}\right]^{1-\sigma} = \tau^{\sigma-1} \cdot \frac{f_x}{f}.$$

Since both the numerator and the denominator of the left-hand side of equation 7.34 depend on the mark-up over marginal costs, the mark-up can be removed from the equation. Equation 7.34 can then be simplified to:

$$\left[\frac{\varphi^*}{\varphi_x^*}\right]^{1-\sigma} = \tau^{\sigma-1} \cdot \frac{f_x}{f}. \tag{7.35}$$

Rearranging terms in equation 7.35 yields a function for the export market cut-off productivity level, explained by means of the domestic market cut-off productivity level:

$$\varphi_x^* = \varphi^* \cdot \tau \cdot \left[\frac{f_x}{f}\right]^{\frac{1}{\sigma-1}}. \tag{7.36}$$

**Proof A9: Equation 3.52, The Transformed Zero Cut-off Profit Condition for the Foreign Market**

Deriving the transformed zero cut-off profit condition for the foreign market follows the exact same procedure as the procedure followed for the derivation of the zero cut-off profit condition for the domestic market. Using equation 3.15, the ratio between the revenues earned by an exporter with the cut-off productivity level and the revenues earned by an exporter with the average productivity level can be determined:

$$\frac{r\left(\varphi_x^*\right)}{r\left(\tilde{\varphi}^*\right)} = \left[\frac{\varphi_x^*}{\tilde{\varphi}_x}\right]^{\sigma-1}. \tag{7.37}$$

Equation 7.37 can be rearranged into a function for the cut-off revenue level:

$$r\left(\varphi_x^*\right) = r\left(\tilde{\varphi}_x\right) \cdot \left[\frac{\varphi_x^*}{\tilde{\varphi}_x}\right]^{\sigma-1}. \tag{7.38}$$

The equation for the cut-off revenue level can be plugged into the original zero cut-off profit condition. This yields:

$$\frac{r\left(\tilde{\varphi}_x\right) \cdot \left[\frac{\varphi_x^*}{\tilde{\varphi}_x}\right]^{\sigma-1}}{\sigma} = f_x. \tag{7.39}$$

Equation 7.39 can be rewritten into the transformed zero cut-off profit condition for the foreign market:

$$r\left(\tilde{\varphi}_x\right) = \sigma \cdot f_x \cdot \left[\frac{\tilde{\varphi}_x}{\varphi_x^*}\right]^{\sigma-1}. \tag{7.40}$$

**Proof A10: An Example of the Derivation of the Closed Economy and the Open Economy Equilibrium**

This example makes the assumptions of a constant elasticity of substitution $\sigma = 2$ and a uniform distribution of the productivity parameter $\varphi$ on the interval $[\underline{\varphi}; \overline{\varphi}]$. The conditional distribution $\mu(\varphi)$ of productivity levels characterizing firms that are active in the market, accordingly, is equal to:

(7.41) $$\mu(\varphi) = \frac{1}{\bar{\varphi} - \varphi^*}.$$

The average productivity parameter, in accordance with its definition in equation 3.22, is equal to:

(7.42) $$\tilde{\varphi} = \left[ \int_{\varphi^*}^{\bar{\varphi}} \frac{1}{\bar{\varphi} - \varphi^*} \cdot \varphi d\varphi \right].$$

Because of the assumption of a uniform distribution of the productivity parameter $\varphi$, the function for the average productivity parameter can be simplified to:

(7.43) $$\tilde{\varphi} = \frac{1}{2} \cdot \left( \bar{\varphi} + \varphi^* \right).$$

The probability of successful market entry equals:

(7.44) $$1 - G\left(\varphi^*\right) = 1 - \frac{\varphi^* - \underline{\varphi}}{\bar{\varphi} - \underline{\varphi}} = \frac{\bar{\varphi} - \varphi^*}{\bar{\varphi} - \underline{\varphi}}.$$

By combining equations 7.43 and 7.44, the free entry condition can be completed in accordance with equation 3.31. This yields:

(7.45) $$\frac{\bar{\varphi} - \varphi^*}{\bar{\varphi} - \underline{\varphi}} \cdot \left[ \left( \frac{\frac{1}{2} \cdot \left( \bar{\varphi} + \varphi^* \right)}{\varphi^*} \right) - 1 \right] = \theta \cdot \frac{f_e}{f}.$$

Equation 7.45 characterizes the closed economy equilibrium and can be used to perform the comparative statics exercises discussed in section 3.3.2. In an open economy setting, the free entry condition consists of two components, namely the expected profits conditional on successful domestic market entry and the expected profits conditional successful export market entry. The probability of successful domestic market entry equals:

(7.46) $$1 - G\left(\varphi^*\right) = \frac{\bar{\varphi} - \varphi^*}{\bar{\varphi} - \underline{\varphi}}.$$

The average productivity level in the domestic market is similar to equation 7.43 and equals:

(7.47) $$\tilde{\varphi} = \frac{1}{2} \cdot \left( \bar{\varphi} + \varphi^* \right).$$

The probability of successful export market entry equals:

(7.48) $$1 - G\left(\varphi_x^*\right) = \frac{\bar{\varphi} - \varphi_x^*}{\bar{\varphi} - \underline{\varphi}}.$$

The average productivity level in the export market is similar to equation 7.43 and equals:

(7.49) $$\tilde{\varphi}_x = \frac{1}{2} \cdot \left( \bar{\varphi} + \varphi_x^* \right).$$

The link between the export market cut-off productivity level and the domestic market cut-off productivity level, as in equation 3.50, can be expressed as follows:

$$\varphi_x^* = \varphi^* \cdot \tau \cdot \left[ \frac{f_x}{f} \right]. \tag{7.50}$$

By combining equations 7.46, 7.47, 7.48, 7.49 and 7.50, the open economy, free entry condition can be completed in accordance with equation 3.53. This yields:

$$\frac{\bar{\varphi} - \varphi^*}{\bar{\varphi} - \underline{\varphi}} \cdot \left[ \frac{\bar{\varphi} + \varphi^*}{2 \cdot \varphi^*} - 1 \right] \cdot f + \frac{\bar{\varphi} - \varphi^* \cdot \tau \cdot \left[ \frac{f_x}{f} \right]}{\bar{\varphi} - \underline{\varphi}} \cdot \left[ \frac{\bar{\varphi} + \varphi^* \cdot \tau \cdot \left[ \frac{f_x}{f} \right]}{2 \cdot \varphi^* \cdot \tau \cdot \left[ \frac{f_x}{f} \right]} - 1 \right] \cdot f_x = \theta \cdot f_e. \tag{7.51}$$

In comparison with the closed economy equilibrium, equation 7.51 contains an additional positive term, which implies that trade liberalization has a positive impact on the cut-off productivity level and the sector-wide average productivity level. Namely, to maintain balance in equation 7.51, the left-hand side of the equation needs to decrease, which happens only after an increase in the cut-off productivity level and, accordingly, the average productivity level. This results points at the importance of resource, market share and profit reallocations in explaining the effect of trade liberalization on sector-wide average productivity, which into detail is discussed in section 3.4.5.

