# Heterogeneous firms, mark-ups and income inequality

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# Heterogeneous firms, mark-ups and income inequality

Heterogene bedrijven, winstmarges en inkomensongelijkheid
(met een samenvatting in het Nederlands)

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Saara Tamminen
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# Chapter 1

# Introduction

This dissertation consists of three interlinked articles on firm heterogeneity, mark-ups and income inequality. I will first explain the background of the articles and topics in section 1.1. In section 1.2 I discuss the main research questions of the articles and their place in the literature. Section 1.3 provides an outline of the whole dissertation.

## 1.1 Background

In order to understand one of the main contexts of this dissertation - firm heterogeneity - we need to go back in time by some 20 years. Before micro databases on firms were available for research, economists simply used the assumption that within narrowly defined sectors, all firms are relatively similar. With the analyses of firm and plant level micro data this assumption was soon found to be unwarranted. For example, among the first to study differences between exporters and non-exporters within the same sector, Bernard et al. (1995) and Bernard and Jensen (1999) found that exporting firms in US manufacturing sectors are significantly different from non-exporting firms operating in the same sector. The broad literature on the topic after that has found that exporters and multinational firms are for instance larger, more productive, pay higher wages, do more R&D and have higher survival probability than firms engaged primarily in the domestic markets. Over

time, a whole new research field in the area of international economics has emerged along with the 'new new trade theory' that takes firm heterogeneity into consideration in the analysis of open economies. The literature on the topic is probably best known from the famous article of Melitz (2003).

Wagner (2012b), Bernard et al. (2012) and Greenaway and Kneller (2007a) provide excellent reviews on the different theoretical and empirical studies conducted on firm heterogeneity. The literature has concentrated especially on analysing how extensive firm heterogeneity is with regards to productivity, measured by sales per employee, value added per employee or total factor productivity. Another important research question has concerned why exporting firms are more productive. Most of the evidence indicates that initially more productive firms self-select into exporting instead of obtaining a productivity advantage via 'learning-by-exporting'. In addition to the productivity research, the literature has analysed especially wage differences, firm survival and the effects of importing, but to a lesser degree. Recently, the research efforts have extended towards analysing firms involved in foreign direct investments (FDI) and multinationals. To summarize, the empirical and theoretical literature in the field has researched how extensive firm heterogeneity is and whether it really matters. If it does, then how does it matter and why do we find these differences? Despite the increasing number of studies in the field, various questions are still open. I will explain some of them in more detail in section 1.2.

Firm heterogeneity affects directly among other things the effects of trade policies on countries. As highlighted by Melitz (2003), when trade costs decrease or a country opens to trade, the firms with the lowest productivity levels drop out of the competition and only more productive firms manage to continue in the tougher competition with foreign firms. However, firms provide also the basis for most people's income in terms of wage and capital income payments. As exporting firms pay higher wages than non-exporting firms, researchers have already wondered whether this affects the wage income inequality within-countries. The conclusion from various empirical and theoretical studies in the field is that according to expectation, trade opening does increase wage income inequality.

Wage income inequality is not the only form of income inequality that has increased during the last years. Empirical studies have emphasized also the role of top income earners (Atkinson and Piketty, 2007, 2010) and very recently the (once again) rising role of capital income and capital gains (Atkinson and Piketty, 2010, Roine and Waldenström, 2012, Biewen and Juhasz, 2010, and Chi, 2012) in the development of total income inequality within-countries, which has risen in the majority of countries (Harrison et al., 2011) over the last decades. The trends in between-countries income inequality and global income inequality have been more diverse. In addition to wage and total income inequality, capital income inequality seems to be also rising in various countries according to the above mentioned recent studies. At the same time, we have witnessed an extensive increase in the global flows of goods, services, capital and people.[1]

While the main emphasis of this dissertation is to study firm heterogeneity in mark-ups and profitability, and their link to income inequality, along the way we touch upon questions related to economic structures in general and the theoretical and applied modelling of economies. At least in the European Union area *ex-ante* policy analyses have become popular and they are typically conducted for all major policy changes. While *ex-post* studies of previous policy changes can provide some views on the possible effects of the future policy changes, most of the time theoretical and applied economic models are used for the occasion. For example, computable general equilibrium (CGE) models and microsimulation models have been particularly popular during the last years in the practical ex-ante assessments of different types of policies, including e.g. trade, fiscal and environmental policies. They take theoretical assumptions from microeconomic research on the behaviour of the different agents in the economy and use real data on economic structures to obtain estimates on the effects of policy changes. All theoretical and applied economic models are by default simplifications of the complex world around us and designed to provide us views on the possible

[1] See UNCTAD statistics on global values of goods and services trade (including tourism), and capital movements (`http://unctadstat.unctad.org`) and OECD statistics on migration (`http://www.oecd.org/statistics/`).

interactions in a subset of important elements. (Francois and Reinert, 1997) Nevertheless, the underlying assumptions in the models can affect the magnitude of the estimated impacts significantly. Therefore, the applied models' results are typically tested for the influence of the different assumptions and parameter values. For instance, Francois and Reinert (1997) and Roson (2006) show that there can be large differences in estimation results of trade policy impacts with an assumption of perfect competition in the markets versus with imperfect competition. Microeconomic analyses on the structures of the economy can help to adjust the assumptions and the behavioural responses in theoretical and applied models to correspond to empirical findings. As the results of our articles point out also some consequences for economic modelling, I will discuss these implications particularly in the conclusions, chapter 6.

## 1.2 Contributions to literature and research questions

Various empirical and theoretical studies have been dedicated towards the research on firm heterogeneity and its implications in the past decades. The research field is yet relatively new and lots of questions remain. The contributions and research questions of the empirical articles in this dissertation are presented first in this section, before the research questions of the theoretical article. However, for ease of reading, the second empirical article is located in practice in chapter 5, since it includes analysis based on the same theoretical model explained in detail in chapter 4.

With the empirical articles in chapters 3 and 5, we[2] contribute to the literature especially with regards to the scope of the analyses. The majority of studies until now have analysed only manufacturing sector firms that have at least 20 employees or goods exporters more in general due to data limitations. (Wagner, 2012b) On the contrary, we can extend the analyses

[2] The empirical articles are joint work with other researchers of the 'GAP Heterogeneity project' in order to obtain better quality, but with different co-authors.

to include also service sector exporters and micro-sized firms with less than 20 employees with Finnish firm level micro data.

First, very little research has been done on services exporters due to data limitations on their identification in most countries. At the same time, especially in advanced countries, most people work in the service sectors and professions and services contribute significantly more to GDP per capita than goods manufacturing. Global exports of services have been growing considerably during recent decades[3] and for example in Finland services exports were found to be less volatile during the most recent recession than goods exports (Newby and Suni, 2012). The few studies that have analysed service sectors in addition to manufacturing sectors have concentrated also on the analysis of possible productivity differences between exporters and non-exporters and the hypotheses of self-selection or learning-by-exporting. Furthermore, most of the empirical studies on service sector exporters have analysed only one or few service sectors. The results on productivity and wage differences between exporters and non-exporters in service sectors until now seem relatively similar to the results from manufacturing sectors. However, the number of studies is not yet high enough to make general conclusions. (Wagner, 2012b) Therefore, we provide a contribution to the literature by extending the analyses to include service sectors' exporters in addition to manufacturing exporters in chapters 3 and 5.

Second, most of the studies thus far have used data that include only firms with a minimum of 20 employees. According to the official EU classification of firms, this means that the smallest firms included are small, not micro-sized firms. However, recently especially in service sectors we have seen many examples of micro-sized firms establishing big innovations and growing consequently to a global market leader position in their field "out-of-nowhere" (often followed by larger firms buying these new contestants with a high cost). These examples include e.g. ITC-related firms such as Facebook, WhatsApp, Rovio with their Angry Birds and Youtube. Many other examples could probably be considered. In general, micro-sized firms

[3] Based on UNCTAD statistics: `http://unctadstat.unctad.org`

have been associated with a high rate of new product innovations (De Mel et al., 2009 and Booyens, 2011). Often, a new innovative business idea creates the entire firm. Accordingly, additional research on the performance of micro-sized firms and how internationalization affects it seems warranted. For example, Criscuolo et al. (2010) found that internationalization boosts the innovations of firms overall. If many micro-sized firms are already innovative, it could be considered that exporting will boost the innovations further and that micro-sized and small exporters will perform also better than domestic firms of the same sector and size category. On the other hand, especially fixed costs in the beginning of exporting can be a bigger burden for smaller firms than for larger firms, which renders the profitability effect of internationalization on micro-sized and small firms uncertain.

Third, in addition to the contributions in the scope of the analyses, we investigate firm heterogeneity within sectors empirically in areas that have been researched little or hardly at all until now. Namely, we analyse mark-ups', i.e. price-cost margins', variation within sectors in chapter 3 and profitability differences within sectors in chapter 5.

Mark-ups are important for two main reasons: i) they reflect market power and ii) they are linked to demand elasticities and therefore a key component of various theoretical and applied economic models. Mark-up differences between sectors and countries have been researched extensively, but mark-up variability within sectors between different types of firms has been studied only by De Loecker and Warzynski (2012) in addition to our analyses until now to the best of our knowledge. From a modelling point of view, empirical findings of similar mark-ups for different firms in the same sector indicate that models based on the Dixit Stiglitz framework may be suitable for policy analysis in that sector. In contrast, empirical findings of great variability in mark-ups within a sector indicate a need for policy analysis using a different (more complicated) framework. Provided that De Loecker and Warzynski (2012) found significantly different mark-ups between exporters and non-exporters within Slovenian manufacturing sectors, we continue the research on mark-up heterogeneity within Finnish manufac-

turing and service sectors with the following research questions in chapter 3:

**Research questions I:** *Do mark-ups vary significantly between different types of firms within sectors? Is the variation higher in some specific types of sectors and are there differences in the variance of mark-ups between manufacturing and service sectors in general?*

In addition to mark-ups, differences in profitability levels between firms within the same sector have been analysed surprisingly little due to data limitations and the few results until now yield inconclusive results. With the term profitability we refer to the ratio of profits divided by the value of sales or assets. Profit rate and profit margin are used as synonyms for profitability. Profitability indicators are crucial for firms since e.g. financial analysts use them to evaluate firm performance instead of trying to measure productivity like economists do (Robinson et al., 2012). This implies that information regarding firm profitability can affect the availability of funds to the firm and the survival of the firm. Further, low profitability levels have been associated with mass layoffs of employees and downsizing (Marques et al., 2011 and McKinley et al., 2000). Various theoretical and empirical studies implicitly or explicitly expect that the productivity premia of exporters translates into profitability premia for exporters as well (Wagner, 2012b), although these expectations are not derived from empirical findings or from other theoretical models at hand. Productivity is correlated with profitability, but various other factors affect profitability as well. Therefore, we cannot unconditionally extend the findings of the huge empirical literature regarding the relationship between productivity and internationalization to include profitability. We contribute to the literature by analysing the topic further with the following research questions in chapter 5:

**Research questions II:** *What kind of predictions do existing theoretical models derive of the effect of exporting on profit margins? Are there significant differences in the profitability measures of firms with different internationalization status and do these differences depend on the profitability measure used? Finally, do export starters convert to a different profitability growth path relative to continuing non-exporters?*

We add to the literature dealing with the relationship between profitability and internationalization both theoretically and empirically. Since there seems to be some confusion in the literature over the effects of internationalization on profit levels versus on profit margins, we also explicitly attend to the differential impact of internationalization on these two variables. In addition to analysing the topic with the Finnish database used in chapter 3 as well, we include also similar analyses with a separate Dutch firm level micro database to account for possible country specific effects.

Last, we link the analysis on firm heterogeneity and mark-ups to income inequality in the theoretical analysis of chapter 4. As mentioned earlier, recent empirical studies have emphasized the role of capital income, capital gains and top incomes earners in the development of total income inequality. However, only Egger and Kreickemeier (2012) analyse theoretically the effects of trade on both profit and wage income distributions within the same framework. The other theoretical models linking trade to income inequality have focused mostly on the effects of trade on wage inequality (Egger and Kreickemeier, 2009, Helpman et al., 2010 and Basco and Mestieri, 2013) or only on capital income (Foellmi and Oechslin, 2010). Especially capital income payments depend on the mark-ups that firms can charge over their variable production costs and on the profitability of the firms in general. Various other factors can also affect the final level of capital income payments to owners and shareholders, but the mentioned two form predominantly the basis for the payments.

While most of the assumptions in the Egger and Kreickemeier (2012) framework match empirical findings, they have assumed that mark-ups remain unchanged from autarky to open economy. This assumption is in

contrast with recent empirical findings on the effect of trade on demand elasticities and mark-ups and on the endogenous mark-up assumption in various other models. Hence, we continue the analysis with the following research questions in chapter 4:

**Research questions III:** *What kind of theoretical effects does an increase in competition, and subsequent decrease in mark-ups, have on the distributions of profit and wage income, on their relationship and on the unemployment rate? How large are these effects?*

Thus, we contribute theoretically on the analyses of the mechanisms behind the increases in within-country total income inequality, consisting of both wage and capital income inequality. We provide a small expansion to the theoretical analysis of Egger and Kreickemeier (2012) by allowing mark-ups to change after a country leaves autarky in their framework. This way we can analyse both the effect of a competition increase and the effect of trade opening on income inequality indicators in an open economy.

To summarize, in this dissertation we research empirically the extensiveness of firm heterogeneity in mark-ups and profit margins within sectors, and analyse theoretically whether mark-up change affects different income inequality measures.

## 1.3 Outline of the Dissertation

Relating to the need to study better especially service sector exporters and services exporters in general, as mentioned in the previous section, we had to first construct a micro database for the analyses. We found that a Finnish database provided by the tax authorities enables the identification of exporters in both manufacturing and in service sectors. In addition, the database includes all Finnish firms so that also micro-sized and small firms can be analysed with it. Chapter 2 provides an explanation on how the database was constructed, what it includes and how service sector exporters in particular are identified with it.

Chapter 3 re-prints[4] the first article of the dissertation. The article analyses the variability of mark-ups in 70 Finnish sectors, including both manufacturing and service sectors. First, we analyse the extent of mark-up variability within sectors and examine whether the data support modelling with a constant mark-up or not. We do this by using non-parametric tests (mainly Kolmogorov-Smirnov (K-S) tests, Welch's t-tests and cumulative probability function analyses) to identify differences in mark-up distributions for various types of firms in each sector and by analyzing differences in coefficients of variation. Thus, we investigate the whole distributions instead of focusing on a single statistic (e.g. the average). Secondly, we perform random effects panel regression on the coefficients of variation and panel probit regression with random effects on the K-S test results to see if we can find any sector characteristics to correlate with larger mark-up heterogeneity. We do this in order to see if mark-up variability is particularly related to some specific types of sectors.

Chapter 4 presents the article on the theoretical effects of a mark-up decrease on different income inequality measures and on unemployment rate. The article is based on the Egger and Kreickemeier (2012) general equilibrium framework. Since the same model is used later on in chapter 5 as well, chapter 4 is presented first for ease of reading.

We present first the main mechanisms of the model in section 4.3. In addition, we explain in the same section the original findings of Egger and Kreickemeier (2012) on the effect of trade opening on the various indicators in the model. We continue by explaining what happens in the model if elasticity of demand increases and mark-ups decrease. Comparative statics and numerical analyses are provided in the appendixes to prove the effects. In addition to explaining the impacts theoretically, we provide some parameterisations so that the magnitudes of the different changes on the indicators' values can be compared.

In chapter 5 we continue with analysing the relationship between profitability and internationalization both theoretically and empirically. While

[4] The chapter is based on a paper that is published.

the non-parametric analyses in chapter 3 reveal sector specific differences in mark-up variability, the results do not take in to consideration the possible firm-specific factors (such as quality of products and management structure) that can affect the results. Therefore, we continue the analysis on firms' revenue-cost-structure differences with other methodologies. Mark-ups are closely linked to the profit margins of firms. In addition, as mentioned, profitability indicators are used by investors and business analysts as one of the main performance measures.

We proceed in three steps. First, we derive predictions from existing theoretical models on the effect of exporting on profit margins. While existing models generally provide the necessary ingredients for this analysis, profit margins have not been made explicit yet. Second, we investigate the relationship between internationalization and profit rates empirically with pooled OLS-regressions and fixed effects panel regressions with data from Finland and the Netherlands. We conduct separate analyses for different firm size classes and for manufacturing, wholesale & retail trading and service sectors. We use four different profitability measures (gross profit margins, net profit margins, return on assets (ROA) and gross profits per employee) to gain an understanding of the robustness of our findings to the choice for a particular profitability measure. However, since we have no good instrumental variable for exporting, the regressions provide us mere correlations not causality. Therefore, in the last step we employ propensity score matching (PSM) to investigate if export starters convert to a different profitability growth path relative to continuing non-exporters. The objective of this procedure is to construct the non-observed counterfactual by matching each export starter (a 'treated' firm) to a firm from the control group (continuing non-trader, an 'untreated' firm) based on similarity of firm characteristics before the treatment.

Chapter 6 includes a summary of the main findings, but also a discussion on the policy and research implications of the results. Furthermore, I provide some general suggestions for future research in section 6.3 besides the chapter specific discussions on future research. The appendixes of each chapter are presented after the conclusions.

# Chapter 2

# Data

## 2.1 Databases used

The Finnish empirical analyses in chapters 3 and 5 are based on the same, exhaustive firm level micro database provided by the Finnish tax authorities. The main tax database includes all information included in corporate tax declarations and in income tax declarations of entrepreneurs for each Finnish firm in each year. In other words, the database covers all Finnish firms operating in all sectors. The main tax database contains large amounts of data for each firm at very detailed levels including for example: the legal form of the firm, main sector of business, all financial accounts information (e.g. total revenue, profit/loss of the accounting period, salary costs, intermediate product costs, depreciations and amortizations, changes in assets' values, financing costs and various other detailed cost categories) and all balance sheet information (e.g. values of different types of capital assets, own capital, and debt). Consequently, the database provides an ideal information source for the analyses of mark-ups and profit margins at firm level.

In chapter 3 the data are analysed from the year 2005 until 2009, while for the second article in chapter 5 data from the year 2010 had arrived and were included in the analyses. The year 2005 was taken as the start year since from that year onwards information could be obtained on the export status of the firms.

In addition to the main database, Value Added Tax (VAT) records are used for the identification of exporters. One of the main strengths of the database is the possibility to study service sectors' exporters with it in addition to exporters in manufacturing sectors.[1] See section 2.2 for more information on the methods to identify the export status of manufacturing and services firms. In addition, the database allows the identification of multinational firms from information on foreign affiliates and from the legal form of the firm.

The firms are classified into four size categories according to the official EU-classification.[2] The number of firms and self-employed included in the database is between 200,000 and 250,000 per year in total. However, self-employed and firms with less than 4 employees had to be dropped from the analyses due to doubts on the reliability of their data.[3] The decision to limit the samples was tested not to affect the main results, but it did bring down the variances of all indicators for micro-sized firms. In addition, the data were carefully checked for reporting errors and some unreliable seeming observations were dropped from the analysis.[4]

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[1] Statistics Finland provides also a micro database with firm level data, which relies similarly strongly on the tax data with some additional information collected with surveys. However, that database does not allow research on services exporters since only information on goods trade can be included in it. Therefore, the original tax database is preferred as a data source.

[2] Firms are classified into four groups: micro (less than 10 employees), small (10-49 employees), medium (50-249 employees), and large (at least 250 employees) firms according to the definitions of the European Union ( see http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/).

[3] Finnish tax legislation provides an incentive for owners of small firms to artificially increase the pre-tax profits of the firm in order to obtain lower taxation on their income, since profits have been taxed less heavily than wages. This renders the profit information of the smallest firms difficult to compare with larger firms. However, most micro-firms have an equal incentive to do so which renders comparing domestic and exporting micro-firms still feasible. In addition, the variation in the data for firms with less than 4 employees is very high. For example, the coefficient of variation in mark-ups for micro-size firms is 6.1 if all firms reporting non-zero variable costs are included in the sample and 2.6 if firms with less than 4 employees are dropped.

[4] Around 0.3 percent of the annual observations were dropped mainly due to a reported export value that was bigger than total sales value.

The firms are grouped into 70 sectors (see tables 3.1 and 3.2) corresponding roughly to NACE 2-3 digit classifications from the original 5-digit level TOL[5] sector codes included in the database. These 70 sectors include the most important activities in the Finnish economy. The sectors are grouped to as low NACE levels as possible in order to include only firms with relatively similar production structures (incl. capital-labour ratios) and end products together, while keeping the group sizes large enough for statistical analyses. In more aggregated levels, the firms could be already too heterogeneous for a meaningful analysis of within sector heterogeneity. Unfortunately, the number of observations per year is relatively low in some sectors at such disaggregated levels. Therefore, in chapter 3 we pooled the observations of each sector from all the five years under study for the non-parametric distribution analyses (except for K-S tests). This way, the possible annual fluctuations in the mark-ups, caused by business cycles, are also balanced.

Since services and manufacturing exporters have typically significantly different types of production processes, manufacturing sectors and service sectors are considered separately. Firms classified to NACE, rev.2, sectors from A to E are grouped to the manufacturing sectors. Exporters identification is possible only in selected service sectors due to data limitations and firms belonging to the other service sectors were not included in the analyses in chapter 5. On the contrary, in chapter 3 some analyses were conducted also for those service sectors, where export status of firms could not be identified. See 2.2 for a detailed explanation on the identification of services exporters from the VAT data and for the service sectors included in the analyses in chapter 5. In addition, we exclude completely not-for-profit sectors from the analyses.

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[5] The 5 digit codes follow the Finnish Standard Industrial Classifications (TOL) 2002 and 2008, which is based on NACE classifications. TOL 2008 codes were transformed to TOL 2002 codes following the correspondence tables provided by Statistics Finland. See `http://www.stat.fi/meta/luokitukset/toimiala/001-2008/index_en.html` for more information on the TOL codes. The 70 sectors used correspond to the industry groups in the Finnish VATTAGE applied general equilibrium model, so that the results of especially chapter 3 could be used in practical policy analysis work as well.

Table 2.1 shows the number of firm observations in total (i.e. observations with data in the main tax database and in VAT records, but excluding self-employed) versus the sub-samples used in the two articles per firm size category. In chapter 3 all firms in all sectors with a minimum of 4 employees are used as the sample. In chapter 5 only firms in manufacturing sectors and in the service sectors included in table 2.2 with a minimum of 4 employees are used in the analyses. One observation accounts for one firm recorded in one year. The number of employees included in the larger sample used in chapter 3 covers around 66-69 percent of total employment[6] in Finland.

Table 2.1: Number of observations in used samples

| | Chapter 3, data from 2005-2009 | Chapter 4, data from 2005-2010 |
|---|---|---|
| All observations available | 715,390 | 964,570 |
| Used samples including only firms with a minimum of 4 employees: | | |
| - All observations in total | 266,640 [1)] | 122,620 [2)] |
| - Micro firms (4-9 employees) | 136,170 | 57,330 |
| - Small firms (10-49 employees) | 107,410 | 49,870 |
| - Medium sized firms (50-249 employees) | 18,870 | 12,240 |
| - Large firms (more than 240 employees) | 4,200 | 3,180 |

*Notes*: [1)] Includes firms from all sectors that have observations in the main database and in the VAT records.
[2)]Includes only firms from manufacturing sectors and the selected services sectors, where firm's export status could be identified. See section 2.2.

## 2.2 Identification of exporters

Value added tax (VAT) records are included in a separate database, but also provided by the Finnish tax authorities. They include the value of goods exports and imports by firm, to and from other EU-countries. In addition, they account for other VAT free sales' value, which do not fall under the Finnish VAT obligation. The VAT free sales include: exports to non-EU

[6] Based on total number of 15-74 year old workforce in Finland between 2005-09 (Statistics Finland).

countries, all exports of services[7], sales of subscribed newspapers, sales of water transportation services and changes in stocks of a few other products (affects mostly wholesale and retailers).[8] Accordingly, when we exclude the data for water transportation, newspaper, wholesale and retailer service sectors, we have information on the status of the firms' services and goods exports in some service sectors. However, the selling/consumption based rules on VAT obligation in services trade need to be acknowledged as well (Verohallinto, 2009). Table 2.2 presents the final list of service sectors where each firms' exporting status can be identified from the VAT records. VAT records were used also by Borchsenius et al. (2010) for the identification of services exporters.

The General Agreement on Trade in Services (GATS) of World Trade Organisation (WTO) classifies four main distribution modes for trade in services:

1. mode: Cross-border supply;
2. mode: Consumption abroad;
3. mode: Commercial presence; and
4. mode: Presence of natural persons.

The VAT free sales can include exports of GATS trade in services modes 1, 3 and 4, while mode 2 services are mostly taxed in Finland and therefore VAT free sales do not account for them (Verohallinto, 2009). As a result, the identification of services exporters can be slightly underestimated. However, as mode 2 trade in services takes place in the reporting country, where the buyer arrives, it could be considered that companies involved only in mode 2 of services trade are not extremely different from domestic companies.

The coverage of exporters' identification with the VAT records was compared to the official trade statistics. The export and import figures for

[7] Until the year 2009, from the year 2010 onwards services exports to EU-countries are reported separately in the database.

[8] Finnish tax authority, Extended VAT reporting directions: `www.vero.fi`

manufacturing goods cover between 96 to 100 percent of the official statistics. Service sectors' exports cover between 44 to 70 percent of the official services exports according to Statistics Finland, since the identification of services exporters is possible only in selected service sectors. (Tamminen and Chang, 2012)

Finally, all firms were classified to one of the following main groups: domestic firms, (EU) importers, exporters, exporter-importers or services exporters according to the rules presented in table 2.3. In addition, in chapter 3 an alternative grouping for manufacturing firms was used occasionally, presented in table 2.3 under the dashed line. For service sectors the same grouping was used in both chapters.

Table 2.2: Services sectors in which exporters could be identified and average statistics from 2005-2010

| Sector code | Industry | Total no. of observations* | Average share of exporters in the sector, % |
|---|---|---|---|
| 62 | Air transport | 99 | 73 |
| 65 | Financial services | 1733 | 25 |
| 66 | Insurance services | 129 | 11 |
| 71 | Renting of machinery and equipment | 1564 | 32 |
| 72 | Computer and related services | 8946 | 43 |
| 73 | Research and development | 781 | 56 |
| 90 | Environmental services | 1465 | 16 |
| 527 | Repair of household goods | 865 | 24 |
| 633 | Other transport and travel services | 1848 | 40 |
| 641 | Post and courier activities | 514 | 21 |
| 642 | Telecommunications | 898 | 34 |
| 672 | Activities auxiliary to financial intermediation | 1127 | 26 |
| 673 | Activities auxiliary to insurance services | 197 | 16 |
| 741 | Legal, accounting, business services | 13485 | 30 |
| 742 | Architectural and engineering serv. | 10900 | 31 |
| 743 | Technical testing services | 797 | 47 |
| 744 | Advertising services | 3635 | 37 |
| 745 | Job agencies | 2977 | 20 |
| 746 | Security services | 840 | 15 |
| 747 | Cleaning services | 3625 | 10 |
| 748 | Other business services | 5118 | 37 |
| 9214 | Entertainment and news services | 2518 | 37 |

*Notes*: * All observations from firms with a minimum of 4 employees.

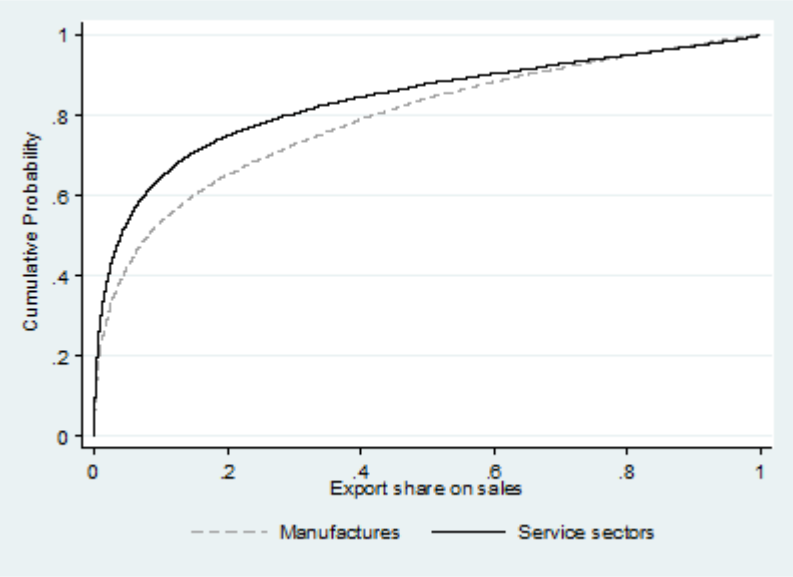
Table 2.3: Classification rules for determining the export status of firms

| | Goods sales to the EU, value EUR | Goods imports, from the EU, value EUR | VAT free sales, value EUR | Aggregated classification |
|---|---|---|---|---|
| **Manufacturing sectors** | | | | |
| 1. Domestic | 0 or missing | 0 or missing | 0 or missing | 1. Domestic |
| 2. Importer | 0 or missing | >0 | 0 or missing | 1. Domestic |
| 3. Exporter | >0 or total exports>0 | 0 or missing | >0 or total exports>0 | 2. Exporter |
| 4. Exporter and importer | >0 or total exports>0 | >0 | >0 or total exports>0 | 2. Exporter |
| (1. Domestic) | 0 or missing | 0 or missing | 0 or missing | 1. Domestic |
| (2. Importer) | 0 or missing | >0 | 0 or missing | 1. Domestic |
| (3. EU Exporter) | >0 | 0 or missing | 0 or missing | 2. Exporter |
| (4. EU Exporter and importer) | >0 | >0 | 0 or missing | 2. Exporter |
| (5. Non-EU Exporter) | 0 or missing | >0 or 0 | >0 | 2. Exporter |
| **Services sectors*** | | | | |
| 1. Domestic | 0 or missing | 0 or missing | 0 or missing | 1. Domestic |
| 2. Importer | 0 or missing | >0 | 0 or missing | 1. Domestic |
| 6. Services exporter | >0 or total exports>0 | 0 or > 0 | >0 or total exports>0 | 2. Exporter |

*Notes*: * The firm must belong to one of the services sectors included in table 2.2.

No minimum share of exports on turnover was set for the classifications. As Figure 2.1 shows, both in the manufacturing and in service sectors the share of exports on turnover is relatively small for the majority of firms. This means that any minimum level requirement on the share of exports on turnover would drop a significant number of the exporter observations. Around 22 percent of exporting manufactures and 21 percent of services exporters report export sales that contribute to less than 1 percent of their total sales. Nevertheless, the share of exporters that export large percentage of their total turnover is rather high in Finland in comparison to other countries. For around 60 percent of manufacturing exporters the total value of exports is over 5 percent of turnover. Only around 40 percent of exporters in Germany and France enjoy this level of exports to turnover (Mayer and Ottaviano, 2008).

Figure 2.1: Share of exports in turnover, averages over 2005-2009



# Chapter 3

# Firm and sectoral heterogeneity in mark-up variability *

## 3.1 Introduction

Heterogeneity in general brings variety to life, but large heterogeneity among people or firms provides problems for policy makers. In the past 15 years economists have uncovered evidence that firms within a sector can vary significantly in production structure, productivity, and paid wage rates, see Wagner (2012b) for a recent overview. Exporters and large firms often have higher productivity levels than domestic firms and small firms. Differences in productivity levels between exporters and non-exporters within a sector are largest in countries with low export participation rates, restrictive trade policies, low GDP per capita levels, and ineffective regulatory environment. All these aspects are characteristics of the developing countries, such that we expect firm heterogeneity to be larger in developing than developed countries.

* The chapter is based on joint research with Han-Hsin Chang. This work is published as: Tamminen, S. & Chang, H.-H. (2013): Firm and sectoral heterogeneity in markup variability, Journal of International Trade and Economic Development, 22(1), 140-159.

We study firms' mark-ups of price over marginal costs within various manufacturing and services sectors for two main reasons: (i) mark-ups are an indicator of market power[2] and (ii) mark-ups are directly linked to demand elasticities.

Ad (i). Economists and policy makers alike are interested in assessing the degree of competition in a market and the effects of various industrial and trade liberalization policies on market power. In industrial organization (IO) studies, the wide variation of mark-ups between industries has long been recognized. This literature suggests that the degree of market power depends on market structure.[3] Only when market competition is "perfect" will the price be equal to marginal costs. Deviations from perfect competition may arise from scale economies, a limited number of firms active in a market, product differentiation, industry (trade) policy, etc. Product differentiation, for example, may explain how small firms are able to remain profitable while producing at a less efficient scale than large firms. In the beer industry, for example, small brewers can have higher per unit costs than large producers such as Heineken, but are able to survive by charging higher prices and catering to specific consumer tastes. We thus expect differences in mark-ups for firms of different size. Moreover, since services firms tend to have larger product variation (catering to specific client needs), we expect larger mark-up heterogeneity for services sectors.

Ad (ii). Mark-ups are directly linked to demand elasticities and are thus a fundamental component of economic models. The new trade, new economic geography, and heterogeneity literature is largely based on the Dixit and Stiglitz (1977) monopolistic competition framework.[4] In this setting all firms have the same (constant) mark-up of price over marginal costs, irrespective

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[2] Konings et al. (2001, 2005); Chen et al. (2009); Abraham et al. (2009); Navas and Licandro (2011).

[3] Pepall et al. (2008), Andreosso and Jacobson (2005), Dunn (2002), Martin (2001), and Sutton (2001).

[4] See Krugman (1980), Krugman (1991), Ethier (1981), Melitz (2003), Helpman et al. (2004), Yeaple (2005), and Helpman (2006).

of firm size.[5] A minority of other studies, such as Bernard et al. (2003), Ottaviano et al. (2002) or Melitz and Ottaviano (2008), analyse a framework in which mark-ups vary between firms. From a modelling point of view, empirical findings of similar mark-ups for different firms in the same sector indicate that models based on the Dixit Stiglitz framework may be suitable for policy analysis in that sector. In contrast, empirical findings of great variability in mark-ups for firms in a sector indicate the need for policy analysis using a different (more complicated) framework.

Some recent studies analyse the effects of trade liberation on mark-up distributions between sectors, while other studies focus on the determinants of mark-up distributions. In both cases important factors for differences in mark-ups are market share, expansion plan, production capacity utilization, labour productivity, trade openness, union power, market concentration, capital intensity, technology level, and R&D investment requirements.[6] These explanations can all be directly or indirectly linked to the IO or new trade literature.

We have detailed information available for virtually all firms and sectors in Finland, a high-income advanced economy. We analyse the variation in mark-ups for different types of firms within and between sectors and characterize the differences we find. On occasion, we speculate on the implications of our findings for developing countries. In contrast to the constant mark-up hypothesis, we find (i) large differences in mark-ups within sectors, (ii)

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[5] Mark-ups are endogenously determined in the Dixit Stiglitz framework, but they are constant for all firms if there are sufficiently many firms active in a sector and an individual firm's market power is small, see Yang and Heijdra (1993) and Dixit and Stiglitz (1993). In practice, researchers assume these conditions to be fulfilled and impose the same mark-up for all firms in a certain sector, irrespective of firm size or efficiency. van Marrewijk (2012, p. 209) suggests that about 20 firms or more in the Dixit Stiglitz framework already suffices in this respect.

[6] Explanations for mark-up heterogeneity include: trade openness (Chen et al., 2009; Epifani and Gancia, 2011), union power (Abraham et al., 2009;), market concentration (Machin and van Reenen, 1993; McDonald, 1999; Lima and Resende, 2004), capital intensity (Feeny et al., 2005; Ponikvar and Tajnikar, 2011), technology level and (sunk) R&D investment requirements (Konings et al., 2001). Empirical studies related to efficiency wage theories have found evidence on large differences in wages and rent sharing within industries (e.g. Krueger and Summers, 1988), which can affect mark-ups.

higher mark-ups for small firms and domestic firms, and (iii) higher variation in mark-ups in sectors with low capital-labour ratios and a large number of firms active in the sector. We contribute to the existing literature in three ways.

First, we analyse the extent of mark-up variability within sectors and examine whether the data supports modelling with a constant mark-up or not. We do this by calculating the mark-up distribution per sector and analysing differences in correlation coefficients. We use non-parametric tests to identify differences in mark-up distributions for various types of firms in each sector, thus investigating the whole distribution instead of focusing on a single statistic (e.g. the average). In addition, we examine how establishment's size and a firm's export status can explain the within sector heterogeneity as suggested by the IO and new trade literature.

Second, we characterize the factors that influence the degree of mark-up variation between sectors. Sectoral characteristics, such as market concentration and trade openness, are associated with the degree of mark-up heterogeneity between sectors. This also allows us to control for factors that could affect our non-parametric results.

Third, our dataset is virtually complete and covers all firms in the Finnish economy.[7] This allows us to give a complete characterization of differences in mark-ups and the factors influencing these. In particular, we include both manufacturing and service sectors and firms of all size, in contrast to the existing literature which focuses on manufacturing sectors only for medium and large size firms.[8]

The purpose of our research is to provide a better understanding of the extent of mark-up heterogeneity within and between sectors. We argue that if significant mark-up heterogeneity is found in Finland, it is likely that the extent of mark-up heterogeneity is even greater in less developed countries. It is frequently observed that technology and capital intensity levels adopted

[7] The underground economy is, of course, not included. Its size in Finland is estimated to be about 18 percent. The size of the underground economy in developing countries is about twice as high (Schneider et al., 2010).

[8] See the literature mentioned in footnote 6.

by firms in less developed countries differ significantly. For example, labour intensive farming and (foreign owned) technology intensive plantation often coexist in countries like Brazil, India and Mexico. In addition, less concentrated markets, limited or restricted trading opportunities, and unequal provision of infrastructure across regions in less developed countries can limit the competition intensity between firms and result in greater observed mark-up heterogeneity. Our research finds that many of these factors influence the degree of mark-up variability. Since Finland has a high export participation rate[9], open EU trade policies, a high level of GDP per capita, and an effective regulatory system (World Bank, 2012, DB), the mark-up variability we find in this paper could be considered a lower bound of what to expect in a developing economy.

The data used for the analysis was described already in chapter 2. Section 3.2 presents the methodology for the calculation of mark-ups, section 3.3 explains the statistical methodologies used in the analyses, section 3.4 provides the results of the analyses on the differences in mark-up variability per sector, and section 3.5 concludes.

## 3.2 Calculation of mark-ups

### 3.2.1 Theory

A large amount of literature has been devoted to the development of techniques to calculate unbiased mark-up estimates. The production function framework developed by Hall (1988) induced a stream of empirical research[10] with modified approaches to estimate mark-ups from production data. The estimations based on the production function framework rely on detailed price and quantity information and on data covering various input costs, which are often unavailable at firm level. In addition, the estimations provide only information on the average mark-ups per sector or per firm type

[9] See section 2.2.

[10] See Levinsohn (1993), Harrison (1994), Roeger (1995), Konings and Vandenbussche (2005), Moreno and Rodriguez (2010), De Loecker and Warzynski (2012).

instead of information on the distributions. They also often suffer from endogeneity problems due to unobserved factors in the specification that have an impact on output growth. Accurate calculations of services sector outputs would be a challenge as well and they have mostly been neglected so far. As the focus of this paper is not on methodology improvement, we apply a straightforward definition of mark-up to insure result tractability. We argue that with sufficiently detailed data on firms' cost structures, this simple method can provide an adequate approximation of mark-up heterogeneity within sectors.

Our empirical approach is based on two fundamental equations, namely the firm's profit function and the equation that links price with variable cost. Based on cost accounting, the cost function is defined to include two main parts: fixed and variable costs, of which only the latter is changing proportionate to the output quantity produced. Firm profits are equal to the difference between revenue from sales and total costs, as defined in equation 3.1. The total revenue is equal to the product of unit price and quantity sold. The last equality again shows that the total variable cost is equal to the product of per unit variable cost and quantity sold. We denote profit of firm $i \in I_j$ in sector $j \in J$ as $\pi_{ij}$, sales as $S_{ij}$, total costs as $TC_{ij}$, price as $p_{ij}$, quantity sold as $x_{ij}$, total fixed and variable cost as $F_{ij}$ and $V_{ij}$, and per unit variable costs as $c_{ij}$. Notice that the per unit variable costs here represents the firms' constant input investment for production of one unit of output, which is relatively stable in the short-run. The relationship between the price and variable costs for each unit of output is as in equation 3.2. It shows that each firm charges a mark-up rate $1 + \mu_{ij}$ over its variable costs $c_{ij}$.

$$\pi_{ij} = S_{ij} - TC_{ij} = p_{ij}x_{ij} - \left(c_{ij}x_{ij} + F_{ij}\right) = p_{ij}x_{ij} - \left(V_{ij} + F_{ij}\right) \tag{3.1}$$

$$p_{ij} = \left(1 + \mu_{ij}\right) c_{ij} \tag{3.2}$$

The main problem faced in empirical estimations of mark-ups is that we often do not observe the quantities individual firms produce, nor the individual unit prices or the per unit variable costs a firm bears. We define mark-up

as the difference between product price and unit variable cost relative to the unit variable cost (equation 3.3). By multiplying both the denominator and nominator by the quantity produced, empirical estimation difficulties can be overcome with the availability of information on the aggregated sales and total variable costs. This information combined is sufficient to calculate the key variables of interest: the firm specific mark-ups.[11]

$$\mu_{ij} = \frac{p_{ij} - c_{ij}}{c_{ij}} = \frac{p_{ij} - c_{ij}}{c_{ij}} \frac{x_{ij}}{x_{ij}} = \frac{S_{ij} - V_{ij}}{V_{ij}} = \frac{\pi_{ij} + F_{ij}}{V_{ij}} \tag{3.3}$$

Bresnahan (1987) noticed that there is no stable connection between firms' reported annual profits and their actual mark-up. This observation is rectified with our methodology since the mark-up estimates include fixed costs within the mark-up ratio and all the firms within narrowly defined sectors can be assumed to face the same business cycle. In addition, it should be also noted that mark-ups calculated according to our specification are not affected by inflation.

### 3.2.2 Calculation of variable and fixed costs

Data used for the analysis of mark-ups is described in chapter 2. In order to calculate the mark-ups in practise, information on firm specific fixed costs is required. We calculate first the total costs of each firm after which the costs are split into two parts, the variable costs and fixed costs. This division is based on the assumption that only variable costs vary proportionately to the level of output within a period of one year - the standard reporting period in Finland. The following specifications on total costs and variable costs were made in line with the Finnish and international accounting specifications:

- Total costs = all revenues – profits (or + losses);

[11] This definition of mark-ups is very close to the definition of gross profit margin used in chapter 5. The main difference is that here we relate gross profits to variable costs and in chapter 5 gross profits are divided by total revenue to obtain a measure for gross profit margin.

- Variable costs: salary costs, intermediate input costs (goods), changes in stocks, outside services costs, incidental expenses, representation costs, and leasing costs and office rents[12]; and
- Fixed costs = total costs – variable costs.

Fixed costs calculated this way consist mainly of depreciations, changes in capital assets values and interest payments on loans. Recognising that especially asset value fluctuations can impact the fixed costs heavily in public limited firms (whose shares are traded in the stock markets), we control for this potential source of variation in the regression analyses by taking into account the average value of stock assets in all equity. The shares of labour costs and intermediate input costs that could be considered as fixed costs differ also between firms, depending on their organisational structures. While we cannot correct for these potential sources of measurement error in the non-parametric tests, we can control for them in the regression analyses that analyse the correlation of sectoral characteristics with the within sector mark-up heterogeneity. In practise, we use data from the national accounts of Statistics Finland on the share of employees at management level positions[13] out of the total number of employees at each sector to control for the potential fixed labour costs.

Since there are only a few multinationals operating in most of the sectors at each year, we include only the comparison of mark-up distributions by size categories and by export status in the analyses. These two dimensions provide relatively straightforward ways to group firms and allow us to compare our results to earlier studies in which these categories have been used extensively (Mayer and Ottaviano, 2008, Wagner, 2012b).

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[12] Some of the leasing and rental costs might be in practice fixed costs. However, most leasing and office rental agreements in Finland are nowadays made for relatively short time periods or can be terminated on few months' notice. Leasing costs are, again, mostly based on actual consumption.

[13] This includes employees under group 1 of the 10 main occupation groups used by Statistics Finland.

## 3.3 Statistical methodologies

### 3.3.1 Methodology for the analysis of distributions

For the analyses of mark-up distributions, we use non-parametric methods. First, we measure the general variation of the firm specific mark-ups with coefficients of variations ($CV_{jt}$) in each sector $j \in J$ at time $t \in T$ . Coefficient of variation is a normalized and dimensionless measure on the dispersion of a distribution. It is not affected by large differences in the mean levels of mark-ups or by standard deviations that increase proportionate to the level of the mean.

Second, we analyse whether the mark-up distributions of different types of firms within each sector are significantly different from each other. We use Kolmogorov-Smirnov (K-S) tests to measure whether there are significant differences in the mark-up distributions of different types of firms. In addition, Welch's t-tests, cumulative probability function analyses and Kruskal-Wallis (KW) equality-of-populations non-parametric test are used to analyse whether either of the distributions in the comparison pair stochastically dominates the other. Welch's t-tests are used in sectors with high levels of observations for all different firm type categories. The other tests are used next to the K-S tests in sectors with few observations.[14] According to the central limit theorem, t-tests provide valid results even if the distributions tested are non-normal, as long as the number of observations is sufficiently high.[15]

In the K-S tests, under the null hypothesis the two samples are from the same underlying distribution, i.e. the mark-ups can be assumed homogenous. These non-parametric methodologies for distributions analyses were used also by Delgado et al. (2002). To perform the K-S test, the observations in the different groups should be independent. Therefore we perform these

[14] Since the K-S tests are already sensitive to both the location and to the shape of the distributions, the KW tests do not report significant differences in the medians at any time when the K-S test reports no significant difference in the distributions. Hence, the KW test results are not explicitly reported.

[15] Usually around 80 observations per type is considered enough (Ratcliffe, 1968).

tests for each year separately and use the average of the five yearly p-values to reflect whether the homogeneity assumption is rejected at most years or not. The t-tests are done with pooled data (see chapter 2).

### 3.3.2 Methodology for the regression analyses

For empirical and theoretical model developers it is not only relevant to know whether the mark-ups (or demand elasticities) are heterogeneous within sectors, but also to see in what types of sectors heterogeneity is found. In case some specific sector characteristics can be concluded to correlate with heterogeneous mark-ups, it will be easier to account for them. With regression analyses we can also control for possible measurement errors related to our mark-up calculation methodology. These are discussed in detail in section 3.2.2.

The regression analyses are done with two main specifications. In the first one we analyse in what type of sectors the within sector mark-ups vary the most. In this regression, the coefficients of variation ($CV_{jt}$) are regressed on various sectoral characteristics ($X_{jt}$) using random effects panel regression with robust standard errors (equation 3.4). The selection of random effects is based on Hausman-test statistics. The sectoral characteristics include: the average export share in turnover, log of capital -labour ratio, average size of firms in terms of employees, total number of firms, Herfindahl index on market concentration, average share of management level employees, and average share of tradable stocks in the total value of equity. Summary statistics for these variables can be found in appendix A.1.

$$CV_{jt} = X_{jt}^{'}\beta + \varepsilon \tag{3.4}$$

In the second part, we perform panel probit regressions with random effects on the K-S test results on mark-up distributions similarity. We base these regressions on the p-values of the non-parametric K-S distribution tests of each sector at each year. The dependent variable is one if the K-S test result suggests the two distributions to have significantly different underlying distributions. We perform separate regressions on the probability

of finding heterogeneous mark-ups between firms of different size and on the probability of finding heterogeneous mark-ups between domestic and exporting firms.

$$Y_{jt} = X_{jt}^{'}\beta + \varepsilon, \ where \tag{3.5}$$

$$\begin{cases} Y = 1, \ if \ p - value \ on \ mark - up \ distributions \ similarity \leq 0.05, \\ Y = 0, \ otherwise. \end{cases}$$

### 3.3.3 Test of data and methodology

Since we have data only from one country for the analyses, we test first if there are any major differences between the Finnish sample we use and the samples used in earlier studies (from other countries). First, comparisons of the average salary distributions of small versus large firms reveal that larger firms in Finland pay significantly higher wages than smaller firms in the same sector. Similarly, larger firms and exporting firms report higher productivity levels (both in terms of sales per employee and value added per employee) compared to small and domestic firms, respectively. These results are in line with the wage and productivity premiums of exporters found in other studies (e.g. Mayer and Ottaviano, 2008, Wagner, 2012b). Sector specific results on the average salary and productivity levels between different types of firms are reported in appendix A.2.

Second, we calculate average mark-up estimates for all 70 sectors (appendix A.2). In line with previous studies on firm heterogeneity (Wagner, 2012b), the average mark-ups are calculated after removing the first and last one percentile of outlier observations in each sector.[16] These average mark-ups were checked to approximately match the 50th percentile of the cumulative probability function drawn from all the observations within each

[16] In most of the sectors, these top outliers affect the calculation of the means significantly and hence they are usually dropped. As an example, if the outliers are included in the sample, the mean mark-ups in financial services (IND 65) and in activities auxiliary to financial services (IND 671) are 3.3 and 3.1, with standard deviations of 9.9 and 22.6, respectively. When the top outliers are dropped, the same means are 1.2 and 1.03, with standard deviations of 1.3 and 1.1, respectively.

sector. In general, the average mark-up in manufacturing sectors is around 0.56 and around 0.8 in service sectors. These results correspond well to earlier findings (e.g. Molnar and Bottini, 2008 [17]).

## 3.4 Results

According to the IO and new trade literature (see section 3.1), mark-up variation within each sector can be attributed to differences in firm size and firms' export status. We present first in subsection 3.4.1 the extent of mark-up variation in each sector together with the results on the similarity of the mark-up distributions between different firm types (based on size and export status). We show first a couple of examples on mark-up distributions for different types of firms and after that present the main results for 28 manufacturing and 42 services sectors in subsection 3.4.1. Subsection 3.4.2 continues by presenting the regression results. They show i) in what type of sectors mark-ups vary the most and ii) in what type of sectors significant differences are found in the mark-up distributions of different types of companies.

### 3.4.1 The extent of mark-up heterogeneity within each sector

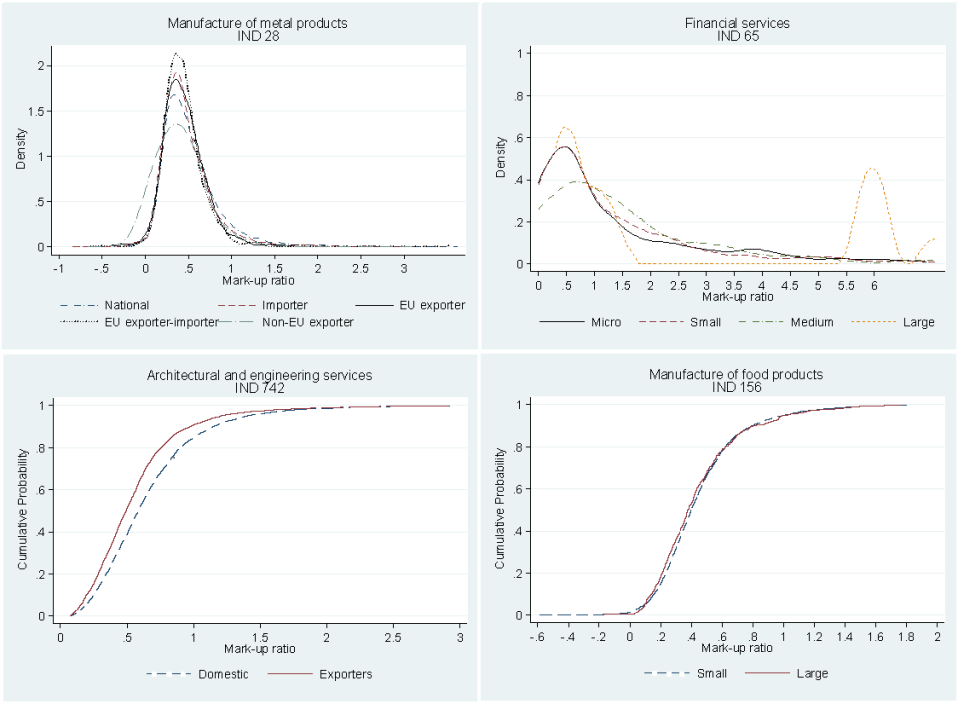
Mark-ups seem to vary significantly within and between sectors in Finland. The standard deviation of average sector level mark-ups is around 0.3, while mark-ups within sectors have a mean standard deviation of 0.6 when outliers are dropped (appendix A.2). The mark-ups' coefficients of variation (CV) and K-S tests reveal also great mark-up heterogeneity within sectors (tables 3.1 and 3.2).

We illustrate the variation of mark-ups within few sectors in general and between different types of firms (figure 3.1). The cumulative probability

[17] Molnar and Bottini (2008) based their research on the Amadeus database with observations for Finland from years 1996-2006 with limit on firms with minimum 20 employees. Average mark-ups calculated in this paper match well with theirs when we use the same limit on firm size.

functions of mark-ups distributions depict a clear picture for the comparison of firms' mark-up distributions among different firm types (lower graphs in figure 3.1) as compared to the kernel density curves (upper graphs in figure 3.1). The graphs illustrate that mark-ups variation and the mark-up distributions of different firm types differ significantly across sectors.[18] The K-S tests are applied later to reflect whether the distributions of different types of firms within each sector have the same underlying distribution.

Figure 3.1: Examples of Kernel density functions and cumulative probability functions of mark-ups in different firm categories




Numbers of observations: Manufacture of metal products: around 3,800 domestic, 1,700 importing, 450 EU exporter, 800 EU exporter-importer and 2,750 Non-EU exporter obs. Financial services: around 450 micro, 430 small, 100 medium and 30 large firms obs. Architectural and engineering services: 6100 domestic (incl. importers) and 2600 exporter obs. Manufacture of food products: 3000 small (micro and small) and 600 large (medium and large) observations.

[18] The top and bottom last percent of observations has been cut for each graph.

We compare the differences in the distributions[19] for three comparison pairs, namely the differences in the mark-up distributions of:

1. Small firms[20] vs. large firms in 69 sectors,
2. Small domestic firms vs. small exporting firms in 47 sectors; and
3. Large domestic firms vs. large exporting firms in 47 sectors.

The exporting status is analysed individually for firms of different size in order to differentiate the possible size effect on mark-ups from the export effect. Due to the limited possibilities to identify exporters in the service sectors, the comparisons of small versus large firms could be performed in more sectors than the comparisons based on the export status.

Based on the K-S tests, in 57 percent of (16 out of 28) manufacturing sectors and in 73 percent of (31 out of 42) service sectors significant differences are found in the mark-up distributions within the sectors at least in one comparison pair. Tables 3.1 and 3.2 show in the top parts (parts A) in detail the sectors in which significant heterogeneity[21] is found (see appendix A.2 for detailed results for each sector). In 38 out of 69 cases, significant differences are found in the mark-ups of small firms versus large firms. Similarly, in 20 out of 47 sectors, small firms with different export status have significantly different mark-up distributions. These results hold, even when they are double checked with fixed effects panel regressions where all possible exporter and size dummies are included. The coefficients of variations are also above 1 in many sectors, which suggests great mark-up variation within the sectors. Nevertheless, the connection between the coefficients of variations and the K-S test results is not straightforward. In sectors with low dispersion of mark-ups (i.e. relatively low CV), significant differences

[19] In the analyses we drop the observations where no variable costs are reported due to overshooting problem (according to our specification, mark-up will approach indefinite if variable costs are zero). Otherwise, the distribution analyses include also outliers.

[20] The small category includes micro and small firms and large category includes medium sized and large firms as categorized by the EU classification mentioned earlier.

[21] The null hypothesis of homogenous mark-ups is rejected at 5 per cent significance level (p-value $\leq 0.05$).

exist still between different types of firms. Similarly, large general variation does not mean that the mark-up distributions of different types of firms would differ systematically.

**Results for manufacturing sectors**

Table 3.1 presents the p-values of the K-S tests and coefficients of variation in detail for each manufacturing sector. Consequently, it provides an overview on the types of sectors where significant mark-up heterogeneity is found. In 12 out of total 27 manufacturing sectors, significant differences are found in the mark-up distributions of small firms versus large firms. Out of these 12 sectors with significant test statistics, in 11 sectors smaller firms are found to have on average higher mark-ups than larger firms based on the t-tests and KW-tests, with the exception of sector 4013.[22] Similarly, in all the 11 sectors where small domestic firms and small exporters' mark-up distributions differ, the domestic firms report significantly higher average mark-ups. The lack of significant results in the mark-up distribution analyses of large domestic firms versus large exporting firms seem to result from the low numbers of observations in both of these categories. Even so, in the only significant sector, the manufacturing of metal products sector, large domestic firms have on average higher mark-ups than large exporting firms in that sector (appendix A.2).

De Loecker and Warzynski (2012) also report mark-up heterogeneity within sectors, but they find higher mark-ups for exporters in manufacturing sectors. This contrasting outcome could result from differences in the samples used in terms of firm-size limit. It should be also noted that the Finnish tax systems does encourage owners of micro-sized firms of to take part of their own salary from the profits of the firm (that have lower effective taxes than salaries (Ropponen, 2012)). The effect of this incentive problem is not clear for firms with more than 4 employees. For this reason, we will control for the average size of firms later in our regression analyses.

[22] Distribution of electricity and gas sector.

Table 3.1: Mark-up distributions variability and p-values of similarity tests, manufactures

| Sector code | Manufacturing sectors | P-value on distributions similarity: Large vs. small | Small, domestic vs. exporter | Large, domestic vs. exporter | CV: All firms |
|---|---|---|---|---|---|
| A. Sectors with significant differences in at least one comparison pair | | | | | |
| 2 | Forestry and logging | 0.01 | 0.01 | 0.15 | 0.78 |
| 20 | Manufacture of wood and wood products | 0.00 | 0.00 | 0.14 | 1.04 |
| 22 | Publishing and printing | 0.00 | 0.00 | 0.39 | 0.90 |
| 25 | Manufacture of rubber and plastic | 0.00 | 0.00 | 0.12 | 0.87 |
| 26 | Manufacture of glass and ceramic | 0.00 | 0.08 | 0.08 | 0.82 |
| 28 | Manufacture of metal products | 0.00 | 0.00 | 0.02 | 0.79 |
| 29 | Manufacture of machinery | 0.00 | 0.00 | 0.40 | 0.88 |
| 32 | Manufacture of electronics | 0.05 | 0.30 | 0.69 | 1.06 |
| 33 | Manufacture of medical, testing and optical equipment | 0.00 | 0.00 | 0.28 | 0.85 |
| 134 | Mining of non-ferrous metals | 0.51 | 0.00 | 0.11 | 0.97 |
| 179 | Manufacture of textiles, wearing apparel and shoes | 0.37 | 0.00 | 0.35 | 0.75 |
| 345 | Manufacture of cars and other transport equipment | 0.00 | 0.20 | 0.60 | 1.02 |
| 2725 | Manufacture of processed iron and steel | 0.86 | 0.00 | 0.07 | 0.65 |
| 3626 | Manufacture of jewellery, music instruments and toys | 0.16 | 0.00 | 0.81 | 0.95 |
| 4013 | Distribution of electricity and gas | 0.04 | 0.91 | 0.74 | 1.15 |
| 21121 | Manufacture of pulp, paper and paperboard | 0.00 | 0.51 | 0.29 | 0.83 |
| B. Sectors with no significant differences in any comparison pair | | | | | |
| 1 | Agricultural production | 0.20 | 0.39 | 0.86 | 0.94 |
| 5 | Fishing and fish farming | n.a | 0.25 | n.a | 1.05 |
| 23 | Manufacture of coke and refined petroleum | 0.56 | n.a | n.a | 0.65 |
| 24 | Manufacture of chemicals | 0.13 | 0.38 | 0.87 | 1.02 |
| 37 | Recycling of metal and non-metal waste | 0.32 | n.a | n.a | 0.76 |
| 41 | Distribution of water | 0.51 | 0.53 | 0.39 | 0.79 |
| 103 | Extraction and agglomeration of peat | 0.77 | 0.48 | n.a | 0.82 |
| 156 | Manufacture of food products and beverages | 0.95 | 0.07 | 0.10 | 0.78 |
| 212 | Manufacture of paper and paperboard | 0.29 | 0.11 | 0.11 | 0.63 |
| 271 | Manufacture of iron and steel | 0.70 | 0.79 | 0.20 | 1.19 |
| 301 | Manufacture of office and electrical equipment | 0.22 | 0.59 | 0.25 | 0.96 |
| 361 | Manufacture of furniture | 0.25 | 0.41 | 0.23 | 0.77 |
| Total number of sectors with significant* heterogeneity | | 12 | 11 | 1 | |
| Total number of sectors tested | | 27 | 26 | 24 | 28 |
| Percentage of sectors with significant heterogeneity | | 44% | 42% | 4.2% | |

*Notes:* * Significant heterogeneity is concluded to occur in sectors with K-S p-values smaller or equal to 0.05.

### Results for services sectors

The results for the services sectors presented in table 3.2 are very similar to the results for manufacturing sectors. In 26 out of the 42 analysed sectors, significant differences are found between small firms and large firms' mark-up distributions. Out of the 26 sectors, 24 sectors show smaller firms to have a higher mark-up than larger firms and only in two sectors larger firms report higher mark-ups (sectors 61 and 642). Among the significant comparison pairs by export status, small domestic firms report again higher mark-ups than small exporting firms. The comparison between large domestic firms and large exporting firms are mostly insignificant. However, large exporting

firms in the significant sectors place higher mark-ups than large domestic firms.

Table 3.2: Mark-up distributions variability and p-values of similarity tests, services sectors

| | | P-value on distributions similarity | | | CV |
|---|---|---|---|---|---|
| Sector code | Manufacturing sectors | Large vs. small | Small, domestic vs. exporter | Large, domestic vs. exporter | All firms |
| A. Sectors with significant differences in at least one comparison pair | | | | | |
| 51 | Wholesale trade and commission trade | 0.00 | n.a | n.a | 1.21 |
| 61 | Water transport | 0.01 | n.a | n.a | 0.93 |
| 72 | Computer and related services | 0.93 | 0.88 | 0.02 | 0.92 |
| 73 | Research and development | 0.27 | 0.05 | 0.76 | 1.36 |
| 80 | Education | 0.00 | n.a | n.a | 0.72 |
| 501 | Sale of motor vehicles | 0.00 | n.a | n.a | 2.20 |
| 502 | Maintenance and repair of motor vehicles | 0.00 | n.a | n.a | 0.98 |
| 521 | Retail sale | 0.00 | n.a | n.a | 1.07 |
| 527 | Repair of household goods | 0.41 | 0.00 | n.a | 0.70 |
| 633 | Other transport and travel services | 0.02 | 0.00 | 0.58 | 1.18 |
| 641 | Post and courier activities | 0.00 | 0.25 | 0.09 | 0.79 |
| 642 | Telecommunications | 0.04 | 0.06 | 0.10 | 1.04 |
| 671 | Activities auxiliary to financial intermediation | 0.63 | 0.00 | 0.61 | 1.10 |
| 741 | Legal, accounting, book-keeping and auditing services | 0.00 | 0.19 | 0.87 | 0.82 |
| 742 | Architectural and engineering activities | 0.00 | 0.00 | 0.52 | 0.78 |
| 743 | Technical testing and analysis services | 0.52 | 0.02 | 0.89 | 0.73 |
| 744 | Advertising services | 0.00 | 0.00 | 0.07 | 0.79 |
| 745 | Job agencies and personnel recruitment | 0.00 | 0.07 | 0.10 | 1.11 |
| 746 | Security services | 0.00 | 0.45 | 0.62 | 0.96 |
| 747 | Cleaning services | 0.00 | 0.01 | 0.96 | 0.93 |
| 748 | Other business services | 0.00 | 0.00 | 0.02 | 0.96 |
| 851 | Human health services | 0.00 | n.a | n.a | 0.79 |
| 853 | Social work services | 0.00 | n.a | n.a | 0.86 |
| 4501 | Construction of buildings | 0.00 | n.a | n.a | 0.83 |
| 4502 | Civil engineering | 0.00 | n.a | n.a | 0.98 |
| 4509 | Construction service activities | 0.00 | n.a | n.a | 0.86 |
| 6023 | Road transportation services | 0.00 | n.a | n.a | 0.93 |
| 7032 | Management of real estate | 0.00 | n.a | n.a | 0.77 |
| 9214 | Entertainment and news services | 0.00 | 0.20 | 0.60 | 0.94 |
| 9267 | Sports and other recreational services | 0.00 | n.a | n.a | 0.75 |
| 63019 | Road, track and air transport service activities | 0.00 | n.a | n.a | 1.14 |
| B. Sectors with no significant differences in any comparison pair | | | | | |
| 62 | Air transport | 0.26 | 0.61 | 0.46 | 0.99 |
| 65 | Financial services | 0.17 | 0.60 | 0.15 | 1.10 |
| 66 | Insurance services | 0.78 | n.a | n.a | 1.05 |
| 71 | Renting of machinery and equipment | 0.46 | 0.29 | 0.96 | 0.91 |
| 90 | Environmental services | 0.16 | 0.58 | 0.83 | 0.80 |
| 551 | Hotels | 0.37 | n.a | n.a | 0.78 |
| 553 | Restaurants | 0.43 | n.a | n.a | 0.66 |
| 601 | Transport via railways | 0.72 | n.a | n.a | 1.05 |
| 672 | Activities auxiliary to insurance services | 0.48 | 0.47 | n.a | 0.79 |
| 7012 | Real estate activities | 0.20 | n.a | n.a | 1.03 |
| 7031 | Real estate agencies | 0.45 | n.a | n.a | 0.67 |
| Total number of sectors with significant* heterogeneity | | 26 | 9 | 2 | |
| Total number of sectors tested | | 42 | 21 | 19 | 42 |
| Percentage of sectors with significant heterogeneity | | 62% | 43% | 11% | |

*Notes*: * Significant heterogeneity is concluded to occur in sectors with K-S p-values smaller or equal to 0.05.

To summarize, significant differences in the mark-up distributions of different types of firms are found in over half of the sectors, and more in the services than in the manufacturing sectors. In the sectors where significant differences are found, small firms place on average higher mark-ups than large firms and domestic firms place higher mark-ups than exporting firms. These results imply that small domestic firms are able to retain some degree of market power in the presence of larger exporting firms in the sector. The sector level coefficients of variation show that mark-ups vary also significantly within sectors. However, the sectors with higher coefficients of variations are not more likely to have significant K-S test results.

### 3.4.2 Characterizing sectors with greater mark-up heterogeneity

In this section, we characterize the factors that correlate with the degree of mark-up variation between sectors. Regression analyses (specified in subsection 3.3.2) are carried out to examine how sectoral characteristics are associated with the degree of mark-up heterogeneity between sectors. This also allows us to control for factors that could affect our non-parametric results and for the possible measurement bias mentioned in subsection 3.2.2.

First, we regress the mark-ups' coefficient of variation (CV) on various sectoral characteristics. The results presented in table 3.3 show that mark-ups' variation is greater in sectors with on average more employees per firm and in sectors with greater share of management level employees (table 3.3). The sectors with higher capital-labour ratio[23] and higher value of stocks in equity have also greater mark-up variation. In addition, service sectors reveal greater mark-up variation than manufacturing sectors.

[23] Leonardi (2007) found indications on within sector deviations in capital-labour ratios, which could affect the mark-up variations. However, their study analysed only 1 percent of all companies in comparison to our full sample. Our data also does not allow for an unbiased estimation of firm level capital-labour ratios due to pricing of asset values in historical prices. With the lowest possible level of sectoral disaggregation, we assume therefore the capital-labour ratios to vary less within sectors than between sectors. The sector level estimates for capital-labour ratios are checked against official Statistics Finland estimates.

Table 3.3: Regression results on variation of mark-ups

| Dependant variable: Coefficient of variation (CV) | Coefficient | P-value |
|---|---|---|
| Number of firms | 0.00 | 0.89 |
| Average size of firms | 0.0003* | 0.01 |
| Dummy for services sectors | 0.14* | 0.02 |
| Market concentration (Herfindahl) | -0.23 | 0.30 |
| Average export share in turnover | 0.00 | 0.10 |
| Share of multinationals | -0.89 | 0.26 |
| Capital-Labour ratio | 0.09* | 0.00 |
| Value of stocks in equity | 0.04* | 0.03 |
| Share of management | 1.23* | 0.04 |
| Year dummies | Yes | |
| R2 within | 0.16 | |
| R2 between | 0.03 | |
| R2 overall | 0.04 | |
| Number of observations | 348 | |
| Number of sectors | 70 | |

*Notes*: * Significant at 5 percent level.

The large, positive effects from the share of management and from the value of stocks on the coefficient of variation suggests that there might be some measurement bias in the fixed costs as mentioned in subsection 3.2.2. Specifically, fixed costs might be underestimated for some firms in sectors with high share of management level employees. Coefficients of variation might not provide therefore an unbiased measure on the true within sector mark-up heterogeneity. Nevertheless, this does not undermine the K-S test results. In order to test their validity, the panel probit regression results are presented in table 3.4.

The results of the panel probit regressions report the sector characteristics that affect the probability of finding significant differences in mark-up distributions between different types of firms (table 3.4). Due to the low number of observations for large firms, the regression analysis on distribution differences by export status is conducted on the small firms only. The two columns in table 3.4 show the results on the differences between small and large firms (i.e differences by size) and on the differences between small domestic versus small exporting firms. In addition to the control variables included earlier, these regressions include the mark-ups' coefficients of vari-

ation as a control variable in order to measure the correlation between our two mark-up heterogeneity measures.

Sector characteristics that affect the probability of finding significantly different mark-up distributions include the number of firms in a sector, the average capital-labour ratio and the share of management level employees. The capital-labour ratio and the average share of management level employee in particular have significant, negative coefficients. This suggests that sectors with on average higher capital-labour ratios and higher average share of management level employee are more likely to reveal insignificant differences between mark-up distributions of small and large size firms. The negative effect from the share of management indicates that the possibility of finding mark-up heterogeneity is not increased even if the (labour) fixed costs are underestimated for firms with high levels of management. On the contrary, mark-up heterogeneity might exist also in sectors with high management levels. The highly fluctuating stock changes (that affect directly the level of fixed costs in our mark-up calculations) and the average size of firms (related to small firms tax incentives in Finland mentioned earlier) are also found not to affect the possibility of finding heterogeneous mark-ups within sectors.

The only significant sector characteristic explaining the difference in mark-up distributions between small domestic and small exporting firms is the average number of firms in the sector. The effect is, however, arbitrarily small. Therefore, the assumption of homogenous mark-ups seems to hold better when the sectors are well disaggregated or have otherwise relatively few firms. These results reflect also the limitation of the annual K-S tests p-values in capturing significant differences at such disaggregated sector levels with low numbers of observations per year.

To summarize, the K-S tests provide the most reliable estimations on the extent of mark-up heterogeneity within sectors. According to our results, mark-ups are heterogeneous in over half of the sectors studied. Only sectors with low capital-labour ratio and large amount of firms are found to have a greater possibility for mark-up heterogeneity between firms of different size.

Table 3.4: Probit regressions on differences in mark-up distributions

| Dependent variables: p-values of annual K-S tests | Differences by size (small vs. large) | | Differences by export status [1] (domestic vs. exporter) | |
|---|---|---|---|---|
| Number of firms | 0.002* | (0.00) | 0.001* | (0.00) |
| Average size of firms | -0.002 | (0.31) | 0.000 | (0.98) |
| Coefficient of variation | 1.69 | (0.10) | 0.48 | (0.63) |
| Dummy for services sectors | -0.67 | (0.45) | -0.62 | (0.30) |
| Concentration (Herfindahl) | 1.75 | (0.31) | -1.9 | (0.23) |
| Average export share in turnover | -0.14 | (0.93) | -1.55 | (0.12) |
| Share of multinationals | -16.8 | (0.45) | 3.1 | (0.91) |
| Capital-Labour ratio | -0.93* | (0.02) | -0.30 | (0.21) |
| Value of stocks in equity | 0.61 | (0.18) | -0.17 | (0.67) |
| Share of management | -26.1* | (0.01) | -4.6 | (0.45) |
| Year dummies | Yes | | Yes | |
| Wald chi2, p-value | 0.02 | | 0.04 | |
| Number of observations | 343 | | 235 | |
| Number of sectors | 69 | | 47 [1]) | |

*Notes*: [1]) Results are based on the K-S test result of the small size firms only. P-values in brackets.
* Significant results at 5 percent confidence level.

Overall, mark-up heterogeneity is not found only in some specific types of sectors, but is a wider phenomenon.

## 3.5 Conclusions

We contribute to the literature on firm heterogeneity and mark-up pricing by analysing mark-up distributions of different types of firms within 70 sectors. Contrary to earlier studies, we include micro-sized firms and analyse the differences in the distributions between exporting and non-exporting firms covering both manufacturing and services sectors. The analysis is done with 5-year period firm level data, in which we can identify fixed and variable costs. The database covers virtually all firms in Finland.

Our non-parametric tests indicate mark-up heterogeneity for firms of different size and of exporting status (for 47 out of 70 sectors). We find that smaller firms have significantly higher overall mark-ups than larger firms in nearly half of the sectors. This suggests that small firms preserve some market power through successful product differentiation even if their fixed costs are higher than in larger companies. In addition, evidence in a few sectors shows domestic firms to have higher mark-ups as compared to the exporting firms.

The coefficients of variation for mark-ups are high and contrary to the constant mark-up hypothesis. The mark-up variations are regressed on various sector characteristics to control for possible measurement bias and to test in what types of sectors mark-up heterogeneity is found. The coefficient of variation might be affected by an underestimation of fixed costs in sectors with a high share of management level employees. Panel probit regressions show that this share and the capital-labour ratio have a negative effect on the probability of finding significant mark-up heterogeneity. A higher number of firms in a sector increases the probability for mark-up heterogeneity, but the effect is minimal.

To summarize, in contrast to the constant mark-up hypothesis, we find (i) large differences in mark-ups within sectors even at NACE 2-3 digit levels, (ii) higher mark-ups for small firms and domestic firms, and (iii) greater mark-up heterogeneity in sectors with a low capital-labour ratio and a large number of firms active in the sector. One simple explanation on the findings

could be that different types of firms within each sector cater to specific market or consumer segments with unequal demand elasticities.

As Finland is a country with relatively high export participation rates, open trade policies, high GDP per capita and effective regulatory system, the mark-up heterogeneity we find should be considered a minimum level to be expected. Mark-up heterogeneity in developing countries is expected to be significantly higher since these countries are often characterized by lower capital-labour ratio endowments and a high number of firms in each sector, operating in rather fragmented markets. Therefore, additional research on mark-up heterogeneity within sectors is recommended with other methodologies and with data from less developed countries. Caution is needed regarding policy suggestions based on theoretical models with a homogeneous mark-up assumption.

# Chapter 4

# Varying mark-ups and income inequality in an open economy

## 4.1 Introduction

During the past decades within-country income inequality has increased in most countries (e.g. Anand and Segal, 2008, Galbraith and Kum, 2005, and Harrison et al., 2011), while the trends in between-country and global income inequality have been more diverse. Widening income distributions and the concentration of money and power are claimed to increase instability in societies. For example, recently increasing income inequality levels have been blamed for the political and social turmoil in the Arab countries, the Democratic Republic of Congo, Brazil, Syria and Ukraine.[1] In addition to wage income inequality, recent empirical studies have emphasized the role of top income earners (Atkinson and Piketty, 2007, 2010), capital income and capital gains (Atkinson and Piketty, 2010, Roine and Waldenström, 2012,

[1] Jason Stearns (2012): Dancing in the Glory of Monsters: The Collapse of the Congo and the Great War of Africa, PublicAffairs publishing, Reprint edition (March 27, 2012). Oxfam (2014): Working for the few: Political capture and economics inequality, Oxfam Briefing paper 187. Global Post: 26.12.2012, "Why rising income inequality matters".

Biewen and Juhasz, 2010, and Chi, 2012) in the development of total income inequality within-countries.

The literature on firm heterogeneity has found empirical evidence that companies involved in the international markets are significantly different than non-traders. Firms provide usually the basis for people's incomes. As exporting firms pay for example higher wages than non-exporting firms, the effects of trade and firm heterogeneity on income inequality within-countries have gained attention, next to the studies on the various other factors influencing income distributions. Consequently, general equilibrium (GE) models with heterogeneous firms have been popular tools in theoretical analyses on the effects of trade on income inequality. These theoretical assessments have focused mostly on the effects of trade on wage inequality (e.g. Helpman et al., 2010 and Basco and Mestieri, 2013) or only on capital income (Foellmi and Oechslin, 2010). A more general framework for the analysis of the effects of trade on both income types at the same time was developed by Egger and Kreickemeier (2012). In addition to accounting for the heterogeneity in firms, it is assumed in their framework that workers obtain a 'fair wage' that depends both on the external conditions in the labour markets and on the profits of the firm.

While most of the assumptions in the Egger and Kreickemeier (2012) framework match empirical findings, they have assumed that mark-ups remain unchanged from autarky to open economy. This assumption is in contrast with empirical findings on the effect of trade on mark-ups (e.g. Epifani and Gancia, 2011 and Chen et al., 2009) and on the endogenous mark-up assumption in various other models.

In this paper we contribute to the analyses of the mechanisms behind the increase of total income inequality within-countries. We provide a small expansion on the theoretical analysis of Egger and Kreickemeier (2012) by allowing mark-ups to change after a country moves from autarky to free trade in their framework. We assume that both domestic firms and exporters face still the same elasticity of demand (and have same level of mark-ups), but the open economy elasticity is higher than the autarky elasticity due to tougher competition in the market. We concentrate on analysing the

differences in three income inequality indicators and in the unemployment level before and after the increase of competition in an open economy.[2] As far as we know, until now the distributional and labour market effects of tougher market competition have not been analysed with a heterogeneous firms' model. With the use of a well-known model, the results remain clear and tractable and we can provide some initial comparisons on the effect of a competition increase versus the effect of trade liberalisation on the different indicators. We obtain noteworthy results that strengthen the original findings of Egger and Kreickemeier (2012) and provide additional insights on the possible reasons for the increases in total income inequality within-countries and in the rise of top incomes and capital income inequality.

Section 4.2 provides a review on the empirical and theoretical literature on income inequality, trade and mark-ups. In section 4.3 we present the theoretical framework of Egger and Kreickemeier (2012) together with their main results. Section 4.4 demonstrates the effects of a general mark-up change in a country after the opening of the economy to foreign competition. Subsections 4.4.1 and 4.4.2 provide analytical explanations on the effects, while subsection 4.4.3 shows some examples on the magnitudes of the effects. The comparative statics and numerical analyses required to illustrate these results are presented in appendix B. Section 4.5 concludes.

## 4.2 Literature

### 4.2.1 Income inequality and trade

According to the literature review of Anand and Segal (2008), the direction in global inequality is unclear. This is mainly due to the varying methods, data and definitions used in the studies. Studies looking more in detail at the decomposition of *global income inequality* to *between- and within-country income inequality* typically find that within-country income inequality has increased since the 1970s in average. Various directions have been found on

[2] If mark-ups change in the EK model, also the main functional form of output changes and therefore we refrain from welfare analysis.

the income inequality between countries, though mostly between-country inequality has been found to decline (Ferreira and Ravallion, 2008; Anand and Segal, 2008). As Ferreira and Ravallion (2008) and Galbraith and Kum (2005) point out, income inequality within-countries rose in average throughout most of the world at the same time as globalisation, but not everywhere. Harrison et al. (2011) conclude in their literature review that more countries have witnessed an increase rather than a decline in within-country income inequality. Therefore, we will concentrate the rest of the literature review on the trends and reasons for the increases in within-country income inequality.

Opening of trade and globalisation have been commonly accused for the increases in within-country income inequality,[3] while contrary results have been obtained as well.[4] For example, Rodriquez-Pose (2012) finds empirical evidence on increase in trade leading to higher regional income inequality within-countries based on static and dynamic panel analyses from 28 countries for the time period 1975 to 2005. Bergh and Nilsson (2010) find similarly that trade increases within-country income inequality specifically in rich countries, and social globalization (increased contact with other cultures) in middle- and low-income countries. They use panel data from 80 countries for the years 1970 to 2005. In general, most of the relatively recent empirical studies have found a positive association between trade liberalization and an increase in within-country income inequality. However, as Atkinson and Piketty (2007, 2010) point out in their books covering various articles, many other aspects can affect real income distributions as well, including technological progress, social norms and in particular institutional settings.

The above mentioned findings have resulted in a growing number of empirical and theoretical analyses trying to explain the mechanisms behind the

[3] See e.g. Rodriquez-Pose, 2012, Bergh and Nilsson, 2010, Meschi and Vivarelli, 2009, Milanovic and Squire, 2005 and Lundberg and Squire (2003).

[4] Dollar and Kraay (2004) and Calderon and Chong (2001) document a negative association between income inequality and trade. However, the former article uses rather fragmented, low-quality data from few countries, while the latter finds the negative association only for developed countries and a positive association for developing countries.

increases in within-country income inequality. People's total incomes consist of different parts, including for example wage income, capital income and social security transfers, out of which wage and capital income form typically the largest share. Various empirical studies have analysed the effects of trade (and trade in tasks) on wages and wage differences within-countries (e.g. Klein et al., 2013, Van Reenen, 2011 and Harrison et al., 2011). Most studies conclude that globalisation has increased wage income inequality. Similarly, theoretical analyses until now have concentrated especially on studying the effect of trade on wage income inequality.[5] For example, Egger and Kreickemeier (2009), Helpman et al. (2010) and Basco and Mestieri (2013) all conclude with different models that trade leads to an increase in wage inequality within-countries.

While wages are the most important income source for the majority, empirical studies have emphasized also the role of top income earners (Atkinson and Piketty, 2007, 2010) and very recently the (once again) rising role of capital income and capital gains on total income inequality (see Atkinson and Piketty, 2010, Roine and Waldenström, 2012, Biewen and Juhasz, 2010, and Chi, 2012).[6] Nevertheless, there are only a couple theoretical analyses on the effects of trade on capital income inequality and on total income inequality. Foellmi and Oechslin (2010) analyse theoretically the effect of open trade on capital income. They study the income distributions of heterogeneous firm's owners in less-developed countries and conclude that trade increases the incomes of initially relatively wealthy firm owners. Poorer firm owners, on the contrary, lose as profit margins shrink and access to capital

[5] Harrison et al. (2011) provide an excellent review on the theoretical frameworks used to study the effect of trade on within-country income inequality published by 2011.

[6] Roine and Waldenström (2012) conclude that the large increases found in top incomes have been mainly driven by capital income gains in Sweden over the past 20 years. The rise of top incomes has, again, increased total income inequality. Similarly, Biewen and Juhasz (2010) conclude that the rise in German total income inequality resulted from the increase in unemployment and the rising dispersion of both labour market returns and capital gains. Chi (2012) find that in urban China the contribution of capital income to the Gini index of total income has similarly increased over the recent years. Capital income forms the largest part of the top income earners' total income in urban China and the concentration of capital income has been increasing steadily.

is constrained. Therefore, capital income distribution widens in their model with open trade.[7] Egger and Kreickemeier (2012) continued their previous work on wage income inequality effects of trade by analysing also the effects on firm owners. This way, they seem to have been the first to analyse the effects of trade on both wage and (one form of) capital income inequality at the same time. As will be explained later, they provide insightful views in particular on the possible effects of trade and capital income on the increasing total income inequality within-countries. Consequently, we will use their framework for our analysis.

### 4.2.2 Trade and mark-ups

Egger and Kreickemeier (2012) assume in their GE framework that when a country goes from autarky to open trade nothing happens to the mark-ups of firms and to the preferences of consumers. However, in empirical literature mark-ups have been found to decrease when trade opens. Mark-ups vary also significantly between (trading and non-trading) sectors and within sectors in a given country.[8] For example, Epifani and Gancia (2011) find that trade openness decreases average price-costs margins (mark-ups) and increases their dispersion across industries based on US data from the year 1960 to 2000. Chen et al. (2009) conclude that increased import penetration decreased prices (growth rates), lowered mark-ups and lead to higher productivity due to the increased competition in European manufacturing sectors in time period 1989 to 1999 based on difference-in-difference estimations. According to the traditional pricing equation (see subsection 4.3.1), an increase in the number of varieties has to increase also the elasticity of substitution (and elasticity of demand) in order to obtain a decrease in prices and mark-ups. Based on the empirical studies until now, it seems realistic

[7] Microeconomic research of Hopkins and Kornienko (2010) and Hopkins (2011) conclude also that in a tournament type of competition situation, the inequality of rewards from the tournament increases risk-taking and causes greater inequality of wealth.

[8] Tamminen and Chang (2013) and De Loecker and Warzynski (2012) find significant differences in the mark-ups of domestic versus exporting firms within sectors.

to assume that mark-ups change at least in average when trade opens, while evidence on mark-up heterogeneity within-sectors is not yet conclusive.

Various theoretical models have taken already an assumption of endogenous mark-ups. For example, Melitz and Ottaviano (2008) build a general equilibrium framework, where mark-ups depend on the 'toughness' of competition in each market, with larger markets inhibiting more competition and lower mark-ups. In their framework trade opening lowers average mark-ups, but increases average productivity of operating firms and welfare. In addition, for example Epifani and Gancia (2011), Bernard et al. (2003), Ottaviano et al. (2002) and Asplund and Nocke (2006) have constructed trade models where mark-ups vary instead of being fixed.