## Table A1: Descriptive Statistics Albania

| Albania | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 93698966 | 1464000 | 0 | 6550000000 | 392000000 | 529 |
| **Sector-Wide Profit Ratio** | 0.358 | 0.284 | -0.570 | 1 | 0.339 | 644 |
| **Profits ($)** | 31476771 | 71785.420 | -719000000 | 2330000000 | 186000000 | 732 |
| **Sector-Wide Export Intensity** | 0.155 | 0 | 0 | 1 | 0.299 | 689 |
| **Sector-Wide Exports ($)** | 7689048 | 0 | 0 | 300000000 | 34463688 | 689 |
| **Share of Foreign Ownership** | 0.127 | 0 | 0 | 1 | 0.228 | 731 |
| **Sector-Wide Skill Intensity** | 0.288 | 0.307 | 0 | 1 | 0.258 | 732 |
| **Sector-Wide Firm Age** | 1.988 | 1.969 | 0 | 4.263 | 0.566 | 732 |
| **Sector-Wide Firm Size** | 3.512 | 3.408 | 0 | 8.056 | 1.213 | 732 |
| **Number of FT Workers** | 62 | 15 | 2 | 3360 | 216 | 725 |
| **Sector-Wide Foreign Inputs** | 0.405 | 0.259 | 0 | 1 | 0.403 | 732 |
| **Sector-Wide Foreign Technology** | 0.092 | 0 | 0 | 1 | 0.240 | 732 |
| **Inflation (GDP Deflator, %)** | 3.956 | 3.910 | 1.995 | 6.008 | 1.680 | 732 |
| **GDP per Capita ( Const. 2000 $)** | 1533.695 | 1524.259 | 1281.843 | 1804.419 | 221.183 | 732 |

## Table A2: Descriptive Statistics Armenia

| Armenia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 1583850 | 120000 | 0 | 516000000 | 18554325 | 798 |
| **Sector-Wide Profit Ratio** | 0.396 | 0.346 | -0.642 | 1 | 0.330 | 596 |
| **Profits ($)** | -188000000 | 18000 | -160000000000 | 43849505 | 5340000000 | 896 |
| **Sector-Wide Export Intensity** | 0.075 | 0 | 0 | 1 | 0.198 | 866 |
| **Sector-Wide Exports ($)** | 96991 | 0 | 0 | 5600000 | 449550.7 | 866 |
| **Share of Foreign Ownership** | 0.103 | 0 | 0 | 1 | 0.207 | 896 |
| **Sector-Wide Skill Intensity** | 0.314 | 0.333 | 0 | 0.978409 | 0.277 | 896 |
| **Sector-Wide Firm Age** | 2.249 | 2.092 | 0 | 4.394 | 0.751 | 896 |
| **Sector-Wide Firm Size** | 3.877 | 3.646 | 0.693 | 7.438 | 1.454 | 896 |
| **Number of FT Workers** | 67 | 15 | 1 | 3000 | 192 | 895 |
| **Sector-Wide Foreign Inputs** | 0.266 | 0.074 | 0 | 1 | 0.333 | 896 |
| **Sector-Wide Foreign Technology** | 0.044 | 0 | 0 | 1 | 0.173 | 896 |
| **Inflation (GDP Deflator, %)** | 5.456 | 5.990 | 4.069 | 6.310 | 1.212 | 896 |
| **GDP per Capita ( Const. 2000 $)** | 1059.393 | 975.047 | 683.097 | 1520.034 | 424.796 | 896 |

## Table A3: Descriptive Statistics Azerbaijan

| Azerbaijan | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 1442490 | 224909.300 | 0 | 58266650 | 5357141 | 469 |
| **Sector-Wide Profit Ratio** | 0.362 | 0.336 | -1 | 1 | 0.350 | 373 |
| **Profits ($)** | 362929.5 | 0 | -13703627 | 45046238 | 2597820 | 900 |
| **Sector-Wide Export Intensity** | 0.032 | 0 | 0 | 1 | 0.131 | 507 |
| **Sector-Wide Exports ($)** | 71079.700 | 0 | 0 | 5318580 | 401084.8 | 507 |
| **Share of Foreign Ownership** | 0.117 | 0.023 | 0 | 1 | 0.206 | 898 |
| **Sector-Wide Skill Intensity** | 0.314 | 0.333 | 0 | 1 | 0.259 | 900 |
| **Sector-Wide Firm Age** | 2.160 | 2.104 | 0 | 4.394 | 0.770 | 898 |
| **Sector-Wide Firm Size** | 4.382 | 4.206 | 0 | 8.169 | 1.598 | 900 |
| **Number of FT Workers** | 106 | 21 | 2 | 5000 | 333 | 898 |
| **Sector-Wide Foreign Inputs** | 0.243 | 0.082 | 0 | 1 | 0.291 | 899 |
| **Sector-Wide Foreign Technology** | 0.060 | 0 | 0 | 1 | 0.201 | 900 |
| **Inflation (GDP Deflator, %)** | 12.853 | 8.315 | 2.515 | 27.730 | 13.206 | 900 |
| **GDP per Capita ( Const. 2000 $)** | 1256.945 | 945.469 | 714.396 | 2110.970 | 748.577 | 900 |

### Table A4: Descriptive Statistics Belarus

| Belarus | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| Sales ($) | 3190000000 | 745000 | 2000 | 228000000000 | 14800000000 | 658 |
| Sector-Wide Profit Ratio | 0.523 | 0.482 | -0.204 | 1 | 0.306 | 799 |
| Profits ($) | 1070000000 | 113000 | -82500000000 | 226000000000 | 10000000000 | 848 |
| Sector-Wide Export Intensity | 0.122 | 0 | 0 | 1 | 0.233 | 801 |
| Sector-Wide Exports ($) | 270000000 | 1100 | 0 | 26200000000 | 1780000000 | 801 |
| Share of Foreign Ownership | 0.117 | 0 | 0 | 1 | 0.219 | 848 |
| Sector-Wide Skill Intensity | 0.424 | 0.470 | 0 | 1 | 0.308 | 840 |
| Sector-Wide Firm Age | 2.439 | 2.336 | 0 | 4.942 | 0.723 | 848 |
| Sector-Wide Firm Size | 4.348 | 4.464 | 0 | 7.566 | 1.567 | 848 |
| Number of FT Workers | 110 | 26 | 1 | 2032 | 246,8975 | 847 |
| Sector-Wide Foreign Inputs | 0.297 | 0.198 | 0 | 1 | 0.319 | 848 |
| Sector-Wide Foreign Technology | 0.021 | 0 | 0 | 1 | 0.124 | 848 |
| Inflation (GDP Deflator, %) | 41.123 | 22.675 | 21.160 | 79.535 | 33.274 | 848 |
| GDP per Capita ( Const. 2000 $) | 1849.860 | 1701.451 | 1337.850 | 2510.278 | 600.138 | 848 |