## 4.3 Egger-Kreickemeier (EK) model

### 4.3.1 Closed economy

We use the Egger and Kreickemeier (2012) model without changing the main dynamics. We present them and the most important calculation steps here only for a better tractability of the model and the results. See also the original article for more detailed instructions on the calculation steps.

A population mass N is assumed, which is divided into production workers (L) and managers (M). The economy produces two types of goods: differentiated intermediate goods, q, and homogeneous final output, Y. Each firm produces one type of intermediate good. The final output Y is a CES aggregation of the differentiated intermediate goods production. In equation 4.1, V represents the mass of available intermediate goods M, and $0 < \rho_A < 1$ is the CES love-of-variety parameter in autarky. The subscript A is used for all parameters that are autarky specific and will change in the open economy in our analysis. The parameter $\rho_A$ is linked to the elasticity of substitution between varieties (equals demand elasticity in this case), $\sigma_A$, by $\sigma_A \equiv 1/(1-\rho_A)$.

$$Y = \left[ M^{-(1-\rho_A)} \int_{v \in V} q(v)^{\rho_A} dv \right]^{1/\rho_A} \tag{4.1}$$

The profit maximisation of final output multiplied by price index,[9] minus production costs, $\int_{v\in V} p(v)q(v)dv$, and subject to the output function leads to demand functions for intermediate goods. The demand of each variety, $q(v)$, takes the form presented in equation 4.2 when constant mark-up over marginal cost pricing is assumed. The price of a specific variety equals $p(v) = c(v)/\rho_A$, where $c(v) = w(v)/[\varphi(v)\varepsilon(v)]$ is marginal cost, $w(v)$ refers to wages, $\varphi$ is the productivity level and $\varepsilon$ measures the workers efficiency. The mark-up over marginal costs, $\mu_A \equiv 1/(\rho_A)$, depends of the CES parameter. Total revenue $r(v)$ is derived from the demand function multiplied by the price function.

$$q(v) = \frac{Y}{M}p(v)^{-\sigma_A} = \frac{Y}{M}\left[\frac{c(v)}{\rho_A}\right]^{-\sigma_A}, \; r(v) = \frac{Y}{M}\left[\frac{c(v)}{\rho_A}\right]^{1-\sigma_A} \tag{4.2}$$

The production technology in each firm requires one manager/owner and many workers. Therefore, the number of firms is the same as the number of managers and the number of varieties, M. Productivity of a person determines whether he/she will become a manager or a worker. Only the most productive individuals will have high enough productivity to become a manager.

Workers are paid a fair wage following Akerlof and Yellen (1990). According to them employees will decrease their effort, $\varepsilon$, if they do not consider their wage "fair". Since profit maximising firms have no incentive to pay less than the efficiency maximising wage level $\hat{w}$, all employees will supply at the end the maximum amount of efficiency units in the model, $\varepsilon = 1$. See p. 186-187 of Egger and Kreickemeier (2012) for a more detailed discussion on this. Subsequently, the marginal costs function turns to $c(v) = w(v)/\varphi(v)$.

In the determination of the fair wage level, the workers compare their wage to the external labour market conditions and to the profits of the firm, $\pi(v) = r(v)/\sigma_A$. The external reference is defined to equal employment share of labour $(1 - U_A)$, where $U_A$ is the unemployment level, multiplied by average wage $\bar{w_A}$. See equation 4.3. The fair wage increases if revenue

[9] Price index $P = \left[M^{-1}\int_{v\in V} p(v)^{1-\sigma_A}dv\right]^{\frac{1}{1-\sigma_A}}$ is normalised to one due to perfect competition in the final goods market.

or total profits increase, unemployment decreases or average wage increases (ceteris paribus). This way, in this model firm profits are shared between managers and workers depending on the rent sharing parameter $\theta \in (0,1)$. It should be noticed that in there is no wage rigidity in the EK model based on the fair wage equation. Therefore, it can be considered to model the economy in somewhat longer run, when the wages are flexible. In most countries, wages are relatively rigid in the short run, especially downwards.

$$\hat{w} = \left(\frac{r(v)}{\sigma_A}\right)^{\theta} \left[(1-U)\,\bar{w}\right]^{1-\theta} \tag{4.3}$$

The wage formula together with the revenue function in equation 4.2, form a base for the relative wage and revenue rates between two firms. When the marginal cost function is taken into consideration, the relative wages and revenues depend only on the productivity levels of the firms when the firms have the same export status (which in this case is a non-exporter).[10]

$$\frac{w(\varphi(v_1))}{w(\varphi(v_2))} = \left[\frac{r(v_1)}{r(v_2)}\right]^{\theta} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\theta\eta_A} \tag{4.4}$$

$$\frac{r(\varphi(v_1))}{r(\varphi(v_2))} = \left[\frac{w(v_1)}{w(v_2)}\frac{\varphi(v_1)}{\varphi(v_2)}\right]^{1-\sigma_A} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\eta_A} \tag{4.5}$$

The formulas include a simplification parameter, $\eta_A$, which is defined as $\eta_A \equiv (\sigma_A - 1)/\left[1 + \theta(\sigma_A - 1)\right]$. The labour productivity of firms, which equals the manager's productivity in this model, follows Pareto distribution $G(\varphi) = 1 - \varphi^{-k}$, where $k > \eta_A$. The lower the k is, the higher is the dispersion of the firms' productivity levels. Based on the Pareto distribution, the average productivity $\tilde{\varphi}$ is proportional to the cut-off productivity $\varphi^*$, which is the productivity of the lowest-producing firm.

$$\tilde{\varphi} = \left(\frac{k}{k-\eta_A}\right)^{1/\eta_A} \varphi^* \tag{4.6}$$

[10] As both the wage ratio and the revenue ratio presented in equations 4.4 and 4.5 depend on the relative productivity levels, the firm level variables can be linked to a respective productivity. Therefore, in the following a simplified notation is used for productivity: $\varphi_i \equiv \varphi(v_i)$.

The equilibrium factor allocation is determined from the resource constraint (RC), $L_A = N - M_A$, where $L_A$ is labour supply to production, and from the labour indifference condition (LI). The LI, equation 4.8, states that the average expected wage of a worker has to be the same as the profit income of the manager with the cut-off ability level ${\varphi_A}^*$ (the productivity level of the marginal firm). All people with a higher ability will choose to be managers due to higher expected income from that position compared to being a worker. With equations 4.5 and 4.6, and the fact that with monopolistic competition aggregate labour income equals $\rho_A Y$ and aggregate profits $(1-\rho_A)\,Y$, and the same multipliers for wage share and profit share apply at firm level, the ratio of average profits to marginal profits turns to the following form:

$$\frac{\pi(\tilde{\varphi})}{\pi(\varphi^*)} = \frac{(1-\rho_A)r(\tilde{\varphi})}{(1-\rho_A)r(\varphi^*)} = \left(\left(\frac{k}{k-\eta_A}\right)^{1/\eta_A}\right)^{\eta_A} = \frac{k}{k-\eta_A} \tag{4.7}$$

Given the above function on the relationship of profits and the earlier mentioned fact on the aggregate labour income, the labour indifference condition transforms from equation 4.8 to equation 4.9:

$$LI:\ (1-U_A)\bar{w_A} = \pi(\varphi*) \tag{4.8}$$

$$LI:\ \frac{\rho_A Y}{L} = \frac{(1-\rho_A)Y}{M}\left(\frac{k-\eta_A}{k}\right) \tag{4.9}$$

Equation 4.9 and the resource constraint are used to solve total labour supply $L_A$ and the number of companies $M_A$ in autarky. The solutions are presented in table 4.1, rows 3 and 4, part A. The ability level required to become a manager (operate a firm profitably) is calculated by solving $\varphi^*$ from $M_A = [1-G(\varphi^*)]\,N$. It results in the definition that $\varphi^* = \left(\frac{N}{M}\right)^{\frac{1}{k}}$, which holds both in autarky and in open economy. The final solution for the marginal productivity level in autarky is calculated from the previous definition and the equation of M. It is presented in table 4.1, row 5, part A.

Welfare is defined in a utilitarian way as income per capita, which in the model equals consumption per capita. The calculation of income per

capita is based on the fact that aggregate profit income is a constant share $(1-\rho_A) = (1/\sigma_A)$ of total income Y. Based on this, the total income Y is first defined as: $Y = \sigma_A M_A \pi(\tilde{\varphi})$.

The profit of the firm with an average productivity level, $\pi(\tilde{\varphi})$, can be determined to equal:[11]

$$\begin{aligned}\pi(\tilde{\varphi}) = \frac{k}{k-\eta_A}\pi(\varphi^*) = \frac{k}{k-\eta_A}w(\varphi^*) = \frac{k}{k-\eta_A}\left(\frac{w(\varphi^*)}{w(\tilde{\varphi})}\right)w(\tilde{\varphi}) \\ = \frac{k}{k-\eta_A}\left(\frac{w(\varphi^*)}{w(\tilde{\varphi})}\right)\rho_A\tilde{\varphi} = \left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}}\rho_A\varphi^* \quad (4.10)\end{aligned}$$

Using the two above solutions, output per capita is solved:

$$\begin{aligned}\frac{Y}{N} = \sigma_A M_A \pi(\tilde{\varphi}) * N^{-1} = (\sigma_A - 1)\left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}} M_A \varphi^* N^{-1} \\ = (\sigma_A - 1)\left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}}\left(\frac{k-\eta_A}{k\sigma_A-\eta_A}\right)^{\frac{k-1}{k}} \quad (4.11)\end{aligned}$$

Due to the rent sharing mechanism, unemployment is strictly positive in the model. It is determined from the fact that aggregate total employment has to equal the sum of firm's employees. The unemployment level can be solved from: $(1-U_A)\,L_A = \frac{M_A}{1-G(\varphi^*)}\int_{\varphi^*}^{\infty} l(\varphi)dG(\varphi)$, by using the information that $Ml(\tilde{\varphi}) = Mq(\tilde{\varphi})/\tilde{\varphi} = Y/\tilde{\varphi}$, and $\frac{l(\varphi)}{l(\tilde{\varphi})} = \left(\frac{\varphi}{\tilde{\varphi}}\right)^{(1-\theta)\eta_A}$, and the second definition of equation 4.11. The final solution is presented in table 4.1, row 6, part A.

Income inequality is measured in three ways in the EK model: 1) difference in the average expected income of workers versus managers, labelled as inter-group inequality, 2) income inequality within managers and 3) income inequality within workers. A Gini index for the total income inequality (capital and wage income together) is not calculated. Inter-group inequality is defined as the ratio of average managerial income (equals average profits) over average expected wage. Based on equations 4.7 and 4.8, inter-group

[11] The steps are derived from: equation 4.5 with equation 4.6 (step 1), equation 4.4 with equation 4.6 (step 2), mark-up pricing condition for the average firm with notion that average price is one (step 4), and equation 4.4 with equation 4.6 (step 5).

income inequality is determined by the autarky equation presented in table 4.1, row 9. The ratio is higher than one, which means that average managerial income is higher than the expected average production worker wage in autarky.

In order to determine a Gini index for managerial income, we need to calculate first the cumulative profits of all firms with a productivity level lower than or equal to $\bar{\varphi} \in [\varphi^*, \infty]$, relative to the aggregate profits $\Pi$. Based on the productivity distribution, the proportion of firms with a productivity level smaller or equal to $\bar{\varphi}$ is determined as $\gamma \equiv 1 - \left(\frac{\bar{\varphi}}{\varphi^*}\right)^{-k}$. Using the latter solution, the cumulative profits relative to aggregate profits can be solved.[12] The actual Gini index for managerial income, $A_M$, which by definition is between zero and one, is calculated in a standard way from $A_M = 1 - 2\int_0^1 Q_M(\gamma)d\gamma$. The solution is presented in table 4.1, row 10.

The calculation of a Gini index for labour income, $A_L$, follows closely the steps taken in the determination of a Gini index for managerial income. Since total wages paid by a firm are proportional to the profits, the ratio of all salaries paid by firms with a productivity level lower than or equal to $\bar{\varphi} \in [\varphi^*, \infty]$ relative to the aggregate wages $W$ is the same as the ratio of profit incomes calculated earlier. However, the share of workers, $\mu$, employed in firms with the same productivity level out of total employment needs to be calculated first.[13] With the solutions for proportional wages and employment, the cumulative wages relative to aggregate wages can be derived.[14] The definition of Lorenz curve, $A_L = 1 - 2\int_0^1 Q_L(\mu)d\mu$, is used again to obtain a solution for the Gini index for labour income presented in table 4.1, row 11, part A. As mentioned in Egger and Kreickemeier (2012), the Gini index for managerial income is always bigger than the Gini for labour

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[12] The cumulative profits equal:
$Q_M(\gamma) = \frac{\Pi(\bar{\varphi})}{\Pi} = \frac{M_A}{[1-G(\varphi^*)]\Pi}\int_{\varphi^*}^{\bar{\varphi}} \pi(\varphi)dG(\varphi) = 1 - (\bar{\varphi}/\varphi^*)^{\eta_A - k} = 1 - (1-\gamma)^{1-\frac{\eta_A}{k}}$.

[13] The calculation steps are similar to those taken for the calculation of the unemployment level and the share is derived to equal: $\mu \equiv \frac{L(\bar{\varphi})}{(1-U)L} = \frac{M_A}{[1-G(\varphi^*)](1-U)L}\int_{\varphi^*}^{\bar{\varphi}} l(\varphi)dG(\varphi) = 1 - (\bar{\varphi}/\varphi^*)^{(1-\theta)\eta_A - k}$.

[14] The cumulative wages equal: $Q_L(\mu) = \frac{W(\bar{\varphi})}{W} = 1 - \left(\frac{\bar{\varphi}}{\varphi^*}\right)^{\eta_A - k} = 1 - (1-\mu)^{\frac{k-\eta_A}{k-\eta_A+\theta\eta_A}}$.

income in autarky. This means that income inequality within managers is larger than income inequality within workers.

### 4.3.2 Open economy

The main changes in this article compared to the Egger and Kreickemeier (2012) article relate to the open economy solutions. In line with recent empirical findings (e.g. Chen et al., 2009, Epifani and Gancia, 2011), it can be assumed that mark-ups decrease after the opening of the economy due to higher competition in the home market and in the foreign market and changes in consumer preferences. In this scenario we assume that both exporters and domestic companies face a higher, but identical demand elasticity in the open economy in comparison to autarky. In other words, we assume that in the open economy $\rho_T > \rho_A$, where $\rho_T$ stands for CES parameter in an open economy and $\rho_A$ stands for the CES parameter in autarky. In general, all parameters with the subscript T refer to the values after open trade with a new elasticity in comparison to the autarky solutions. All parameters and variables without a subscript are the same as in autarky. Based on the definitions used, we obtain the new, higher elasticity of demand $\sigma_T \equiv 1/(1-\rho_T) > \sigma_A$. The higher elasticity of demand lowers average mark-ups in the open economy following the definition: $\mu_T \equiv 1/(\rho_T) < \mu_A$.

The main functional forms do not change much from the original Egger and Kreickemeier (2012) model. In this subsection, we derive the main solutions in the open economy in order to ease following of the later sections. We explain at the same time how open trade affects the various indicators in comparison to autarky, following closely Egger and Kreickemeier (2012). In section 4.4 we continue from the main open economy solutions and show what happens to the different indicators when mark-ups decrease.

Following the Egger and Kreickemeier (2012) article, the country starts trade with a similar country. The labour indifference curve changes after the opening of the economy due to a possibility for people to work as local experts for foreign firms with salary s. Therefore, the marginal manager can choose between three options: 1) to run a firm, 2) to be a production worker or 3) to act as a local expert for a foreign firm. The labour indifference

condition changes to the following form:

$$\pi(\varphi^*) = (1 - U_T)\bar{w_T} = s \tag{4.12}$$

Exporters are assumed to sell both domestically and abroad. Due to additional iceberg transport costs in exporting, $\tau > 1$, the total revenue of an exporter is $\Omega_T r^e(\varphi)$, where $r^e(\varphi)$ equals the domestic revenue of the exporting firm and $1 < \Omega_T \equiv 1 + \tau^{1-\sigma_T} \leq 2$.

The indifference condition for the marginal exporter with productivity $\varphi_x^*$ on whether to start exporting or not is defined as:

$$\frac{\Omega_T r^e(\varphi_x^*)}{\sigma_T} - s = \frac{r^n(\varphi_x^*)}{\sigma_T} \tag{4.13}$$

$r^n(\varphi)$ is the total revenue of a non-exporting firm. Revenue and wage ratios' of two firms with the same productivity level, but differing export status, are determined jointly by the fair wage equation 4.3, the demand function and the definition for revenue in equation 4.2. The solutions in equations 4.14 point out that exporters pay higher wages than non-exporters in line with empirical findings. On the other hand, they have lower operating profits in the home market since their domestic revenues are lower than those of non-exporting firms.

$$\frac{w^e}{w^n} = \Omega_T^{\frac{\theta\eta_T}{\sigma_T - 1}} > 1, \; and \; \frac{r^e}{r^n} = \Omega_T^{-\theta\eta_T} < 1 \tag{4.14}$$

The total revenue of exporters, $\Omega_T^{1-\theta\eta_T} r^n(\varphi)$, is still higher than the total revenue of non-exporting firms, since the multiplier is always positive and bigger than one.

The indifference condition of the marginal exporter can be rewritten with the solution for $r^e$ from equation 4.14 and using $s = r^n(\varphi^*)/\sigma_T$[15] as: $\Omega_T^{\frac{\eta_T}{\sigma_T - 1}} = 1 + \left(\frac{\varphi^*}{\varphi_x^*}\right)^{\eta_T}$. Using this solution, the share of exporting firms $\chi_T$ can be calculated from the pareto distribution based on the productivity limits for exporting, $\varphi_x^*$, and for operating a firm in general, $\varphi^*$. The share

[15] Based on equation 4.12.

of exporters can take values from nearly zero to one.

$$\chi_T = \frac{[1 - G(\varphi_x^*)]}{[1 - G(\varphi^*)]} = \left(\frac{\varphi^*}{\varphi_x^*}\right)^k = \left(\Omega_T^{\frac{\eta_T}{\sigma_T - 1}} - 1\right)^{\frac{k}{\eta_T}} \tag{4.15}$$

Labour supply and number of firms (number of managers) are derived in a similar way as in the closed economy. The labour supply $L_T$ follows from the labour indifference condition (equation 4.12) and the definitions that $\pi(\tilde{\varphi}) = r(\tilde{\varphi})/\sigma_T$, $\rho_T Y = (1 - U_T)L_T\bar{w}_T$ and $Y = M_T(1 + \chi_T)r^n(\tilde{\varphi})$. With these notions, the labour indifference condition turns into the following form with the average expected labour income on the right hand side and the profit level of the marginal firm in the left hand side:

$$\frac{\rho_T Y}{L_T} = \frac{(1 - \rho_T)Y}{(1 + \chi_T)M_T}\left(\frac{k - \eta_T}{k}\right)$$

Solving the above function for L results in:

$$L_T = \frac{k(\sigma_T - 1)(1 + \chi_T)}{k - \eta_T} M_T \tag{4.16}$$

Taking into account that part $\chi_T M$ of the labour force will work as experts for foreign firms, the resource constraint (RC) converts to $L_T = N - (1 + \chi_T)M_T$. From equation 4.16 and the RC, we calculate the functions for labour supply and for the number of managers/firms M. Merely the change from autarky to open trade does not affect the quantity of labour supply, but the number of firms goes down, as shown in Egger and Kreickemeier (2012). Similar to the autarky solution, the cut-off ability required to run a firm is still solved from the ratio of N to M. The number of firms in an open economy is smaller than in autarky, since the marginal productivity required to run a firm is higher. The solutions for L, M and marginal productivity in the open economy are presented in table 4.1, rows 3, 4 and 5, part T.

Aggregate output and welfare per capita are calculated in the same way as in the case of closed economy from the definition $Y_T = M(1 + \chi_T)r^n(\tilde{\varphi})$. The new utilian welfare in the open economy equals:

$$\frac{Y_T}{N} = (1 + \chi_T)^{\frac{1}{k}} * \frac{Y_A}{N} \tag{4.17}$$

As the share of exporting firms is larger than zero, output and welfare per capita are always larger with open trade in comparison to autarky. However, if mark-ups change, also the main functional form of output changes. Therefore, we concentrate on the distributional and labour market effects of a competition increase.

The level of unemployment in the open economy is calculated also in a similar way as in the closed economy case. The use of the solution for ratio $\tilde{\varphi}/\varphi^*$, as derived in the appendix A of Egger and Kreickemeier (2012), helps to solve the equations. At the end we obtain the solution presented in table 4.1, row 6. As presented in Egger and Kreickemeier (2012), the level of unemployment is always higher in open trade than in autarky.

The ratio of average manager income in comparison to the average expected production worker income is determined with the help of the indifference condition: $(1-U_T)\bar{w}_T = s = \pi(\varphi^*) = r(\varphi^*)/\sigma_T$ and definition of average profits as defined earlier. The ratio is used as an indicator for the income inequality between workers and managers. It turns in to the form presented in table 4.1, row 9, part T. As the multiplier of the autarky level intergroup inequality is above one, intergroup inequality is higher in open economy than in autarky in the EK model.

Further, the Gini indexes for profit income (managers' income) and labour income are derived in a similar way as in the closed economy case. However, the final Gini indexes are calculated from the integral of the two segments of the Lorenz curve. First segment of the profit income Gini, $Q_M^1(\gamma)$[16], calculates the share of profits that go to non-exporting firms. The second segment, $Q_M^2(\gamma)$[17], derives the share of profits allocated to exporting firms. Detailed steps for the calculations can be found in the

[16] $Q_M^1(\gamma) = \frac{\Pi(\bar{\varphi})}{\Pi} = \frac{M_T}{[1-G(\varphi^*)]\Pi}\int_{\varphi^*}^{\bar{\varphi}} \pi(\varphi)dG(\varphi)$. This leads to solution:
$Q_M^1(\gamma) = \frac{k}{k+\eta_T\chi_T}\left[1-(\frac{\bar{\varphi}}{\varphi^*})^{\eta_T-k}\right] = \frac{k}{k+\eta_T\chi_T}\left[1-(1-\gamma)^{1-\frac{\eta_T}{k}}\right]$, when $\bar{\varphi} \in [\varphi^*, \varphi_x^*]$.

[17] $Q_M^2(\gamma) = \frac{\Pi(\bar{\varphi})}{\Pi} = Q_M^1(\gamma) + \frac{M}{[1-G(\varphi^*)]\Pi}\int_{\varphi_x^*}^{\bar{\varphi}} \pi(\varphi)dG(\varphi)$. It leads to the further solution that:
$Q_M^2(\gamma) = Q_M^1(\gamma) + \frac{k\Omega_T^{1-\theta\eta_T}}{k+\eta_T\chi_T}\left[\chi_T^{1-\frac{\eta_T}{k}} - (1-\gamma)^{1-\frac{\eta_T}{k}}\right] - \frac{(k-\eta_T)(\gamma-b_M)}{k+\eta_T\chi_T}$, when $\bar{\varphi} \in [\varphi_x^*, \infty]$ and where $b_M \equiv 1-\chi_T$.

appendix A of Egger and Kreickemeier (2012). As Egger and Kreickemeier (2012) show, inequality of managerial income is derived again from $A_{M,T} = 1 - 2\int_0^1 Q_M^t(\gamma)d\gamma$. The final solution is presented in table 4.1, row 10, part T, which shows that the inequality in profit income increases when the economy moves from autarky to an open economy.

In the determination of the labour income Gini index, the first segment, $Q_L^1(\mu)$[18], measures the proportion of labour income going to workers employed in non-exporting firms. The second segment, $Q_L^2(\mu)$[19], measures labour income of exporting firms' employees. The detailed derivations can be found from the appendixes of the original paper. Similar to the managerial income Gini, open trade in itself increases labour income inequality as is shown in the original article. The final solution for labour income Gini is derived from $A_{L,T} = 1 - 2\int_0^1 Q_L^t(\mu)d\mu$ and presented in table 4.1, row 11, part T. It is transformed to a slightly different form compared to Egger and Kreickemeier (2012) in order to simplify the derivatives presented in appendix B.1. See calculations before equation B.15.

## 4.4 What happens when competition increases in an open economy?

In this section, we explain and summarise what happens in the EK model when competition and consequently also demand elasticity increase in the open economy in comparison to autarky, in other words, when parameter $\rho_T > \rho_A$. These changes decrease mark-ups following the pricing equation.

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[18] $Q_L^1(\mu) = \frac{M_T}{[1-G(\varphi^*)](1-U_T)L_T}\int_{\varphi^*}^{\bar{\varphi}} w^n(\varphi)l^n(\varphi)dG(\varphi)$. This leads to:
$Q_L^1(\mu) = \frac{1}{1+\chi_T}\left[1-(\frac{\bar{\varphi}}{\varphi^*})^{\eta_T-k}\right] = \frac{1}{1+\chi_T}\left[1-(1-\Gamma\mu)^{\frac{k-\eta_T}{k-(1-\theta)\eta_T}}\right]$, when $\bar{\varphi} \in [\varphi^*, \varphi_x^*]$.

[19] $Q_L^2(\mu) = Q_L^1(b_L) + \frac{M_T\Omega_T}{[1-G(\varphi^*)]W}\int_{\varphi_x^*}^{\bar{\varphi}} w^e(\varphi)l^e(\varphi)dG(\varphi)$, leading to:
$Q_L^2(\mu) = Q_L^1(b_L) + \frac{\Omega_T^{1-\theta\eta_T}}{1+\chi_T}\left[\chi_T^{1-\frac{\eta_T}{k}} - (\frac{\bar{\varphi}}{\varphi^*})^{\eta_T-k}\right] = 1 - \frac{\Omega^{1-\theta\eta_T}}{1+\chi}\left[\frac{1-\mu\Gamma}{\Omega^{\frac{(1-\theta)\eta_T}{\sigma_T-1}}}\right]^{\frac{k-\eta_T}{k-(1-\theta)\eta_T}}$, when $\bar{\varphi} \in [\varphi_x^*, \infty]$ and where $b_L \equiv \left[1-\chi_T^{1-(1-\theta)\eta_T/k}\right]/\Gamma_T$. See table 4.1 for the definition of $\Gamma_T$.

Table 4.1 summarises all the main functions from the closed economy and the open economy.[20] In addition, it summarises the sign of the derivatives of the various open economy functions with respect to $\rho_T$ (or $\sigma_T$). The derivatives' calculations are in appendix B.1. In case no analytical solution is found on the sign of the derivative, we use numerical analyses to determine the sign with the given parameter restrictions. These numerical analyses are explained and derived in appendix B.2. As mentioned earlier, since the functional form of output changes when $\rho_T$ changes, we concentrate on the distributional and labour market effects of a competition increase.

### 4.4.1 Effect on the number of firms, labour supply and unemployment rate

First, in case the CES parameter $\rho_T$ increases (elasticity of demand increases and mark-ups decrease) with open trade, the total revenue of exporters decreases compared to the situation where there is no change in $\rho_T$ after open trade. However, the multiplier for the exporters' revenue stays above one[21] and exporters have larger total revenue than domestic firms even if mark-ups change. Equation B.3 in the comparative statics part demonstrates this. Since the revenue differential between exporters and non-exporters is lower with the new $\rho_T$, the share of firms that can export decreases at the same time.[22]

[20] Please notice that the functional forms for average labour income and average profits are derived in equations 4.18 to 4.21 after the table.

[21] Omega is defined to be larger than one.

[22] There are few parameter values with which the derivative of $\chi_T$ with respect to sigma is positive, but as table B.2 shows, these are rather unusual value combinations for the different parameters. Therefore, it can be concluded that in most cases, the share of exporters decreases when $\sigma_T$ increases.

Table 4.1: Summary of functions and the signs of derivatives

| | Indicator | Solution in autarky (A) | Solution in open economy (T) | Sign[1)] of the derivative over $\rho_T/\sigma_T$ |
|---|---|---|---|---|
| 1) | Revenue | $r^n(\varphi)$ [2)] | $\Omega_T^{1-\theta\eta_T} * r^n(\varphi)$ [3)] | - |
| 2) | Share of exporters | - | $\chi_T = \left(\Omega_T^{\frac{\eta_T}{\sigma_T-1}} - 1\right)^{\frac{k}{\eta_T}}$ | (-)/(+)* |
| 3) | Labour supply | $L_A = \frac{k(\sigma_T-1)}{k\sigma_T-\eta_T}N$ | $L_T = \frac{k(\sigma_T-1)}{k\sigma_T-\eta_T}N$ | (+) |
| 4) | Number of firms | $M_A = \frac{k-\eta_A}{k\sigma_A-\eta_A}N$ | $M_T = \frac{k-\eta_T}{(k\sigma_T-\eta_T)(1+\chi_T)}N$ | (-) |
| 5) | $\varphi^*$ | $\varphi_A^* = \left(\frac{k\sigma_A-\eta_A}{k-\eta_A}\right)^{\frac{1}{k}}$ | $\varphi_T^* = \left(\frac{(k\sigma_T-\eta_T)(1+\chi_T)}{k-\eta_T}\right)^{\frac{1}{k}}$ | (+) |
| 6) | Employment share | $(1-U_A) = \frac{k-\eta_A}{k-(1-\theta)\eta_A}$ | $(1-U_T) = \frac{\Gamma_T}{(1+\chi_T)}[\frac{k-\eta_T}{k-(1-\theta)\eta_T}]$ [4)] | (-) |
| 7) | Average wage | $\bar{w_A} = \left(\frac{k-(1-\theta)\eta_A}{k-\eta_A}\right) * \Xi_A$ | $\bar{w_T} = (1+\chi_T)^{\frac{1}{k}}(1-U_T)^{-1} * \Xi_T$ [5)] | (+) |
| 8) | Average profit | $\bar{\pi_A} = \rho_A\left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}}\left(\frac{k\sigma_A-\eta_A}{k-\eta_A}\right)^{\frac{1}{k}}$ | $\bar{\pi_T} = \left[(1+\chi_T)\left(\frac{k}{k-\eta_T}\right) - \chi_T\right](1+\chi_T)^{\frac{1}{k}} * \Xi_T$ | (+) |
| 9) | Between inequality | $\frac{\bar{\pi_A}}{(1-U_A)\bar{w_A}} = \frac{k}{k-\eta_A} \equiv \omega_A$ | $\frac{\bar{\pi_T}}{(1-U_T)\bar{w_T}} = \frac{k}{k-\eta_T} * (1+\frac{\eta_T\chi_T}{k})$ | (+) |
| 10) | Manager income gini | $A_M = \frac{\eta_A}{2k-\eta_A}$ | $A_{M,T} = [\frac{\eta_T}{2k-\eta_T}] * [1+\frac{\chi_T(2-\chi_T)(k-\eta_T)}{k+\eta_T\chi_T}]$ | (+) |
| 11) | Labour income Gini | $A_L = \frac{\theta\eta_A}{2[k-(1-\theta)\eta_A]-\theta\eta_A}$ | $A_{L,T} = \frac{\theta\eta_T}{2[k-(1-\theta)\eta_T]-\theta\eta_T} * [1+\Lambda]$ [6)] | (+) |

*Notes*: [1)] Results without brackets are based on analytical analysis and results with brackets on numerical analyses.

[2)] Domestic revenue. [3)] Exporters' revenue.

[4)] $\Gamma_T \equiv 1 + \chi_T^{\frac{k-(1-\theta)\eta_T}{k}}(\Omega_T^{\frac{(1-\theta)\eta_T}{\sigma_T-1}} - 1)$.

[5)] $\Xi_{S=A,T} = \left(\frac{(\sigma_S-1)^2}{\sigma_S}\right)\left(\frac{k}{k-\eta_S}\right)^{\frac{\sigma_S}{\sigma_S-1}}\left(\frac{k-\eta_S}{k\sigma_S-\eta_S}\right)^{\frac{k-1}{k}}\left(\frac{k\sigma_S-\eta_S}{k(\sigma_S-1)}\right) > 0$

[6)] $\Lambda \equiv \left(\frac{2k}{(\sigma_T-1)\theta} + 2k - \frac{2}{\theta}\right)\left(\frac{\chi_T-\chi_T^{2-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}}{(1+\chi_T)\Gamma_T}\right) - \left(\frac{2k}{(\sigma_T-1)\theta} + 2k + 2 - \frac{2}{\theta}\right)\left(1-\frac{1}{\Gamma_T}\right)\left(\frac{1-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}}{1+\chi_T}\right) > 0$

* See appendix B.2, table B.2, for the analysis on the sign of the derivative with different parameter values.

Second, in addition to the decrease in the share of exporting firms, a higher $\rho_T$ results in a lower number of firms in general. With smaller mark-ups, the productivity of the marginal firm needs to be higher than without a change in $\rho_T$. The (growth rates of) product prices decrease since the elasticity of demand increases. See the pricing equation in subsection 4.3.1. Subsequently, a smaller share of firms manage to reach the required level of productivity to produce profitably with the lower prices and mark-ups. Out of the population of N, fewer people will be managers and fewer can work as local experts for foreign firms. Therefore, the open economy labour supply, $L_T = N - (1 + \chi_T)M_T$, increases.

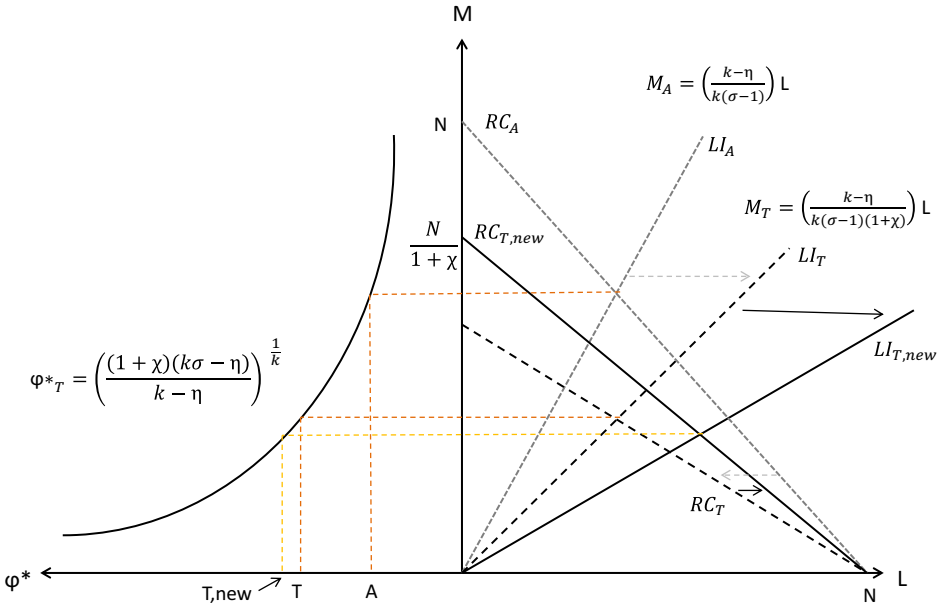
Graph 4.1 demonstrates these effects in a similar way as Egger and Kreickemeier (2012) did in the original article. See also equations B.6, B.7 and B.8 in appendix B.1 and numerical analyses in appendix B.2 for proof.

The equilibrium values of L and M are determined from the labour indifference (LI) condition[23] and the resource constraint (RC). The latter illustrates the possible divisions of population to workers and managers provided that share $\chi_T$ will work as experts for foreign firms in the open economy. The LI line is already lower with open trade than in autarky ($LI_A$ vs. $LI_T$) and shifts further to $LI_{T,new}$ as $\rho_T$ increases. The resource constraint turns somewhat to the right after the change in mark-ups. This results from the lower share of exporting firms after the new mark-up. However, the RC line will still stay below the autarky level. The new equilibrium values for L and M are found from the intersection of the solid $LI_{T,new}$ and $RC_{T,new}$ lines. Based on the derivatives, the shift in the LI line has always a larger effect than the change in the RC line. At the equilibrium, labour supply is higher than previously and the number of firms is lower. The equivalent productivity level required to produce, on the left side of the graph, is also higher.

With the previously explained changes in labour supply, the number of firms and marginal productivity, unemployment rate is found to increase in the EK model when mark-ups decrease. This result is contrary to what has

[23] Equation 4.9 in autarky and equation 4.16 in open economy.

Figure 4.1: Equilibrium in open economy with lower mark-ups




been considered until now. For example, Blanchard and Giavazzi (2003) come to the exact opposite conclusion. They find that when the number of firms is endogenous (as it is in the EK model), the unemployment level will decrease when product markets are deregulated and the demand elasticity increases. The main difference between their GE model and the EK model is the inclusion of firm heterogeneity and fair wages in the latter.

The reason for this result in the EK model is straightforward. There are three main reasons for the increase in the share of unemployed people:

1. The firms that continue operations are more productive and due to the higher productivity level they need less employees to obtain the same level of revenue than less productive firms that drop out of competition;

2. The number of firms that employ people decreases; and

3. Labour supply increases after the elasticity of demand increases.

Due to these mechanisms, more workers from the labour supply will stay unemployed compared to the situation where there is no change in demand elasticity and mark-ups after trade opening. See appendixes B.1 and B.2 for proof.[24]

These kinds of dynamics have been observed in reality as well. In industries that face high elasticities of demand, consumers change to a cheaper brand even due to a small price difference. In these industries the number of firms decreases at the same time as the elasticity of demand goes up. Workers are typically replaced by machines, which in this model is captured by the manager's productivity level. In case the competition increases in a relatively short time, the (sectoral) unemployment rate can mount.

As an example of a sector that has faced these dynamics in a pronounced way, we can think about the trends in the production of flour. Most consumers consider flour (of a specific wheat) to be a relatively homogenous product. A hundred years ago, every small village typically had a mill. As transportation and trade costs sank, consumers could easier obtain cheaper flour from neighbouring mills and countries, and the elasticity of demand increased.[25] Competition in the industry increased at the same time. The number of mills and their employees went down. By now, there are relatively few firms producing flour compared to history. The existing firms operate with few employees, many machines and very low per unit costs. For example, in the year 1993 Finland already had less than 100 firms producing flour products. Between 1993 and 2007 the number of these firms went further down by 27 percent and employment in the sector decreased similarly.[26] On the other hand, over the last hundred years the demand for flour per person has probably not changed considerably and the Finnish population has more

[24] In the analyses of the functional forms, it should be noticed that while the share of exporting firms is smaller after a change in the mark-ups, the inequality of $\Gamma_T < 1 + \chi_T$ in the employment rate equation in row 6 of table 4.1 holds also after an equal change in mark-ups.

[25] Retailers have become also larger with more negotiation power, which has increased similarly the elasticity of demand.

[26] Source: Statistics Finland, firm statistics by industry, 1993-2007.

than doubled. Finland has also remained a net exporter of milling industry products at least from 1995 onwards.[27]

### 4.4.2 Income inequality effects

First, detailed analyses on the changes in the average labour wage and average profits clarify the results of the EK model with regards to income inequality. The function for average labour wage is not derived in Egger and Kreickemeier (2012), but can be solved from the definition of average expected income: $\bar{w_i}(1-U_i) = \frac{\rho_i Y_i}{L_i}$, $i \in [A,T]$. The same definition applies both in autarky and in open economy, but the level of Y is different in the open economy even if $\rho_T$ would not change. Using the autarky and open economy solutions for Y and L, as presented in subsections 4.3.1 and 4.3.2 respectively, the average labour wage in autarky is:

$$\begin{aligned} \bar{w_A} = \frac{\rho_A Y_A}{L_A(1-U_A)} &= \frac{\rho_A(\sigma_A-1)\left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}}\left(\frac{k-\eta_A}{k\sigma_A-\eta_A}\right)^{\frac{k-1}{k}} N}{\frac{k(\sigma_A-1)}{k\sigma_A-\eta_A} N * \frac{k-\eta_A}{k-(1-\theta)\eta_A}} \\ &= \left(\frac{(\sigma_A-1)^2}{\sigma_A}\right)\left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}}\left(\frac{k-\eta_A}{k\sigma_A-\eta_A}\right)^{\frac{k-1}{k}} * \\ &\qquad \left(\frac{k\sigma_A-\eta_A}{k(\sigma_A-1)}\right)\left(\frac{k-(1-\theta)\eta_A}{k-\eta_A}\right) \end{aligned} \tag{4.18}$$

In comparison, with open trade, the average salary paid to employed workers is:

$$\bar{w_T} = \frac{\rho_T Y_T}{L_T(1-U_T)} = \frac{\rho_T(1+\chi_T)^{\frac{1}{k}} * (\sigma_T-1)(\frac{k}{k-\eta_T})^{\frac{\sigma_T}{\sigma_T-1}}(\frac{k-\eta_T}{k\sigma_T-\eta_T})^{\frac{k-1}{k}}}{\frac{k(\sigma_T-1)}{k\sigma_T-\eta_T} * (1-U_T)}$$

[27] Source: Eurostat trade statistics, CN8 classification. Based on the value and quantity of exports and imports to and from all partner countries in EUR and in kg. Before 1995 no statistics available for Finland.

$$\bar{w_T} = (1+\chi_T)^{\frac{1}{k}} \left[\frac{1+\chi_T}{\Gamma_T}\right] \left(\frac{k-(1-\theta)\eta_T}{k-\eta_T}\right) \left(\frac{(\sigma_T-1)^2}{\sigma_T}\right) * \left(\frac{k}{k-\eta_T}\right)^{\frac{\sigma_T}{\sigma_T-1}} \left(\frac{k-\eta_T}{k\sigma_T-\eta_T}\right)^{\frac{k-1}{k}} \left(\frac{k\sigma_T-\eta_T}{k(\sigma_T-1)}\right) \quad (4.19)$$

Even without a change in the mark-ups between autarky and open trade, the average wage increases with open trade since the first two terms of function 4.19 are both above 1 (as shown in Egger and Kreickemeier, 2012). In case mark-ups decrease and a larger fraction of revenue is allocated to employees, the average wage in the economy increases further. The average wage is affected also by the amount of firms in the market, their productivity levels and export status. See equation B.11 and subsection B.2 in the appendix for proof. As mentioned earlier, there is no wage rigidity in the EK model, while in reality wages can be relatively rigid in the short run. Therefore, the mechanisms in the model can be considered as somewhat longer run dynamics.

Similar to the average labour wage, final solutions for average profits in autarky and open economy are not included in Egger and Kreickemeier (2012), but can be derived from the other definitions. In autarky average profits equal:

$$\bar{\pi_A} = \pi(\tilde{\varphi}) = \rho_A \left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}} \varphi^* = \rho_A \left(\frac{k}{k-\eta_A}\right)^{\frac{\sigma_A}{\sigma_A-1}} \left(\frac{k\sigma_A-\eta_A}{k-\eta_A}\right)^{\frac{1}{k}} \quad (4.20)$$

When the average managerial income is compared to the average wage of a production worker[28] in autarky, the managers are found to obtain a higher average income. With open trade the average profits equal:

$$\bar{\pi_T} = (1+\chi_T) r^n(\tilde{\varphi})/\sigma_T - \chi_T s = (1+\chi_T) \frac{\left(\frac{k}{k-\eta_T}\right)\sigma_T \pi(\varphi^*)}{\sigma_T} - \chi_T \pi(\varphi^*)$$

[28] In comparison, in the EK model average manager income is compared to expected average worker income $\bar{w}(1-U)$, see row 9, table 4.1.

$$\begin{aligned}\bar{\pi_T} &= \left[(1+\chi_T)\left(\frac{k}{k-\eta_T}\right)-\chi_T\right]\bar{w_T}(1-U_T)\\ &= \left[(1+\chi_T)\left(\frac{k}{k-\eta_T}\right)-\chi_T\right](1+\chi_T)^{\frac{1}{k}}\left(\frac{(\sigma_T-1)^2}{\sigma_T}\right)*\\ &\qquad \left(\frac{k}{k-\eta_T}\right)^{\frac{\sigma_T}{\sigma_T-1}}\left(\frac{k-\eta_T}{k\sigma_T-\eta_T}\right)^{\frac{k-1}{k}}\left(\frac{k\sigma_T-\eta_T}{k(\sigma_T-1)}\right) \quad (4.21)\end{aligned}$$

The average managerial income is higher in open trade than in autarky.[29] If mark-ups fall, the average managerial income increases further. This results from the fact that the fewer firms that continue to operate are more productive. Therefore, even the manager's lower share of revenue results in a higher average income for them. See equation B.12 and subsection B.2 in the appendixes for proof.

Finally, we analyse the income inequality effects of a change in elasticity of demand and in mark-ups. The opening of trade by itself increases the income inequality between managers and production workers. In case mark-ups decrease with open trade, the intergroup inequality increases further (see equation B.13 and numerical analyses). This results from the wage setting equation, which stresses the external labour market conditions in addition to the firms' profits. In other words, the average profits of the operating firms go up more than the average expected labour wage, $\bar{w_T}(1-U_T)$. While the average labour wage, $\bar{w_T}$, increases, the share of employed people decreases at the same time. The comparison of average profits to average expected labour wage shows that the increase in $\bar{w_T}$ is not sufficient to compensate for the decrease in $(1-U_T)$ in comparison to the increase in average profits.

A decrease in the mark-ups also results in a higher Gini index for profit income compared to an open economy situation without a change in mark-ups. See equation B.14 in the comparative statics section and the numerical analyses. Since there are fewer firms that can export and materialize higher total profits (based on the higher total revenue of exporters), the share of managers that can enjoy the export premium on profits decreases. At the

[29] This is based on the following inequality:
$\left[(1+\chi_T)\left(\frac{k}{k-\eta_T}\right)-\chi_T\right](1+\chi_T)^{\frac{1}{k}}\left(\frac{(\sigma_T-1)^2}{\sigma_T}\right)\left(\frac{k-\eta_T}{k\sigma_T-\eta_T}\right)^{\frac{k-1}{k}}\left(\frac{k\sigma_T-\eta_T}{k(\sigma_T-1)}\right) > \rho_A\left(\frac{k\sigma_A-\eta_A}{k-\eta_A}\right)^{\frac{1}{k}}$

same time, a higher share of firms will operate only in the domestic market with lower total profits. This widens the income distribution and increases the Gini index of profit income.

Similarly, a higher demand elasticity increases the Gini index of labour income inequality. The reason is similar to the case of profit income inequality. A higher share of workers will be employed in non-exporting firms, which pay lower salaries than exporting firms. The distribution of labour income becomes broader and the Gini index increases. See comparative statics, equation B.16 for the derivations and subsection B.2 in the appendixes for the numerical analyses.

### 4.4.3 Magnitude of the effects

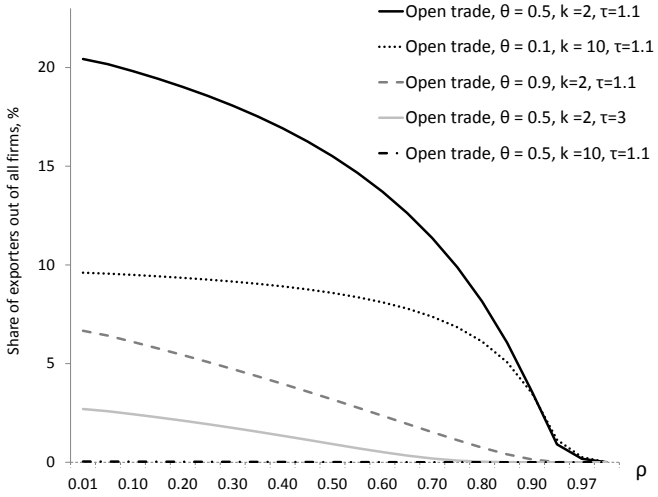
When we understand the dynamics behind the main effects, there is still the question of how extensive the effects are. In practise, many people might be interested to know whether increased competition will result for example in an 0.1 or 5 percentage points higher unemployment rate or labour income Gini index. In order to magnify and compare the main effects, figures from 4.2 up to 4.6 provide few examples. They show the share of exporting firms, the level of unemployment rate, the rate of the two Gini indexes and intergroup inequality with different values of $\rho_T$ and other parameters. With respect to the evaluation of the other three parameters, it should be remembered that the higher the parameter $\theta$ is, the higher emphasis employees give to the profits of the firm in their wage demands in comparison to the external conditions in the labour markets. The lower the value of k, the more spread out is the distribution of firms' productivity levels. Last, the higher $\tau$ is, the higher are transport costs for the exporters.

#### Share of exporters

Figure 4.2 displays the share of exporting firms with different parameter values. The lines show the decrease in the share of exporting firms as $\rho_T$ increases. In addition, it provides a view on the variation of the share of exporters depending on the magnitude of the different parameters. With

a relatively low transport cost level of 10 percent ($\tau = 1.1$), the share of exporting firms is higher if the dispersion of the productivity distribution is bigger (the lower k is).[30] On the other hand, a higher emphasis on profits (a higher $\theta$) with a given level of k, results in a lower share of exporting firms. In that case exporting firms need to pay higher wages than with a lower $\theta$, which would emphasise their profits less. This increases their costs and pulls the productivity level requirement higher.[31] The level of transport costs has also a considerable effect on the share of exporting firms in the EK model similar to other theoretical and empirical studies' findings. This is evident in the figure from the difference between the solid black and grey lines. In general, as mark-ups approach one, the share of exporting firms approaches zero.

Figure 4.2: Share of exporters, %, with different parameter values




[30] This is visible by comparing line $\theta = 0.5, k = 2, \tau = 1.1$ to line $\theta = 0.5, k = 10, \tau = 1.1$ in the figure.

[31] Compare line $\theta = 0.5, k = 2, \tau = 1.1$ to line $\theta = 0.9, k = 2, \tau = 1.1$, and line $\theta = 0.1, k = 10, \tau = 1.1$ to line $\theta = 0.5, k = 10, \tau = 1.1$ in figure 4.2.

**Unemployment rate**

With regards to the unemployment rate and the income inequality indicators in figures from 4.3 to 4.6, we can compare:

1. Parts (a) of the figures: The effect of a competition increase on the indicator's rate versus the effect of trade opening; and

2. Parts (b) of the figures: The effect of a competition increase on the indicator's rate versus the effect of trade costs decrease.

The other parameters, expect for $\rho_T$, are kept constant in the lines with the same colour. It should be noticed that in the first comparisons in parts (a), the movement from autarky to open trade is not a percentage change in any variable. Therefore the comparison of the effects depends on the change in $\rho_T$, but also on the magnitude of the various other parameters. On the other hand, in parts (b) of the figures, we compare the effect of a 95 percent increase in $\rho_T$ to a 95 percent decrease in trade costs.[32] By comparing the solid lines with lower transport costs to the dotted lines with higher transport costs, one can quantify the effect of trade cost decreases. The effect of a competition increase is visible by moving along the different lines.

Part (a) of figure 4.3 shows that for example in case A, see orange lines, the unemployment rate increases slightly more when the economy goes from autarky to open trade than when competition increases (when $\rho_T$ increases from 0.3 to 0.35). With other parameter values in case B, the effect of a competition increase on the unemployment rate seems to be bigger than the effect of trade opening. See the blue lines. In general, it cannot be concluded whether the move from autarky to trade or the change in mark-ups has a larger impact on the level of the unemployment rate.

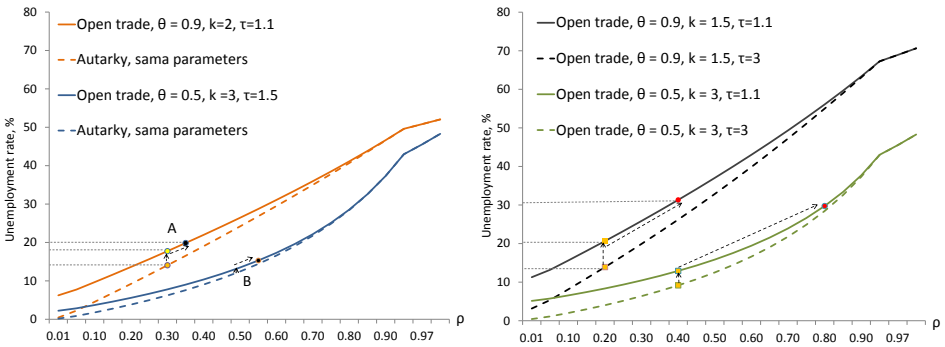
On the contrary, part (b) of figure 4.3 shows that if $\rho_T$ goes for example from 0.2/0.4 to around 0.4/0.8, the unemployment rate increases more than it does from an equal percentage change in trade costs with the provided

[32] Trade costs are 200 percent when $\tau = 3$ and 10 percent when $\tau = 1.1$, which equals a 95 percent drop in the rate of trade costs.

parameter values.[33] The effects seem also quite large. The unemployment rate increases by some 10 to 16 percentage points from a 95 percent increase in $\rho_T$, while the parameter assumptions cannot be considered unusual (see appendix B.2). For comparison, if trade costs decrease by 95 percent, the unemployment rate increases by around 4 to 7 percentage points with the same parameter values.

The flour industry example can help to understand the unemployment rates with the highest values for $\rho_T$, which seem somewhat extreme. At the moment when the elasticity of demand is very high, only a few mills would be able to survive in the competition and they will produce all the flour demanded. These few firms will have a high productivity level and need only few employees in addition to the machines. Most of the people that used to work in the sector will be either unemployed or employed in another sector. The sectoral unemployment rate could reach even 70 percent if these dynamics would happen in a relatively short time and the employees cannot move flexibly between sectors. So high values for $\rho_T$ are not likely to occur on average at the level of the whole economy, but for some specific industries they can hold.

Figure 4.3: Unemployment rate, %, with different parameter values




(a) Autarky vs. Open trade

(b) Trade costs vs. competition

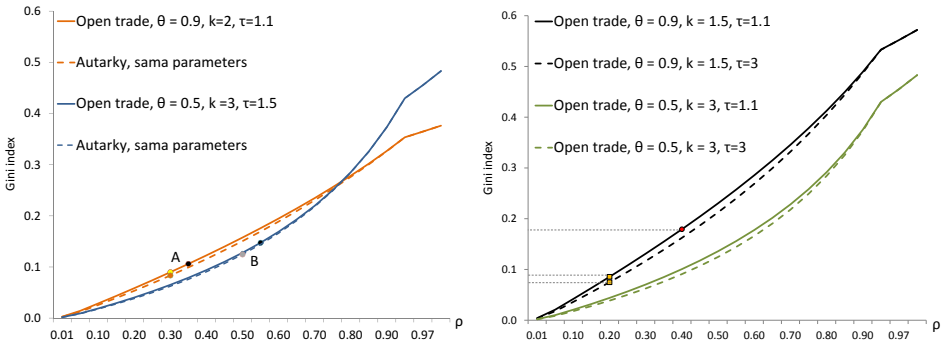
[33] See the difference between the two orange dots versus the difference between the orange and the red dot in the solid lines.

**Gini indexes**

Figures 4.4 and 4.5 provide examples on the levels of the Gini indexes in a similar way as for the unemployment rate. The profit income Gini increases somewhat more from any change in competition compared to the movement from autarky to open trade with the shown parameter values (see cases A and B in part (a) of figure 4.4). Contrarily, labour income Gini, presented in figure 4.5, increases in general in both presented cases more than the profit income Gini if the country moves from autarky to open trade. This is visible by comparing parts (a) of the figures. The effect of a competition increase on the labour income Gini varies according to the magnitude of the change in $\rho_T$ and the value of the other parameters.

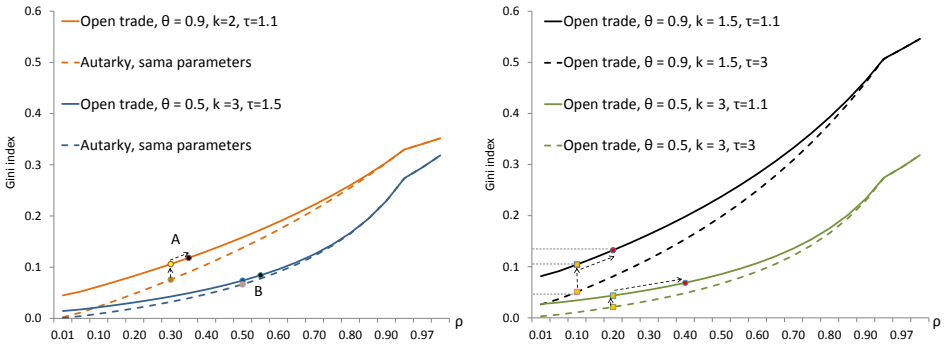
With regards to the comparisons of the competition increase to the decrease of trade costs in parts (b), a change in $\rho_T$ affects the profit income Gini more than an equal percentage change in trade costs in the two examples. In contrast, a change in $\rho_T$ from 0.1 to nearly 0.2 (or 0.2 to 0.4) has a smaller or equal effect on the labour income Gini than a 95 percent decrease in trade costs. See the cases presented in part (b) of figure 4.5. With higher values of $\rho_T$, competition has again a larger impact on the labour income Gini than trade costs decrease. To conclude, these comparisons' results depend on the level of the other parameters (k and $\theta$) and on the initial level of $\rho_T$. Overall, the higher $\rho_T$ is, the higher the inequality within managers and workers since a smaller share of the firms can export.

Figure 4.4: Profit income Gini with different parameters




(a) Autarky vs. Open trade (b) Trade costs vs. competition

Figure 4.5: Labour income Gini with different parameters



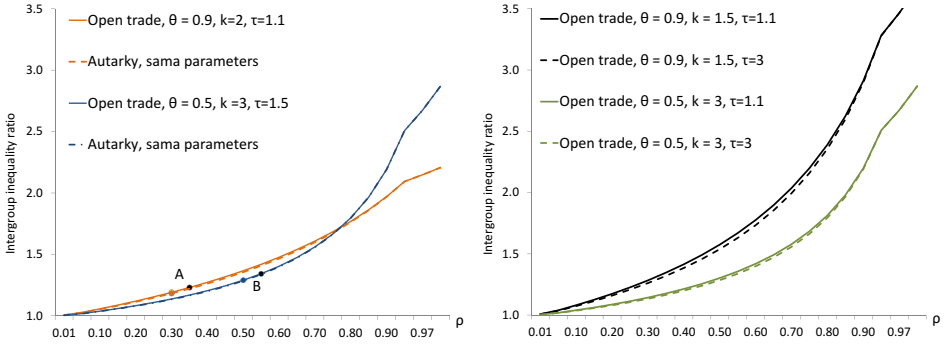

(a) Autarky vs. Open trade (b) Trade costs vs. competition

### Intergroup inequality

Last, figure 4.6 presents comparisons for the ratio of average profits to average expected wages. The effect of a competition increase on the ratio seems to be again somewhat bigger in both presented cases (A and B, part (a) of the figure) than the effect of the movement from autarky to open trade. In effect, the differences in the intergroup inequality ratios between autarky and open trade are so small that they are hardly visible in the figure. Part (b) of the figure presents that an equal percentage change in $\rho_T$, as com-

pared to $\tau$, results in a bigger change in the ratio with the given parameter values. This is detectable by comparing the solid and the dotted lines with same values of $\rho_T$ and e.g. a change in $\rho_T$ from 0.4 to 0.8 in the solid lines. In general, the level of the other parameters affects the absolute changes and levels significantly and no definite conclusions can be drawn from the comparisons.

Figure 4.6: Intergroup inequality ratio with different parameters




(a) Autarky vs. Open trade (b) Trade costs vs. competition

To summarize, we find that the absolute changes in the different indicators depend critically on the values of the various parameters in the model/economy. In some cases trade opening after autarky seems to have a bigger effect on the indicators' levels than a competition increase, while in other cases the opposite holds. On the other hand, in most studied cases a decrease in mark-ups, which is as big as the decrease in trade costs in percentage terms, leads to a larger change in the indicators' values than the decrease in trade costs. Opposite results are found as well, though. It is noteworthy that even with some relatively common assumptions for the different parameters' values, the magnitude of the effect from increased competition can be substantial in size.

## 4.5 Conclusions

During the past decades within-country income inequality has increased in most countries, while the trends in between-country and global income inequality have been more diverse. Especially the role of top incomes and capital income as contributors to the rising total income inequality within-countries have gained attention recently. However, theoretical analyses on the effects of trade on within-country income inequality have focused mostly on wage inequality or only on capital income. The only more general framework with heterogeneous firms was developed by Egger and Kreickemeier (2012) (EK). The EK model allows the assessment of trade liberalisation effects on both income inequality types at the same time. In line with empirical findings, in the EK model workers obtain also a 'fair wage' that depends both on the external conditions in the labour markets and on the profits of the firm. While most of the assumptions in the EK framework match empirical findings, they have assumed that mark-ups remain unchanged after a country moves from autarky to open trade. This assumption is in contrast with empirical findings on the effect of trade on demand elasticities and mark-ups, and on the endogenous mark-up assumption in various other models.

In this article we contribute to the analyses on the mechanisms behind the increase of within-country income inequality. We provide a small expansion on the theoretical analysis of Egger and Kreickemeier (2012) by allowing mark-ups to change after a country leaves autarky in their framework. In the analysis we assume that both domestic firms and exporters face the same elasticity of demand (and have same level of mark-ups), but that this elasticity is higher in an open economy than it was in autarky due to increased competition in the market.

Our results strengthen the original findings of Egger and Kreickemeier (2012). We find that increased competition in an open economy will increase the unemployment rate, the Gini index of profit income, the Gini index of wage income and the inequality between profit and wage income. Especially the result on unemployment rate is in contrast to an earlier study on the

effect of an increase in demand elasticity, based on a model that does not take into account firm heterogeneity or have 'fair wage' setting. However, the reasons for these results in the EK model are straightforward.

With smaller mark-ups (higher $\rho_T$), the productivity of the marginal firm needs to be higher than without a change in $\rho_T$. Only a smaller number of managers/firms reach the required level of productivity to produce profitably. Also, a smaller share of firms reach the higher marginal productivity level required to export. Out of the population, fewer people can be managers and fewer can work as local experts for foreign firms. Therefore, labour supply increases, but the operating firms with higher (labour) productivity need less employees than the firms with lower productivity levels that drop out of the competition. Unemployment level increases.

With the lower mark-ups and a larger fraction of firms' revenue being allocated to employees, the average wage in the economy increases. In addition, as the fewer firms that still operate in the markets are more productive, even the managers' lower share of revenue results in a higher average income for them. The average profits of the operating firms increase more than the average expected labour wage due to the fair wage setting that emphasises the external conditions in addition to the firm's profits. Subsequently, intergroup inequality increases. The share of high profits earning managers decreases since there are fewer firms that can export and materialize higher total profits. Therefore, the distribution of profit income widens as well. The Gini index of wage income also increases, as a higher share of employees work for non-exporting firms, which pay lower salaries than exporting firms.

As an example of these types of dynamics from increased competition in reality, one can think of the trends in the milling industry. While the demand for flour per person has most likely not changed much and population has increased over time in most countries, the number of mills and employees in the industry has decreased significantly over the years. This is due to the decrease in trade and transport costs and increase in competition, which have resulted in a growing productivity level in the operating firms and an expanding use of machinery in the production. Similarly, if mark-ups

decrease on average in an open economy, these dynamics can be present in a smaller scale.

The parametrizations on the magnitude of the different impacts illustrate a need for more empirical research on the topic. Depending on the underlying parameter values of the economy in question, the effect of a competition increase on the unemployment rate or on the various income inequality indicators can be bigger than the effect of an equal decrease in trade costs in percentage terms. Even with some relatively common parameter values, the effects on the unemployment rate are also substantial in size. However, opposite and negligibly small results are found as well.

In future, an endogenous mark-up function could be also introduced in the model e.g. following Melitz and Ottaviano (2008). In addition, quality-adjusted demand models could be considered. In recent literature mark-ups have been found to differ also between exporting firms and domestic firms in the same industry, which might affect these dynamics as well.

# Chapter 5

# Exporting and profits - confusing profit levels and profit margins *

## 5.1 Introduction

The assumption of profit maximization is at the heart of economic theory regarding firm behaviour. While the notion that internationally competing firms are on average more productive than domestically competing firms is well-demonstrated (Wagner, 2012b), the empirical evidence regarding the question whether this productive advantage translates into higher *profitability*[2], the level of profits relative to revenue or assets, is not conclusive (Wagner, 2012a). In fact, there seems to be some kind of confusion over the effects of internationalization on profit levels versus on profit rates.

Theoretical models regarding the behavior of individual firms on international markets are generally developed from the notion that a firm starts exporting if expected profits derived from international markets at least equal

* Based on joint research with Marcel van den Berg and Charles van Marrewijk.

[2] Throughout the paper we use the terms profitability, profit margins and profit rates interchangeably. All terms express exactly the same, that is, profit levels *relative to* some other quantity such as revenues or assets.

the expected profits derived from only serving domestic markets (Clerides et al., 1998; Melitz, 2003; Egger and Kreickemeier, 2012), i.e. it is *profitable* to export. However, this does not mean that by default exporting would increase also profitability. The cost level of internationally competing firms is generally higher than that of firms focusing on domestic markets. In order to start exporting a firm faces additional fixed costs associated with e.g. market research, locating foreign trade partners or modifying products to comply with local regulations and preferences. In addition, internationally operating firms generally have a higher skilled and more productive workforce, which requires paying higher wages compared to domestically operating firms (Egger and Kreickemeier, 2012). The combination of higher revenues associated with access to a larger market and higher costs renders the net effect on firm-level profitability ambiguous.

However, as Wagner (2012b, p.253) summarizes the literature: *"..Often profitability is viewed both in theoretical models of market selection and in empirical studies on firm entry and exit as a positive monotonic function of productivity, and selection on profits then is equivalent to selection on productivity"*.[3] In other words, literature concerning the relationship between internationalization and profitability generally seems to start from the explicit or implicit expectation that the productivity premia of exporters translates into an exporter premia on profitability as well, although these expectations are not derived from the predictions of different theoretical models at hand. In addition, the terms profitability and 'to export profitably' seem to be sometimes used as equivalents, while the former measures the profit margins and the latter the profit levels associated with exporting.

The fact that the empirical literature concerning the relationship between profitability and internationalization of firm activities is still rather small seems to stem mainly from the limited availability of profit data. However, the question on whether exporting affects firm level profitability is important. Financial analysts generally evaluate firm performance based on information provided in financial statements whereby profitability indica-

[3] See also e.g. Foster et al., 2008, Aw et al., 2008 and Pavcnik, 2002.

tors play a particularly important role (Robinson et al., 2012). This implies that information regarding firm profitability is crucial in the decision making process of investors and thus affects the availability of funds to the firm and the survival of the firm. In addition, low profitability levels, measured by return on assets (ROA) or net profit margins, have been associated with mass layoffs of employees and downsizing (Marques et al., 2011; McKinley et al., 2000). This supports the hypothesis that profitability indicators are used as one of the main performance measures in business life. In fact, Foster et al. (2008) mention that the selection of firms that will manage to produce in a given market environment is not based on their productivity level (as Melitz, 2003, assumed), but more likely based on their profitability. Productivity is correlated with profitability, but various other factors affect profitability as well. Therefore, we cannot unconditionally extend the findings of the huge empirical literature regarding the relationship between productivity and internationalization to include profitability. Nonetheless, the empirical literature dealing with the relationship between productivity and profitability, surveyed in Wagner (2012b), yields inconclusive results thus far.

We add to the still small literature dealing with the relationship between profitability and internationalization both theoretically and empirically. We aim to explicitly attend to the differential impact of internationalization on profit levels and profit margins. The broad literature on productivity has shown that exporting firms have typically higher revenues than firms operating in the domestic markers (Bernard et al., 2012). As final profit level is determined by the profit margin of the firm multiplied by revenue, we concentrate mostly on analysing the relationship between profit margins and internationalization, which finally provides us also a view on the profit levels associated with internationalization. First, we derive predictions from existing theoretical models of the effect of exporting on profit margins. The leading theoretical models regarding firm heterogeneity, such as Melitz (2003) and Egger and Kreickemeier (2012), explicitly include profit levels and do not explicitly consider profit rates. However, these models provide

the necessary ingredients for this analysis. Second, we empirically investigate the relationship between internationalization and profit rates.

In our analysis, we separate between firms from different size classes and we distinguish between key sectors such as manufacturing, wholesale & retail trading and services. Most micro data based studies regarding firm heterogeneity focus on manufacturing sectors, mainly motivated by a lack of data regarding trade in services. However, employing Finnish micro data we are able to include service sectors in our analysis. We investigate four different profitability measures to gain an understanding of the robustness of our findings to the choice for a particular profitability measure. We analyse gross profit margins, net profit margins, return on assets (ROA) and gross profits per employee as profitability measures. To be able to assess the consistency and the robustness of our findings we apply our empirical framework separately to firm level micro databases from two small, open Western-European economies, namely Finland and the Netherlands. We believe, as Hamermesh (2000, p. 376), puts it, that *"the credibility of a new finding that is based on carefully analysing two data sets is far more than twice that of a result based only on one".*

This paper is organized as follows. Section 5.2 provides a brief discussion of the existing empirical literature regarding the relationship between exporting and profitability. Section 5.3 provides a theoretical framework for the empirical investigation of the relationship between profit margins and trade. Section 5.4 introduces the data employed in the analysis. In section 5.5 we discuss the measurement of profitability and the methodology adopted in the empirical analysis. In section 5.6 we present our empirical findings. Section 5.7 concludes and provides some directions for further research.

## 5.2 Firm heterogeneity and profitability

In recent years a few empirical studies dealing with profitability and internationalization, recently reviewed in Wagner (2012b), have been added to the firm heterogeneity literature. The topic has been studied more intensively

in the international business literature. However, the available evidence is rather diffuse and fragmented in terms of profitability measures and research methodologies employed. Overall, the relationship between internationalization and profitability is still not well-established and contradictory results are common.

Various theoretical and empirical studies implicitly or explicitly expect that the productivity premia of exporters translates into a profitability premia for exporters as well (Wagner, 2012b). However, as Wagner (2012b) phrases it: *"As of today, a big picture has not emerged"* regarding the relationship between exporting and profitability. We briefly discuss the empirical literature relating export status and profitability in the firm heterogeneity field thus far, heavily drawing on the literature survey of Wagner (2012b).[4] Girma et al. (2004), employing a series of Kolmogorov-Smirnov tests, find no significant difference between domestic non-exporters and domestic exporters on the profit level per employee. Grazzi (2012) finds no significant relationship between exporting and profit margins in Italy, similar to the findings of Temouri et al. (2013) for British service exporters and Wagner (2012a) for Germany. Temouri et al. (2013) find a positive relationship between service exporting and profit margins in France and a negative relationship in Germany. In addition, Fryges and Wagner (2010) document a small exporter premium on profit margins for German manufacturing firms. They show that being an exporter as such does not increase profit margins, and present evidence suggesting an inverted U-shaped correlation between the export share and profit margins. For firms with a sufficiently small share of exports in total sales they even find a negative export premium. Kox and Rojas-Romagosa (2010) present evidence for the Netherlands indicating that profits per employee in exporting firms are higher and that more profitable firms seem to self-select into exporting.[5]

[4] For an overview of the empirical studies on this topic see Table 5 of Wagner (2012b, p. 257-258).

[5] This paper does not mark an attempt to replicate the results presented by Kox and Rojas-Romagosa (2010) for the Netherlands, since our analysis differs on numerous dimensions.

In the field of international business management the relationship between internationalization and firm performance has been heavily debated over the past decennia. In a meta-analysis of the internationalization-performance relationship, Bausch and Krist (2007, p 320) summarize the current state of affairs in this field of research in a series of citations as: *"inconsistent", "mixed", "decidedly mixed", "contradictory", "inconsistent and contradictory", "inconclusive and contradictory", and "conflicting"*. Nonetheless, in their meta-analysis of 36 studies from 25 years of research (41 samples, N=7,792), Bausch and Krist (2007) present empirical evidence suggesting that internationalization fosters firm performance, albeit that this relationship is heavily moderated by various other firm characteristics, such as firm size and age. Reviewing 43 empirical papers published between 1998 and 2004, Sousa (2004) argues that little consensus has been reached in the field, which has produced contradictory and fragmented findings thus far. An important objection against the way in which the relationship between exporting and firm performance is generally analysed in the field of international business management is that the performance of exporters is not related to that of importers, two-way traders and domestically oriented firms. This makes it difficult to claim that exporting in itself does or does not foster firm performance, since a benchmark against which the performance of exporters is evaluated is lacking. Furthermore, many studies are survey-based and contain relatively small samples, which, combined with employing various methodologies and measures of internationalization and profitability, renders generalization of the findings a delicate process.

The main lesson we learn from the discussion in this section is that no consensus has been reached thus far regarding the question whether internationalization fosters firm performance. That is, neither in the field of economics and international trade, nor in the field of international business management has this question been decidedly answered.

## 5.3 Theoretical framework

In order to gain theoretical understanding of the relationship between trade status and profitability we start by taking on the theoretical models developed by Melitz (2003) and Egger and Kreickemeier (2012). In both models firm total profits $\pi$ are an integral part of the firm profit maximization problem. However, the profit margin $\frac{\pi}{r}$, the key parameter of interest in our empirical analysis, is not explicitly considered. Profit margins are an important indicator of the degree of competitiveness of the firm, since they indicate to which extent the firm is able to operate efficiently, not only on the production side, but also as a seller on domestic and foreign markets. In addition, by expressing profits in relative terms the size component is removed, enabling investigation of the relationship between profitability and exporting across the firm size distribution. In this section we will investigate to what extent these two theoretical models yield empirically testable predictions regarding the relationship between trade status, productivity and profit margins.

### 5.3.1 Profit margins in the Melitz (2003) model

Figure 5.1 shows that in the Melitz (2003) model the profit margin increases in firm productivity along the productivity distribution for both exporters and non-exporters. In the figure $\varphi^*$ refers to the marginal productivity level required to operate and $\varphi_x^*$ to the marginal productivity level required to export, where $\varphi$ refers to firm-level productivity. In order to ensure partitioning of firms by export status, Melitz (2003) assumes that $\tau^{\sigma-1} f_x > f$, where $f > 0$ refers to fixed costs of operations, $\tau > 1$ to the per-unit iceberg variable trade costs and $f_x$ to the fixed costs of exporting. In addition, it is assumed that the marginal exporter with productivity $\varphi_x^*$ generates total revenues approximately equal to the marginal non-exporter just below the threshold productivity level: $r_e(\varphi_x^*) = r_d(\varphi_x^* - \epsilon)$, where subindex $e$ denotes

the exporting firm and subindex $d$ denotes the domestic firm.[6] See appendix C.1 for a more detailed explanation on the derivation of profit rates in the Melitz (2003) model.

These assumptions imply that, as equation 5.2 shows, the profit margin, $\pi_e(\varphi_x^*)/r_e(\varphi_x^*)$, of the marginal exporter will be lower than the profit margin of a domestic firm, $\pi_d(\varphi_x^* - \epsilon)/r_d(\varphi_x^* - \epsilon)$, with productivity level $\varphi_x^* - \epsilon$, where $\epsilon$ is positive, but arbitrarily small and approaching zero. The profit margin of the non-exporter with productivity level $\varphi_x^* - \epsilon$ is larger than profit margin with productivity $\varphi_x^*$ as equation 5.2 shows, since

$$\lim_{\epsilon \to 0} r_d(\varphi_x^* - \epsilon) = r_d(\varphi_x^*) \tag{5.1}$$

and $\tau > 1$. In this equation $r$ refers to firm revenue, parameter $\sigma > 1$ to the elasticity of substitution between any two goods, and $n \geq 1$ to the number of countries where the firm exports to.

$$\lim_{\epsilon \to 0} \frac{\pi_d(\varphi_x^* - \epsilon)}{r_d(\varphi_x^* - \epsilon)} = \frac{1}{\sigma} - \frac{f}{r_d(\varphi_x^*)} > \frac{1}{1 + n\tau^{1-\sigma}} \left[ \frac{1}{\sigma} - \frac{f}{r_d(\varphi_x^*)} \right] = \frac{\pi_e(\varphi_x^*)}{r_e(\varphi_x^*)} \tag{5.2}$$

These analytical results yield the relationship between firm-level productivity and profit margins as depicted in figure 5.1. However, deriving testable predictions from this model of the relationship between trade status and profitability is not feasible, since every outcome is possible, depending on the distribution of profit margins along the productivity dimension for different trade statuses. In addition, contrary to the empirical findings (Mayer and Ottaviano, 2008), it is assumed in the Melitz (2003) model that there is no overlap between the productivity levels of domestic firms versus exporting firms.

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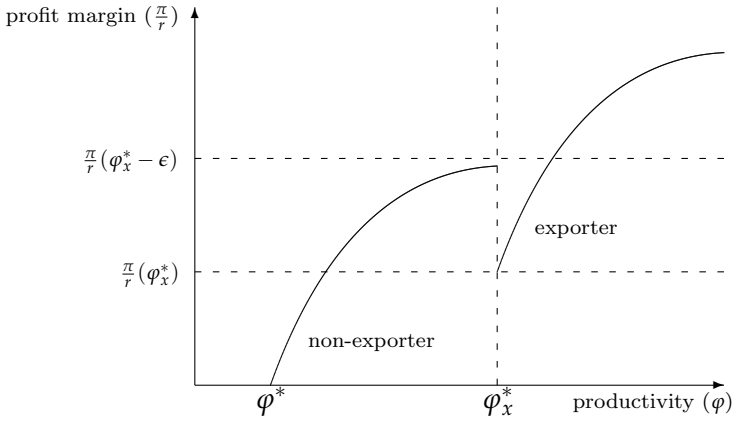
[6] Since the profit margin does not directly depend on firm-level revenues, only indirectly through productivity, the relationship between firm-level revenue and profit margins mirrors that between productivity and profit margins.

Figure 5.1: Relating profit margins and productivity in the Melitz (2003) model




### 5.3.2 Profit margins in the Egger and Kreickemeier (2012) model

In addition to the Melitz (2003) model we consider the model developed by Egger and Kreickemeier (2012) in which wages are endogenised in a fair wage framework. This model is equipped to accommodate the well-established empirical fact that exporting firms pay higher wages than non-exporters. See appendix C.2 for a detailed explanation on the calculation of the profit margins in the Egger and Kreickemeier (2012) model.

Figure 5.2 shows that the profit margin of firms that focus solely on domestic markets is independent of firm-level productivity and thus constant along the productivity distribution up to the productivity level $\varphi_x^*$. In addition, the profit margin of the marginal exporter with productivity level $\varphi_x^*$ is, analogous to the Melitz (2003) model, lower than that of the marginal non-exporter with a productivity level just below $\varphi_x^*$. Firms with productivity levels higher than $\varphi_x^*$ are active on foreign markets in addition to domestic markets and experience profit margins increasing in firm-level productivity. However, a crucial analytical implication of the Egger and Kreickemeier (2012) model is that profit margins of exporters never exceed that of non-exporters; at the limit of the firm-level productivity distribu-

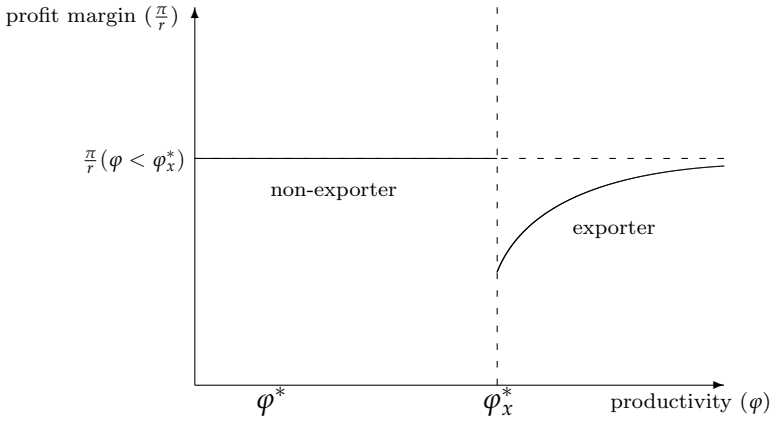
tion the profit margin of exporters approaches that of non-exporters. This becomes immediately clear from the functional forms of the profit margin of domestic firms and the profit margin of exporters presented in equation 5.3. The individual terms in both parts of the inequality are all consistently positive. Therefore, the domestic firms profit margin, $\pi_d(\varphi)/r_d(\varphi)$ with any given productivity level $\varphi$, is always larger than the profit margin of the exporting firm, $\pi_e(\varphi)/r_e(\varphi)$.[7]

$$\frac{\pi_d(\varphi)}{r_d(\varphi)} = \frac{1}{\sigma} > \frac{1}{\sigma} - (1-\rho)(1+\chi)^{-1}\left(\frac{k-\eta}{k}\right)\Omega^{\theta\eta-1}\tilde{\varphi}^{(1-\theta\eta)(\sigma-1)}\varphi^{(\theta\eta-1)(\sigma-1)} = \frac{\pi_e(\varphi)}{r_e(\varphi)} \tag{5.3}$$

From these analytical results we derive the expectation that the exporting firm will face profit margins lower than or equal to the profit margin of the domestic firm. Particularly if exporting firms tend to have relatively high productivity levels, it is likely that no statistical difference will be found between the exporters and domestic firms profit margin.

[7] See appendix C.2 for a detailed explanation of the model and for an explanation of the parameters of equation 5.3 which have not been explained yet.

Figure 5.2: Relating profit margins and productivity in the Egger and Kreickemeier (2012) model




Given the analytically diverging results of both models and the strong evidence regarding the existence of wage premia of exporting, we consider the Egger and Kreickemeier (2012) model to be better equipped to provide testable predictions for the empirical analysis (especially in labor intensive sectors). In addition, deriving testable predictions from the analytical results from the Melitz (2003) model of the relationship between trade status and profitability is not trivial, since every outcome is possible, depending on the distribution of profit margins along the productivity dimension for different trade statuses. In other words, the analytical results regarding the relationship between profit margins, profitability and export status that can

be derived from the theoretical models discussed in this section bring us to the following hypotheses that will be empirically tested in section 5.6:[8]

*Hypothesis I:* Profit margins of exporting firms are lower than or equal to those of non-exporting firms

*Hypothesis II:* Firm-level profit margins are positive correlated with productivity

The empirical implications from deriving profit margins from the theoretical models developed in Melitz (2003) and Egger and Kreickemeier (2012) might seem puzzling at first in the sense that they raise the question why a firm would start exporting at all if it is confronted with lower profit margins after foreign market entry. However, it is crucial to explicitly distinguish between profit margins and total profits at the firm-level. Exporters are on average considerably larger than non-exporters and show to have a higher probability of survival. This leaves the possibility open for exporters to generate higher annual firm-level profits and a higher net present value of future profits relative to non-exporters, even though profit margins might be lower at first. In addition, competition on international markets is generally fiercer than competition on domestic markets, which is likely to be reflected in a lower profit margin for exporters relative to domestic firms.

[8] The theoretical models discussed in this section thus far focus solely on the role of exporting, and ignores the role of importing. Kasahara and Lapham (2013) explicitly include importing in a Melitz-type model. Their analytical findings suggest that the profit margins of importing firms will be larger than the profit margins of domestic firms. However, empirical results of e.g. Machin and van Reenen (1993) show that importing has a negative impact on profit margins. As the issue of importing and profit margins is sparsely researched theoretically, we leave the derivation of empirically testable expectations from theoretical research concerning the relationship between importing and profit margins as a direction for further research.

## 5.4 Data

For the empirical analysis we employ firm-level micro-data from two countries. For the Finnish analyses we use the same database as in chapter 3, which is described in detail in chapter 2.

In addition, in order to gain an understanding of the consistency and robustness of the findings, we run similar analyses also with Dutch firm-level micro-data. The analyses are conducted separately for both countries. Further, to maximize the comparability of the Finnish and the Dutch data for the analysis, we unify the data preparation process particularly regarding the profitability measures employed.

For the Dutch empirical analysis we merge data from three main data sources: (i) the General Business Register (GBR), (ii) the Baseline Database and (iii) the International Trade Database, all provided by Statistics Netherlands into a panel data set covering the years 2002 to 2010.[9]

The GBR is, in principle, exhaustive in the sense that it contains information about every firm in the Netherlands similar to the Finnish data. It includes a set of basic firm characteristics such as the number of employees in fulltime equivalents and the sector in which the firm operates according to the internationally standardized ISIC Rev. 3.1 sector classification.[10] Analogous to the Finnish data we eliminate firms with less than 4 employees from the analysis because comparable tax incentives apply to small firms in the Netherlands. We take from separate but related database information concerning the ultimate controlling institution of the firm, indicating whether the ultimate controlling owner of the Dutch firm is located abroad. The Baseline database contains a wealth of financial information collected from both corporate tax declarations and income tax declarations of entrepreneurs, which is merged to the GBR. The Baseline database contains information about profits, gross output, value added and the value of cap-

[9] We confine ourselves to discussing some key characteristics of each data source in this paper. For details regarding the merging procedure see Van den Berg (2013).

[10] The ISIC Rev. 3.1 sector classification equals the SBI'93 2 digit classification employed by Statistics Netherlands

ital, labour and intermediate inputs. In both the Finnish and Dutch data, the values are deflated in order to remove the influence of inflation. Because of their fundamentally different nature, we separate the Dutch data into two main sectors, manufacturing, and wholesale & retail trading sectors.[11]

Trade data are taken from the International Trade database and includes information on all imports and exports of goods by Dutch firms. Extra-EU trade is recorded by the Customs Authority and intra-EU imports and exports are recorded by the Dutch Tax Authority. The trade data available at the firm level covers more than 80% of annual aggregate trade in terms of value in the Netherlands.[12] The merging procedure results in an unbalanced panel data set containing a total of 501,769 observations of 139,160 firms spanning a period of nine years (2002-2010).[13]

## 5.5 Empirical methodology

### 5.5.1 Measuring profitability

The definition of profit ($\pi$) per employee ($E$) is presented in equation 5.4 and shows that the profit rate results from two factors: a scale effect ($\frac{R}{E}$) and a margin effect ($\frac{\pi}{R}$), where R represents annual revenue. The scale effect refers to the level of revenue and productivity and the margin effect to

[11] We focus the analysis of Dutch firms on manufacturing and wholesale & retail trading, thereby excluding service sectors, since data regarding trade in services are not yet sufficiently available for the Netherlands. We choose *financial intermediation* as the cut-off point for service sectors, which corresponds to ISIC Rev. 3.1 section J, division 65. Manufacturing sectors correspond in the analysis to ISIC Rev. 3.1 sections A through I, excluding G. Wholesale & retail traders correspond to ISIC Rev. 3.1 section G. The OECD and Eurostat recommend to define manufacturing as sections A through F and to include section G to Q in services. However, in terms of goods trade this division is less sensible, since a considerable part of goods trade takes place in trade and transport sectors it is therefore more appropriate to separate these sections from typical (financial and public) service sectors.