### Table A5: Descriptive Statistics Bosnia

| Bosnia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| Sales ($) | 3320413 | 692790.800 | 0 | 119000000 | 8603180 | 596 |
| Sector-Wide Profit Ratio | 0.420 | 0.349 | -0.673 | 1 | 0.419 | 477 |
| Profits ($) | 1695896 | 49712.3 | -21180398 | 117000000 | 7433603 | 743 |
| Sector-Wide Export Intensity | 0.144 | 0.008 | 0 | 1 | 0.250 | 637 |
| Sector-Wide Exports ($) | 552180.600 | 5400 | 0 | 42913800 | 2550948 | 637 |
| Share of Foreign Ownership | 0.103 | 0 | 0 | 1 | 0.241 | 742 |
| Sector-Wide Skill Intensity | 0.341 | 0.324 | 0 | 1 | 0.317 | 743 |
| Sector-Wide Firm Age | 2.595 | 2.552 | 0 | 4.868 | 1.022 | 742 |
| Sector-Wide Firm Size | 3.915 | 4.104 | 0 | 7.262 | 1.708 | 743 |
| Number of FT Workers | 95 | 24 | 0 | 3000 | 214 | 739 |
| Sector-Wide Foreign Inputs | 0.291 | 0.116 | 0 | 1 | 0.341 | 743 |
| Sector-Wide Foreign Technology | 0.042 | 0 | 0 | 1 | 0.161 | 743 |
| Inflation (GDP Deflator, %) | 4.398 | 2.962 | 2.572 | 7.661 | 2.832 | 743 |
| GDP per Capita ( Const. 2000 $) | 1840.799 | 1766.301 | 1533.533 | 2222.565 | 350.505 | 743 |

### Table A6: Descriptive Statistics Bulgaria

| Bulgaria | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| Sales ($) | 4831832 | 600000 | 0 | 340000000 | 20124937 | 1681 |
| Sector-Wide Profit Ratio | 0.413 | 0.338 | -0.536 | 1 | 0.290 | 1556 |
| Profits ($) | 2019415 | 131000 | -183000000 | 200000000 | 11906367 | 1853 |
| Sector-Wide Export Intensity | 0.221 | 0.071 | 0 | 1 | 0.263 | 1804 |
| Sector-Wide Exports ($) | 901453 | 219188.900 | 0 | 102000000 | 4143863 | 1804 |
| Share of Foreign Ownership | 0.191 | 0.059 | 0 | 1 | 0.256 | 1853 |
| Sector-Wide Skill Intensity | 0.344 | 0.283 | 0 | 1 | 0.324 | 1853 |
| Sector-Wide Firm Age | 2.360 | 2.338 | 0 | 4.663 | 0.643 | 1596 |
| Sector-Wide Firm Size | 4.476 | 4.753 | 0.693 | 8.476 | 1.385 | 1853 |
| Number of FT Workers | 94 | 23 | 1 | 4800 | 276 | 1850 |
| Sector-Wide Foreign Inputs | 0.239 | 0.060 | 0 | 1 | 0.302 | 1853 |
| Sector-Wide Foreign Technology | 0.050 | 0 | 0 | 1 | 0.130 | 1853 |
| Inflation (GDP Deflator, %) | 6.401 | 6.508 | 4.173 | 8.416 | 1.757 | 1853 |
| GDP per Capita ( Const. 2000 $) | 2176.023 | 2183.726 | 1675.655 | 2660.986 | 420.128 | 1853 |

### Table A7: Descriptive Statistics Croatia

| Croatia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 40145720 | 4346000 | 0 | 2000000000 | 128000000 | 1052 |
| **Sector-Wide Profit Ratio** | 0.421 | 0.362 | -0.963 | 1 | 0.329 | 904 |
| **Profits ($)** | 17347325 | 800500 | -337000000 | 950000000 | 74524915 | 1160 |
| **Sector-Wide Export Intensity** | 0.209 | 0.049 | 0 | 1 | 0.273 | 1109 |
| **Sector-Wide Exports ($)** | 8151013 | 704329.400 | 0 | 366000000 | 25960370 | 1109 |
| **Share of Foreign Ownership** | 0.105 | 0.007 | 0 | 1 | 0.218 | 1160 |
| **Sector-Wide Skill Intensity** | 0.337 | 0.375 | 0 | 1 | 0.281 | 1160 |
| **Sector-Wide Firm Age** | 2.829 | 2.703 | 0 | 5.233 | 0.724 | 1115 |
| **Sector-Wide Firm Size** | 4.517 | 5.017 | 0 | 8.067 | 1.562 | 1160 |
| **Number of FT Workers** | 119 | 22 | 1 | 4000 | 316 | 1155 |
| **Sector-Wide Foreign Inputs** | 0.271 | 0.137 | 0 | 1 | 0.306 | 1160 |
| **Sector-Wide Foreign Technology** | 0.171 | 0 | 0 | 1 | 0.257 | 1160 |
| **Inflation (GDP Deflator, %)** | 4.511 | 4.081 | 3.794 | 6.089 | 1.062 | 1160 |
| **GDP per Capita ( Const. 2000 $)** | 5982.594 | 6053.870 | 5023.530 | 6799,104 | 762.541 | 1160 |

### Table A8: Descriptive Statistics Czech Republic

| Czech Republic | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 8305329 | 550000 | 0 | 493000000 | 33274232 | 698 |
| **Sector-Wide Profit Ratio** | 0.416 | 0.310 | -0.537 | 1 | 0.318 | 676 |
| **Profits ($)** | 633263.2 | 55000 | -856000000 | 493000000 | 49559102 | 861 |
| **Sector-Wide Export Intensity** | 0.125 | 0 | 0 | 1 | 0.231 | 760 |
| **Sector-Wide Exports ($)** | 1498623 | 97.5 | 0 | 139000000 | 9217851 | 760 |
| **Share of Foreign Ownership** | 0.167 | 0 | 0 | 1 | 0.312 | 859 |
| **Sector-Wide Skill Intensity** | 0.410 | 0.499 | 0 | 1 | 0.308 | 861 |
| **Sector-Wide Firm Age** | 2.184 | 2.217 | 0 | 4.673 | 0.839 | 860 |
| **Sector-Wide Firm Size** | 3.768 | 3.835 | 0 | 9.159 | 2.034 | 861 |
| **Number of FT Workers** | 132 | 15 | 1 | 9950 | 588 | 852 |
| **Sector-Wide Foreign Inputs** | 0.221 | 0.100 | 0 | 1 | 0.278 | 860 |
| **Sector-Wide Foreign Technology** | 0.026 | 0 | 0 | 1 | 0.143 | 861 |
| **Inflation (GDP Deflator, %)** | 3.746 | 4.533 | 1.834 | 4.872 | 1,665 | 861 |
| **GDP per Capita ( Const. 2000 $)** | 6515.003 | 6274.549 | 5677.151 | 7593.310 | 980.449 | 861 |