[12] The trade data are recorded on VAT-numbers. Connection to the firm identification key used by Statistics Netherlands leads to a merging loss of about 20% of annual trade values.

[13] This is after eliminating four sectors with eight observations or less, micro firms (less than four fulltime equivalents) and implausible observations with zero or negative output or exports exceeding gross output.

the cost structure, i.e. to the margin of profits over revenues. Gross profit per employee is calculated according to the following equation, where the definition of gross profit is derived in equation 5.5:

$$\frac{\pi_G}{E} = \frac{R * (\frac{\pi_G}{R})}{E} \tag{5.4}$$

While some business people have taken an interest on analysing also the trends in profits per employee[14], investors still typically employ indicators based on margins and returns from financial statements to assess the profitability, performance and attractiveness of a firm as an investment (Robinson et al., 2012). A few of the most common indicators for profitability in financial analysis based on the International Financial Reporting Standards (IFRS) include (but are not limited to):

Gross profit margin,

$$\frac{\pi_G}{R} = \frac{R - VC}{R} = 1 - (\frac{VC}{R}) \tag{5.5}$$

Net profit margin,

$$\frac{\pi_N}{R} = \frac{R - VC - FC - FC_X}{R} = 1 - (\frac{VC}{R}) - (\frac{FC}{R}) - (\frac{FC_X}{R}) \tag{5.6}$$

and return on assets (ROA).

$$ROA = (\frac{R - VC - FC - FC_X}{A}) = (\frac{R}{A}) - (\frac{VC}{A}) - (\frac{FC}{A}) - (\frac{FC_X}{A}) \tag{5.7}$$

$R$ accounts for annual revenue (or sales), $VC$ accounts for variable costs (or costs of goods sold), $FC$ are fixed costs of production that do not depend on the size of production in the short run, $FC_X$ represents the fixed cost of exporting (which is zero for companies operating only on the domestic market), and $A$ represents total asset value.[15] In addition, the operating margin (return on sales) and return on equity are well-established profitability indicators in financial analysis (Robinson et al., 2012). Investors typically use

[14] `http://www.mckinsey.com/insights/strategy/the_new_metrics_of_corporate_performance_profit_per_employee`

[15] The total asset value is defined as the book value of total assets at the end of the year in both the Finnish and the Dutch data.

also indicators defined *per dividend* or *per share*, but most of the commonly available financial statements and balance sheets do not include that information. Therefore, we restrict our analysis to the four profitability indicators (equations 5.4, 5.5, 5.6 and 5.7) discussed above.

### 5.5.2 Empirical methodology

We start the empirical analysis by investigating the correlation between export status and profitability with fixed effects panel regressions. The existing empirical evidence suggesting that highly productive firms self-select into exporting is compelling (Wagner, 2012b). This implies that there is the threat of endogeneity arising in any regression of profitability on export status, due to a sample selection bias. The purpose of the regressions in the first stage is thus to provide us an indication of the correlation between export status and the various profitability measures we employ.

The fixed effects panel regressions are of the following form:[16]

$$\frac{\pi_{Xijt}}{R_{ijt}} or \frac{\pi_{Xijt}}{A_{ijt}} = \alpha + Y'_{ijt}\beta + Z'_{ijt}\gamma + \mu_i + \epsilon_{ijt}, \tag{5.8}$$

where $\frac{\pi_{Xijt}}{R_{ijt}}$ refers to profit margin $\pi_X$ of firm $i \in I$ from sector $j \in J$ in year $t \in T$ relative to the mean profit margin over sales in sector $j$. Analogously, $\frac{\pi_{Xijt}}{A_{ijt}}$ represents the firms return on assets ($A_{ijt}$) relative to the sector mean. $Y_{ijt}$ refers to a set of firm specific explanatory variables that include a set of dummy variables indicating the trade status of the firm and a set of control variables. The control variables included are the export share in total sales, (the log of) firm size in terms of employment, a dummy variable indicating

[16] As a starting point we estimated basic pooled OLS-models without firm-specific fixed effects, which yield only an indication of the direction of the relationship between profitability and trade status. Unobservable firm characteristics are likely to affect both the export decision and profit rates of the firm. As the results of the OLS-models do not yield insights additional to the fixed effects findings, they are not further discussed. Results are available from the authors upon request.

whether the firm is under foreign control/multinational[17] and (the log of) labour productivity (defined as value added per employee).[18] It should be noticed that the firm size coefficient provides also a mere correlation due to the endogeneity between profitability and firm size.[19] Non-trading firms mark the reference group, implying that $\alpha$ captures the general correlation of being a non-trader with the different profit measures. In addition, as investors often require a risk premium to finance starting firms, we would like to control for the age of the firm. Unfortunately this is not possible with our data, but the included control for the size of the firm correlates typically with the firm's age. Albuquerque (2009) argues that size and industry specific groups provide the best view on the comparative performance of firms, since business cycles are mostly industry specific and firm size significantly affects the firms ability to respond to shocks. Therefore, a full set of industry and year specific dummy variables, represented by $Z_{ijt}$, has been included in the regressions. $\mu_i$ represents the firm fixed effect, which captures firm specific factors, such as the quality of management, that affect both the decision to export and profitability of the firm. Finally, the error term is denoted $\epsilon$.

Due to the expected sample selection bias, it is difficult to identify a fully exogenous instrument for export status. To deal with this problem, and in line with existing literature (Greenaway and Kneller, 2007b), we employ propensity score matching (PSM) to investigate if export starters convert to a different profitability growth path relative to continuing non-exporters. The objective of this procedure is to construct the non-observed

[17] In the Dutch data, the dummy variable indicating whether a firm is ultimately controlled by a foreign company is not derived from the underlying ownership structure, it indicates whether the controlling institution is effectively located abroad. For Finland we control for whether the firm is a multinational or not. A firm is classified as multinational if it has a subsidiary abroad or if it is classified as foreign firm or foreign subsidiary to the tax authorities.

[18] With Dutch data the regressions were run also with total factor productivity (TFP) instead of labour productivity to control for the sensitivity of the results with regards to the productivity measure included. The regression results were not significantly different between the two productivity measures.

[19] While larger firms can decrease the fixed costs per unit of production and increase profitability this way, profitability measures have been found to impact also the employment level of the firm as mentioned in section 5.1.

counterfactual by matching each export starter (a 'treated' firm) to a firm from the control group (continuing non-trader, an 'untreated' firm) based on similarity of firm characteristics before the treatment. In this particular application the 'treatment' is the export start of the firm. Matching is done based on the estimated probability of becoming an exporter. This probability is estimated by means of a probit-model of the export status on a set of firm characteristics prior to export start (equation 5.9).[20]

$$Pr(exp_{ijt} = 1) = \alpha + Y'_{ijt-1}\beta + Z'_{ijt-1}\gamma + \epsilon_{ijt-1}, \tag{5.9}$$

The predicted values from this regression serve as the propensity score, based on which export starters and continuing non-exporters are paired up for the next step. The explanatory variables included in the probit-model are the import status, a dummy variable indicating whether the firm is under foreign control / multinational, the relative net profit margin, (the log of) labour productivity, labour productivity growth, (the log of) assets per employee, (the log of) wages per employee and two sets of dummy variables representing size class and sector. All explanatory variables are lagged one year, in order to pair treated and untreated firms based on the similarity of their characteristics one year prior to treatment. The variable selection and methodology resemble the procedure presented by Ilmakunnas and Nurmi (2010)[21] and Arnold and Hussinger (2005) who find that particularly firm size, productivity, labour quality, price-cost margins and foreign ownership status affect the decision to export. As the data do not contain information on the skill level of the employees, we use the logarithm of the wage bill over employment as a proxy. Since an export start is expected to imply incurring additional export related fixed costs, the lagged net profit margin relative to the sector mean is included in the probit-regressions to account for differences in cost structures.

[20] A firm is considered an exporter in a particular year if it generates an export value larger than zero in that year.

[21] The estimated propensities of becoming an exporter in Finland are remarkably similar to the findings of Ilmakunnas and Nurmi (2010) when we align our data set with theirs and limit the sample to firms with a minimum size of 20 employees.

We define a firm as an export starter in case it reports exports larger than zero in year $t$ and export values of zero in *t-1* and *t-2* (see Table C.8 in the appendix for the exact definition of the various cohorts that serve as input for the PSM-analysis). Firms which remain non-exporting for the full three years represent the control group. The probit-regressions are run separately for each combined cohort of export starters and continuing non-exporters. We run in total 4 annual probit-regression for manufacturing and 4 probits for services sectors for Finland and 7 annual probit-regression for manufacturing and for wholesale & retail sectors separately for the Netherlands.

Firms from the export-starting cohort are matched to a peer from the continuingly non-exporting control group by minimizing the difference in individual propensity scores. This procedure is referred to as nearest neighbour propensity score matching, where we also employ a caliper to avoid the matching of export starters for which a sufficiently similar peer is not available in the control group. In addition, we force matching only to be allowed between firms from the same sector. The only additional condition that needs to be satisfied is that both treated and matched untreated firms continuously stay in business throughout the period under investigation. In the final step the profitability growth paths of the matched pairs of export starters and continuing non-exporters are compared.[22]

## 5.6 Empirical findings

The results presented in this section are based on separate analysis of the data sets concerning Finland and the Netherlands. Table 5.1 provides an

[22] To evaluate the average treatment effect on the treated (ATT) we construct bias-corrected 95% confidence intervals by bootstrapping the ATT with 200 replications. Abadie and Imbens (2008) show that bootstrapping nearest neighbour matching estimators yields invalid standard errors. However, Caliendo and Kopeinig (2008) argue that if propensity scores need to be estimated there is no feasible alternative available. To pursue caution we will however abstain from estimating and evaluating exact $p$-values and only construct bias-corrected 95% confidence intervals.

insight in the panel size of both countries.[23] The table shows that the available number of observations is larger for the Netherlands. This can be explained by the relative size of both economies and the fact that the panel regarding the Netherlands includes three more years. The table also shows that exporting is more persistent among Finnish manufacturing firms in every size class. Although at the macro-level the Dutch economy is much more trade-oriented than Finnish economy, it is well-established that at the micro-level the export involvement of Dutch firms is relatively low in international perspective (Mayer and Ottaviano, 2008).

Table 5.1: Persistence of exporting

| | firm size class | micro | | small | medium | large | all |
|---|---|---|---|---|---|---|---|
| | (fte) | 0-3 | 4-9 | 10-49 | 50-249 | $\geq 250$ | firms |
| *Finland: goods and service trade* | | | | | | | |
| manufacturing | no. of observations | excluded | 24,278 | 25,402 | 6,680 | 1,602 | 57,962 |
| | share exporting (%) | excluded | 31.4 | 52.5 | 84.1 | 93.5 | 48.4 |
| services | no. of observations | excluded | 32,022 | 23,687 | 5,429 | 1,566 | 62,704 |
| | share exporting (%) | excluded | 24.6 | 37.4 | 43.8 | 51.2 | 31.7 |
| *Netherlands: goods trade* | | | | | | | |
| manufacturing | no. of observations | excluded | 149,983 | 111,976 | 14,276 | 1,384 | 277,619 |
| | share exporting (%) | excluded | 13.2 | 26.0 | 51.0 | 71.1 | 20.6 |
| wholesale & retail trade | no. of observations | excluded | 143,968 | 70,759 | 7,405 | 728 | 222,860 |
| | share exporting (%) | excluded | 28.9 | 46.4 | 61.0 | 79.4 | 35.7 |

### 5.6.1 Fixed effects regression results

Tables 5.2 and 5.3 show the results from the fixed effects regressions on the four profit rate measures, where the fixed effects dimension of the model enables us to control for non-observed firm-specific heterogeneity. Finnish manufacturing and service sectors return mostly insignificant trade premia, but also significant, albeit small, negative trade premia for two-way traders in the manufacturing sectors.[24] The picture emerging for the Netherlands is more mixed. Manufacturing sectors show significantly negative premia for both sole importers, sole exporters and two-way traders, except when gross

[23] The top and bottom last percent of observations has been cut for each dependant variable in line with previous studies.

[24] We also ran the fixed effect regressions for Finland on the subset of non-MNCs to exclude the possibility of artificially deflated profit margins through transfer pricing. The results show that this does not affect the results to a noteworthy extent.

profits per employee serves as the profit rate measure under investigation in which case only sole exporters experience a significantly negative trade premium. The results regarding the relative gross profit margin per employee show both the scale effect of exporting and the margin effect (see section 5.5.1). In wholesale & retail trading sectors a comparable picture emerges. The only deviation regards net profit rates which only yield a significant (and negative) coefficient for two-way traders.

Table 5.2: Profit rate premia in Finland (fixed effects panel regressions, 2005-2010)

| | manufacturing sectors | | | | service sectors | | | |
|---|---|---|---|---|---|---|---|---|
| | rel. GPM | rel. NPM | rel. ROA | rel. GPPE | rel. GPM | rel. NPM | rel. ROA | rel. GPPE |
| *trade dummies* | | | | | | | | |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | -0.007 | 0.005 | -0.001 | -470.0 | | | | |
| | (-1.75) | (0.57) | (-0.18) | (-1.15) | | | | |
| only EU imports | -0.009 | 0.002 | -0.006 | -131.9 | 0.017 | 0.267 | -0.005 | 653.7 |
| | (-1.51) | (0.21) | (-1.13) | (-0.48) | (0.94) | (0.89) | (-0.63) | (1.43) |
| two-way trade | -0.008 | -0.008* | -0.011 | -545.8 | | | | |
| | (-1.70) | (-2.16) | (-1.61) | (-1.34) | | | | |
| services exporter | | | | | 0.001 | 0.069 | 0.014 | -468.8 |
| | | | | | (0.05) | (0.81) | (1.71) | (-0.95) |
| *control variables* | | | | | | | | |
| export share | 0.045* | -0.211 | 0.005 | 4889.9*** | 0.291 | -0.066 | 0.014 | 1379.2 |
| | (2.39) | (-1.03) | (0.27) | (3.61) | (1.12) | (-0.49) | (0.51) | (0.81) |
| firm size (fte, log) | 0.035*** | 0.019*** | 0.037*** | -4191.2*** | 0.055*** | 0.041* | 0.065*** | -2042.3*** |
| | (7.39) | (4.49) | (6.07) | (-6.70) | (4.46) | (2.49) | (8.09) | (-4.20) |
| domestic firm | reference | reference | reference | reference | reference | reference | reference | reference |
| multinational | 0.006 | -0.008 | -0.020 | -2300.5 | -0.008 | 8.912 | -0.080 | 3356.9 |
| | (0.20) | (-0.31) | (-0.55) | (-0.67) | (-0.13) | (0.84) | (-1.62) | (0.38) |
| labor productivity (log) | 0.067*** | 0.081*** | 0.058*** | 5697.5*** | 0.107*** | 0.139*** | 0.068*** | 4531.6*** |
| | (13.37) | (10.25) | (20.69) | (7.16) | (8.73) | (4.50) | (19.70) | (14.89) |
| *No. of observations* | 57,787 | 57,962 | 43,584 | 58,864 | 62,261 | 62,704 | 49,333 | 63,757 |
| $R^2$ - *within* | 0.156 | 0.059 | 0.090 | 0.091 | 0.032 | 0.030 | 0.068 | 0.070 |
| $R^2$ - *between* | 0.043 | 0.121 | 0.036 | 0.018 | 0.009 | 0.003 | 0.062 | 0.023 |
| $R^2$ - *overall* | 0.055 | 0.066 | 0.024 | 0.019 | 0.014 | 0.000 | 0.041 | 0.031 |

*Notes*: *GPM* identifies the gross profit rate, *NPM* the net profit rate, *ROA* the return on assets and *GPPE* the gross profit per employee. All regressions include a full set of year-sector dummies and fixed effects at firm level. $t$ statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For manufacturing sectors both in Finland and in the Netherlands, and similar to the findings of Fryges and Wagner (2010) regarding Germany, we generally find a significant and positive coefficient for export share in total sales. This indicates that exporting per se does not foster profitability rather than the extent to which foreign markets add to firm sales. This

observation makes sense in the context of the fixed costs associated with exporting, which thus renders exporting profitable once a certain threshold share of exports in turnover is reached. In addition, we find a consistently positive and significant correlation between firm size and other profitability indicators than GPPE. This reflects both the positive correlation between firm size and lower production costs per unit though economies of scale and positive correlation between profitability and employment (see earlier findings mentioned in section 5.1). On the other hand, the correlation between firm size and profitability turns negative and significant both in Finland and in the Netherlands except for Dutch wholesale & retail trading sectors when we consider profit rates per employee. This finding is most likely related to the variable definition in addition to the endogeneity problem. Gross profits per employee hinge directly on firm size and if the number of employees goes up, the indicator goes down in the short run if wages and other costs are rigid by definition. Furthermore, productivity is an important indicator for profitability in the fixed effects regressions, considering the relatively large, positive and significant coefficients, which is an intuitively straightforward finding and in line with theoretical expectations.

In the next step we run our baseline fixed effects model (equation 5.8) separately for different firm size classes, since inclusion of firm size in terms of employment in fulltime equivalents does not allow for any nonlinearities in the relationship with profit rates.[25] The estimation results are robust to the profit rate measures employed, and we thus confine the discussion in this section to the fixed effects regressions with the gross profit rate as the profitability measure under investigation (see table 5.4 for the key results).[26] Dividing the Finnish sample in size categories shows that gross profit mar-

[25] Firm size is less likely to affect access to capital and capital costs, since access to capital markets for SMEs is relatively easy in both Finland and the Netherlands. Specifically in developing countries capital market frictions tend to be larger, which is particularly problematic for smaller firms and can affect their profits and profitability in an open economy (Foellmi and Oechslin, 2010). Variation in our results between firm size classes is therefore less likely to stem from differences in access to capital.

[26] The concise regression results regarding the other profit rate measures are presented in appendix C.3. The full regression results are available from the authors upon request.

Table 5.3: Profit rate premia in the Netherlands (fixed effects panel regressions, 2002-2010)

| | manufacturing sectors | | | | wholesale & retail trading sectors | | | |
|---|---|---|---|---|---|---|---|---|
| | rel. GPM | rel. NPM | rel. ROA | rel. GPPE | rel. GPM | rel. NPM | rel. ROA | rel. GPPE |
| *trade dummies* | | | | | | | | |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | -0.004** | -0.005** | -0.008*** | -515.5** | -0.003* | -0.002 | -0.007** | -511.3* |
| | (-3.12) | (-3.20) | (-3.96) | (-3.12) | (-2.54) | (-1.08) | (-3.15) | (-2.26) |
| only imports | -0.002* | -0.002* | -0.005** | -175.2 | -0.002** | -0.002 | -0.007*** | -197.6 |
| | (-2.40) | (-2.11) | (-3.17) | (-1.54) | (-2.91) | (-1.83) | (-4.65) | (-1.71) |
| two-way trader | -0.004** | -0.005*** | -0.008*** | -181.3 | -0.005*** | -0.003** | -0.013*** | -280.8 |
| | (-3.28) | (-3.70) | (-3.93) | (-1.09) | (-4.48) | (-2.79) | (-6.80) | (-1.51) |
| *control variables* | | | | | | | | |
| export share | 0.022*** | 0.016** | 0.030*** | 829.6 | 0.005 | 0.006 | -0.008 | -1982.7* |
| | (4.24) | (2.77) | (4.33) | (1.07) | (1.09) | (1.23) | (-1.39) | (-2.36) |
| firm size (fte, log) | 0.054*** | 0.069*** | 0.047*** | -1008.6*** | 0.044*** | 0.053*** | 0.057*** | 84.4 |
| | (41.69) | (47.78) | (25.04) | (-6.37) | (38.10) | (42.00) | (30.01) | (0.40) |
| domestically controlled | reference | reference | reference | reference | reference | reference | reference | reference |
| foreign controlled | 0.006 | 0.008 | 0.012* | 348.1 | 0.001 | 0.000 | 0.009* | 1126.8* |
| | (1.75) | (1.88) | (2.19) | (0.61) | (0.43) | (-0.03) | (2.10) | (2.13) |
| labor productivity (log) | 0.089*** | 0.111*** | 0.104*** | 10497.1*** | 0.069*** | 0.083*** | 0.110*** | 14549.5*** |
| | (64.05) | (71.82) | (59.49) | (66.01) | (61.25) | (64.83) | (65.55) | (71.13) |
| *No. of observations* | 269,122 | 269,362 | 266,520 | 269,594 | 214,651 | 214,796 | 213,518 | 212,476 |
| $R^2$ - *within* | 0.253 | 0.285 | 0.176 | 0.241 | 0.232 | 0.264 | 0.219 | 0.302 |
| $R^2$ - *between* | 0.003 | 0.011 | 0.002 | 0.191 | 0.027 | 0.051 | 0.004 | 0.291 |
| $R^2$ - *overall* | 0.015 | 0.030 | 0.002 | 0.210 | 0.044 | 0.075 | 0.020 | 0.317 |

*Notes*: *GPM* identifies the gross profit rate, *NPM* the net profit rate, *ROA* the return on assets and *GPPE* the gross profit per employee. All regressions include a full set of year-sector dummies and fixed effects at firm level. $t$ statistics in parentheses. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

gin has a significant, negative correlation with importing and with two-way trade in medium sized firms only. The significantly negative profit rate premia we find in Dutch manufacturing pooled over all firms turns out to be again mainly on account of micro firms. Analogously, the results in Dutch wholesale & retail trading are most prominently shaped by small, and, to a lesser extent, micro sized firms and particularly persistent for two-way trading. Both the Finnish and Dutch sub-samples covering large firms show insignificant trade premia, which could be partly explained by the relatively small sample sizes, compared to the sample sizes of especially micro sized and small firms. The observed differences in profit margin premia between the firm size classes should thus be interpreted with caution. Labour productivity is an important indicator in all country-sector-size combinations with a consistently positive and significant profit rate premium. This premium does however generally decrease in firm size class.

Table 5.4: Relative gross profit rate premia by firm size

| | Finland (2005-2010) | | | | | the Netherlands (2002-2010) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | manufacturing sectors | | | | | manufacturing sectors | | | | |
| | all | micro | small | medium | large | all | micro | small | medium | large |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | -0.007 | -0.005 | -0.008 | -0.028 | -0.050 | -0.004** | -0.008*** | 0.001 | -0.007 | -0.019 |
| only (EU) imports | -0.009 | -0.010 | -0.004 | -0.032** | -0.059 | -0.002* | -0.003* | -0.001 | -0.001 | -0.002 |
| two-way trade | -0.008 | -0.011 | -0.007 | -0.033* | -0.049 | -0.004** | -0.005* | -0.001 | -0.005 | -0.020 |
| firm size (fte, log) | 0.035*** | 0.043*** | 0.032*** | 0.044 | 0.106** | 0.054*** | 0.064*** | 0.044*** | 0.036*** | 0.012 |
| labor productivity (log) | 0.067*** | 0.080*** | 0.066*** | 0.048** | 0.023*** | 0.089*** | 0.104*** | 0.076*** | 0.053*** | 0.025*** |
| Number of observations | 57,787 | 24,180 | 25,319 | 6,686 | 1,602 | 269,122 | 144,467 | 109,596 | 13,810 | 1,249 |
| | service sectors | | | | | wholesale & retail trading sectors | | | | |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | | | | | | -0.003* | -0.003 | -0.003 | 0.002 | -0.035 |
| only imports | 0.017 | -0.000 | 0.029 | 0.017 | 0.001 | -0.002** | -0.002 | -0.005** | 0.006 | -0.022 |
| two-way trader | | | | | | -0.005*** | -0.004** | -0.007*** | 0.007 | -0.018 |
| services exporter | 0.001 | 0.029 | -0.031 | 0.013 | -0.007 | | | | | |
| firm size (fte, log) | 0.055*** | 0.058 | 0.082* | -0.015 | 0.005 | 0.044*** | 0.048*** | 0.039*** | 0.029*** | -0.006 |
| labor productivity (log) | 0.107*** | 0.111*** | 0.101*** | 0.064*** | 0.028 | 0.069*** | 0.073*** | 0.064*** | 0.045*** | 0.014* |
| Number of observations | 62,261 | 31,769 | 23,549 | 5,388 | 1,555 | 214,651 | 138,255 | 68,613 | 7,095 | 688 |

*Notes*: In addition to the variables presented in the table, all regressions include the export share in sales, a dummy variable indicating if a firm is under foreign control and a full set of year-sector dummies as explanatory variables in addition to fixed effects at firm level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We draw a number of conclusions from the regression results presented in this section:

*Empirical finding I:* The decision to enter foreign import or export markets is not heavily correlated with profit rates

This finding stems from the largely insignificant or significantly negative but relatively small trade premia that we find. This empirical result aligns with the hypothesis inferred from the theoretical analysis in section 5.3 stating that profit margins of exporting firms are lower than or equal to those of non-exporting firms. In addition, the negative profit rate premia

patterns are more pronounced for micro, small and medium sized firms than for larger firms.

*Empirical finding II:* Negative profit rate premia are tied to exporting rather than to importing

Although the relationship between trade status and profit rates is not strong, the empirical results do indicate that the negative premia patterns are more pronounced for exporting than for importing. In addition, in manufacturing sectors we generally find a significantly positive relationship between the export share in sales and profit margins, indicating that exporting per se does not seem to foster profitability rather than the extent to which foreign markets add to firm sales.

*Empirical finding III:* Productivity is an important indicator for firm-level profitability

This empirical finding is also in line with the hypothesis derived from the Egger and Kreickemeier (2012) model. Furthermore, the empirical results show that profitability tends to increase in the share of exports in total sales. In addition, we find that the choice for the profit measure under investigation does not heavily affect the findings. The overall quality and performance of the fixed effects regressions indicate that the relative gross and net profit margins and return on assets yield the most consistent and robust results.

Exporter churning might provide also a partial explanation for the findings of negative or insignificant profitability premia for exporters. If a relatively large fraction of firms starts exporting or switches trade status frequently, the relative impact of the fixed costs associated with an export start will be high, which can drive down profits relative to non-exporters. We further look into this issue in section 5.6.2. Since we explicitly investigate export *starters* vis-a-vis continuing non-exporters there, the subset of firms included in the analysis is purged from firms that repeatedly switch their export status in a short period of time.

### 5.6.2 Propensity score matching results

In line with the fixed effects estimation results, propensity score matching analysis shows no discernible difference between export starters and firms that keep their focus on domestic markets in terms of profitability in the years following foreign market entry. Tables 5.5 and 5.6 present summary statistics of the accompanying results of this analysis for Finland and for the Netherlands, respectively. Tables C.4 through C.7 in the appendix present detailed results.[27]

For Finland we find virtually no empirical evidence suggesting that Finnish export starters convert to a different profitability growth path relative to continuing non-exporters. Table 5.5 shows a short summary of the main results from a total of 96 PSM-procedures. The table outlines the number of individual PSM-procedures which yielded either: 1) no difference between the treated firms and continuing non-exporters, 2) profit margin premia for exporters, or 3) profit margin premia for the control group. The results are separated for static and dynamic effects and for tests on profit margin levels and profit margin growth. Out of 96 investigated cohort-outcome variable combinations we find just three significant treatment effects in Finland. Manufacturing firms that entered foreign markets in 2007 show consistently lower gross profit margins and growth rates following export market entry, ultimately resulting in a significantly lower gross profit margin after three years. On the other hand, manufacturing firms entering foreign markets in 2008 show significantly higher return on assets growth one year after export start and service providers from the same cohort return a significantly higher ROA in the year of treatment. However, in the years following, this cohort of firms returns lower growth rates, quickly rendering the treatment effect insignificant. These three isolated cases provide no solid basis supporting the claim that firms entering export markets convert to a different profitability path, neither lower nor higher, than firms that keep focusing solely on domestic markets. The result is according to the expectations from

[27] The results of the total of 22 probit-regressions underlying the matching can be obtained from the authors upon request.

the theoretical frameworks, which forecast that profit margins of exporters can be either lower or equal to the profit margins of domestic firms.

Table 5.5: PSM results for Finland

| Main finding | Manufacturing sectors | | | | Services sectors | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| no. of cases | Static effect | t+1 | t+2 | t+3 | Static effect | t+1 | t+2 | t+3 | no. of cases |
| *Levels* | | | | | | | | | |
| No difference | 12 | 9 | 6 | 2 | 11 | 9 | 6 | 3 | 58 |
| Higher profitability for exporters | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Lower profitability for exporters | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| *Growth* | | | | | | | | | |
| No difference | - | 8 | 6 | 3 | - | 9 | 6 | 3 | 35 |
| Higher profitability for exporters | - | 1 | 0 | 0 | - | 0 | 0 | 0 | 1 |
| Lower profitability for exporters | - | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 |

The PSM-procedure concerning the Netherlands returns a few more significant results, although the majority of the estimated treatment effects remain insignificant similar to the Finnish results. In Dutch manufacturing we find some evidence suggesting that export starters materialize higher profit growth rates two to three years after foreign market entry, on several occasions resulting in significantly higher profit levels as well. Particularly for the 2008-cohort these findings seem relatively robust, which is most likely mainly due to the relatively large number of available treated cases. Wholesale & retail trading sectors in the Netherlands show less pronounced profitability patterns. Only for the 2006-cohort do we find noteworthy treatment effects, particularly for profit growth in year two and profit levels in year three after foreign market entry. However, despite the fact that we do find a few more significant results, as said, the majority of the estimated treatment effects remain insignificant.

Table 5.6: PSM results for the Netherlands

| Main finding | Manufacturing sectors | | | | Wholesale & retail trading | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| no. of findings | Static effect | t+1 | t+2 | t+3 | Static effect | t+1 | t+2 | t+3 | no. of cases |
| *Levels* | | | | | | | | | |
| No difference | 21 | 17 | 12 | 12 | 21 | 18 | 15 | 8 | 124 |
| Higher profitability for exporters | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 | 6 |
| Lower profitability for exporters | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 |
| *Growth* | | | | | | | | | |
| No difference | - | 16 | 12 | 8 | - | 18 | 13 | 12 | 79 |
| Higher profitability for exporters | - | 0 | 3 | 4 | - | 0 | 2 | 0 | 9 |
| Lower profitability for exporters | - | 2 | 0 | 0 | - | 0 | 0 | 0 | 2 |

The main conclusion we draw from the propensity score matching procedures discussed in this section is in line with the previously mentioned stylized facts.

*Empirical finding IV:* Export starters do not convert to a different profitability growth path compared to continuing non-exporters

We find a few cases where the profit rates of exporting firms are lower or higher than that of the control group. However, in the majority of the studied cases, we find no significant difference in the profit rates of export starters and the continuing non-exporters.

## 5.7 Conclusion

Compiling two parallel data sets covering Dutch firms over the years 2002-2010 and Finnish firms over the years 2005-2010, we investigate the relationship between trade status, firm size and profitability. At the same time, we attend to the differential impact of internationalization on profit levels versus on profit margins. We proceed in three steps. We start by analysing the predictions of existing theoretical literature regarding the relationship between profit margins and exporting and by deriving empirically testable hypothesis from them. We then proceed with the empirical analysis by establishing the relationship between exporting and profitability, irrespective of the direction of causality, by means of regression analysis and by employing four different profit measures. Ultimately we resort to propensity score matching to investigate whether firms entering foreign markets convert to a different profitability path compared to firms that persist in their focus on domestic markets.

From the theoretical model of Egger and Kreickemeier (2012) we derive the hypothesis that profit margins of exporting firms are lower than or equal to those of non-exporting firms. In addition, we hypothesize that profit margins increase in productivity, at least for exporting firms. We also investigate the possibility to derive testable hypothesis from the Melitz (2003) model.

However, this proved to be not feasible, since depending on the distribution of profit margins along the productivity dimension for different trade statuses every relationship between profit rates and export status is possible.

The results from the regression analysis suggest that internationalization of firm activities is not heavily correlated with profitability. We find largely insignificant or significantly negative trade premia of small magnitude, which aligns with earlier empirical research and the theoretical expectations. The negative trade premia seem to be tied mainly to exporting rather than to importing and particularly to micro, small and medium sized firms. The choice of profit rate measure does not heavily affect the findings regarding the relationship with trade status. Gross profits per employee (GPPE) do return slightly deviating profitability premia compared to the other three profitability measures employed, which generally yield mutually consistent results. The GPPE results indicate that the 'scale effect' of exporting could be positive or insignificant, while the 'margin effect' is negative or insignificant based on the gross margin and net margin results. Regarding the control variables our findings indicate that particularly productivity is an important indicator for firm-level profitability in line with theoretical expectations. In addition, we show that profit rates tend to increase in the share of exports in total sales.

Exporter churning might provide also a partial explanation for the negative and insignificant profitability premia for exporters. If a relatively large fraction of firms starts exporting or switches trade status frequently, the relative impact of the fixed costs associated with an export start will be high, which can drive down profits relative to non-exporters.

Using propensity score matching we analyse whether export starters convert to a different profitability growth path relative to firms that keep focus on domestic markets. The results provide support to the theoretical hypothesis that exporting either decreases profitability or does not affect profit margins. For Finland we find virtually no evidence suggesting that Finnish export starters convert to a different profitability path relative to continuing non-traders. However, for the Netherlands there is some evidence suggesting

that export starters in manufacturing sectors materialize higher profit rates in the longer run, that is, two to three years after foreign market entry.

The results indicate that new exporters seem to be willing to fully explore the possibilities that foreign markets provide even at the cost of (temporarily) materializing lower profit rates. Since exporting is associated with higher revenues as a result of the access to a larger (foreign) markets, the final profit level of exporting firms is most likely higher than the profit level of domestic firms, even if the profit margins would be slightly lower, but especially if there is no significant difference between the profit margins of exporting and domestic firms. The profit level premia from exporting might appear only sometime after export start, though. If the profit margin does not change for export starters and the revenues increase only gradually to a higher level, there might be no profit level premia visible immediately after export start. However, also the export share in total sales can increase over time relative to the first years of foreign market entry. Since the export share of sales is shown to correlate positively with profit margins, this could drive the final profit level further up in the long run.

An interesting avenue for future research would be to further explore the profitability path of export starters and investigate whether they convert to a different profitability path in the longer run, say, three to five years, when export skills are fully internalized by the export starter. The data requirements tied to investigating this hypothesis are however considerable, since a sufficiently sizeable balanced panel of export starters and continuing non-exporters over a period of at least five to seven years would be needed. An important note we should finally make is that it is well established that internationalization positively affects the probability of firm survival. This implies that the discounted value of future profits is likely to be higher for trading firms compared to non-traders, irrespective of the insignificant premia we find in our analysis regarding annual profit rates. Unfortunately we are unable to factor in the impact of trading on firm survival in the relationship between exporting and profitability at this point. This would also be an interesting line of research to further explore in the future.

# Chapter 6

# Conclusions

In this chapter, I summarize first of all the main findings of the three articles and their links to each other in section 6.1. The results indicate some implications for policy choices, but also to policy analysis research, which I discuss in section 6.2. In section 6.3 I discuss the potential for future research based on the results of all articles.

## 6.1 Summary of main findings

In this dissertation, we investigate empirically the heterogeneity of mark-ups and profitability within sectors specifically between exporting and domestic firms. While research on the heterogeneity of firms is important on its own due to the effects it can have on economic policies and modelling, firms provide also the basis for most peoples' income. Therefore, we analyse also theoretically what kinds of implications a decrease in mark-ups has on the unemployment rate and on different measures of income inequality in an open economy.

Before any research could be undertaken, a firm level micro database on Finnish firms was constructed for the analyses. As chapter 2 describes, the database is based on information from the tax authority of Finland and it includes therefore all Finnish firms, i.e. also micro-sized firms, operating in all sectors. Further, the data provide a possibility to identify service sector

exporters in addition to exporters in manufacturing sectors. Value added tax (VAT) records are used for the identification of services exporters similar to Borchsenius et al. (2010). Therefore, we contribute to the literature by covering both manufacturing and service sectors and by including micro-sized firms in the analyses in chapters 3 and 5.

In chapter 3 we analyse mark-up distributions of different types of firms within 70 sectors with non-parametric methods and the Finnish data from 5 years. Firstly, in contrast to the constant mark-up hypothesis, we find significant differences in the mark-ups within 47 sectors out of the 70 sectors studied even at NACE 2-3 digit levels. Significant differences are found especially between the mark-ups of small and large firms, and also to a lesser degree between exporting and domestic firms of the same size. The results indicate that smaller firms have significantly higher overall mark-ups than larger firms in nearly half of the sectors and that domestic firms have higher mark-ups compared to exporting firms. Service sectors exhibit somewhat higher coefficients of variation than manufacturing sectors in general and a higher share of service sectors display significant divergence in different types of firms' mark-ups within sector.

Last, we study if any sector level characteristics correlate with larger mark-up heterogeneity. The coefficients of variation are regressed with random effect panel regression on various sector characteristics and K-S tests' results with panel probit regression. We find that the coefficient of variation might be affected by an underestimation of fixed costs in sectors with a high share of management level employees. The K-S tests provide a more reliable view on the differences. The probit regression reveals greater mark-up heterogeneity in sectors with a low capital-labour ratio and a large number of firms active in the sector.

The findings indicate that mark-ups can be significantly heterogeneous within sectors in contrast to previous assumptions. One simple explanation on the findings could be that different types of firms within each sector cater to specific market or consumer segments with unequal demand elasticities. As Finland is a country with relatively high export participation rates, open trade policies, high GDP per capita and an effective regulatory system, the

mark-up heterogeneity we find should be considered a minimum level to be expected. In particular, mark-up heterogeneity in developing countries is expected to be significantly higher.

In the second article in chapter 4, we analyse theoretically the impacts of a competition increase on income inequality and unemployment rate. At the same time, we introduce the Egger and Kreickemeier (2012)(EK) model in detail, which is used also for the theoretical assessment in chapter 5. We provide a small expansion to the analysis of Egger and Kreickemeier (2012) by allowing mark-ups to change on average after a country leaves autarky in their framework in comparison to their original assumption of a constant mark-up. In addition to accounting for firm heterogeneity, it is assumed in the EK model that workers obtain a 'fair wage' that depends both on the external conditions in the labour markets and on the profits of the firm.

We obtain results that strengthen the original findings of Egger and Kreickemeier (2012) and provide additional insights on the possible reasons for the increases found in total income inequality within-countries. We find that increased competition in an open economy will increase the unemployment rate, the Gini index of profit income, the Gini index of wage income and the inequality between profit and wage income. Especially the result on unemployment rate is in contrast to an earlier study on the effect of a competition increase and deregulation of markets, based on a model that does not take into account firm heterogeneity or have 'fair wage' setting. However, the reasons for these results in the EK model are straightforward.

With a higher elasticity of demand and a smaller mark-up, the productivity of a firm needs to be higher than previously in order to survive in the competition. Only fewer firms (which equals the number of managers in the model) reach the required level of productivity and also a smaller share of firms will be able to reach the higher marginal productivity level required to export. Therefore, labour supply increases, but the operating firms with greater (labour) productivity need less employees than the firms with a lower productivity level that drop out of the competition. Unemployment level increases. At the same time, the average profits of operating firms go up more than the average expected labour wage due to the fair wage

setting. This means that intergroup inequality increases. As there are also fewer firms that can export and materialize higher total profits, the share of managers earning large profits decreases and the distribution of profit income increases. For similar reasons, the Gini index of wage income increases as well.

The parametrizations on the magnitude of the different impacts illustrate a need for more empirical research on the topic. Depending on the underlying parameter values of the economy in question, the effect of a competition increase on the unemployment rate or on the various income inequality indicators can be bigger than the effect of an equal decrease in trade costs in percentage terms. Even with some relatively common parameter values, the effects on the unemployment rate are also substantial in size. However, opposite and negligibly small results are found as well.

In the last chapter 5, we investigate the relationship between trade status, firm size and profitability in order to analyse further the revenue-cost-structure differences between exporting firms and domestic firms. For the analyses we use Finnish data covering the years 2005-2010, but in addition we employ a similar database from the Netherlands over the years 2002-2010. This provides us also with an opportunity to compare the results of two different countries and to control for any country specific effects. Compared to chapter 3, the methods used in chapter 5 provide us only aggregate results for manufacturing and service sectors, not sector specific results like in chapter 3.

We start by analysing the predictions of existing theoretical literature regarding the relationship between profit margins and exporting and by deriving empirically testable hypotheses from them. From the theoretical model of Egger and Kreickemeier (2012) we derive the hypothesis that profit margins of exporting firms are lower than or equal to those of non-exporting firms. We investigate also the predictions of the Melitz (2003) model, but derivation of empirically testable hypothesis from that model is not possible.

Secondly, the results of panel regressions suggest that internationalization of firm activities is not heavily correlated with profitability on average. We find largely insignificant or significantly negative trade premia of small

magnitude, which align with earlier empirical research and the theoretical expectations. The negative trade premia seem to be tied mainly to exporting rather than to importing and particularly to micro, small and medium sized firms. Further, our findings indicate that productivity correlates significantly positively with firm-level profitability in line with theoretical expectations, and that profit rates tend to increase in the share of exports in total sales.

Ultimately, the results from propensity score matching provide support to the theoretical hypothesis that exporting either decreases profitability or does not affect profit margins. The results indicate that new exporters seem to be willing to fully explore the possibilities that foreign markets provide even at the cost of (temporarily) materializing lower profit rates in order to obtain higher total profit level in the future when their revenues increase thanks to the foreign market access.

## 6.2 Policy and research implications

The above mentioned results indicate some implications to policy options. However, they have potentially even more implications to economic modelling and especially to the popular ex-ante policy analyses. In order to follow the sequence of the articles, I start with the research implications.

First of all, the implication of the first article in chapter 3 on theoretical and applied economic modelling is clear. Caution is needed regarding policy suggestions based on (theoretical) models with a homogeneous mark-up assumption. While we find significant differences especially between small and large firms' mark-up distributions, significant differences are found also between exporting and domestic firms in some sectors similar to De Loecker and Warzynski (2012). If a constant mark-up assumption is used especially in sector specific economic analyses, the results could turn significantly biased for sectors with large mark-up heterogeneity and provide a wrong picture on the expected effects. Consequently, various models have already taken an assumption of endogenous mark-ups. While this can be slightly

more cumbersome to implement in applied economic models[1] with real data behind them, it seems recommended to adjust the models at least to reproduce the found behavioural patterns.

Secondly, the results of chapter 4 highlight further the need to perform ex-ante policy analyses at least with varying mark-ups and/or elasticities between sectors and countries, but preferably also with varying mark-ups within sectors. In addition, it would be good to test how large differences appear in the results of practical policy analyses when modelled with firm heterogeneity and varying mark-ups versus without them. According to the parametrisation results presented in subsection 4.4.3, the change in the elasticity of demand can have even higher absolute impact on the value of e.g. unemployment rate than an equal change in trade costs in percentage terms. The magnitude of the effect depends on the underlying economic structures. Large increases in income inequality and/or (long-term) unemployment rate might seem undesirable by many. Therefore, estimations on the income inequality effects of both trade liberalization and competition increases would be good to conduct before finalising any major policy changes.

This brings us accordingly to the policy implications of the results. Trade liberalizations and tightened competition increase welfare on average according to previous studies, but the benefits are distributed unevenly among the population according to our results and earlier studies. Depending on the current level of income inequality in a country, some might consider rising income inequality acceptable. However, especially if the increases are large or income inequality is already in a relatively high level, many consider higher total income inequality unwanted. The concentration of money and power have been claimed to increase instability in societies. This leaves the policy problem of how to correct for any undesired distributional effects of trade

[1] See e.g. Roson (2006) on the various options and difficulties on introducing imperfect competition in CGE models with an assumption of market specific mark-ups. In the models it is still assumed that firms are symmetric within sectors, but as mentioned earlier, the results for differences between mark-ups of exporters and non-exporters in chapter 3 could stem also from major differences in demand elasticities between markets (with foreign markets showing higher elasticities than the Finnish domestic markets) and be in line with modelling with market specific mark-ups.

liberalization and competition increases. Depending on the country, various options are most likely possible and policy makers need to consider the benefits and costs associated with each. In addition, especially during trade liberalization negotiations, it could be considered that who and how many within each country will benefit substantially in reality from the different types of liberalizations.

## 6.3 Future research

The conclusions of the different chapters point out already some possible extensions to research in the future and the chapters discuss the limitations of the analyses. I will not repeat those here. Instead, in this section I discuss more generally a few of the main research areas and topics that stem out of our results as potentially important areas to research further in the future.

First, related to the discussion in the introduction of this dissertation, more and better statistics on services exports and exporters and on the division of goods and services exports by industry and firm would be more than welcome in order to extend the research on services exports. From the Finnish data we use we can obtain information on services exporters in few sectors, but the identification is not perfect as consumer services exporters cannot be identified. In addition, for most years in the data, we cannot control whether the service sector firms export actually services or goods. Neither do we know, how much firms categorised in manufacturing sectors actually export services. In other words, data limitations in the area seem to be a hindrance for further research.

The results in chapter 3 show that in the few service sectors where significant mark-up variability was found between large exporters versus large domestic firms, the exporters had on average higher mark-ups than domestic firms. To the contrary, in most manufacturing sectors large exporters were not found to have significantly different mark-ups or they had smaller ones than large domestic firms in the same sector. In addition, in chapter 5 we do not find a negative export premia on profitability in the Finnish service sectors, while for manufacturing sectors negative premia on prof-

itability are found both with Finnish and Dutch data. Further, according to the OECD Trade in Value Added (TiVA) statistics[2], the value added share of service sector exports is generally significantly higher than in manufacturing sectors. This means that out of the total gross value of exports, services exports generate more capital and wage income flows to the country than goods exports (since foreign intermediate inputs form a larger share of the value of goods exports). Based on these findings, it could be considered that services exports and exporters are also more important to employment than goods exporters at least in advanced countries. However, in order to say anything more on services exports and service sector exporters, significantly more research efforts would need to be contributed on analysing the topic.

Secondly, our results indicate also that more research could be still allocated to the study of micro-sized and small firms and the effect of internationalization on them. We find that small and micro-sized firms have significantly higher mark-ups in various sectors than larger firms, but at least in Dutch manufacturing sectors exporting is associated negatively with profitability in micro and small firms. This leaves for example the question of whether micro-sized firms engaged in international markets still have higher survival rate than competing firms engaged primarily in the domestic market. Furthermore, does this survival probability differ between sectors? One could think that in service sectors, where fewer investments are needed for the operation of firms and transport costs are often lower than in goods trade, the probability of survival in foreign markets would be higher for micro-sized firms than in more traditional manufacturing sectors.

Last, the results of chapter 4 point out that even though the distributional effects of trade have been studied already especially with regards to wage inequality, more efforts could be allocated towards research on the effects of trade on capital gains, capital income and total income inequality. In addition, our results point towards further research needs on the effects of competition policy on employment and income distributions in open economies. We find that both trade liberalization and tightening com-

[2] `www.oecd.org/trade/valueadded`

petition in the markets increase profit income gains more than wage income, which could drive the total income inequality upwards. At the same time unemployment rate increases, which is contrary to earlier findings on the topic. As mentioned earlier, the estimation of these effects' magnitude in practice (especially in any ex-ante policy analyses) could be important as well. I reckon that many people would be interested to know whether trade liberalization and a following increase in competition will raise income inequality and unemployment in reality and whether these increases will be 2 percent or 20 percent.

# Appendix A

# Appendixes of Chapter 3

## A.1 Descriptive statistics of variables included in the regression analyses

Table A.1: Descriptive statistics for regression variables[1)], averages and standard deviations over all sectors

| | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|
| Coefficient of variation | 0.91 | 0.24 | 0.08 | 2.26 |
| Number of companies | 751 | 1,125 | 2 | 5,050 |
| Average size of companies in terms of employees | 108 | 256 | 9 | 2,067 |
| Concentration (Herfindahl) | 0.16 | 0.25 | 0.00 | 0.97 |
| Average export share in turnover[2)] | 0.10 | 0.14 | 0.00 | 1.0 |
| Share of multinationals | 0.01 | 0.03 | 0.00 | 0.35 |
| Capital-Labour ratio [3)] | 8.9 | 1.1 | 5.1 | 12.3 |
| Share of management | 0.08 | 0.05 | 0.01 | 0.21 |
| Value of stocks in equity[2)] | 0.55 | 0.42 | 0.00 | 1.0 |

*Notes*: Number of Services sectors is 47. Total number of sectors is 70.
[1)] See section 3 for explanations on the variables.
[2)] The sector averages are calculated without the first and last percentile of outlier observations (see section 3 on data).
[3)] Measured as the log of capital value per employee.

## A.2 Industry specific results

See tables A.2 and A.3 for general sector specific results and tables A.4 and A.5 for the differences in the distributions between different types of firms within sectors.

Table A.2: Industry specific mark-up estimates and differences in salary and productivity levels - part 1

| Ind. code | Sector | No. of obs. (5 years) | Mark-ups mean | Mark-ups s.d. | Mark-ups CV | Fixed costs over VC, mean | Profit over VC, mean | Significant differences in average salary levels [1] | Significant differences in value added per employee [1] | Mean, mark-up, sub-sample [2] | Mean, mark-up, another study [3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Agricultural production | 1,945 | 0.64 | 0.61 | 0.94 | 0.56 | 0.08 | Yes, for L&X | Yes, for X | 0.54 | |
| 2 | Forestry and logging | 3,107 | 1.11 | 0.87 | 0.78 | 0.96 | 0.15 | Yes, for X | No | 0.72 | |
| 5 | Fishing and fish farming | 101 | 0.52 | 0.54 | 1.05 | 0.50 | 0.02 | No | Yes, for X | 0.51 | |
| 20 | Manuf. of wood and wood products | 3,717 | 0.38 | 0.40 | 1.04 | 0.41 | -0.02 | Yes, for L&X | Yes, for L&X | 0.29 | |
| 22 | Publishing and printing | 4,759 | 0.56 | 0.51 | 0.90 | 0.54 | 0.02 | Yes, for L&X | Yes, for L&X | 0.49 | |
| 23 | Manuf. of coke and refined petroleum | 21 | 0.58 | 0.38 | 0.65 | 0.54 | 0.04 | n.a | n.a | 0.48 | |
| 24 | Manuf. of chemicals | 820 | 0.55 | 0.56 | 1.02 | 0.58 | -0.04 | Yes, for L&X | Yes, for L&X | 0.52 | |
| 25 | Manuf. of rubber and plastic | 1,640 | 0.45 | 0.39 | 0.87 | 0.39 | 0.07 | Yes, for L | Yes, for L&X | 0.37 | |
| 26 | Manuf. of glass and ceramic | 1,586 | 0.51 | 0.41 | 0.82 | 0.43 | 0.08 | Yes, for L&X | Yes, for L&X | 0.40 | |
| 28 | Manuf. of metal products | 9,629 | 0.48 | 0.38 | 0.79 | 0.40 | 0.09 | Yes, for L&X | Yes, for L&X | 0.38 | |
| 29 | Manuf. of machinery | 4,912 | 0.45 | 0.40 | 0.88 | 0.37 | 0.09 | Yes, for L&X | Yes, for L&X | 0.36 | |
| 32 | Manuf. of electronics | 918 | 0.40 | 0.42 | 1.06 | 0.44 | -0.05 | Yes, for X | Yes, for L&X | 0.36 | |
| 33 | Manuf. of medical, testing & optical eqpt. | 1,709 | 0.48 | 0.41 | 0.85 | 0.44 | 0.04 | Yes, for L&X | Yes, for L&X | 0.43 | |
| 37 | Recycling of metal and non-metal waste | 103 | 0.65 | 0.49 | 0.76 | 0.48 | 0.17 | Yes, for L | Yes, for L | 0.47 | |
| 41 | Distribution of water | 341 | 1.15 | 0.91 | 0.79 | 1.25 | -0.09 | No | No | 0.75 | |
| 51 | Wholesale trade and commission trade | 21,765 | 0.39 | 0.47 | 1.21 | 0.35 | 0.05 | Yes, for L | Yes, for L | 0.33 | 0.32 |
| 61 | Water transport | 563 | 0.94 | 0.87 | 0.93 | 0.86 | 0.09 | Yes, for L | Yes, for L | 0.75 | 1.01 |
| 62 | Air transport | 77 | 1.18 | 1.16 | 0.99 | 1.23 | -0.05 | No | Yes, for L | 0.59 | |
| 65 | Financial services | 888 | 1.19 | 1.31 | 1.10 | 1.07 | 0.12 | Yes, for X | Yes, for L | 0.80 | 0.68 |
| 66 | Insurance services | 17 | 2.06 | 2.17 | 1.05 | 1.87 | 0.19 | No | No | 0.60 | |
| 71 | Renting of machinery and eqpt. | 1,270 | 1.00 | 0.90 | 0.91 | 0.89 | 0.11 | Yes, for X | Yes, for L&X | 0.82 | 0.77 |
| 72 | Computer and related services | 7,172 | 0.64 | 0.59 | 0.92 | 0.62 | 0.02 | Yes, for L&X | Yes, for L&X | 0.61 | |
| 73 | Research and development | 552 | 0.69 | 0.93 | 1.36 | 1.00 | -0.32 | Yes, for X | Yes, for L | 0.58 | |
| 80 | Education | 2,160 | 0.94 | 0.68 | 0.72 | 0.80 | 0.14 | No | No | 0.70 | 1.57 |
| 90 | Environmental services | 1,245 | 0.86 | 0.69 | 0.80 | 0.74 | 0.13 | Yes, for X | Yes, for L&X | 0.83 | |
| 103 | Extraction and agglomeration of peat | 603 | 1.16 | 0.95 | 0.82 | 0.96 | 0.19 | Yes, for L | Yes, for L&X | 0.95 | |
| 134 | Mining of non-ferrous metals | 544 | 0.82 | 0.79 | 0.97 | 0.73 | 0.09 | Yes, for X | Yes, for L | 0.57 | |
| 156 | Manuf. of food products and beverages | 3,754 | 0.46 | 0.36 | 0.78 | 0.41 | 0.05 | Yes, for L&X | Yes, for L&X | 0.43 | |
| 179 | Manuf. of textiles, clothes and shoes | 1,893 | 0.43 | 0.32 | 0.75 | 0.39 | 0.04 | Yes, for L&X | Yes, for L&X | 0.40 | |
| 212 | Manuf. of paper and paperboard | 348 | 0.41 | 0.26 | 0.63 | 0.38 | 0.03 | Yes, for L&X | Yes, for L&X | 0.37 | |
| 271 | Manuf. of iron and steel | 81 | 0.49 | 0.59 | 1.19 | 0.44 | 0.05 | No | Yes, for X | 0.45 | |
| 301 | Manuf. of office and electrical eqpt. | 773 | 0.38 | 0.36 | 0.96 | 0.31 | 0.06 | Yes, for L&X | Yes, for L&X | 0.32 | |
| 345 | Manuf. of cars & other transport eqpt. | 1,480 | 0.38 | 0.38 | 1.02 | 0.32 | 0.05 | Yes, for L&X | Yes, for L&X | 0.29 | |
| 361 | Manuf. of furniture | 1,795 | 0.40 | 0.31 | 0.77 | 0.35 | 0.05 | Yes, for L&X | Yes, for L&X | 0.36 | |
| 501 | Sale of motor vehicles | 1,994 | 0.19 | 0.42 | 2.20 | 0.18 | 0.01 | Yes, for L | Yes, for L | 0.11 | |
| 502 | Maintenance and repair of motor vehicles | 9,568 | 0.33 | 0.32 | 0.98 | 0.27 | 0.06 | Yes, for L | Yes, for L | 0.28 | |

*Notes*: * CV = Coefficient of variation

[1] Significant differences found between firms of different size or between firms with different export status at 5% significance level, where the higher values are obtained for : S=small, L=large, D=domestic or X=exporting firms. N.a indicates that comparison is not possible.

[2] This sub-sample consists of firms with minimum of 20 employees for ease of comparison with the Molnar and Bottini (2008) sample.

[3] Results of Molnar and Bottini (2008) for Finland. Their sample includes only firms with minimum 20 employees and in the education sector only private companies.

Table A.3: Industry specific mark-up estimates and differences in salary and productivity levels - part 2

| Ind. | | No. of obs. | Mark-ups | | | Fixed costs over VC, | Profit over VC, | Significant differences in average | Significant differences in value added | Mean, mark-up, sub- | Mean, mark-up, another |
|---|---|---|---|---|---|---|---|---|---|---|---|
| code | Sector | (5 years) | mean | s.d. | CV | mean | mean | salary levels [1)] | per employee [1)] | sample [2)] | study [3)] |
| 521 | Retail sale | 24,236 | 0.34 | 0.36 | 1.07 | 0.30 | 0.04 | No | Yes, for L | 0.29 | |
| 527 | Repair of household goods | 733 | 0.46 | 0.32 | 0.70 | 0.36 | 0.09 | Yes, for X | No | 0.37 | |
| 551 | Hotels | 2,519 | 1.05 | 0.81 | 0.78 | 1.00 | 0.04 | Yes, for L | Yes, for L | 0.88 | |
| 553 | Restaurants | 14,883 | 0.53 | 0.35 | 0.66 | 0.48 | 0.05 | Yes, for L | No | 0.53 | |
| 601 | Transport via railways | 22 | 0.76 | 0.80 | 1.05 | 0.56 | 0.20 | No | No | 0.87 | 0.77 |
| 633 | Other transport and travel serv. | 1,519 | 0.60 | 0.71 | 1.18 | 0.62 | -0.02 | Yes, for L&X | Yes, for L&X | 0.44 | 0.55 |
| 641 | Post and courier activities | 427 | 0.70 | 0.55 | 0.79 | 0.59 | 0.11 | Yes, for L | Yes, for S&X | 0.52 | |
| 642 | Telecommunications | 709 | 0.76 | 0.79 | 1.04 | 0.71 | 0.05 | Yes, for X | Yes, for L&X | 0.71 | |
| 671 | Serv. auxiliary to financial intermediation | 787 | 1.03 | 1.13 | 1.10 | 1.08 | -0.05 | No | No | 0.83 | 0.62 |
| 672 | Serv. auxiliary to insurance services | 125 | 0.93 | 0.74 | 0.79 | 0.88 | 0.05 | No | No | 0.74 | |
| 741 | Legal, accounting, auditing, etc. services | 10,958 | 0.93 | 0.76 | 0.82 | 0.73 | 0.20 | Yes, for L&X | Yes, for L&X | 0.71 | 0.98 |
| 742 | Architectural and engineering serv. | 9,003 | 0.63 | 0.49 | 0.78 | 0.50 | 0.13 | Yes, for L&X | Yes, for L&X | 0.49 | 0.67 |
| 743 | Technical testing and analysis serv. | 647 | 0.98 | 0.71 | 0.73 | 0.75 | 0.23 | Yes, for X | Yes, for X | 0.89 | |
| 744 | Advertising serv. | 2,953 | 0.60 | 0.47 | 0.79 | 0.54 | 0.06 | Yes, for L&X | Yes, for S&X | 0.51 | |
| 745 | Job agencies and personnel recruitment | 2,342 | 0.43 | 0.48 | 1.11 | 0.39 | 0.04 | Yes, for L | Yes, for S&X | 0.35 | |
| 746 | Security serv. | 673 | 0.62 | 0.59 | 0.96 | 0.67 | -0.04 | No | Yes, for X | 0.49 | |
| 747 | Cleaning serv. | 2,882 | 0.72 | 0.67 | 0.93 | 0.51 | 0.21 | Yes, for L | Yes, for S | 0.45 | |
| 748 | Other business serv. | 4,120 | 0.76 | 0.73 | 0.96 | 0.68 | 0.08 | Yes, for L&X | Yes, for S&X | 0.61 | |
| 851 | Human health serv. | 1,554 | 0.85 | 0.66 | 0.79 | 0.71 | 0.13 | Yes, for L | Yes, for S | 0.63 | |
| 853 | Social work serv. | 1,041 | 0.66 | 0.57 | 0.86 | 0.59 | 0.07 | No | No | 0.55 | |
| 2725 | Manuf. of processed iron and steel | 302 | 0.42 | 0.27 | 0.65 | 0.34 | 0.08 | Yes, for L&X | Yes, for L | 0.38 | |
| 3626 | Manuf. of jewellery, instruments, toys, etc. | 646 | 0.50 | 0.47 | 0.95 | 0.44 | 0.06 | Yes, for L&X | Yes, for L&X | 0.44 | |
| 4013 | Distribution of electricity and gas | 906 | 0.63 | 0.72 | 1.15 | 0.56 | 0.06 | Yes, for L&X | Yes, for L&X | 0.51 | 0.93 |
| 4501 | Construction of buildings | 5,700 | 0.85 | 0.71 | 0.83 | 0.74 | 0.11 | Yes, for L | Yes, for L | 0.54 | |
| 4502 | Civil engineering | 21,724 | 0.46 | 0.45 | 0.98 | 0.38 | 0.08 | Yes, for L | Yes, for L | 0.31 | 0.33 |
| 4509 | Construction service activities | 17,552 | 0.44 | 0.38 | 0.86 | 0.35 | 0.09 | Yes, for L | Yes, for L | 0.35 | 0.33 |
| 6023 | Road transportation serv. | 20,596 | 0.88 | 0.82 | 0.93 | 0.76 | 0.13 | No | Yes, for S | 0.57 | |
| 7012 | Real estate activities | 1,197 | 1.21 | 1.24 | 1.03 | 1.07 | 0.13 | No | Yes, for L | 0.65 | |
| 7031 | Real estate agencies | 1,755 | 1.02 | 0.68 | 0.67 | 0.92 | 0.09 | No | No | 0.82 | |
| 7032 | Management of real estate | 4,642 | 0.76 | 0.58 | 0.77 | 0.61 | 0.14 | Yes, for L | Yes, for S | 0.55 | |
| 9214 | Entertainment and news serv. | 1,992 | 0.87 | 0.82 | 0,94 | 0.82 | 0.06 | Yes, for L&X | Yes, for S&X | 0.67 | |
| 9267 | Sports and other recreational services | 3,065 | 1.16 | 0.87 | 0.75 | 1.20 | -0.04 | Yes, for L | Yes, for L | 1.03 | |
| 21121 | Manuf. of pulp, paper and paperboard | 233 | 0.47 | 0.38 | 0.83 | 0.46 | 0.01 | No | Yes, for L&X | 0.39 | |
| 63019 | Road, track and air transport serv. | 2,996 | 0.70 | 0.79 | 1.14 | 0.63 | 0.07 | No | No | 0.53 | |
| Total | | Mean | 0.70 | 0.62 | 0,92 | 0.63 | 0.06 | | | 0.55 | |
| | | Sd | 0.30 | 0.30 | 0,22 | 0.29 | 0.08 | | | 0.20 | |

*Notes*: * CV = Coefficient of variation

[1)] Significant differences found between firms of different size or between firms with different export status at 5% significance level, where the higher values are obtained for : S=small, L=large, D=domestic or X=exporting firms. N.a indicates that comparison is not possible.

[2)] This sub-sample consists of firms with minimum of 20 employees for ease of comparison with the Molnar and Bottini (2008) sample.

[3)] Results of Molnar and Bottini (2008) for Finland. Their sample includes only firms with minimum 20 employees and in the education sector only private companies.

Table A.4: Differences in mark-up distributions between different types of companies - part 1

| | All firms | | | | | Small firms | | | | | Large firms | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Small | | Large | | P-value*, | Domestic | | Exporters | | P-value*, | Domestic | | Exporters | | P-value*, |
| Ind. code | Mean mark-up | Obs. | Mean mark-up | Obs. | small vs. large | Mean mark-up | Obs. | Mean mark-up | Obs. | domestic vs. exporter | Mean mark-up | Obs. | Mean mark-up | Obs. | domestic vs. exporter |
| 1 | 0.65 | 1866 | 0.47 | 79 | 0.20 | 0.66 | 1510 | 0.63 | 356 | 0.39 | 0.46 | 41 | 0.47 | 38 | 0.86 |
| 2 | 1.12 | 3030 | 0.61 | 77 | 0.01 | 1.13 | 2667 | 1.02 | 363 | 0.01 | 0.69 | 45 | 0.50 | 32 | 0.15 |
| 5 | n.a | n.a | n.a | n.a | n.a | 0.58 | 51 | 0.45 | 49 | 0.25 | n.a | n.a | 0.46 | 1 | n.a |
| 20 | 0.40 | 3227 | 0.29 | 490 | 0.00 | 0.44 | 1965 | 0.33 | 1262 | 0.00 | 0.27 | 76 | 0.30 | 414 | 0.14 |
| 22 | 0.58 | 4016 | 0.48 | 743 | 0.00 | 0.65 | 1503 | 0.54 | 2513 | 0.00 | 0.53 | 111 | 0.48 | 632 | 0.39 |
| 23 | 0.72 | 14 | 0.30 | 7 | 0.56 | 1.33 | 1 | 0.68 | 13 | n.a | n.a | n.a | 0.30 | 7 | n.a |
| 24 | 0.53 | 557 | 0.59 | 263 | 0.13 | 0.56 | 149 | 0.51 | 408 | 0.38 | 0.58 | 4 | 0.59 | 259 | 0.87 |
| 25 | 0.47 | 1238 | 0.39 | 402 | 0.00 | 0.55 | 376 | 0.44 | 862 | 0.00 | 0.32 | 12 | 0.39 | 390 | 0.12 |
| 26 | 0.53 | 1251 | 0.41 | 335 | 0.00 | 0.52 | 800 | 0.56 | 451 | 0.08 | 0.31 | 79 | 0.44 | 256 | 0.08 |
| 28 | 0.50 | 8581 | 0.34 | 1048 | 0.00 | 0.53 | 5417 | 0.45 | 3164 | 0.00 | 0.38 | 117 | 0.33 | 931 | 0.02 |
| 29 | 0.48 | 4041 | 0.35 | 871 | 0.00 | 0.54 | 1988 | 0.41 | 2053 | 0.00 | 0.32 | 46 | 0.35 | 825 | 0.40 |
| 32 | 0.41 | 676 | 0.36 | 242 | 0.05 | 0.44 | 193 | 0.40 | 483 | 0.30 | 0.32 | 3 | 0.36 | 239 | 0.69 |
| 33 | 0.50 | 1436 | 0.43 | 273 | 0.00 | 0.55 | 480 | 0.47 | 956 | 0.00 | 0.67 | 5 | 0.42 | 268 | 0.28 |
| 37 | 0.68 | 97 | 0.16 | 6 | 0.32 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 41 | 1.17 | 327 | 0.69 | 14 | 0.51 | 1.20 | 301 | 0.91 | 26 | 0.53 | 0.64 | 9 | 0.79 | 5 | 0.39 |
| 51 | 0.39 | 19980 | 0.36 | 1785 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 61 | 0.89 | 429 | 1.13 | 134 | 0.01 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 62 | 1.50 | 52 | 0.52 | 25 | 0.26 | 1.34 | 14 | 1.56 | 38 | 0.61 | 0.48 | 6 | 0.54 | 19 | 0.46 |
| 65 | 1.17 | 792 | 1.37 | 96 | 0.17 | 1.18 | 585 | 1.13 | 207 | 0.60 | 1.14 | 41 | 1.54 | 55 | 0.15 |
| 66 | 1.74 | 12 | 2.81 | 5 | 0.78 | 1.74 | 12 | n.a | n.a | n.a | 2.81 | 5 | n.a | n.a | n.a |
| 71 | 0.99 | 1184 | 1.06 | 86 | 0.46 | 0.97 | 840 | 1.04 | 344 | 0.29 | 0.86 | 39 | 1.23 | 47 | 0.96 |
| 72 | 0.64 | 6464 | 0.64 | 708 | 0.93 | 0.64 | 3933 | 0.64 | 2531 | 0.88 | 0.58 | 243 | 0.67 | 465 | 0.02 |
| 73 | 0.70 | 470 | 0.59 | 82 | 0.27 | 0.80 | 224 | 0.62 | 246 | 0.05 | 0.94 | 19 | 0.49 | 63 | 0.76 |
| 80 | 0.96 | 1993 | 0.75 | 167 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 90 | 0.87 | 1163 | 0.79 | 82 | 0.16 | 0.87 | 1008 | 0.84 | 155 | 0.58 | 0.80 | 53 | 0.78 | 29 | 0.83 |
| 103 | 1.16 | 595 | 0.87 | 8 | 0.77 | 1.17 | 552 | 1.08 | 43 | 0.48 | n.a | n.a | 0.87 | 8 | n.a |
| 134 | 0.83 | 496 | 0.67 | 48 | 0.51 | 0.91 | 381 | 0.57 | 115 | 0.00 | 0.98 | 15 | 0.53 | 33 | 0.11 |
| 156 | 0.46 | 3138 | 0.46 | 616 | 0.95 | 0.47 | 2345 | 0.44 | 793 | 0.07 | 0.50 | 188 | 0.44 | 428 | 0.10 |
| 179 | 0.43 | 1659 | 0.41 | 234 | 0.37 | 0.49 | 660 | 0.39 | 999 | 0.00 | 0.47 | 23 | 0.41 | 211 | 0.35 |
| 212 | 0.44 | 259 | 0.33 | 89 | 0.29 | 0.49 | 84 | 0.42 | 175 | 0.11 | 0.43 | 2 | 0.33 | 87 | 0.11 |
| 271 | 0.51 | 45 | 0.47 | 36 | 0.70 | 0.62 | 30 | 0.29 | 15 | 0.79 | 1.74 | 2 | 0.39 | 34 | 0.20 |
| 301 | 0.39 | 597 | 0.34 | 176 | 0.22 | 0.38 | 254 | 0.39 | 343 | 0.59 | 0.30 | 11 | 0.35 | 165 | 0.25 |
| 345 | 0.41 | 1189 | 0.26 | 291 | 0.00 | 0.43 | 439 | 0.39 | 750 | 0.20 | 0.24 | 14 | 0.26 | 277 | 0.60 |
| 361 | 0.40 | 1598 | 0.37 | 197 | 0.25 | 0.41 | 931 | 0.39 | 667 | 0.41 | 0.63 | 10 | 0.36 | 187 | 0.23 |

*Notes*: * P-value on the difference of the distributions based on average annual K-S test value or Welsh's t-test (if high number of observations).
"n.r" stands for not reported due to very low number of observations; "n.a" stands for not available.

Table A.5: Differences in mark-up distributions between different types of companies - part 2

| | All firms | | | | | Small firms | | | | | Large firms | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Small | | Large | | P-value*, | Domestic | | Exporters | | P-value*, | Domestic | | Exporters | | P-value*, |
| Ind. code | Mean mark-up | Obs. | Mean mark-up | Obs. | small vs. large | Mean mark-up | Obs. | Mean mark-up | Obs. | domestic vs. exporter | Mean mark-up | Obs. | Mean mark-up | Obs. | domestic vs. exporter |
| 501 | 0.20 | 1684 | 0.12 | 310 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 502 | 0.33 | 9270 | 0.27 | 298 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 521 | 0.34 | 22645 | 0.31 | 1591 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 527 | 0.46 | 724 | 0.29 | 9 | 0.41 | 0.48 | 570 | 0.38 | 154 | 0.00 | 0.18 | 1 | 0.30 | 8 | n.a |
| 551 | 1.04 | 2158 | 1.08 | 361 | 0.37 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 553 | 0.53 | 14159 | 0.54 | 724 | 0.43 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 601 | 0.53 | 15 | 1.24 | 7 | 0.72 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 633 | 0.61 | 1368 | 0.50 | 151 | 0.02 | 0.71 | 842 | 0.46 | 526 | 0.00 | 0.47 | 82 | 0.53 | 69 | 0.58 |
| 641 | 0.80 | 292 | 0.47 | 135 | 0.00 | 0.87 | 223 | 0.59 | 69 | 0.25 | 0.49 | 112 | 0.42 | 23 | 0.09 |
| 642 | 0.72 | 501 | 0.85 | 208 | 0.04 | 0.76 | 361 | 0.61 | 140 | 0.06 | 0.91 | 122 | 0.76 | 86 | 0.10 |
| 671 | 1.03 | 749 | 1.09 | 38 | 0.63 | 1.10 | 541 | 0.83 | 208 | 0.00 | 1.01 | 29 | 1.33 | 9 | 0.61 |
| 672 | 1.00 | 95 | 0.72 | 30 | 0.48 | 1.02 | 74 | 0.92 | 21 | 0.47 | 0.72 | 30 | n.a | n.a | n.a |
| 741 | 0.93 | 10354 | 0.83 | 604 | 0.00 | 0.94 | 7521 | 0.92 | 2833 | 0.19 | 0.84 | 229 | 0.82 | 375 | 0.87 |
| 742 | 0.64 | 8346 | 0.49 | 657 | 0.00 | 0.67 | 5995 | 0.56 | 2351 | 0.00 | 0.51 | 201 | 0.48 | 456 | 0.52 |
| 743 | 0.98 | 607 | 0.97 | 40 | 0.52 | 1.04 | 330 | 0.90 | 277 | 0.02 | 1.52 | 13 | 0.71 | 27 | 0.89 |
| 744 | 0.61 | 2696 | 0.49 | 257 | 0.00 | 0.64 | 1763 | 0.55 | 933 | 0.00 | 0.53 | 119 | 0.46 | 138 | 0.07 |
| 745 | 0.55 | 1094 | 0.32 | 1248 | 0.00 | 0.53 | 869 | 0.62 | 225 | 0.07 | 0.31 | 980 | 0.35 | 268 | 0.10 |
| 746 | 0.65 | 560 | 0.47 | 113 | 0.00 | 0.66 | 491 | 0.60 | 69 | 0.45 | 0.47 | 95 | 0.50 | 18 | 0.62 |
| 747 | 0.76 | 2570 | 0.39 | 312 | 0.00 | 0.76 | 2348 | 0.66 | 222 | 0.01 | 0.39 | 247 | 0.39 | 65 | 0.96 |
| 748 | 0.78 | 3611 | 0.63 | 509 | 0.00 | 0.81 | 2329 | 0.72 | 1282 | 0.00 | 0.57 | 308 | 0.70 | 201 | 0.02 |
| 851 | 0.89 | 1341 | 0.59 | 213 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 853 | 0.68 | 893 | 0.52 | 148 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 2725 | 0.42 | 217 | 0.43 | 85 | 0.86 | 0.50 | 93 | 0.36 | 124 | 0.00 | 0.94 | 6 | 0.39 | 79 | 0.07 |
| 3626 | 0.50 | 583 | 0.51 | 63 | 0.16 | 0.66 | 165 | 0.44 | 418 | 0.00 | 0.49 | 6 | 0.51 | 57 | 0.81 |
| 4013 | 0.59 | 694 | 0.73 | 212 | 0.04 | 0.59 | 596 | 0.59 | 98 | 0.91 | 0.72 | 165 | 0.76 | 47 | 0.74 |
| 4501 | 0.87 | 5503 | 0.40 | 197 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 4502 | 0.47 | 20578 | 0.28 | 1146 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 4509 | 0.45 | 16769 | 0.34 | 783 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 6023 | 0.90 | 19808 | 0.48 | 788 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 7012 | 1.19 | 1102 | 1.40 | 95 | 0.20 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 7031 | 1.02 | 1723 | 0.98 | 32 | 0.45 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 7032 | 0.77 | 4321 | 0.49 | 321 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 9214 | 0.90 | 1710 | 0.72 | 282 | 0.00 | 0.92 | 1089 | 0.87 | 621 | 0.20 | 0.74 | 163 | 0.70 | 119 | 0.60 |
| 9267 | 1.17 | 2814 | 1.01 | 251 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |
| 21121 | 0.53 | 125 | 0.39 | 108 | 0.00 | 0.56 | 54 | 0.51 | 71 | 0.51 | 0.62 | 4 | 0.38 | 104 | 0.29 |
| 63019 | 0.73 | 2525 | 0.53 | 471 | 0.00 | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a | n.a |

*Notes*: * P-value on the difference of the distributions based on average annual K-S test value or Welsh's t-test (if high number of observations).
"n.r" stands for not reported due to very low number of observations; "n.a" stands for not available.

# Appendix B

# Appendixes of Chapter 4

## B.1 Comparative statics - Derivatives

The way how the change in mark-ups affects the main solutions do not depend only on the way $\rho_T$ affects the solutions, but also on how it affects the various parameters that depend on $\rho_T$ . Therefore, we start the comparative statics analyses from the effect of $\rho_T$ on the other parameters used in the solutions.

First of all, in case $\rho_T$ increases, the price demand elasticity (and substitution) increases based on:

$$\frac{\partial \sigma_T}{\partial \rho_T} = \frac{1}{(1-\rho_T)^2} > 1 \tag{B.1}$$

Mark-ups $\mu_T$, on the other hand, decrease in case $\rho_T$ increases:

$$\frac{\partial \mu_T}{\partial \rho_T} = -\frac{1}{(\rho_T)^2} < 0 \tag{B.2}$$

In the following, the other functions derivatives are done with respect to $\sigma_T$. As presented earlier, if $\rho_T$ increases, $\sigma_T$ increases as well. The derivations of specifically the more complicated functions are clearer when done based on the changes of $\sigma_T$.

The exporter multiplier $\Omega_T \equiv 1 + \tau^{1-\sigma_T}$ is smaller in case $\rho_T$ increases in comparison to the case where there is no change in $\rho_T$ after open trade as presented by function B.3.

$$\frac{\partial \Omega_T}{\partial \sigma_T} = -\tau^{1-\sigma_T} ln(\tau) < 0 \tag{B.3}$$

Similarly, the difference between the total revenue of exporters, $\Omega_T r^e(\varphi) = \Omega_T^{1-\theta\eta_T} r^n(\varphi) = (1+\tau^{1-\sigma_T})^{\frac{1}{1+\theta(\sigma_T-1)}} r^n(\varphi)$, and the total revenue of non-exporting firms, $r^n(\varphi)$, decreases if $\sigma_T$ (and $\rho_T$) increases. This is demonstrated by the derivative of the exporters' revenue multiplier with respect to sigma in equation B.4. The function is always negative, as both parts inside the brackets are negative and the multiplier is positive.

$$\frac{\partial \Omega_T}{\partial \sigma_T} = (1+\tau^{1-\sigma_T})^{\frac{1}{1+\theta(\sigma_T-1)}} * [\frac{-\theta}{[1+\theta(\sigma_T-1)]^2} ln(1+\tau^{1-\sigma_T}) - \frac{\tau^{1-\sigma_T} ln(\tau)}{[1+\theta(\sigma_T-1)] * (1+\tau^{1-\sigma_T})}] < 0 \quad \text{(B.4)}$$

The derivative of export share with respect to $\sigma_T$ is slightly more complicated as $\sigma_T$ appears in the powers of the function in various parts. First, the function needs to be derived as a function of only $\sigma_T$, instead of a function of $\sigma_T$ and $\eta_T$. Secondly, logarithm of the function is taken in order to simplify the derivation. The full derivative is named $D\chi_T$, since it is needed later on in the derivations of other functions. The signs of the first few derivatives are clear from the functional forms. However, both of the first two terms inside the brackets of derivative B.5 are negative (as $ln(\Omega_T^{\frac{\eta_T}{\sigma_T-1}} - 1)$ is defined to be positive but less than 1). This way the first multiplication is positive, while the last terms are all negative. No analytical solution can be found on the comparison of the positive vs. negative parts values. In other words, no analytical solution can be obtained on the sign of the derivative with respect to sigma. Therefore, we test the sign of the derivative numerically with in total nearly 98 million combinations of different values for $\rho_T$, $\theta$, k and $\tau$. See section B.2 for the results. So, mostly, when mark-ups decrease, the share of firms that can export decreases.

$$\chi_T = \left(\Omega_T^{\frac{\eta_T}{\sigma_T-1}} - 1\right)^{\frac{k}{\eta_T}} = \left(\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma_T-1)}} - 1\right)^{\frac{k(1+\theta(\sigma_T-1)}{\sigma_T-1}}$$

$$ln\chi_T = \frac{k(1+\theta(\sigma-1)}{\sigma-1} * ln\left(\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right)$$

$$\frac{\partial \chi}{\partial \sigma} * \frac{1}{\chi} = \frac{(\sigma-1)k\theta - k\theta\sigma + k\theta - k}{(\sigma-1)^2} * ln\left(\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right)$$

$$+ \frac{k(1+\theta(\sigma-1)}{\sigma-1} * \frac{d}{d\sigma}\left(ln\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right)$$

$$\frac{\partial \chi}{\partial \sigma} * \frac{1}{\chi_T} = \frac{(\sigma-1)k\theta - k\theta\sigma + k\theta - k}{(\sigma-1)^2} * ln\left(\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right)$$

$$+ \frac{k(1+\theta(\sigma-1)}{\sigma-1} * \frac{\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}}}{\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1} * \frac{d}{d\sigma}\left(\frac{1}{1+\theta(\sigma-1)} ln\left(1+\tau^{1-\sigma}\right)\right)$$

$$\frac{\partial \chi}{\partial \sigma} = \chi_T * [\left(\frac{k\theta}{(\sigma-1)} - \frac{k\theta\sigma - k\theta + k}{(\sigma-1)^2}\right) * ln\left(\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right)$$

$$+ \frac{k(1+\theta(\sigma-1)) * \left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} * \left(\frac{-\tau^{1-\sigma} * ln(\tau)}{(1+\tau^{1-\sigma})(1+\theta(\sigma-1))} - \frac{ln\left(1+\tau^{1-\sigma}\right)\theta}{(1+\theta(\sigma-1))^2}\right)}{(\sigma-1) * \left[\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right]}]$$

$$D\chi_T \equiv \frac{\partial \chi}{\partial \sigma} = \chi_T * [\left(\frac{-k}{(\sigma-1)^2}\right) * ln\left(\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right)$$

$$+ \frac{\left(-\tau^{1-\sigma} * ln(\tau) * k * \left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}-1} - \frac{ln\left(1+\tau^{1-\sigma}\right)k\theta\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}}}{(1+\theta(\sigma-1))}\right)}{(\sigma-1) * \left[\left(1+\tau^{1-\sigma}\right)^{\frac{1}{1+\theta(\sigma-1)}} - 1\right]}] \tag{B.5}$$

Similarly, the sign of the derivative of labour supply with respect to sigma in equation B.6 is not a very clear cut and no analytical solution is found for the sign of the derivative again. It depends especially on the magnitudes of the parameters k and $\theta$. For the derivation, the labour supply equation is first transferred again as a function of $\sigma_T$. However, based on the numerical analyses in subsection B.2 the derivative is always positive. In other words, labour supply increases in case there

is an increase in $\rho_T$ and consequently in $\sigma_T$ after open trade.

$$L_T = \frac{k(\sigma_T - 1)}{k\sigma_T - \eta_T} N = \frac{k(\sigma_T - 1)}{k\sigma_T - \frac{\sigma_T - 1}{1+\theta(\sigma_T - 1)}} N = \frac{k(\sigma_T - 1)(1+\theta(\sigma_T - 1))}{k\sigma_T(1+\theta(\sigma_T - 1)) - \sigma_T + 1} N$$

$$\frac{\partial L_T}{\partial \sigma} = N * [\frac{k + 2k\theta(\sigma - 1)}{k\sigma_T + (k\sigma_T\theta - 1)(\sigma_T - 1)} - \frac{k(\sigma_T - 1)\left[1 + \theta(\sigma_T - 1)\right] * (k + k\theta(2\sigma - 1) - 1)}{\left[k\sigma_T(1 + \theta(\sigma_T - 1)) - \sigma_T + 1\right]^2}] \quad \text{(B.6)}$$

The derivative of the number of firms/managers with regards to $\sigma_T$ is presented in equation B.7. Within the derivation the earlier result on $\frac{\partial \chi_T}{\partial \sigma} \equiv D\chi_T$ has been used as defined in equation B.5. For the ease of calculations, the function of $M_T$ is also first transferred to logarithmic terms and as a function of $\sigma_T$. Due to the fact that $D\chi_T$ can take both positive and negative values, the last part of the equation can be either positive or negative (though in most cases positive, see subsection B.2). No easy comparison can be made on the magnitude of the different parts' values in the derivative. Therefore, we use numerical analysis to value the sign of the derivative with different parameter values. Based on the results, presented in subsection B.2, the sign of the derivative is always negative.