### Table A9: Descriptive Statistics Estonia

| Estonia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 9162860 | 920000 | 0 | 389000000 | 30108022 | 639 |
| **Sector-Wide Profit Ratio** | 0.487 | 0.346 | -0.470 | 1 | 0.359 | 543 |
| **Profits ($)** | -1409826 | 222161.1 | -723000000 | 366000000 | 53728226 | 662 |
| **Sector-Wide Export Intensity** | 0.1477 | 0.010 | 0 | 1 | 0.271 | 655 |
| **Sector-Wide Exports ($)** | 1258819 | 25000 | 0 | 81635960 | 4567176 | 655 |
| **Share of Foreign Ownership** | 0.202 | 0.020 | 0 | 1 | 0.299 | 662 |
| **Sector-Wide Skill Intensity** | 0.303 | 0.269 | 0 | 1 | 0.288 | 662 |
| **Sector-Wide Firm Age** | 2.356 | 2.336 | 0.949 | 4.700 | 0.601 | 662 |
| **Sector-Wide Firm Size** | 4.110 | 3.995 | 0.693 | 8.476 | 1.488 | 662 |
| **Number of FT Workers** | 130 | 20 | 1 | 4800 | 4.502 | 661 |
| **Sector-Wide Foreign Inputs** | 0.303 | 0.123 | 0 | 1 | 0.353 | 662 |
| **Sector-Wide Foreign Technology** | 0.049 | 0 | 0 | 1 | 0.175 | 662 |
| **Inflation (GDP Deflator, %)** | 5.026 | 4.289 | 3.601 | 7.190 | 1.905 | 662 |
| **GDP per Capita ( Const. 2000 $)** | 5740.506 | 5682.608 | 4515.027 | 7023.882 | 1255.429 | 662 |

## Table A10: Descriptive Statistics FYROM

| FYROM | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| Sales ($) | 3333318 | 459500 | 0 | 112000000 | 9923913 | 548 |
| Sector-Wide Profit Ratio | 0.299 | 0.281 | -1 | 1 | 0.334 | 441 |
| Profits ($) | -17951461 | 0.402 | -4760000000 | 48757526 | 200000000 | 736 |
| Sector-Wide Export Intensity | 0.122 | 0 | 0 | 0.999 | 0.221 | 596 |
| Sector-Wide Exports ($) | 614941.700 | 0 | 0 | 53834337 | 3152786 | 596 |
| Share of Foreign Ownership | 0.127 | 0 | 0 | 1 | 0.230 | 734 |
| Sector-Wide Skill Intensity | 0.314 | 0.307 | 0 | 1 | 0.313 | 736 |
| Sector-Wide Firm Age | 2.376 | 2.368 | 0 | 4.495 | 1.046 | 734 |
| Sector-Wide Firm Size | 3.573 | 3.912 | 0 | 8.162 | 1.926 | 736 |
| Number of FT Workers | 98 | 18 | 1 | 3600 | 284 | 732 |
| Sector-Wide Foreign Inputs | 0.291 | 0.068 | 0 | 1 | 0.361 | 735 |
| Sector-Wide Foreign Technology | 0.060 | 0 | 0 | 1 | 0.210 | 736 |
| Inflation (GDP Deflator, %) | 3.962 | 3.610 | 0.791 | 7.485 | 3.361 | 736 |
| GDP per Capita ( Const. 2000 $) | 1912.111 | 1827.504 | 1698.630 | 2210.198 | 266.072 | 736 |

## Table A11: Descriptive Statistics Georgia

| Georgia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| Sales ($) | 2875989 | 200000 | 1000 | 350000000 | 17057304 | 552 |
| Sector-Wide Profit Ratio | 0.372 | 0.270 | -0.539 | 1 | 0.391 | 708 |
| Profits ($) | 883014.500 | 17400 | -106000000 | 321000000 | 13141263 | 747 |
| Sector-Wide Export Intensity | 0.079 | 0 | 0 | 1 | 0.197 | 712 |
| Sector-Wide Exports ($) | 266046.900 | 0 | 0 | 44250000 | 1829952 | 712 |
| Share of Foreign Ownership | 0.110 | 0 | 0 | 1 | 0.220 | 747 |
| Sector-Wide Skill Intensity | 0.236 | 0.083 | 0 | 1 | 0.276 | 747 |
| Sector-Wide Firm Age | 2.263 | 2.197 | 0.693 | 4.979 | 0.747 | 747 |
| Sector-Wide Firm Size | 4.179 | 4.011 | 0.693 | 8.057 | 1.576 | 747 |
| Number of FT Workers | 91 | 16 | 1 | 4800 | 340 | 743 |
| Sector-Wide Foreign Inputs | 0.238 | 0 | 0 | 1 | 0.320 | 747 |
| Sector-Wide Foreign Technology | 0.058 | 0 | 0 | 1 | 0.190 | 747 |
| Inflation (GDP Deflator, %) | 7.817 | 8.368 | 5.377 | 9.707 | 2.217 | 747 |
| GDP per Capita ( Const. 2000 $) | 966.552 | 920.125 | 730.526 | 1249.005 | 262.339 | 747 |

## Table A12: Descriptive Statistics Hungary

| Hungary | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| Sales ($) | 19120718 | 1450000 | 0 | 3120000000 | 152000000 | 967 |
| Sector-Wide Profit Ratio | 0.399 | 0.280 | -0.591 | 1 | 0.309 | 951 |
| Profits ($) | -448000000 | 146000 | -399000000000 | 1570000000 | 11800000000 | 1151 |
| Sector-Wide Export Intensity | 0.185 | 0.050 | 0 | 1 | 0.256 | 1113 |
| Sector-Wide Exports ($) | 3477293 | 153040 | 0 | 327000000 | 19017500 | 1113 |
| Share of Foreign Ownership | 0.222 | 0.066 | 0 | 1 | 0.312 | 1151 |
| Sector-Wide Skill Intensity | 0.363 | 0.382 | 0 | 1 | 0.272 | 1151 |
| Sector-Wide Firm Age | 2.503 | 2.481 | 0 | 4.937 | 0.626 | 1134 |
| Sector-Wide Firm Size | 4.385 | 4.754 | 0 | 9.579 | 1719432 | 1151 |
| Number of FT Workers | 134 | 20 | 1 | 18208 | 666 | 1149 |
| Sector-Wide Foreign Inputs | 0.263 | 0.200 | 0 | 1 | 0.277 | 1151 |
| Sector-Wide Foreign Technology | 0.020 | 0 | 0 | 1 | 0.116 | 1151 |
| Inflation (GDP Deflator, %) | 7.258 | 5.276 | 5.234 | 11.263 | 3.469 | 1151 |
| GDP per Capita ( Const. 2000 $) | 5360.969 | 5413.573 | 4722.175 | 5947.158 | 614.184 | 1151 |

### Table A13: Descriptive Statistics Kazakhstan

| Kazakhstan | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 2138164 | 184500 | 0 | 147000000 | 8232560 | 1166 |
| **Sector-Wide Profit Ratio** | 0.324 | 0.231 | -0.942 | 1 | 0.320 | 908 |
| **Profits ($)** | -31501003 | 11000 | -7930000000 | 139000000 | 303000000 | 1379 |
| **Sector-Wide Export Intensity** | 0.043 | 0 | 0 | 0.990 | 0.108 | 1345 |
| **Sector-Wide Exports ($)** | 99377.100 | 0 | 0 | 13642947 | 611356.8 | 1345 |
| **Share of Foreign Ownership** | 0.074 | 0.007 | 0 | 1 | 0.172 | 1379 |
| **Sector-Wide Skill Intensity** | 0.370 | 0.458 | 0 | 0.958 | 0.277 | 1379 |
| **Sector-Wide Firm Age** | 2.097 | 2.144 | 0 | 4.595 | 0.522 | 1332 |
| **Sector-Wide Firm Size** | 4.676 | 4.745 | 0 | 9.190 | 1.277 | 1379 |
| **Number of FT Workers** | 109 | 30 | 2 | 9800 | 369 | 1375 |
| **Sector-Wide Foreign Inputs** | 0.224 | 0.120 | 0 | 1 | 0.266 | 1379 |
| **Sector-Wide Foreign Technology** | 0.027 | 0 | 0 | 1 | 0.129 | 1379 |
| **Inflation (GDP Deflator, %)** | 15.742 | 16.132 | 10.156 | 20.937 | 5.401 | 1379 |
| **GDP per Capita ( Const. 2000 $)** | 1865.445 | 1818.959 | 1397.290 | 2380.085 | 493.044 | 1379 |

### Table A14: Descriptive Statistics Kyrgyz

| Kyrgyz | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 715779 | 92453 | 0 | 42474785 | 2751874 | 506 |
| **Sector-Wide Profit Ratio** | 0.449 | 0.360 | -0.906 | 1 | 0.348 | 413 |
| **Profits ($)** | -7552606 | 11000 | -1250000000 | 28718786 | 87276594 | 610 |
| **Sector-Wide Export Intensity** | 0.091 | 0 | 0 | 1 | 0.221 | 572 |
| **Sector-Wide Exports ($)** | 125079.500 | 0 | 0 | 19147250 | 1007057 | 572 |
| **Share of Foreign Ownership** | 0.118 | 0 | 0 | 1 | 0.231 | 609 |
| **Sector-Wide Skill Intensity** | 0.341 | 0.347 | 0 | 0.900 | 0.277 | 610 |
| **Sector-Wide Firm Age** | 2.393 | 2.291 | 0 | 4.715 | 0.773 | 605 |
| **Sector-Wide Firm Size** | 3.856 | 3.869 | 0 | 7.754 | 1.339 | 610 |
| **Number of FT Workers** | 84 | 24 | 1 | 2331 | 2.019 | 608 |
| **Sector-Wide Foreign Inputs** | 0.280 | 0.119 | 0 | 1 | 0.339 | 609 |
| **Sector-Wide Foreign Technology** | 0.048 | 0 | 0 | 1 | 0.181 | 610 |
| **Inflation (GDP Deflator, %)** | 11.552 | 7.332 | 5.108 | 22.216 | 9.302 | 610 |
| **GDP per Capita ( Const. 2000 $)** | 330.527 | 323.670 | 291.725 | 376.187 | 42.646 | 610 |

### Table A15: Descriptive Statistics Latvia

| Latvia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 9223165 | 609500 | 0 | 773000000 | 47495023 | 604 |
| **Sector-Wide Profit Ratio** | 0.507 | 0.513 | -0.937 | 1 | 0.364 | 555 |
| **Profits ($)** | 4866722 | 212830 | -57528000 | 376000000 | 2.577 | 652 |
| **Sector-Wide Export Intensity** | 0.127 | 0 | 0 | 1 | 0.266 | 639 |
| **Sector-Wide Exports ($)** | 897640.600 | 0 | 0 | 24800643 | 3.141 | 639 |
| **Share of Foreign Ownership** | 0.236 | 0 | 0 | 1 | 0.326 | 652 |
| **Sector-Wide Skill Intensity** | 0.317 | 0.294 | 0 | 1 | 0.289 | 652 |
| **Sector-Wide Firm Age** | 2.228 | 2.262 | 0 | 4.803 | 0.677 | 652 |
| **Sector-Wide Firm Size** | 4.232 | 4.657 | 0 | 8.441 | 1.909 | 652 |
| **Number of FT Workers** | 127 | 18 | 1 | 6697 | 469 | 648 |
| **Sector-Wide Foreign Inputs** | 0.328 | 0.193 | 0 | 1 | 0.353 | 652 |
| **Sector-Wide Foreign Technology** | 0.051 | 0 | 0 | 1 | 0.191 | 652 |
| **Inflation (GDP Deflator, %)** | 7.696 | 7.009 | 1.695 | 14.383 | 6.372 | 652 |
| **GDP per Capita ( Const. 2000 $)** | 4729.393 | 4538.848 | 3593.665 | 6055.665 | 1242.011 | 652 |