$$lnM_T = ln\left(\frac{k - \eta_T}{k\sigma_T - \eta_T}\right) - ln(1 + \chi_T) + lnN$$

$$lnM_T = ln\left(\frac{1 + \theta(\sigma_T - 1) - \frac{1}{k}(\sigma_T - 1)}{\sigma_T[1 + \theta(\sigma_T - 1)] - \frac{1}{k}(\sigma_T - 1)}\right) - ln((1 + \chi_T) + lnN$$

$$\frac{\partial M}{\partial \sigma} * \frac{1}{M} = \frac{1}{\frac{k - \eta_T}{k\sigma_T - \eta_T}} * [\frac{\theta - \frac{1}{k}}{\sigma_T[1 + \theta(\sigma_T - 1)] - \frac{1}{k}(\sigma_T - 1)} - \frac{[1 + \theta(\sigma_T - 1) - \frac{1}{k}(\sigma_T - 1)] * (1 + 2\theta\sigma - \theta - \frac{1}{k})}{[\sigma_T[1 + \theta(\sigma_T - 1)] - \frac{1}{k}(\sigma_T - 1)]^2}] - \frac{1}{1 + \chi_T} * \frac{\partial \chi_T}{\partial \sigma}$$

$$\frac{\partial M}{\partial \sigma} = \frac{N}{1+\chi_T} *$$

$$\left[ \frac{\theta - \frac{1}{k}}{\sigma_T[1+\theta(\sigma_T-1)] - \frac{1}{k}(\sigma_T-1)} - \frac{(1+2\theta\sigma-\theta-\frac{1}{k})\left[1+\theta(\sigma_T-1)-\frac{1}{k}(\sigma_T-1)\right]}{[\sigma_T[1+\theta(\sigma_T-1)]-\frac{1}{k}(\sigma_T-1)]^2} \right]$$

$$- \left[ \frac{1+\theta(\sigma_T-1)-\frac{1}{k}(\sigma_T-1)}{\sigma_T[1+\theta(\sigma_T-1)]-\frac{1}{k}(\sigma_T-1)} \right] \frac{N * D\chi_T}{[1+\chi_T]^2} \quad \text{(B.7)}$$

The definition of the marginal productivity required to run a firm is very close to the definition of M. Therefore, its derivative is also a very close one. Similarly to the previous derivative, the sign is analysed with numerical methods. Based on them, the derivative is always positive. So, if mark-ups decrease in open trade and therefore $\sigma_T$ increases, the marginal productivity required to run a firm increases. Again, the use of the above defined $D\chi_T$ shortens the derivation significantly.

$$\varphi^* = \left( \frac{(k\sigma_T - \eta_T)(1+\chi_T)}{k-\eta_T} \right)^{\frac{1}{k}}$$

$$\frac{\partial \varphi^*}{\partial \sigma} = \frac{1}{k} \left( \frac{(k\sigma_T - \eta_T)(1+\chi_T)}{k-\eta_T} \right)^{\frac{1}{k}-1} * \frac{d}{d\sigma} \left( \frac{(k\sigma_T - \eta_T)(1+\chi_T)}{k-\eta_T} \right)$$

$$\frac{\partial \varphi^*}{\partial \sigma} = \frac{1}{k} \left( \frac{(k\sigma_T - \eta_T)(1+\chi_T)}{k-\eta_T} \right)^{\frac{1}{k}-1} * \left( \frac{(k\sigma_T - \eta_T)(1+\chi_T)}{k-\eta_T} \right) *$$

$$\{ \frac{1+\theta(\sigma_T-1)-\frac{1}{k}(\sigma_T-1)}{\sigma_T[1+\theta(\sigma_T-1)]-\frac{1}{k}(\sigma_T-1)} *$$

$$\left[ \frac{(1+2\theta\sigma-\theta-\frac{1}{k})}{1+\theta(\sigma_T-1)-\frac{1}{k}(\sigma_T-1)} - \frac{[\sigma_T[1+\theta(\sigma_T-1)]-\frac{1}{k}(\sigma_T-1)] * (\theta-\frac{1}{k})}{[1+\theta(\sigma_T-1)-\frac{1}{k}(\sigma_T-1)]^2} \right]$$

$$+ \frac{D\chi_T}{1+\chi_T} \}$$

$$\frac{\partial \varphi^*}{\partial \sigma} = \frac{1}{k}\left(\frac{(k\sigma_T - \eta_T)(1+\chi_T)}{k-\eta_T}\right)^{\frac{1}{k}} *$$

$$\{\left[\frac{(1+2\theta\sigma-\theta-\frac{1}{k})}{\sigma_T[1+\theta(\sigma_T-1)]-\frac{1}{k}(\sigma_T-1)} - \frac{(\theta-\frac{1}{k})}{[1+\theta(\sigma_T-1)-\frac{1}{k}(\sigma_T-1)]}\right]$$

$$+\frac{D\chi_T}{1+\chi_T}\} \quad \text{(B.8)}$$

Equation B.9 shows the derivative of employment share (out of total labour supply) with regards to sigma. The derivative is split into two main parts and the earlier result on $D\chi_T$ is used again to shorten it. Analytical solution on the sign of the derivative is again not found. Based on numerical analyses, the derivative $D(1-U_T)$ is negative with the given restrictions on the parameters. In other words, employment decreases and unemployment increases if sigma increases. As labour supply increases but the number of firms decreases, unemployment increases.

$$1-U_T = \frac{\Gamma}{(1+\chi_T)} * [\frac{k-\eta_T}{k-(1-\theta)\eta_T}]$$

$$= \frac{1+\chi_T^{\frac{k-(1-\theta)\eta_T}{k}}(\Omega_T^{\frac{(1-\theta)\eta_T}{\sigma_T-1}}-1)}{(1+\chi_T)} * [\frac{k-\eta_T}{k-(1-\theta)\eta_T}]$$

$$ln(1-U_T) = ln\left[1+\chi_T^{\frac{k-(1-\theta)\eta_T}{k}}(\Omega_T^{\frac{(1-\theta)\eta_T}{\sigma_T-1}}-1)\right] - ln(1+\chi_T) + ln[\frac{k-\eta_T}{k-(1-\theta)\eta_T}]$$

$$ln(1-U_T) = ln\left[1+\chi_T^{1-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}((1+\tau^{1-\sigma_T})^{\frac{(1-\theta)}{1+\theta(\sigma_T-1)}}-1)\right]$$

$$- ln(1+\chi_T) + ln[\frac{k(1+\theta(\sigma_T-1))-\sigma_T+1}{k(1+\theta(\sigma_T-1))-(1-\theta)(\sigma_T-1)}]$$

$$D(1-U_T) \equiv \frac{\partial(1-U_T)}{\partial\sigma} = (1-U_T)\{\frac{1}{\Gamma} * \frac{d}{d\sigma}\Gamma - \frac{D\chi_T}{(1+\chi_T)} +$$

$$\left(\frac{k\theta-1}{k(1+\theta(\sigma_T-1))-\sigma_T+1} - \frac{k\theta+\theta-1}{k(1+\theta(\sigma_T-1))-(1-\theta)(\sigma_T-1)}\right)\} \quad \text{(B.9)}$$

, where $\Gamma = 1 + \chi_T^{1-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}((1+\tau^{1-\sigma_T})^{\frac{(1-\theta)}{1+\theta(\sigma_T-1)}} - 1)$ and:

$$\frac{d}{d\sigma}\Gamma = (\Gamma-1) * [\left(\frac{-(1-\theta)}{k[1+\theta(\sigma_T-1)]^2}\right) ln(\chi_T)$$

$$+ \left(1 - \frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}\right)\frac{D\chi_T}{\chi_T}] + \chi_T^{1-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}} * (1+\tau^{1-\sigma_T})^{\frac{(1-\theta)}{1+\theta(\sigma_T-1)}} *$$

$$\left[\frac{-\tau^{1-\sigma_T} ln(\tau)(1-\theta)}{[1+\theta(\sigma_T-1)](1+\tau^{1-\sigma_T})} - \frac{\theta(1-\theta)ln(1+\tau^{1-\sigma_T})}{[1+\theta(\sigma_T-1)]^2}\right] = D\Gamma \quad \text{(B.10)}$$

Before continuing with the derivatives of the different income inequality measures, we solve what happens to average wage and average managerial income when mark-ups change, i.e. when $\rho_T$ and $\sigma_T$ change in comparison to autarky. The earlier solutions $D\chi_T$ and $D(1-U_T)$ are used to shorten the derivative and the original function presented in table 4.1 are first transferred to logarithmic forms. The derivative of average wage with respect to sigma in equation B.11 is always positive based on numerical analyses. In other words, average wage increases if mark-ups decrease (i.e. sigma increases).

$$ln\bar{w}_T = \frac{1}{k}ln(1+\chi_T) + ln\left(\frac{(\sigma_T-1)^2}{\sigma_T}\right)$$

$$+ \frac{\sigma_T}{\sigma_T-1}ln\left(\frac{k[1+\theta(\sigma_T-1)]}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right)$$

$$+ \frac{k-1}{k}ln\left(\frac{1+\theta(\sigma_T-1) - \frac{1}{k}(\sigma_T-1)}{\sigma_T[1+\theta(\sigma_T-1)] - \frac{1}{k}(\sigma_T-1)}\right) +$$

$$ln\left(\frac{k(\sigma_T-1)(1+\theta(\sigma_T-1))}{k\sigma_T(1+\theta(\sigma_T-1)) - \sigma_T + 1}\right) - ln\,(1-U_T)$$

$$\frac{\partial \bar{w_T}}{\partial \sigma} = \bar{w_T}\Big[\frac{D\chi_T}{k(1+\chi_T)} + \left(\frac{\sigma_T^2 - 1}{\sigma_T(\sigma_T-1)^2}\right)$$
$$+ \frac{\sigma_T}{\sigma_T - 1} * \left[\frac{\theta}{(1+\theta(\sigma_T-1))} - \frac{k\theta - 1}{k(1+\theta(\sigma_T-1)) - (\sigma_T - 1)}\right]$$
$$+ \left(\frac{-1}{(\sigma_T-1)^2}\right) ln\left(\frac{k}{k-\eta_T}\right)$$
$$+ \frac{k-1}{k} * \left[\frac{\theta - \frac{1}{k}}{1+\theta(\sigma_T-1) - \frac{1}{k}(\sigma_T-1)} - \frac{(1+2\theta\sigma - \theta - \frac{1}{k})}{[\sigma_T[1+\theta(\sigma_T-1)] - \frac{1}{k}(\sigma_T-1)]}\right]$$
$$+ \left[\frac{k + 2k\theta\sigma - k\theta - 1}{[k\sigma_T(1+\theta(\sigma_T-1)) - \sigma_T + 1]} - \frac{1 + 2\theta(\sigma-1)}{(\sigma_T-1)\,[1+\theta(\sigma_T-1)]}\right]$$
$$- \frac{D(1-U_T)}{1-U_T}\Big] \quad \text{(B.11)}$$

Similar to the average wage income, the average managerial income increases if mark-ups decrease. This is due to the fact that the derivative of average profits with regards to sigma in equation B.12 is also always positive based on numerical analyses.

$$ln\bar{\pi_t} = ln\left[(1+\chi_T)\left(\frac{k}{k-\eta_T}\right) - \chi_T\right] + \frac{1}{k}ln(1+\chi_T) + ln\left(\frac{(\sigma_T-1)^2}{\sigma_T}\right)$$
$$+ \frac{\sigma_T}{\sigma_T - 1} ln\left(\frac{k[1+\theta(\sigma_T-1)]}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right)$$
$$+ \frac{k-1}{k} ln\left(\frac{1+\theta(\sigma_T-1) - \frac{1}{k}(\sigma_T-1)}{\sigma_T[1+\theta(\sigma_T-1)] - \frac{1}{k}(\sigma_T-1)}\right)$$
$$+ ln\left(\frac{k(\sigma_T-1)(1+\theta(\sigma_T-1))}{k\sigma_T(1+\theta(\sigma_T-1)) - \sigma_T + 1}\right)$$

$$\frac{\partial \bar{\pi_T}}{\partial \sigma} = \bar{\pi_T}[\frac{1}{(1+\chi_T)\left(\frac{k}{k-\eta_T}\right) - \chi_T} *$$

$$((1+\chi_T)\left[\frac{k\theta}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)} - \frac{(k\theta-1)k[1+\theta(\sigma_T-1)]}{[k(1+\theta(\sigma_T-1)) - (\sigma_T-1)]^2}\right]$$

$$+\left[\frac{k}{k-\eta_T} - 1\right] D\chi_T)$$

$$+\frac{D\chi_T}{k(1+\chi_T)} + \left(\frac{\sigma_T^2 - 1}{\sigma_T(\sigma_T-1)^2}\right) +$$

$$\frac{\sigma_T}{\sigma_T - 1} * \left[\frac{\theta}{(1+\theta(\sigma_T-1))} - \frac{k\theta - 1}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right]$$

$$+\left(\frac{-1}{(\sigma_T-1)^2}\right) ln\left(\frac{k}{k-\eta_T}\right)$$

$$+\frac{k-1}{k} * \left[\frac{\theta - \frac{1}{k}}{1+\theta(\sigma_T-1) - \frac{1}{k}(\sigma_T-1)} - \frac{(1+2\theta\sigma - \theta - \frac{1}{k})}{[\sigma_T[1+\theta(\sigma_T-1)] - \frac{1}{k}(\sigma_T-1)]}\right]$$

$$+\left[\frac{k+2k\theta\sigma - k\theta - 1}{[k\sigma_T(1+\theta(\sigma_T-1)) - \sigma_T + 1]} - \frac{1+2\theta\sigma - 2\theta}{(\sigma_T-1)\,[1+\theta(\sigma_T-1)]}\right]] \quad \text{(B.12)}$$

The intergroup inequality $I_G$ is measured by the ratio of average managerial income to average expected labour income. In order to solve what happens if sigma changes, the function is transformed again to a logarithmic form and as a function of sigma. This tells us also separately what happens to the autarky level inequality $(k/(k-\eta_T))$ and to the 'open economy multiplier' of the inequality ratio. The first part of the derivative B.13 within the main brackets is positive according to numerical analysis. This means that already in autarky intergroup inequality would increase if mark-ups decrease, since less firms manage to operate in the market. The average profits, i.e. the average managerial income, is higher due to the higher productivity of the operating firms even though the share of the revenue that goes to the managers is lower. Therefore, also the ratio of average profit to average expected wage income is higher. In addition, the second part of the derivative is positive. So, in total the derivative is positive according to the numerical tests. Therefore, intergroup inequality increases both in autarky and in open economy

when mark-ups decrease.

$$\frac{\bar{\pi}}{(1-U)\bar{w}} = \frac{k}{k-\eta_T} * (1 + \frac{\eta_T \chi_T}{k}) \equiv I_G$$

$$\begin{aligned} lnI_G &= ln(\frac{k}{k-\eta_T}) + ln(1 + \frac{\eta_T \chi_T}{k}) \\ &= ln\left(\frac{k[1+\theta(\sigma_T-1)]}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right) + ln\left(1 + \frac{\sigma_T - 1}{k(1+\theta(\sigma_T-1))} * \chi_T\right) \end{aligned}$$

$$\begin{aligned} \frac{\partial I_G}{\partial \sigma} * \frac{1}{I_G} = &\left[\frac{\theta}{(1+\theta(\sigma_T-1))} - \frac{k\theta - 1}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right] \\ &+ \frac{k(1+\theta(\sigma_T-1))}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)\chi_T} * \frac{\sigma_T - 1}{k(1+\theta(\sigma_T-1))} \\ &* \chi_T * \left[\left(\frac{1}{\sigma_T - 1} - \frac{\theta}{(1+\theta(\sigma_T-1))}\right) + \frac{D\chi_T}{\chi_T}\right] \end{aligned}$$

$$\begin{aligned} \frac{\partial I_G}{\partial \sigma} = I_G( &\left[\frac{\theta}{(1+\theta(\sigma_T-1))} - \frac{k\theta - 1}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right] \\ &+ \frac{\sigma_T - 1}{k(1+\theta(\sigma_T-1)) - (\sigma_T-1)\chi_T} * \chi_T * \\ &\left[\left(\frac{1}{\sigma_T - 1} - \frac{\theta}{(1+\theta(\sigma_T-1))}\right) + \frac{D\chi_T}{\chi_T}\right]) \end{aligned} \quad \text{(B.13)}$$

The income inequality between managers is defined in table 4.1, row 10, part T. In order to find the derivative of it with regards to sigma, the function is derived again as a function of only sigma and in logarithmic terms.

$$\begin{aligned} lnA_{M,T} &= ln[\frac{\eta_T}{2k - \eta_T}] + ln[1 + \frac{\chi_T(2-\chi_T)(k-\eta_T)}{k + \eta_T \chi_T}] \\ &= ln\left(\frac{\sigma_T - 1}{2k(1+\theta(\sigma_T-1)) - (\sigma_T-1)}\right) \\ &\quad + ln\left[1 + \frac{\chi_T(2-\chi_T) * [k(1+\theta(\sigma_T-1)) - (\sigma_T-1)]}{k(1+\theta(\sigma_T-1)) + (\sigma_T-1)\chi_T}\right] \end{aligned}$$

Function B.14 provides the final form of the derivative. The sign of the derivative is always positive based on numerical analyses and shows that the income inequality Gini of managerial income increases if sigma increases.

$$\frac{\partial A_{M,T}}{\partial \sigma} = A_{M,T}\Big[\left(\frac{1}{\sigma_T - 1} - \frac{2k\theta - 1}{2k(1+\theta(\sigma_T-1)) - (\sigma_T - 1)}\right) + \frac{\chi_T(2-\chi_T) * [k(1+\theta(\sigma_T-1)) - (\sigma_T-1)]}{(2\chi_T - \chi_T^2 + 1)k[1+\theta(\sigma_T-1)] - [\chi_T(1-\chi_T)(\sigma_T-1)]} * \Big[\frac{(2-2\chi_T) * D\chi_T}{\chi_T(2-\chi_T)} + \left(\frac{k\theta - 1}{[k(1+\theta(\sigma_T-1)) - (\sigma_T-1)]} - \frac{k\theta + \chi_T + (\sigma_T-1)D\chi_T}{[k(1+\theta(\sigma_T-1)) + (\sigma_T-1)\chi_T]}\right)\Big]\Big] \quad \text{(B.14)}$$

Similar to the previous parts, the Gini of labour income is first transferred as a function of sigma. By reshuffling the terms in the original form of the function, we find a new way to define the function. Function B.15 is used as the basis for the derivative with respect to sigma.

$$A_{L,T} = \frac{\theta\eta_T}{2[k-(1-\theta)\eta_T] - \theta\eta_T} * \Big[1 + \frac{2(k-\eta_T)\chi_T(1-\chi_T^{1-(1-\theta)\eta_T/k}) - 2[k-(1-\theta)\eta_T](\Gamma_T - 1)(1-\chi_T^{1-\eta_T/k})}{(1+\chi_T)\theta\eta_T\Gamma_T}\Big]$$

$$A_{L,T} = \frac{\theta\eta_T}{2[k-(1-\theta)\eta_T] - \theta\eta_T} * \Big[1 + \left(\frac{2(k-\eta_T)}{\theta\eta_T}\right)\left(\frac{\chi_T(1-\chi_T^{1-(1-\theta)\eta_T/k})}{(1+\chi_T)\Gamma_T}\right) - \left(\frac{2[k-(1-\theta)\eta_T]}{\theta\eta_T}\right)\left(\frac{\Gamma_T - 1}{\Gamma_T}\right)\left(\frac{1-\chi_T^{1-\eta_T/k})}{1+\chi_T}\right)\Big]$$

$$A_{L,T} = \frac{\theta}{\frac{2k}{(\sigma_T-1)} + (2k+1)\theta - 2}$$
$$* [1 + \left(\frac{2k}{(\sigma_T-1)\theta} + 2k - \frac{2}{\theta}\right)\left(\frac{\chi_T - \chi_T^{2-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}}{(1+\chi_T)\Gamma_T}\right)$$
$$- \left(\frac{2k}{(\sigma_T-1)\theta} + 2k + 2 - \frac{2}{\theta}\right)\left(1 - \frac{1}{\Gamma_T}\right)\left(\frac{1-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}}{1+\chi_T}\right)]$$

$$lnA_{L,T} = ln\left(\frac{\theta}{\frac{2k}{(\sigma_T-1)} + (2k+1)\theta - 2}\right) + ln[1+\Lambda] \tag{B.15}$$

, where

$$\Lambda \equiv \left(\frac{2k}{(\sigma_T-1)\theta} + 2k - \frac{2}{\theta}\right)\left(\frac{\chi_T - \chi_T^{2-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}}{(1+\chi_T)\Gamma_T}\right)$$
$$- \left(\frac{2k}{(\sigma_T-1)\theta} + 2k + 2 - \frac{2}{\theta}\right)\left(1 - \frac{1}{\Gamma_T}\right)\left(\frac{1-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}}{1+\chi_T}\right)$$

$\Gamma$ has been defined earlier in sub-section 4.3.2 and its derivative $\frac{\partial\Gamma}{\partial\sigma} \equiv D\Gamma$ is defined in function B.10. The derivative of labour income Gini with respect to sigma is derived in two parts as:

$$\frac{\partial A_{L,T}}{\partial\sigma_T} = A_{L,T}\left\{\left(\frac{2k}{[\frac{2k}{(\sigma_T-1)} + (2k+1)\theta - 2](\sigma_T-1)^2}\right) + \frac{1}{[1+\Lambda]}\frac{d}{d\sigma_T}\Lambda\right\} \tag{B.16}$$

,where

$$\frac{d}{d\sigma_T}\Lambda = \left(\frac{-2k}{(\sigma_T-1)^2\theta}\right)\left(\frac{\chi_T - \chi_T^{2-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}}{(1+\chi_T)\Gamma_T}\right) + \left(\frac{2k}{(\sigma_T-1)\theta} + 2k - \frac{2}{\theta}\right) *$$

$$\{\frac{D\chi_T - \chi_T^{2-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}} * \left\{\left[\frac{(\theta-1)}{k[1+\theta(\sigma_T-1)]^2}\right] ln\chi_T + \left(2 - \frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}\right)\frac{D\chi_T}{\chi_T}\right\}}{(1+\chi_T)\Gamma_T}$$

$$- \frac{\left(\chi_T - \chi_T^{2-\frac{(1-\theta)(\sigma_T-1)}{k(1+\theta(\sigma_T-1))}}\right)(D\chi_T\Gamma_T + (1+\chi_T)D\Gamma_T)}{[(1+\chi_T)\Gamma_T]^2}\}$$

$$- \left(\frac{-2k}{(\sigma_T-1)^2\theta}\right)\left(1 - \frac{1}{\Gamma_T}\right)\left(\frac{1-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}}{1+\chi_T}\right)$$

$$- \left(\frac{2k}{(\sigma_T-1)\theta} + 2k + 2 - \frac{2}{\theta}\right)\left(\frac{D\Gamma_T}{\Gamma_T^2}\right)\left(\frac{1-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}}{1+\chi_T}\right)$$

$$- \left(\frac{2k}{(\sigma_T-1)\theta} + 2k + 2 - \frac{2}{\theta}\right)\left(1 - \frac{1}{\Gamma_T}\right) *$$

$$\{\frac{-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}[\left(\frac{-1}{k(1+\theta(\sigma_T-1))^2}\right) ln\chi_T + \left(1 - \frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}\right)\frac{D\chi_T}{\chi_T}]}{1+\chi_T}$$

$$- \frac{\left(1-\chi_T^{1-\frac{\sigma_T-1}{k(1+\theta(\sigma_T-1))}}\right)D\chi_T}{[1+\chi_T]^2}\}$$

The derivative B.16 is always positive with the given parameter restrictions (see subsection B.2). It means that labour income Gini index increases if mark-ups decrease. This is due to the fact that a smaller share of workers are employed in exporting firms, which pay higher wages due to their higher productivity. This shows already from the fact that average wage of employed people has increased. So, the distribution of production worker salaries widens after mark-ups decrease.

## B.2 Comparative statics - Numerical analyses

Due to the fact that the signs of various derivatives are not clear from the function forms of the derivatives, numerical tests on the values are calculated with a total of nearly million different combinations of $\rho_T$ , $\theta$ and k and over 98 million different combinations of $\rho_T$, $\theta$, k and $\tau$. The nearly million combinations of only $\rho_T$, $\theta$ and k are used for the analysis of the derivatives which do not include $\tau$. Otherwise, the full sample of 98 million combinations of different parameter values is used.

In order to analyse whether the positive parts are larger than the negative parts, we test the values of the different derivatives with all possible combinations of the parameter values of $\rho_T$, $\theta$, k and $\tau$. Both $\rho_T$ and $\theta$ have clear restrictions on the values they can take. They both need to be strictly between 0 and 1. We divide the range 0.01-0.99 to 99 points with 0.01 between every step. This provides us already with a total of 99*99=9801 different parameter value combinations. The possible values of parameters k and $\tau$ are less clear. Both of the previously mentioned parameters have only a lower bound: $k > \eta_T$ and $\tau > 1$. In order to set some kind of upper limit for both of these parameters, we investigate the empirical estimates of these parameters from literature. Further, as mentioned earlier, it is defined in the model that $1 < \Omega_T \equiv 1 + \tau^{1-\sigma_T} \leq 2$. However, with some values of $\rho_T$ and $\tau$, $\Omega_T \equiv 1 + \tau^{1-\sigma_T}$ is so close to one that at the level of 52 decimals it is rounded to be exactly one. Based on the restriction, we need to rule out also all combinations of $\rho_T$, $\theta$, k and $\tau$ that result in this numerical, forbidden case of $\Omega_T$ that is rounded to be one. In the following, these cases have been marked by noting that the derivative is missing.

Empirical estimates on the value of k are relatively small and close to each other. Most of the found estimates with advanced countries' data range from around 1 to around 2.[1] However, for China significantly higher estimates have been found with range from 0.8 to 24 and average at 7.9 (Hsieh and Ossa, 2011). In our model k needs to be larger than $\eta_T$ even after there is a change in $\rho_T$. In other words, k has to equal at minimum $\eta$ plus a tiny value. Already this restriction results in values

[1] See e.g. Del Gatto et al. (2006), Del Gatto et al. (2008), Eaton et al. (2011), Helpman et al. (2004), Luttmer (2007) and Gabaix (2009). Out of mentioned literature Del Gatto et al. (2006), Del Gatto et al. (2008), Eaton et al. (2011) estimate productivity distributions with European data, while Luttmer (2007) and Gabaix (2009) have studied firm size distributions that are assumed to be directly linked to the productivity of the firms. Helpman et al. (2004) analysed sales distributions, which have a tail index interlinked to productivity distributions' tail index if both are distributed according to pareto distribution. In general, most studies conclude that pareto distribution is a good proxy for the distribution of firm productivity.

for k that can be anywhere between 0.01 and nearly 50 depending on the values of $\rho_T$ and $\theta$. Especially the value of 50 for k appears high in comparison to the empirical findings. Therefore, we assume that k is mostly relatively close to $\eta_T$, but we test also for cases where k is even $\eta_T + 10$. In that case, the maximum value of k is nearly 60, which is 300 times larger than the average empirical estimates of k and still more than 2 times as large as the highest empirical estimate (from China). We include in total 100 different values for the difference of k and $\eta_T$ in the estimations with most of the values between 0 and 4.[2] With the 100 values for the difference of k and $\eta$, we have in total 980,000 different combinations of $\rho_T$, $\theta$ and k. The absolute values of k have a mean of 3.4, standard deviation of 2.6, minimum value of 0.02 and maximum value of 59.7.

The value of $\tau > 1$ is similarly not restricted from above. While the value of $\tau$ affects mostly only $1 < \Omega_T \equiv 1 + \tau^{1-\sigma_T} \leq 2$, there are some derivatives which include $\tau$ in itself. The iceberg transport costs, which $\tau$ measures, can vary from country to country depending on which trading partners are in question. Similarly, in addition to the actual transport costs, $\tau$ includes typically also costs from tariffs and non-tariff measures, NTMs, (Helpman et al. 2004). Via new technologies and negotiations on the abolishing of tariffs and NTMs, these iceberg transport costs change over time and they have fallen significantly in most countries. However, in this type of theoretical consideration, we will consider various different possibilities for their level. Several attempts have been made to assess the level of trade costs in tariff equivalents with different methodologies and datasets. During history, tariff equivalents of up to 350 percent have been found (Jacks et al., 2011), but most of the found estimates on the average level of tariff equivalents in different countries at different times lie in the range of few percents up to 170 percent.[3] In general, the literature has studied tariff equivalents, which means that in order to translate them to the $\tau$ in this model, 1 needs to be added to all values. Therefore, based on literature, we expect the iceberg transport costs to vary from 1.01 to around 10 in reality, but we will additionally test for the derivative's signs if $\tau$ is artificially high, at a maximum of 1000 (meaning a 90000 percent tariff equivalent). In total,

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[2] The 100 values for the difference of k and $\eta$ increase gradually in the distance between the value and most of the values are between 0.01 and 4 with relatively small steps in between every value. In addition, few larger values have been included to account for any abnormally large k's. The included values are: 1) 10 values from 0.01 to 0.1 with steps of 0.01 in between every value, 2) 78 values from 0.15 to 4 with 0.05 between every value, and 3) 12 values from 4.5 to 10 with 0.5 between every value.

[3] See e.g. Anderson and van Wincoop (2004), Novy (2013) and Jacks et al. (2011).

we test for 100 different values of $\tau$, with most of them in the range of 1.01 to 5[4] and a total of 98 million different combinations on the values of parameters $\rho_T$, $\theta$, k and $\tau$.

See table B.1 for the results of the numerical tests on the values of the different derivatives. Based on the around 98 million tests (=100*100*99*99) with different parameter value combinations, all other derivatives have always the same sign (the cases where $\chi_T \approx 0$ at 52 decimal level have been ruled out by the model restrictions) except for the derivative $D\chi_T$. The sign of derivative $D\chi_T$ is analysed further in table B.2. All results presented in table B.1 and their economic explanations are discussed already in the subsection B.1 along each derivative's functional form.

Table B.1: Numerical test on the sign of derivatives with respect to sigma

| Derivative of .. | No of combinations | Mean | Max | Min | Share of inadmissible results, % | Share of admissible results Negative, % | Positive, % |
|---|---|---|---|---|---|---|---|
| Share of exporters | 98,010,000 | -0.015 | 2.60E-16 | -0.251 | 3.034 | 99.995 | 0.005* |
| Labour supply | 980,100 | 0.542 | 2.03E-06 | 27.63 | 0.000 | 0.000 | 100.00 |
| Number of firms | 98,010,000 | -0.468 | -2.02E-06 | -18.659 | 3.034 | 100.00 | 0.000 |
| $\varphi^*$ | 98,010,000 | 1.E+13 | 2.5E+17 | 9.70E-07 | 3.034 | 0.000 | 100.00 |
| Employment share | 98,010,000 | -0.351 | -9.2E-06 | -32.17 | 3.034 | 100.00 | 0.000 |
| Average wage | 98,010,000 | 7.E+42 | 1.3E+47 | 0.001 | 3.034 | 0.000 | 100.00 |
| Average profit | 98,010,000 | 1.E+43 | 2.8E+47 | 0.002 | 3.034 | 0.000 | 100.00 |
| Between inequality | 98,010,000 | 66 | 210764 | 0.00001 | 3.034 | 0.000 | 100.00 |
| Inequality, manager | 98,010,000 | 0.400 | 44.60 | 0.00001 | 3.034 | 0.000 | 100.00 |
| Inequality, labour | 98,010,000 | 0.37 | 42.84 | 0.00001 | 3.034 | 0.000 | 100.00 |

*Notes:** Analyses on the cases where the derivative is positive are in another table.

Analyses on the cases where $D\chi_T$ is positive in table B.2 show that the derivative is positive only in few exceptional cases. In fact, in all of the cases, the parameter value of $\rho_T$ is the last value with which a derivative for $\chi_T$ exists as $\chi_T$ is already tiny. If $\rho_T$ increases further (while the other parameter values keep constant), $\chi_T$ is rounded to zero numerically and we cannot calculate the value of $D\chi_T$ anymore. Table B.2 shows these special cases and the number of parameter combinations that

[4] The 100 values for the value of $\tau$ increase gradually in the distance between the values and most of the values are between 0.01 and 5 with relatively small steps in between every value. In addition, few larger values have been included to account for any artificially high trade costs. The included values are: 1) 5 values from 1.01 to 1.05 with 0.1 between every value, 2) 59 values from 0.1 to 4 with 0.05 between every value, 3) 25 values from 4.1 to 6.5 with 0.1 between every value 4) 7 values from 7 to 10 with 0.5 between every value, and 5) values 25, 50, 100 and 1000.

result in a positive value for $D\chi_T$. Therefore, despite these few parameter value combinations that provide a positive value for $D\chi_T$, it can be concluded that with most realistic values for the different parameters, the derivative of $\chi_T$ is negative. In other words, the share of exporters decreases if most of the tested cases.

Table B.2: Cases where $D\chi_T$ is positive

| No of cases | Value tau | Value rho | Value theta | $(k-\eta_T)$ | Note: |
|---|---|---|---|---|---|
| 200 | 2.1 | 0.98 | [0.01, 0.02] | [0.01, 10] | If rho>0.98 & tau=2.1, $\chi_T \approx 0$ |
| 100 | 3 | 0.97 | 0.01 | [0.01, 10] | If rho>0.97 & tau=3, $\chi_T \approx 0$ |
| 200 | 3.05 | 0.97 | [0.01, 0.02] | [0.01, 10] | If rho>0.97 & tau=3.05, $\chi_T \approx 0$ |
| 300 | 3.1 | 0.97 | [0.01, 0.03] | [0.01, 10] | If rho>0.97 & tau=3.1, $\chi_T \approx 0$ |
| 100 | 4.4 | 0.96 | 0.01 | [0.01, 10] | If rho>0.96 & tau=4.4, $\chi_T \approx 0$ |
| 400 | 4.5 | 0.96 | [0.01, 0.04] | [0.01, 10] | If rho>0.96 & tau=4.5, $\chi_T \approx 0$ |
| 400 | 4.6 | 0.96 | [0.01, 0.04] | [0.01, 10] | If rho>0.96 & tau=4.6, $\chi_T \approx 0$ |
| 100 | 6.3 | 0.95 | 0.01 | [0.01, 10] | If rho>0.95 & tau=6.3, $\chi_T \approx 0$ |
| 100 | 6.5 | 0.95 | 0.01 | [0.01, 10] | If rho>0.95 & tau=6.5, $\chi_T \approx 0$ |
| 600 | 10 | 0.94 | [0.01, 0.06] | [0.01, 10] | If rho>0.94 & tau=10, $\chi_T \approx 0$ |
| 1900 | 1000 | 0.84 | [0.01, 0.19] | [0.01, 10] | If rho>0.84 & tau=1000, $\chi_T \approx 0$ |

*Notes*: The approximation $\chi_T \approx 0$ refers to the numerical value with 52 decimals.

# Appendix C

# Appendixes of Chapter 5

## C.1 Profit margins in the Melitz (2003) model

Profit margins are not explicitly considered in the Melitz (2003) model, but they can be derived from the information provided in the model. The profit margin $\frac{\pi(\varphi)}{r(\varphi)}$ of non-exporting firms in the Melitz (2003) model can be derived from equations 4 and 5 in Melitz (2003, p. 1699):

$$\frac{\pi_d(\varphi)}{r_d(\varphi)} = \frac{\frac{R}{\sigma}(P\rho\varphi)^{\sigma-1} - f}{R(P\rho\varphi)^{\sigma-1}} = \frac{1}{\sigma} - \frac{f}{R(P\rho\varphi)^{\sigma-1}} = \frac{1}{\sigma} - \frac{f}{r_d(\varphi)} \tag{C.1}$$

Subscript $d$ denotes variables regarding domestic firms. $R$ represents the total output of the economy, $P$ the price level, $r$ firm-level revenues, $\pi$ profits, $f > 0$ the fixed cost of production, $\varphi$ firm-level productivity and $\rho$ the CES utility function love-of-variety parameter. Parameter $\sigma \equiv \frac{1}{1-\rho} > 1$ represents the elasticity of substitution between any two goods. In the Melitz (2003) model the assumption is that firms that operate only in domestic markets always have a lower productivity than firms operating both in domestic and in foreign markets. The profit margin increases in the productivity level. The derivative of the profit margin function with respect to productivity in equation C.2 shows this. Similarly, the mark-up increases in firm size, measured by firm-level revenue, as function C.3 shows.

$$\frac{\partial \frac{\pi_d(\varphi)}{r_d(\varphi)}}{\partial \varphi} = \frac{-f * -(\sigma-1)}{R(P\rho)^{\sigma-1}\varphi^{\sigma}} = \frac{f * (\sigma-1)}{R(P\rho)^{\sigma-1}\varphi^{\sigma}} > 0 \tag{C.2}$$

$$\frac{\partial \frac{\pi_d(\varphi)}{r_d(\varphi)}}{\partial r_d(\varphi)} = \frac{-f * (-1)}{r_d(\varphi)^2} = \frac{f}{r_d(\varphi)^2} > 0 \tag{C.3}$$

A firm at the marginal productivity level $\varphi_x^*$ required to export, has a profit margin defined by equations 15 and 16 in Melitz (2003, p. 1708-1709):

$$\begin{aligned}\frac{\pi_e(\varphi)}{r_e(\varphi)} &= \frac{\pi_d(\varphi) + n * \pi_x(\varphi)}{r_d(\varphi) + n * r_x(\varphi)} \\ &= \frac{\frac{r_d(\varphi)}{\sigma} - f + n\left(\frac{\tau^{1-\sigma} r_d(\varphi)}{\sigma} - f_x\right)}{(1 + n\tau^{1-\sigma}) r_d(\varphi)} = \frac{1}{\sigma} - \frac{f + n f_x}{(1 + n\tau^{1-\sigma}) r_d(\varphi)}\end{aligned} \tag{C.4}$$

Where $f_x > 0$ denotes the per-period fixed cost of exporting, $\tau > 1$ the per-unit iceberg variable trade costs and $n \geq 1$ equals the number of countries the firm exports to. The export profits of a firm with exactly the marginal productivity level $\varphi_x^*$ equals $\pi_x(\varphi_x^*) = 0$. In addition, in order to induce the partitioning of firms into domestic and exporting firms Melitz (2003) makes the additional assumption that $\tau^{\sigma-1} f_x > f$. This implies that when a firm has exactly the marginal productivity level for exporting $\varphi_x^*$, its profit margin will equal:

$$\frac{\pi_e(\varphi_x^*)}{r_e(\varphi_x^*)} = \frac{\pi_d(\varphi_x^*) + n * 0}{r_d(\varphi_x^*) + n * r_x(\varphi)} = \frac{1}{1 + n\tau^{1-\sigma}} \left[\frac{1}{\sigma} - \frac{f}{r_d(\varphi_x^*)}\right] \tag{C.5}$$

In other words, the profit margin of the marginal exporter will be lower than the profit margin of a domestic firm with productivity level $\breve{\varphi} = \varphi_x^* - \epsilon$, where $\epsilon$ is positive, but arbitrarily small and approaching zero. The profit margin at $\breve{\varphi}$ is larger than the profit margin at $\varphi_x^*$ since $\tau > 1$ as equation C.6 shows, and $\lim_{\epsilon \to 0} r_d(\varphi_x^* \pm \epsilon) = r_d(\varphi_x^*)$.

$$\frac{1}{\sigma} - \frac{f}{r_d(\breve{\varphi})} > \frac{1}{1 + n\tau^{1-\sigma}} \left[\frac{1}{\sigma} - \frac{f}{r_d(\varphi_x^*)}\right] \tag{C.6}$$

An exporting firm with productivity level $\widehat{\varphi} = \varphi_x^* + \epsilon$ will also have a lower profit margin than the domestic firm with productivity level $\breve{\varphi} = \varphi_x^* - \epsilon$. This is due to the restriction $\tau^{\sigma-1} f_x > f$, as is derived in equation C.7, and due to the limit on the revenue. In other words, in the Melitz (2003) model, the profit margin is lower for the exporting firm with productivity just above the threshold productivity required to export in comparison to domestic firms with a productivity level just below the threshold $\varphi_x^*$.

$$\frac{1}{\sigma} - \frac{f}{r_d(\breve{\varphi})} > \frac{1}{\sigma} - \frac{f + nf_x}{(1 + n\tau^{1-\sigma})r_d(\widehat{\varphi})}$$

$$\rightarrow \frac{1}{\sigma} - \frac{f}{r_d(\varphi_x^*)} > \frac{1}{\sigma} - \frac{f + nf_x}{(1 + n\tau^{1-\sigma})r_d(\varphi_x^*)}$$

$$f < \frac{(f + f_x)}{(1 + \tau^{1-\sigma})}$$

$$f[1 - \frac{1}{(1 + \tau^{1-\sigma})}] < \frac{f_x}{(1 + \tau^{1-\sigma})}$$

$$f < f_x \tau^{\sigma-1} \tag{C.7}$$

Beyond the threshold productivity level for exporting, the profit margin of exporting firms increases in both productivity and firm size, which is demonstrated by the derivatives of exporters profit margin with respect to productivity in equation C.8 and with respect to total revenue in equation C.9.

$$\frac{\partial \frac{\pi_e(\varphi)}{r_e(\varphi)}}{\partial \varphi} = \frac{-(f + nf_x) * -(\sigma - 1)}{R(P\rho)^{\sigma-1}\varphi^{\sigma}} = \frac{(f + nf_x)(\sigma - 1)}{R(P\rho)^{\sigma-1}\varphi^{\sigma}} > 0 \tag{C.8}$$

$$\frac{\partial \frac{\pi_e(\varphi)}{r_e(\varphi)}}{\partial r_e(\varphi)} = \frac{-(f + nf_x)(-1)}{r_d(\varphi)^2} = \frac{f + nf_x}{r_d(\varphi)^2} > 0 \tag{C.9}$$

Figure 5.1 in the main text summarizes the findings of this appendix in a graphical form.

## C.2 Profit margins in the Egger and Kreickemeier (2012) model

The Melitz (2003) model does not take in to account the empirically well established fact that exporters generally pay higher wages than domestic firms. Naturally, this

could affect profit margin differences between exporting and domestic firms. In order to analyse the profit margin differences in a theoretical framework that takes these wage differences into account, we employ the Egger and Kreickemeier (2012) model. Analogous to Melitz (2003), in this model the relationship between trade status and profit margins are not considered explicitly. However, profit margins can be derived from the information provided.

The production technology in Egger and Kreickemeier (2012) model requires two types of labor: one manager/owner and many workers. The productivity of the individual determines whether he will become a manager or a worker. Workers are paid a fair wage $\hat{w}$, with the wage depending on the profits of the firm and on a firm-external point of reference, which is defined as the employment share times the average wage. If firm profits increase, unemployment decreases or the average wage increases (ceteris paribus), the fair wage increases. In doing so, firm profits are shared between managers and workers.

$$\hat{w} = \left(\frac{r(\varphi)}{\sigma}\right)^{\theta} [(1-U)\,\bar{w}]^{1-\theta} \tag{C.10}$$

Where $r(\varphi)$ equals total firm revenue with productivity level $\varphi$, $\rho$ equals the CES love-of-variety parameter in autarky, $\sigma \equiv 1/(1-\rho) > 1$ the demand elasticity, $\theta \in (0,1)$ a rent sharing parameter, $U$ the unemployment level and $\bar{w}$ the average wage of employed production workers.