### Table A16: Descriptive Statistics Lithuania

| Lithuania | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 4927433 | 562000 | 0 | 744000000 | 30919400 | 644 |
| **Sector-Wide Profit Ratio** | 0.463 | 0.447 | -1 | 1 | 0.398 | 553 |
| **Profits ($)** | -462272.900 | 120914.900 | -889000000 | 115000000 | 35927405 | 681 |
| **Sector-Wide Export Intensity** | 0.166 | 0.020 | 0 | 1 | 0.2877 | 659 |
| **Sector-Wide Exports ($)** | 1038639 | 20000 | 0 | 69570108 | 4803335 | 659 |
| **Share of Foreign Ownership** | 0.129 | 0 | 0 | 1 | 0.280 | 681 |
| **Sector-Wide Skill Intensity** | 0.356 | 0.377 | 0 | 0.954 | 0.304 | 681 |
| **Sector-Wide Firm Age** | 2.304 | 2.383 | 0 | 4.443 | 0.733 | 681 |
| **Sector-Wide Firm Size** | 4.175 | 4.248 | 0 | 8.873 | 1.608 | 681 |
| **Number of FT Workers** | 100 | 22 | 2 | 9000 | 382 | 678 |
| **Sector-Wide Foreign Inputs** | 0.248 | 0.072 | 0 | 1 | 0.327 | 681 |
| **Sector-Wide Foreign Technology** | 0.046 | 0 | 0 | 1 | 0.185 | 681 |
| **Inflation (GDP Deflator, %)** | 3.980 | 2.537 | -0.370 | 9.773 | 5.223 | 681 |
| **GDP per Capita ( Const. 2000 $)** | 4679.961 | 4492.771 | 3505.703 | 6041.409 | 1278.175 | 681 |

### Table A17: Descriptive Statistics Moldova

| Moldova | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 1344063 | 203742.400 | 0 | 65898157 | 4757147 | 739 |
| **Sector-Wide Profit Ratio** | 0.315 | 0.226 | -0.648 | 1 | 0.324 | 672 |
| **Profits ($)** | -507571.200 | 16297.900 | -227000000 | 63441188 | 9889990 | 887 |
| **Sector-Wide Export Intensity** | 0.137 | 0.011 | 0 | 1 | 0.254 | 859 |
| **Sector-Wide Exports ($)** | 227977.500 | 3080 | 0 | 16738132 | 1090217 | 859 |
| **Share of Foreign Ownership** | 0.147 | 0.015 | 0 | 1 | 0.227 | 887 |
| **Sector-Wide Skill Intensity** | 0.386 | 0.432 | 0 | 0.960 | 0.299 | 887 |
| **Sector-Wide Firm Age** | 2.259 | 2.297 | 0 | 4.327 | 0.542 | 887 |
| **Sector-Wide Firm Size** | 4.446 | 4.442 | 0 | 7.550 | 1.324 | 887 |
| **Number of FT Workers** | 91 | 25 | 2 | 2200 | 200 | 887 |
| **Sector-Wide Foreign Inputs** | 0.253 | 0.110 | 0 | 1 | 0.301 | 887 |
| **Sector-Wide Foreign Technology** | 0.034 | 0 | 0 | 1 | 0.130 | 887 |
| **Inflation (GDP Deflator, %)** | 9.782 | 9.280 | 7.977 | 12.089 | 2.102 | 887 |
| **GDP per Capita ( Const. 2000 $)** | 478.648 | 468.184 | 376.436 | 591.323 | 107.825 | 887 |

### Table A18: Descriptive Statistics Montenegro

| Montenegro | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 4029810 | 437973.7 | 0 | 82120066 | 9967991 | 118 |
| **Sector-Wide Profit Ratio** | 0.266 | 0.239 | -0.296 | 0.974 | 0.355 | 65 |
| **Profits ($)** | 1949410 | 4927204 | -9207110 | 71059178 | 7543849 | 154 |
| **Sector-Wide Export Intensity** | 0.060 | 0 | 0 | 1 | 0.207 | 117 |
| **Sector-Wide Exports ($)** | 276724.800 | 0 | 0 | 6371605 | 1077879 | 117 |
| **Share of Foreign Ownership** | 0.034 | 0 | 0 | 1 | 0.155 | 151 |
| **Sector-Wide Skill Intensity** | 0.238 | 0 | 0 | 1 | 0.309 | 154 |
| **Sector-Wide Firm Age** | 2.355 | 2.301 | 0 | 3.998 | 0.625 | 151 |
| **Sector-Wide Firm Size** | 3.490 | 3.413 | 0 | 6.551 | 1.356 | 154 |
| **Number of FT Workers** | 58 | 17 | 1 | 800 | 110 | 149 |
| **Sector-Wide Foreign Inputs** | 0.187 | 0 | 0 | 1 | 0.305 | 151 |
| **Sector-Wide Foreign Technology** | 0.067 | 0 | 0 | 1 | 0.212 | 154 |
| **Inflation (GDP Deflator, %)** | 11.268 | 7.685 | 5.915 | 20.204 | 7.789 | 154 |
| **GDP per Capita ( Const. 2000 $)** | 1873.039 | 1730.859 | 1578.785 | 2309.472 | 385.535 | 154 |

## Table A19: Descriptive Statistics Poland

| Poland | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 4851829 | 337000 | 0 | 479000000 | 23800044 | 1541 |
| **Sector-Wide Profit Ratio** | 0.341 | 0.282 | -0.835 | 1 | 0.300 | 1635 |
| **Profits ($)** | 1892107 | 47163.700 | -496000000 | 479000000 | 21832357 | 1930 |
| **Sector-Wide Export Intensity** | 0.120 | 0.036 | 0 | 0.999 | 0.182 | 1767 |
| **Sector-Wide Exports ($)** | 496010.500 | 28482.600 | 0 | 54587000 | 2023035 | 1767 |
| **Share of Foreign Ownership** | 0.133 | 0.017 | 0 | 1 | 0.232 | 1930 |
| **Sector-Wide Skill Intensity** | 0.498 | 0.598 | 0 | 1 | 0.282 | 1930 |
| **Sector-Wide Firm Age** | 2.622 | 2.706 | 0 | 5.016 | 0.919 | 1922 |
| **Sector-Wide Firm Size** | 4.126 | 4.562 | 0 | 8.118 | 1.756 | 1930 |
| **Number of FT Workers** | 78 | 12 | 1 | 6100 | 236 | 1908 |
| **Sector-Wide Foreign Inputs** | 0.206 | 0.146 | 0 | 1 | 0.225 | 1930 |
| **Sector-Wide Foreign Technology** | 0.013 | 0 | 0 | 1 | 0.082 | 1930 |
| **Inflation (GDP Deflator, %)** | 3.557 | 3.480 | 3.102 | 4.089 | 0.498 | 1930 |
| **GDP per Capita ( Const. 2000 $)** | 5268.959 | 5039.117 | 4532.006 | 6235.755 | 874.820 | 1930 |

## Table A20: Descriptive Statistics Romania

| Romania | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 7553357 | 367000 | 0 | 5740000000 | 161000000 | 1271 |
| **Sector-Wide Profit Ratio** | 0.467 | 0.455 | -0.891 | 1 | 0.314 | 924 |
| **Profits ($)** | 5226721 | 49000 | -171000000 | 5720000000 | 153000000 | 1396 |
| **Sector-Wide Export Intensity** | 0.138 | 0 | 0 | 1 | 0.237 | 1369 |
| **Sector-Wide Exports ($)** | 335815.100 | 0 | 0 | 45225000 | 1621643 | 1369 |
| **Share of Foreign Ownership** | 0.132 | 0.033 | 0 | 1 | 0.205 | 1396 |
| **Sector-Wide Skill Intensity** | 0.467 | 0.557 | 0 | 0.970 | 0.322 | 1396 |
| **Sector-Wide Firm Age** | 2.500 | 2.400 | 0 | 5.246 | 0.643 | 1396 |
| **Sector-Wide Firm Size** | 4.813 | 4.961 | 0.693 | 9.185 | 1.269 | 1396 |
| **Number of FT Workers** | 129 | 30 | 1 | 11000 | 4.432 | 1387 |
| **Sector-Wide Foreign Inputs** | 0.190 | 0.064 | 0 | 1 | 0.255 | 1396 |
| **Sector-Wide Foreign Technology** | 0.037 | 0 | 0 | 1 | 0.144 | 1396 |
| **Inflation (GDP Deflator, %)** | 21.353 | 15.041 | 11.77 | 37.442 | 14.040 | 1396 |
| **GDP per Capita ( Const. 2000 $)** | 2259.624 | 2164.635 | 1769.596 | 2844.642 | 543.781 | 1396 |

## Table A21: Descriptive Statistics Russia

| Russia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 7807932 | 413000 | 0 | 1170000000 | 44254482 | 1701 |
| **Sector-Wide Profit Ratio** | 0.427 | 0.359 | -1 | 1 | 0.334 | 1179 |
| **Profits ($)** | 1693492 | 39000 | -1010000000 | 1170000000 | 42161037 | 2111 |
| **Sector-Wide Export Intensity** | 0.040 | 0 | 0 | 1 | 0.104 | 1979 |
| **Sector-Wide Exports ($)** | 533521.900 | 0 | 0 | 118000000 | 4796044 | 1979 |
| **Share of Foreign Ownership** | 0.087 | 0.003 | 0 | 1 | 0.179 | 2111 |
| **Sector-Wide Skill Intensity** | 0.358 | 0.389 | 0 | 1 | 0.250 | 2111 |
| **Sector-Wide Firm Age** | 2.463 | 2.477 | 0 | 4.947 | 0.738 | 2111 |
| **Sector-Wide Firm Size** | 4.992 | 5.175 | 0 | 1.048 | 1.564 | 2111 |
| **Number of FT Workers** | 211 | 40 | 1 | 37772 | 1.042 | 2105 |
| **Sector-Wide Foreign Inputs** | 0.207 | 0.115 | 0 | 1 | 0.239 | 2111 |
| **Sector-Wide Foreign Technology** | 0.103 | 0 | 0 | 1 | 0.208 | 2111 |
| **Inflation (GDP Deflator, %)** | 18.244 | 17.960 | 16.489 | 20.282 | 1.912 | 2111 |
| **GDP per Capita ( Const. 2000 $)** | 2399.692 | 2285.363 | 1870.049 | 3043.666 | 595.103 | 2111 |

**Table A22: Descriptive Statistics Serbia**

| Serbia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 8746391 | 1161846 | 0 | 762000000 | 38878348 | 637 |
| **Sector-Wide Profit Ratio** | 0.346 | 0.293 | -0.585 | 1 | 0.308 | 531 |
| **Profits ($)** | -32143916 | 5000 | -5840000000 | 676000000 | 284000000 | 900 |
| **Sector-Wide Export Intensity** | 0.098 | 0.030 | 0 | 0.950 | 0.150 | 764 |
| **Sector-Wide Exports ($)** | 573112.800 | 108348.200 | 0 | 13445785 | 1521539 | 764 |
| **Share of Foreign Ownership** | 0.165 | 0 | 0 | 1 | 0.274 | 900 |
| **Sector-Wide Skill Intensity** | 0.321 | 0.305 | 0 | 1 | 0.274 | 900 |
| **Sector-Wide Firm Age** | 2.832 | 2.714 | 0 | 5.088 | 0.871 | 877 |
| **Sector-Wide Firm Size** | 4.519 | 4.763 | 0 | 8.613 | 1.767 | 900 |
| **Number of FT Workers** | 151 | 26 | 1 | 9500 | 5.075 | 899 |
| **Sector-Wide Foreign Inputs** | 0.272 | 0.112 | 0 | 1 | 0.326 | 900 |
| **Sector-Wide Foreign Technology** | 0.028 | 0 | 0 | 1 | 0.143 | 900 |
| **Inflation (GDP Deflator, %)** | 37.732 | 12.608 | 12.203 | 88.383 | 43.866 | 900 |
| **GDP per Capita ( Const. 2000 $)** | 1024.315 | 1002.852 | 853.633 | 1216.459 | 182.363 | 900 |

**Table A23: Descriptive Statistics Slovakia**

| Slovakia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 112000000 | 2149000 | 0 | 7320000000 | 490000000 | 558 |
| **Sector-Wide Profit Ratio** | 0.425 | 0.360 | -0.963 | 1 | 0.373 | 492 |
| **Profits ($)** | 50992244 | 263000 | -75761256 | 4930000000 | 279000000 | 665 |
| **Sector-Wide Export Intensity** | 0.140 | 0.009 | 0 | 1 | 0.248 | 599 |
| **Sector-Wide Exports ($)** | 40476620 | 24750 | 0 | 4900000000 | 333000000 | 599 |
| **Share of Foreign Ownership** | 0.127 | 0 | 0 | 1 | 0.256 | 665 |
| **Sector-Wide Skill Intensity** | 0.364 | 0.364 | 0 | 1 | 0.316 | 665 |
| **Sector-Wide Firm Age** | 2.313 | 2.303 | 0 | 4.828 | 0.882 | 644 |
| **Sector-Wide Firm Size** | 3.950 | 4.075 | 0 | 8.797 | 1.832 | 665 |
| **Number of FT Workers** | 134 | 20 | 1 | 9500 | 490 | 655 |
| **Sector-Wide Foreign Inputs** | 0.272 | 0.100 | 0 | 1 | 0.324 | 665 |
| **Sector-Wide Foreign Technology** | 0.053 | 0 | 0 | 1 | 0.201 | 665 |
| **Inflation (GDP Deflator, %)** | 4.576 | 5.017 | 2.863 | 5.849 | 1.541 | 665 |
| **GDP per Capita ( Const. 2000 $)** | 6813.475 | 6357.378 | 5526.110 | 8556.938 | 1566.046 | 665 |

**Table A24: Descriptive Statistics Slovenia**

| Slovenia | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 17226864 | 1708000 | 0 | 1250000000 | 66436653 | 660 |
| **Sector-Wide Profit Ratio** | 0.488 | 0.417 | -0.779 | 1 | 0.341 | 667 |
| **Profits ($)** | 9127166 | 530594.200 | -8725078 | 1140000000 | 50479473 | 687 |
| **Sector-Wide Export Intensity** | 0.227 | 0.096 | 0 | 0.970 | 0.284 | 666 |
| **Sector-Wide Exports ($)** | 6233793 | 284633.300 | 0 | 224000000 | 17554861 | 666 |
| **Share of Foreign Ownership** | 0.123 | 0 | 0 | 1 | 0.265 | 686 |
| **Sector-Wide Skill Intensity** | 0.353 | 0.379 | 0 | 1 | 0.288 | 687 |
| **Sector-Wide Firm Age** | 2.829 | 2.674 | 0 | 5.209 | 0.808 | 686 |
| **Sector-Wide Firm Size** | 4.000 | 3.990 | 0 | 7.726 | 1.759 | 687 |
| **Number of FT Workers** | 109 | 16 | 1 | 3040 | 259 | 685 |
| **Sector-Wide Foreign Inputs** | 0.247 | 0.103 | 0 | 1 | 0.287 | 687 |
| **Sector-Wide Foreign Technology** | 0.018 | 0 | 0 | 1 | 0.110 | 686 |
| **Inflation (GDP Deflator, %)** | 5.349 | 4.124 | 3.271 | 8.652 | 2.892 | 686 |
| **GDP per Capita ( Const. 2000 $)** | 11883.751 | 11490.680 | 10324.383 | 13836.189 | 1788.595 | 686 |

### Table A25: Descriptive Statistics Tajikistan

| Tajikistan | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 1695600 | 150000 | 1000 | 154000000 | 9028251 | 601 |
| **Sector-Wide Profit Ratio** | 0.359 | 0.273 | -0.987 | 1 | 0.331 | 694 |
| **Profits ($)** | 852273.200 | 18000 | -4206140 | 153000000 | 7079699 | 736 |
| **Sector-Wide Export Intensity** | 0.081 | 0 | 0 | 1 | 0.221 | 692 |
| **Sector-Wide Exports ($)** | 236719.700 | 0 | 0 | 11446465 | 1017875 | 692 |
| **Share of Foreign Ownership** | 0.060 | 0 | 0 | 1 | 0.152 | 735 |
| **Sector-Wide Skill Intensity** | 0.300 | 0.312 | 0 | 1 | 0.270 | 736 |
| **Sector-Wide Firm Age** | 2.164 | 2.093 | 0 | 434.831 | 0.742 | 735 |
| **Sector-Wide Firm Size** | 3.932 | 3.892 | 0 | 7.467 | 1.257 | 736 |
| **Number of FT Workers** | 83 | 25 | 2 | 1750 | 186 | 730 |
| **Sector-Wide Foreign Inputs** | 0.181 | 0 | 0 | 1 | 0.287 | 735 |
| **Sector-Wide Foreign Technology** | 0.050 | 0 | 0 | 1 | 0.187 | 736 |
| **Inflation (GDP Deflator, %)** | 25.230 | 28.283 | 17.200 | 30.208 | 7.021 | 736 |
| **GDP per Capita ( Const. 2000 $)** | 201.906 | 197.307 | 152.156 | 256.256 | 52.202 | 736 |

### Table A26: Descriptive Statistics Ukraine

| Ukraine | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 10524080 | 400000 | 2000 | 3450000000 | 99180933 | 1440 |
| **Sector-Wide Profit Ratio** | 0.413 | 0.327 | -0.679 | 1 | 0.304 | 1838 |
| **Profits ($)** | 4150542 | 51300 | -1000000000 | 2520000000 | 67217821 | 1908 |
| **Sector-Wide Export Intensity** | 0.128 | 0.006 | 0 | 1 | 0.207 | 1838 |
| **Sector-Wide Exports ($)** | 3129156 | 5312.500 | 0 | 346000000 | 26964315 | 1838 |
| **Share of Foreign Ownership** | 0.130 | 0 | 0 | 1 | 0.231 | 1908 |
| **Sector-Wide Skill Intensity** | 0.418 | 0.501 | 0 | 1 | 0.261 | 1908 |
| **Sector-Wide Firm Age** | 2.465 | 2.404 | 0 | 4.682 | 0.732 | 1908 |
| **Sector-Wide Firm Size** | 4.642 | 4.845 | 0.693 | 8.972 | 1.531 | 1908 |
| **Number of FT Workers** | 129 | 22 | 1 | 9960 | 5.124 | 1902 |
| **Sector-Wide Foreign Inputs** | 0.268 | 0.161 | 0 | 1 | 0.291 | 1908 |
| **Sector-Wide Foreign Technology** | 0.077 | 0 | 0 | 1 | 0.173 | 1908 |
| **Inflation (GDP Deflator, %)** | 17.895 | 15.156 | 9.947 | 28.583 | 9.615 | 1908 |
| **GDP per Capita ( Const. 2000 $)** | 929.158 | 928.155 | 701.209 | 1158.111 | 228.452 | 1908 |

### Table A27: Descriptive Statistics Uzbekistan

| Uzbekistan | Mean | Median | Minimum | Maximum | Std. Dev. | Observations |
|---|---|---|---|---|---|---|
| **Sales ($)** | 119000000000 | 1405550 | 0 | 100000000000000 | 3440000000000 | 846 |
| **Sector-Wide Profit Ratio** | 0.504 | 0.491 | -0.543 | 1 | 0.339 | 898 |
| **Profits ($)** | 108000000000 | 118900 | -9700000000 | 100000000000000 | 3290000000000 | 926 |
| **Sector-Wide Export Intensity** | 0.055 | 0 | 0 | 1 | 0.172 | 895 |
| **Sector-Wide Exports ($)** | 13400000000 | 0 | 0 | 4000000000000 | 231000000000 | 895 |
| **Share of Foreign Ownership** | 0.117 | 0 | 0 | 1 | 0.211 | 926 |
| **Sector-Wide Skill Intensity** | 0.369 | 0.435 | 0 | 0.950 | 0.295 | 926 |
| **Sector-Wide Firm Age** | 2.465 | 2.485 | 0 | 4.644 | 0.784 | 926 |
| **Sector-Wide Firm Size** | 4.198 | 4.327 | 0 | 8.675 | 1.496 | 926 |
| **Number of FT Workers** | 119 | 20 | 2 | 6000 | 385 | 926 |
| **Sector-Wide Foreign Inputs** | 0.110 | 0 | 0 | 1 | 0.225 | 926 |
| **Sector-Wide Foreign Technology** | 0.033 | 0 | 0 | 1 | 0.163 | 926 |
| **Inflation (GDP Deflator, %)** | 26.910 | 19.892 | 15.648 | 45.190 | 15.972 | 926 |
| **GDP per Capita ( Const. 2000 $)** | 687.096 | 647.022 | 574.348 | 839.917 | 137.245 | 926 |