The revenue of domestic firms with productivity level $\varphi^* < \varphi < \varphi_x^*$ equals:

$$r_d(\varphi) = \frac{Y}{M}(\frac{c(\varphi)}{\rho})^{1-\sigma} \tag{C.11}$$

Where $\varphi^*$ is the marginal productivity level required to operate, $\varphi_x^*$ the marginal productivity level required to export, $Y$ total output of the economy, $M$ the number of firms/managers, and $c(\varphi) = w(\varphi)/\varphi$ the marginal cost. Constant mark-up over marginal cost pricing is assumed. In other words, the firm specific price equals: $p(\varphi) = c(\varphi)/\rho$. The quantity sold at each productivity level equals:

$$q_d(\varphi) = \frac{Y}{M}p(\varphi)^{-\sigma} = \frac{Y}{M}(\frac{c(\varphi)}{\rho})^{-\sigma}$$

Due to this pricing mechanism, the profits of the domestic firm equal:

$$\pi_d(\varphi) = r_d(\varphi) - c_d(\varphi)q_d(\varphi) = (1-\rho)\,r_d(\varphi) = \frac{r_d(\varphi)}{\sigma}$$

Therefore, the gross profit margin of domestic firms is always constant and does not depend on the productivity level of the firm, as equation C.12 shows.

$$\frac{\pi_d(\varphi)}{r_d(\varphi)} = \frac{1}{\sigma} \tag{C.12}$$

The calculation of the gross profit margin of exporting firms is slightly more complicated. Therefore, we choose a stepwise approach. First, the total revenue of an exporting firm equals:

$$r_E = \Omega r^e(\varphi) = \Omega^{1-\theta\eta} r_d(\varphi) \tag{C.13}$$

Where subscript $e$ refers to the exporting firm, $r^e(\varphi)$ equals the domestic revenues of the exporting firm, $\tau > 1$ represents per-unit iceberg variable trade costs and $1 < \Omega \equiv 1 + \tau^{1-\sigma} \leq 2$. Parameter $\eta \equiv (\sigma - 1)/\left[1 + \theta(\sigma - 1)\right]$ depends on the parameters discussed above and $r_d(\varphi)$ refers to the revenue of a domestic firm with productivity level $\varphi$ as defined in equation C.11. The total profits of an exporter thus equal:

$$\pi_E(\varphi) = \frac{\Omega r^e(\varphi)}{\sigma} - s = \frac{\Omega^{1-\theta\eta} r_d(\varphi)}{\sigma} - (1 - U)\,\bar{w}$$

$$\pi_E(\varphi) = \frac{\Omega^{1-\theta\eta} r_d(\varphi)}{\sigma} - \frac{\rho Y}{L} = \frac{\Omega^{1-\theta\eta} r_d(\varphi)}{\sigma} - \frac{(1-\rho)Y}{(1+\chi)M}\left(\frac{k-\eta}{k}\right) \tag{C.14}$$

Where $s$ refers to the fixed cost of exporting, which need to equal the average expected wage based on equation (8') of Egger and Kreickemeier (2012, p. 190). The average expected wage is $(1 - U)\,\bar{w} = \frac{\rho Y}{L}$ and based on the modified labor indifference condition we have $\frac{\rho Y}{L} = \frac{(1-\rho)Y}{(1+\chi)M}\left(\frac{k-\eta}{k}\right)$ (Egger and Kreickemeier, 2012, p. 191). The parameter $k$ hinges on the Pareto-distribution of productivity $\varphi$, with $k > \eta$. The share of exporting firms out of all firms is measured by $\chi \geq 0$. Taking the ratio of exporter profit over revenue and accounting for equation C.11, we arrive at the following solution for the gross profit margin of exporters:

$$\frac{\pi_E(\varphi)}{r_E(\varphi)} = \frac{1}{\sigma} - \frac{\frac{(1-\rho)Y}{(1+\chi)M}\left(\frac{k-\eta}{k}\right)}{\Omega^{1-\theta\eta} r_d(\varphi)} = \frac{1}{\sigma} - \frac{\frac{(1-\rho)Y}{(1+\chi)M}\left(\frac{k-\eta}{k}\right)}{\Omega^{1-\theta\eta}\frac{Y}{M}\left(\frac{w_d(\varphi)/\varphi}{\rho}\right)^{1-\sigma}}$$

All the terms after the minus-sign in this equation are positive. It is thus immediately obvious that the profit margin of exporting firms is lower than the profit

margin of domestic firms, irrespective of the individual productivity level of the exporter.

Based on equation 6 of Egger and Kreickemeier (2012) we have $w_d(\varphi) = \left(\frac{\varphi}{\tilde{\varphi}}\right)^{\theta\eta} w_d(\tilde{\varphi})$. In addition, the calculations presented in Egger and Kreickemeier (2012, p. 189-190, and appendix A) allow us to define $w_d(\tilde{\varphi}) = \frac{\rho r_d(\tilde{\varphi})}{l_d(\tilde{\varphi})} = \frac{\rho r_d(\tilde{\varphi})}{q_d(\tilde{\varphi})/\tilde{\varphi}} = \rho\tilde{\varphi}$ With these additional definitions, the gross profit margin of exporters is defined in equation C.15 to equal:

$$\begin{aligned}\frac{\pi_d(\varphi)}{r_d(\varphi)} &= \frac{1}{\sigma} - \frac{\frac{(1-\rho)}{(1+\chi)}\left(\frac{k-\eta}{k}\right)}{\Omega^{1-\theta\eta}\left(\frac{w_d(\varphi)/\varphi}{\rho}\right)^{1-\sigma}} \\ &= \frac{1}{\sigma} - (1-\rho)(1+\chi)^{-1}\left(\frac{k-\eta}{k}\right)\Omega^{\theta\eta-1}\tilde{\varphi}^{(1-\theta\eta)(\sigma-1)}\varphi^{(\theta\eta-1)(\sigma-1)} \quad \text{(C.15)}\end{aligned}$$

For exporters the profit margin increases in productivity. However, profit margins remain below the profit margin of domestic firms. Unit production costs decrease with increasing productivity. Due to the constant mark-up pricing, the price per unit will therefore also decrease and revenue increases. This is demonstrated by the derivative of the gross profit margin with respect to productivity. The derivative C.16 is positive, since $(\theta\eta - 1) = \frac{\theta(\sigma-1)}{1+\theta(\sigma-1)} - 1 = \frac{-1}{1+\theta(\sigma-1)} < 0$.

$$\begin{aligned}\frac{\partial\frac{\pi_e(\varphi)}{r_e(\varphi)}}{\partial\varphi} &= -(\theta\eta-1)(\sigma-1)\varphi^{(\theta\eta-1)(\sigma-1)-1} \\ &\quad * (1-\rho)(1+\chi)^{-1}\left(\frac{k-\eta}{k}\right)\Omega^{\theta\eta-1}\tilde{\varphi}^{(1-\theta\eta)(\sigma-1)} > 0 \quad \text{(C.16)}\end{aligned}$$

Similarly, if the revenue of the firm increases, also its profit margin will increase as equation C.17 shows.

$$\frac{\partial\frac{\pi_e(\varphi)}{r_e(\varphi)}}{\partial r_d(\varphi)} = -(-1)\frac{\frac{(1-\rho)Y}{(1+\chi)M}\left(\frac{k-\eta}{k}\right)}{\Omega^{1-\theta\eta}r_d(\varphi)^2} > 0 \quad \text{(C.17)}$$

Figure 5.2 in the main text summarizes the findings of this appendix in a graphical form.

## C.3 Additional tables on fixed effects results

Table C.1: Relative net profit margin premia by firm size

| | Finland (2005-2010) | | | | | the Netherlands (2002-2010) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | manufacturing sectors | | | | | manufacturing sectors | | | | |
| | all | micro | small | medium | large | all | micro | small | medium | large |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | 0.005 | 0.007 | 0.002 | -0.019 | -0.005 | -0.005** | -0.008** | 0.000 | -0.006 | -0.029 |
| only (EU) imports | 0.002 | -0.003 | 0.011 | -0.029** | 0.008 | -0.002* | -0.003 | -0.002 | 0.001 | -0.010 |
| two-way trader | -0.008* | -0.005 | -0.020 | -0.028* | 0.013 | -0.005*** | -0.007** | -0.002 | -0.001 | -0.027 |
| firm size (fte, log) | 0.019*** | 0.042*** | 0.034** | 0.006 | 0.028 | 0.069*** | 0.081*** | 0.059*** | 0.042*** | 0.021 |
| labor productivity (log) | 0.081*** | 0.077*** | 0.112*** | 0.053*** | 0.047*** | 0.111*** | 0.127*** | 0.101*** | 0.066*** | 0.027** |
| | service sectors | | | | | wholesale and retail trading sectors | | | | |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | | | | | | -0.002 | -0.001 | -0.001 | 0.004 | -0.009 |
| only imports | 0.267 | 0.434 | 0.014 | -0.004 | 0.009 | -0.002 | -0.001 | -0.004** | 0.007 | 0.01 |
| two-way trader | | | | | | -0.003** | -0.002 | -0.006** | 0.006 | 0.019 |
| services exporter | 0.069 | 0.122 | -0.005 | -0.008 | -0.001 | | | | | |
| firm size (fte, log) | 0.041* | -0.239 | 0.054** | 0.005 | -0.000 | 0.053*** | 0.059*** | 0.047*** | 0.036*** | -0.007 |
| labor productivity (log) | 0.139*** | 0.109*** | 0.123*** | 0.082*** | 0.030 | 0.083*** | 0.089*** | 0.079*** | 0.061*** | 0.011 |

*Notes*: In addition to the variables presented in the table, all regressions include the export share in sales, a dummy variable indicating if a firm is under foreign control and a full set of year-sector dummies as explanatory variables in addition to fixed effects at firm level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.2: Relative return on assets premia by firm size

| | Finland (2005-2010) | | | | | the Netherlands (2002-2010) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | manufacturing sectors | | | | | manufacturing sectors | | | | |
| | all | micro | small | medium | large | all | micro | small | medium | large |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | -0.001 | -0.009 | 0.005 | -0.010 | -0.167 | -0.008*** | -0.008* | -0.003 | -0.015 | -0.084 |
| only (EU) imports | -0.006 | -0.004 | -0.001 | -0.017 | -0.006 | -0.005** | -0.005* | -0.003 | -0.006 | -0.024 |
| two-way trader | -0.011 | -0.016 | 0.006 | -0.020 | 0.007 | -0.008*** | -0.007* | -0.004 | -0.020* | -0.044 |
| firm size (fte, log) | 0.037*** | 0.048** | 0.044*** | 0.056* | 0.087** | 0.047*** | 0.065*** | 0.030*** | 0.032*** | 0.009 |
| labor productivity (log) | 0.058*** | 0.067*** | 0.064*** | 0.048*** | 0.041*** | 0.104*** | 0.125*** | 0.086*** | 0.070*** | 0.033*** |
| | service sectors | | | | | wholesale & retail trading sectors | | | | |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | | | | | | -0.007** | -0.005 | -0.008* | -0.007 | -0.057 |
| only imports | -0.005 | -0.006 | -0.004 | 0.015 | -0.004 | -0.007*** | -0.006** | -0.005 | -0.006 | -0.024 |
| two-way trader | | | | | | -0.013*** | -0.013*** | -0.011*** | -0.003 | -0.023 |
| services exporter | 0.014 | 0.017 | -0.007 | 0.033 | -0.013 | | | | | |
| firm size (fte, log) | 0.065*** | 0.069*** | 0.062*** | 0.093* | 0.187** | 0.057*** | 0.063*** | 0.049*** | 0.056*** | 0.034 |
| labor productivity (log) | 0.068*** | 0.069*** | 0.064*** | 0.083*** | 0.084** | 0.110*** | 0.122*** | 0.098*** | 0.076*** | 0.037** |

*Notes*: In addition to the variables presented in the table, all regressions include the export share in sales, a dummy variable indicating if a firm is under foreign control and a full set of year-sector dummies as explanatory variables in addition to fixed effects at firm level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.3: Relative gross profits per employee premia by firm size

| | Finland (2005-2010) | | | | | the Netherlands (2002-2010) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | manufacturing sectors | | | | | manufacturing sectors | | | | |
| | all | micro | small | medium | large | all | micro | small | medium | large |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | -470.0 | 231.6 | -793.7 | -3717.1 | 1943.2 | -515.5** | -886.6** | -22.6 | -573.6 | -1815.8 |
| only (EU) imports | -131.9 | 780.5* | -341.6 | -3201.2 | 5682.1 | -175.2 | -292.0 | -23.6 | -462.5 | 974.9 |
| two-way trader | -545.8 | -62.2 | -808.4 | -5057.1 | 2200.5 | -181.3 | -78.5 | -35.2 | -1294.7 | -3256.9 |
| firm size (fte, log) | -4191.2*** | -6192.9*** | -4108.8*** | -13490.2 | 7231.9 | -1008.6*** | -1717.2*** | -987.4*** | -1528.5 | -6123.7 |
| labor productivity (log) | 5697.5*** | 4529.1*** | 5624.6*** | 14458.9 | 9915.3** | 10497.1*** | 11748.1*** | 8868.8*** | 9273.0*** | 7127.9*** |
| | service sectors | | | | | wholesale & retail trading sectors | | | | |
| non-trader | reference | reference | reference | reference | reference | reference | reference | reference | reference | reference |
| only exports | | | | | | -511.3* | -636.7* | -142.3 | -1092.7 | -8920.5 |
| only imports | 653.7 | 861.4 | 152.0 | 965.2 | -2106.3 | -197.6 | -185.4 | -106.7 | -753.0 | -12545.0 |
| two-way trader | | | | | | -280.8 | -57.9 | -485.8 | -630.9 | -11141.7 |
| services exporter | -468.8 | -116.1 | -293.4 | 716.0 | -5614.3 | | | | | |
| firm size (fte, log) | -2042.3*** | -4948.9*** | -2063.9 | -209.9 | 244.2 | 84.4 | -586.9 | 78.2 | 165.3 | -5419.3 |
| labor productivity (log) | 4531.6*** | 4682.9*** | 4533.0*** | 4634.4*** | 6125.6* | 14549.5*** | 14815.9*** | 14128.1*** | 12594.5*** | 6132.4*** |

*Notes*: In addition to the variables presented in the table, all regressions include the export share in sales, a dummy variable indicating if a firm is under foreign control and a full set of year-sector dummies as explanatory variables in addition to fixed effects at firm level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

## C.4 Propensity Score Matching results

Table C.4: The effect of exporting on profitability in manufacturing sectors in Finland

| | | relative gross profit margin | | relative net profit margin | | relative return on assets | |
|---|---|---|---|---|---|---|---|
| export start in year $t$ | outcome variable | no. of matched treated firms | ATT (%) | no. of matched treated firms | ATT (%) | no. of matched treated firms | ATT (%) |
| 2007 | $profitlevel$ at time $t$ | 263 | -1.96 | 262 | 0.43 | 262 | -0.08 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 141 | -0.09 | 140 | 0.21 | 138 | 4.48 |
| | $profitlevel$ at time $t+1$ | 139 | -10.71 | 140 | 0.02 | 138 | 14.86 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 99 | -4.34 | 101 | -0.23 | 97 | -4.00 |
| | $profitlevel$ at time $t+2$ | 100 | -4.62 | 100 | -1.57 | 99 | -1.01 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 66 | -3.56 | 66 | -5.46 | 65 | -6.02 |
| | profit level at time $t+3$ | 67 | -11.72* | 66 | -4.59 | 66 | -6.49 |
| 2008 | $profitlevel$ at time $t$ | 214 | -2.02 | 224 | -2.95 | 216 | -4.50 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 87 | 0.65 | 89 | -0.19 | 87 | 5.78* |
| | $profitlevel$ at time $t+1$ | 88 | -1.78 | 88 | -1.29 | 88 | -1.84 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 62 | -1.87 | 65 | -0.77 | 64 | -0.91 |
| | $profitlevel$ at time $t+2$ | 71 | -4.06 | 72 | -2.29 | 72 | -2.27 |
| 2009 | $profitlevel$ at time $t$ | 231 | -1.32 | 244 | -0.78 | 235 | 0.13 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 105 | -2.08 | 106 | -0.65 | 104 | -1.89 |
| | $profitlevel$ at time $t+1$ | 105 | -0.20 | 108 | -0.72 | 107 | -1.62 |
| 2010 | $profitlevel$ at time $t$ | 258 | -1.12 | 264 | 0.14 | 257 | 1.40 |

*Notes*: Nearest neighbor propensity score matching was done using Stata 11 and the psmatch2 package developed by Leuven and Sianesi (2003). The common support condition is imposed on the matching procedure, implying that treated firms with a propensity score higher than the maximum of the non-treated control group and lower than the minimum of the control group are taken off support and are not matched to a peer. The balancing property condition, requiring absence of statistically significant differences between the means of the matching characteristics of the firms in the treatment and the control group is fully satisfied in all instances. The bias-corrected 95% confidence intervals are generated by bootstrapping the ATT with 200 replications. * $p < 0.05$

Table C.5: The effect of exporting on profitability in service sectors in Finland

| export start in year $t$ | outcome variable | relative gross profit margin no. of matched treated firms | ATT (%) | relative net profit margin no. of matched treated firms | ATT (%) | relative return on assets no. of matched treated firms | ATT (%) |
|---|---|---|---|---|---|---|---|
| 2007 | $profitlevel$ at time $t$ | 353 | -2.04 | 358 | 0.78 | 354 | 1.60 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 185 | -8.22 | 187 | -0.03 | 188 | 6.81 |
| | $profitlevel$ at time $t+1$ | 185 | -14.92 | 187 | -3.19 | 188 | 25.53 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 130 | -15.18 | 129 | -0.40 | 131 | 9.55 |
| | $profitlevel$ at time $t+2$ | 141 | -16.68 | 142 | -2.79 | 141 | -0.88 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 93 | 0.18 | 93 | -1.30 | 93 | -0.11 |
| | $profitlevel$ at time $t+3$ | 93 | 4.51 | 92 | -1.01 | 93 | 2.76 |
| 2008 | $profitlevel$ at time $t$ | 331 | -1.73 | 343 | -1.16 | 331 | 8.47* |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 166 | 1.21 | 168 | 1.13 | 166 | -7.53 |
| | $profitlevel$ at time $t+1$ | 166 | 0.64 | 168 | 0.77 | 168 | 3.13 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 108 | 2.48 | 109 | 1.36 | 109 | -1.17 |
| | $profitlevel$ at time $t+2$ | 111 | -1.76 | 115 | -6.10 | 117 | 2.22 |
| 2009 | $profitlevel$ at time $t$ | 350 | -1.33 | 358 | -3.65 | 346 | -1.66 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 190 | 2.30 | 191 | -0.21 | 196 | 0.38 |
| | $profitlevel$ at time $t+1$ | 195 | 0.52 | 193 | -5.12 | 197 | -3.11 |
| 2010 | $profitlevel$ at time $t$ | 616 | -3.61 | 625 | 0.49 | 620 | 1.63 |

*Notes*: Nearest neighbor propensity score matching was done using Stata 11 and the psmatch2 package developed by Leuven and Sianesi (2003). The common support condition is imposed on the matching procedure, implying that treated firms with a propensity score higher than the maximum of the non-treated control group and lower than the minimum of the control group are taken off support and are not matched to a peer. The balancing property condition, requiring absence of statistically significant differences between the means of the matching characteristics of the firms in the treatment and the control group is fully satisfied in all instances. The bias-corrected 95% confidence intervals are generated by bootstrapping the ATT with 200 replications. * $p < 0.05$

Table C.6: The effect of exporting on profitability in manufacturing sectors in the Netherlands

| export start in year $t$ | outcome variable | relative gross profit margin no. of matched treated firms | ATT (%) | relative net profit margin no. of matched treated firms | ATT (%) | relative return on assets no. of matched treated firms | ATT (%) |
|---|---|---|---|---|---|---|---|
| 2004 | $profitlevel$ at time $t$ | 280 | 0.7 | 282 | -0.18 | 283 | 0.76 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 94 | -0.88 | 96 | -0.41 | 99 | -0.11 |
| | $profitlevel$ at time $t+1$ | 103 | 0.49 | 104 | 0.29 | 102 | 1.83 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 47 | -1.61 | 47 | -0.89 | 47 | -1.22 |
| | $profitlevel$ at time $t+2$ | 49 | -1.87 | 49 | -2.2 | 49 | -2.57 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 34 | 0.32 | 35 | -0.82 | 35 | -1.55 |
| | $profitlevel$ at time $t+3$ | 36 | 0.58 | 36 | -0.12 | 36 | -0.5 |
| 2005 | $profitlevel$ at time $t$ | 280 | -0.24 | 280 | 1.65 | 278 | 0.75 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 84 | 0.68 | 86 | 0.5 | 88 | 2.3 |
| | $profitlevel$ at time $t+1$ | 94 | 0.61 | 95 | 1.81 | 95 | 1.43 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 51 | 0.16 | 50 | 0.38 | 53 | 1.01 |
| | $profitlevel$ at time $t+2$ | 55 | 3.4 | 55 | 3.56 | 55 | 1.49 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 42 | -0.63 | 42 | -1.12 | 42 | 2.06 |
| | $profitlevel$ at time $t+3$ | 43 | 2.57 | 43 | 1.42 | 43 | 3.24 |
| 2006 | $profitlevel$ at time $t$ | 233 | -0.93 | 232 | -0.78 | 232 | -0.89 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 87 | -0.51 | 87 | -0.62 | 90 | -1.93 |
| | $profitlevel$ at time $t+1$ | 94 | -1.79 | 94 | -1.04 | 93 | 0.14 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 47 | 0.34 | 45 | 0.11 | 49 | -0.71 |
| | $profitlevel$ at time $t+2$ | 51 | 1.56 | 51 | 0.3 | 51 | 0.91 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 24 | 4.85* | 26 | 2.76 | 28 | 4.51* |
| | $profitlevel$ at time $t+3$ | 31 | 3.49 | 31 | 3.34 | 31 | 1.91 |
| 2007 | $profitlevel$ at time $t$ | 244 | -0.33 | 244 | 0.69 | 244 | -1.08 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 117 | -0.55 | 117 | -0.91 | 120 | -1.88 |
| | $profitlevel$ at time $t+1$ | 128 | -2.19 | 128 | -1.65 | 128 | -1.74 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 52 | -0.47 | 55 | -0.46 | 58 | 0.38 |
| | $profitlevel$ at time $t+2$ | 66 | -1.83 | 66 | -2.16 | 66 | -3.73* |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 40 | 2.97* | 41 | 1.44 | 45 | 4.62* |
| | $profitlevel$ at time $t+3$ | 48 | 2.01 | 48 | 0.48 | 48 | -2.88 |
| 2008 | $profitlevel$ at time $t$ | 983 | 0.42 | 983 | -0.22 | 984 | -1.25 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 442 | -0.51 | 437 | -1.11* | 465 | -0.97* |
| | $profitlevel$ at time $t+1$ | 503 | 0.39 | 502 | 0.53 | 502 | -0.08 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 332 | 1.28* | 320 | 1.44* | 347 | 2.18* |
| | $profitlevel$ at time $t+2$ | 366 | 2.46* | 367 | 2.25* | 367 | 1.68 |
| 2009 | $profitlevel$ at time $t$ | 405 | 0.54 | 405 | 0.12 | 404 | 0.37 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 146 | 0.29 | 144 | 0.58 | 153 | 1.74 |
| | $profitlevel$ at time $t+1$ | 169 | 3.43 | 169 | 3.22* | 168 | 2.74 |
| 2010 | $profitlevel$ at time $t$ | 995 | -0.51 | 995 | -0.24 | 988 | 0.12 |

*Notes*: Nearest neighbor propensity score matching was done using Stata 11 and the psmatch2 package developed by Leuven and Sianesi (2003). The common support condition is imposed on the matching procedure, implying that treated firms with a propensity score higher than the maximum of the non-treated control group and lower than the minimum of the control group are taken off support and are not matched to a peer. The balancing property condition, requiring absence of statistically significant differences between the means of the matching characteristics of the firms in the treatment and the control group is fully satisfied in all instances. The bias-corrected 95% confidence intervals are generated by bootstrapping the ATT with 200 replications. * $p < 0.05$

Table C.7: The effect of exporting on profitability in wholesale & retail trading sectors in the Netherlands

| export start in year $t$ | outcome variable | relative gross profit margin no. of matched treated firms | ATT (%) | relative net profit margin no. of matched treated firms | ATT (%) | relative return on assets no. of matched treated firms | ATT (%) |
|---|---|---|---|---|---|---|---|
| 2004 | $profitlevel$ at time $t$ | 236 | -0.79 | 237 | -0.5 | 238 | -0.07 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 93 | -0.68 | 95 | -1.02 | 98 | -0.46 |
| | $profitlevel$ at time $t+1$ | 99 | 0.45 | 99 | 0.18 | 99 | 1.95 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 44 | 0.08 | 44 | -0.46 | 43 | -2.3 |
| | $profitlevel$ at time $t+2$ | 45 | 1.9 | 45 | 2.67 | 46 | 3.98 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 31 | 1.74 | 31 | 1.77 | 32 | 0.84 |
| | $profitlevel$ at time $t+3$ | 32 | -1.05 | 32 | -0.45 | 32 | -1.46 |
| 2005 | $profitlevel$ at time $t$ | 294 | -0.14 | 294 | 0.43 | 293 | -0.05 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 92 | -0.84 | 92 | -0.63 | 91 | -1.93 |
| | $profitlevel$ at time $t+1$ | 98 | -0.99 | 98 | -1.15 | 98 | -1.72 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 50 | -0.25 | 50 | -0.36 | 49 | -0.11 |
| | $profitlevel$ at time $t+2$ | 52 | 0.6 | 52 | 1.02 | 52 | -2.68 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 38 | -0.42 | 37 | -0.45 | 36 | -1.93 |
| | $profitlevel$ at time $t+3$ | 41 | -3.12* | 41 | -2.18 | 41 | -3.43 |
| 2006 | $profitlevel$ at time $t$ | 217 | -1.17 | 217 | -0.6 | 216 | 1 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 93 | 0.12 | 91 | 0.27 | 90 | 2.08 |
| | $profitlevel$ at time $t+1$ | 93 | -0.42 | 93 | 0.22 | 92 | 0.87 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 62 | 1.76* | 62 | 1.31* | 65 | 0.49 |
| | $profitlevel$ at time $t+2$ | 68 | 0.7 | 68 | 1.05 | 68 | 4.18 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 44 | 0.8 | 44 | 0.8 | 44 | -0.24 |
| | $profitlevel$ at time $t+3$ | 45 | 5.68* | 45 | 6.48* | 45 | 5.77* |
| 2007 | $profitlevel$ at time $t$ | 243 | 0.41 | 242 | 0.76 | 243 | 0.71 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 126 | 0.42 | 128 | 0.03 | 126 | 0.35 |
| | $profitlevel$ at time $t+1$ | 130 | -0.24 | 130 | -0.09 | 129 | -1.16 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 80 | -0.34 | 80 | -0.44 | 81 | -0.26 |
| | $profitlevel$ at time $t+2$ | 85 | 0.1 | 85 | 1.08 | 85 | -1.19 |
| | $profitgrowth_{t+2,t+3}$ (percentage point change) | 64 | 1.37 | 64 | 1.08 | 65 | 1.47 |
| | $profitlevel$ at time $t+3$ | 67 | 2.79 | 67 | 3.82 | 67 | 3.38 |
| 2008 | $profitlevel$ at time $t$ | 822 | -0.83 | 822 | -0.17 | 822 | -0.55 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 401 | 0.01 | 402 | -0.16 | 397 | -0.64 |
| | $profitlevel$ at time $t+1$ | 418 | 0.38 | 418 | 0.97 | 419 | 0.49 |
| | $profitgrowth_{t+1,t+2}$ (percentage point change) | 312 | -0.06 | 316 | 0.11 | 313 | 0.39 |
| | $profitlevel$ at time $t+2$ | 321 | -0.54 | 321 | 0.34 | 321 | 1.24 |
| 2009 | $profitlevel$ at time $t$ | 357 | -0.28 | 357 | 0.16 | 355 | 0.55 |
| | $profitgrowth_{t,t+1}$ (percentage point change) | 149 | -0.27 | 150 | -0.2 | 150 | 0.37 |
| | $profitlevel$ at time $t+1$ | 161 | 1.78 | 161 | 1.72 | 159 | -0.45 |
| 2010 | $profitlevel$ at time $t$ | 569 | 0.44 | 569 | 0.01 | 570 | 0.28 |

*Notes*: Nearest neighbor propensity score matching was done using Stata 11 and the psmatch2 package developed by Leuven and Sianesi (2003). The common support condition is imposed on the matching procedure, implying that treated firms with a propensity score higher than the maximum of the non-treated control group and lower than the minimum of the control group are taken off support and are not matched to a peer. The balancing property condition, requiring absence of statistically significant differences between the means of the matching characteristics of the firms in the treatment and the control group is fully satisfied in all instances. The propensity score for the 2005-cohort is estimated with the control variable for sectors included as a numerical variable instead of a categorical variable, since the model presented in equation 5.9 does not converge for this cohort. The bias-corrected 95% confidence intervals are generated by bootstrapping the ATT with 200 replications. * $p < 0.05$

Table C.8: Definition of cohorts for PSM-analysis of export starters

| 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| *continuing non-trader* | | | | | | | | |
| NT | NT | $NT*$ | $NT$ | $NT$ | $NT$ | | | |
| | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ | | | |
| | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ | | | |
| | NT | NT | $NT*$ | $NT$ | $NT$ | $NT$ | | |
| | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ | | |
| | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ | | |
| | | NT | NT | $NT*$ | $NT$ | $NT$ | $NT$ | |
| | | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ | |
| | | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ | |
| | | | NT | NT | $NT*$ | $NT$ | $NT$ | $NT$ |
| | | | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ |
| | | | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ |
| | | | | NT | NT | $NT*$ | $NT$ | $NT$ |
| | | | | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ |
| | | | | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ |
| | | | | | NT | NT | $NT*$ | $NT$ |
| | | | | | | | $prof_t$ | $prof_{t+1}$ |
| | | | | | | | | $prof.gr_{t,t+1}$ |
| | | | | | | NT | NT | $NT*$ |
| | | | | | | | | $prof_t$ |
| *export starter* | | | | | | | | |
| NT | NT | $EXP*$ | $EXP$ | $EXP$ | $EXP$ | | | |
| | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ | | | |
| | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ | | | |
| | NT | NT | $EXP*$ | $EXP$ | $EXP$ | $EXP$ | | |
| | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ | | |
| | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ | | |
| | | NT | NT | $EXP*$ | $EXP$ | $EXP$ | $EXP$ | |
| | | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ | |
| | | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ | |
| | | | NT | NT | $EXP*$ | $EXP$ | $EXP$ | $EXP$ |
| | | | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ | $prof_{t+3}$ |
| | | | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ | $prof.gr_{t+2,t+3}$ |
| | | | | NT | NT | $EXP*$ | $EXP$ | $EXP$ |
| | | | | | | $prof_t$ | $prof_{t+1}$ | $prof_{t+2}$ |
| | | | | | | | $prof.gr_{t,t+1}$ | $prof.gr_{t+1,t+2}$ |
| | | | | | NT | NT | $EXP*$ | $EXP$ |
| | | | | | | | $prof_t$ | $prof_{t+1}$ |
| | | | | | | | | $prof.gr_{t,t+1}$ |
| | | | | | | NT | NT | $EXP*$ |
| | | | | | | | | $prof_t$ |

*Notes*: $NT$ denotes non-trading, $EXP$ denotes exporting. $*$ marks the year $t$ of treatment. The years of measurement of the average treatment effect on the treated (ATT) are italicized. The outcome variables employed for measurement of the ATT are presented below the trade status in the relevant years, with $prof_t$ denoting the profit level in year $t$ and $prof.gr_{t,t+1}$ denoting profit growth from year $t$ to $t+1$. The sections above the dashed lines only apply to the Netherlands, the sections below the dashed lines apply to both Finland and the Netherlands.

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# Samenvatting

Deze dissertatie bestaat uit drie gerelateerde artikelen. Twee empirische artikelen analyseren de heterogeniteit van bedrijven betreffende de opslag van prijzen over marginale kosten (mark-up) en de winstgevendheid, welke de basis vormen voor het inkomen van de eigenaren van bedrijven en de aandeelhouders. Een theoretisch artikel analyseert de invloed van een daling in de mark-up op de inkomensongelijkheid.

De term bedrijfsheterogeniteit verwijst naar allerlei verschillen tussen bedrijven in dezelfde sectoren. Dit beïnvloedt de gevolgen van handelspolitiek van landen, de economische structuur, en de inkomensverdeling binnen een land, aangezien bedrijven een groot deel van de betalingen voor lonen en kapitaalinkomen voor hun rekening nemen. Eerdere studies argumenteren dat handel de ongelijkheid voor lonen doet toenemen. Ook de totale inkomensongelijkheid en de ongelijkheid binnen landen betreffende kapitaalinkomen stijgen echter de laatste decennia.

In de twee empirische artikelen is onze bijdrage met name betreffende de reikwijdte van de analyse. De meeste studies hadden zich tot nu beperkt tot de maakindustrie met minstens 20 werknemers of de export van goederen. Wij breiden deze analyses uit met zogenaamde micro- en kleine bedrijven en de dienstensectoren voor een uitputtende database voor Finland.

Het eerste artikel, hoofdstuk 3, analyseert de verdeling van de mark-up voor 70 finse maakindustrie- en dienstensectoren van 2005 tot 2009. Veel theoretische modellen veronderstellen dat deze mark-up hetzelfde is voor alle bedrijven in een sector, ongeacht grootte van het bedrijf, het type bedrijf of de efficiëntie van het bedrijf. We analyseren eerst de mate van de variabili-

teit van de mark-up met non-parametrische methoden. Daarna analyseren we of deze variabiliteit gerelateerd is aan bepaalde typen sectoren. In tegenstelling tot de constante mark-up hypothese vinden we dat (i) er grote verschillen zijn in mark-up binnen de sectoren, (ii) er hogere mark-ups zijn voor kleine bedrijven en bedrijven die alleen produceren voor de binnenlandse markt en (iii) er grotere heterogeniteit in mark-up is voor sectoren met lage kapitaal-arbeid ratios en een groot aantal bedrijven. Verder hebben dienstensectoren iets hogere variatie in de mark-up en zijn de verschillen tussen diverse typen bedrijven vaker significant dan voor de maakindustrie. Een simpele verklaring voor deze bevindingen kan zijn dat verschillende bedrijven zich toeleggen op de specifieke wensen van kleinere segmenten met ongelijke prijselasticiteit van de vraag.

Het tweede artikel, hoofdstuk 4, analyseert theoretisch wat de invloed is van een toename van de concurrentie, leidende tot een dalende mark-up, op de inkomensongelijkheid en de werkloosheid van een land met een open economie. We gebruiken het model van Egger and Kreickemeier (2012) als basis voor de analyse. Dit model incorporeert bedrijfsheterogeniteit in een zogenaamde 'fair wage' structuur. Het wordt tevens gebruikt in hoofdstuk 5. Wij laten de prijselasticiteit van de vraag stijgen en de mark-up dalen in een open economie in vergelijking met een autarkische economie als gevolg van de toegenomen internationale concurrentie.

In tegenstelling tot eerdere studies vinden wij dat sterkere concurrentie de werkloosheid doet toenemen, alsmede de inkomensongelijkheid binnen winsten, het looninkomen en de Gini indices van beiden. Deze resultaten zijn het gevolg van de vereiste stijging in de productiviteit voor exporterende en succesvol opererende bedrijven, waardoor het aantal bedrijven daalt. De werkgelegenheid daalt doordat de meer productieve bedrijven die overblijven minder werknemers nodig hebben dan de minder productieve bedrijven die kopje onder gaan. Een kleiner aandeel van bedrijfseigenaren en werknemers kunnen uiteindelijk profiteren van de stijging in winsten en lonen voor exporterende bedrijven en de inkomensongelijkheid stijgt daardoor.

Onze resultaten versterken de initiële bevindingen van Egger and Kreickemeier (2012) en geven een additionele verklaring voor de stijgende inko-

mensongelijkheid binnen landen. De meelindustrie kan als voorbeeld dienen. De vraag naar bloem per hoofd van de bevolking is niet veranderd de afgelopen jaren terwijl tegelijkertijd het aantal bedrijven en werknemers drastisch gedaald is. Volgens onze modelstructuur kan het effect van toenemende concurrentie op werkloosheid en inkomensongelijkheid groter zijn dan de impact van een equivalente daling van de handelskosten. Ook met 'redelijke' parameter waarden kunnen de effecten vrij groot zijn, hoewel dit geen automatisme is.

Het laatste artikel, hoofdstuk 5, analyseert de relatie tussen winstgevendheid en internationalisatie zowel theoretisch als empirisch. Aangezien er wat verwarring is over de relatie tussen internationalisatie, het niveau van de winsten en de winstgevendheid besteden we hier expliciet aandacht aan.

Theoretische modellen voorspellen dat de winstgevendheid van exporterende bedrijven lager is dan van bedrijven die alleen produceren voor de binnenlandse markt in dezelfde sector. We testen deze hypothese empirisch met data voor Finland in de periode 2005-2010 en met data voor Nederland in de periode 2002-2010. We analyseren vier verschillende winstgevendheid indicatoren voor verschillende sectoren en categorieën van bedrijfsgrootte. We vinden dat de internationalisatie van bedrijven relatief weinig gecorreleerd is met de winstgevendheid, aangezien de coëfficiënten ofwel niet significant zijn ofwel significant negatief maar met een kleine waarde. Dit correspondeert dus zeer goed met de theoretische modellen. De significant negatieve resultaten van internationalisatie worden vooral gevonden voor exporterende bedrijven (dus niet voor importerende bedrijven) en voor kleinere bedrijven.

Onze aanvullende analyse van 'propensity score matching', waarin gelijksoortige bedrijven met elkaar worden vergeleken, ondersteunt ook de hypothese dat exporterende bedrijven gelijke of lagere winstgevendheid hebben dan bedrijven die alleen produceren voor de binnenlandse markt. Exporterende bedrijven lijken bereid de mogelijkheden van de buitenlandse markt te willen onderzoeken ook als dit (tijdelijk) ten koste gaat van lagere winstgevendheid. Aangezien exporteren gepaard gaat met een toename van bedrijfsomvang is het winstniveau voor exporterende bedrijven over het algemeen wel hoger dan voor binnenlandse bedrijven.

Samenvattend geldt dat onze resultaten aangeven dat we voorzichtig moeten zijn met beleidsaanbevelingen gebaseerd op (theoretische) modellen gebaseerd op een homogene mark-up. De veronderstelling van een per marktsegment en land variërende mark-up sluit beter aan bij de door ons gevonden empirische resultaten. Onze theoretische en empirische analyse van de relatie tussen inkomensongelijkheid en handelsliberalisatie toont aan dat het verstandig is om voorgestelde veranderingen in beleid eerst grondig te analyseren betreffende de te verwachten gevolgen voor de verdeling van inkomen alvorens tot invoering over te gaan.

Verder onderzoek is gewenst in de nabije toekomst betreffende de relatie tussen internationalisering en bedrijfsheterogeniteit voor met name exporteurs in de dienstensector en voor de relatie tussen handelsliberalisatie, concurrentie en inkomensverdeling in het algemeen.

# Summary

This dissertation consists of three interlinked articles. Two empirical articles analyse firm heterogeneity in mark-ups and profit margins (i.e. profitability), since they form the basis for firm owners' and shareholders' income payments. In addition, we study theoretically how a decrease in mark-ups affects income inequality in particular.

Firm heterogeneity, referring to the dissimilarity of firms within narrowly defined sectors, affects for example the effects of trade policies on countries and on economic structures, but also income distributions within-countries since firms pay a large share of wage and capital income payments. Trade opening increases wage income inequality according to previous studies. However, also total income inequality and, to lesser degree, capital income inequality within-countries have been rising over the last decades.

In the two empirical articles, we contribute to the literature especially with regards to the scope of the analyses. Most studies on firm heterogeneity until now have analysed only manufacturing sector firms that have at least 20 employees, or goods exporters more in general, due to data limitations. On the contrary, we can extend the analyses to include also service sector exporters and micro-sized and small firms with an exhaustive Finnish firm level micro database.

In the first article, chapter 3, we analyse the distributions of mark-ups in 70 Finnish manufacturing and service sectors from the year 2005 to 2009. Many theoretical models assume that mark-ups of price over marginal cost are the same for all firms in a sector, irrespective of firm size, type, or efficiency. First, we analyse the extent of mark-up variability within sectors

with non-parametric methods, after which we study if mark-up variability is particularly related to some specific types of sectors. In contrast to the constant mark-up hypothesis, we find (i) large differences in mark-ups within sectors, (ii) higher mark-ups for small firms and domestic firms, and (iii) greater mark-up heterogeneity in sectors with low capital-labour ratios and a large number of firms. Further, according to the results, service sectors exhibit somewhat higher coefficients of variation than manufacturing sectors and a higher share of service sectors have significant differences in different types of firms' mark-ups within sector. One simple explanation on the findings could be that different types of firms cater to specific market or consumer segments with unequal demand elasticities.

In the second article in chapter 4, we contribute to the literature by analysing theoretically how a competition increase, which leads to a decrease in firms' mark-ups, affects different income inequality measures and the unemployment rate in an open economy. We use the general equilibrium framework of Egger and Kreickemeier (2012) for the analysis, which includes firm heterogeneity in productivity and fair wage setting. The same theoretical model is used later in chapter 5. In our analysis, we allow demand elasticities to increase and mark-ups to decrease in the open economy in comparison to autarky due to the competition increase and in opposite to the original assumption of the framework.

Contrary to an earlier study, our results indicate that tougher competition increases the unemployment rate, the income inequality between profit and wage income and the Gini indexes of both wage and profit income. This is due to the increase in the productivity levels required to export and to operate, which subsequently decrease the number of firms. Labour supply increases, since the more productive firms that stay in operation need less employees than the less productive firms that drop out of business. In the end, a smaller share of firm owners and employees will be able to enjoy the premium in profits and wages from exporting and income distributions widen.

Our results strengthen the original findings of Egger and Kreickemeier (2012) and provide additional insights on the possible reasons for the in-

creases found in total income inequality within-countries. The milling industry provides a practical example on these types of dynamics in reality. While demand for flour per person has not changed much over the years, the number of firms and employees in the industry has decreased drastically due to tighter competition.

According to parameterisations, the effect of a competition increase on the unemployment rate or on the various income inequality indicators can be bigger than the effect of an equal decrease in trade costs in percentage terms. Even with some relatively common parameter values, the effects on the unemployment rate are also substantial in size. However, opposite and negligibly small results are found as well.

With the last article in chapter 5, we study the relationship between profitability (ratio of profits over sales or assets) and internationalization both theoretically and empirically. Since there seems to be some confusion over the effects of internationalization on profit levels versus on profit margins, we explicitly attend to these.

First, predictions derived from existing theoretical models suggest that profit rates of exporters are lower than or equal to those of non-exporters in the same sector. Second, we put this hypothesis to an empirical test with two parallel data sets covering the Finnish micro data over the years 2005-2010, but also by employing a similar Dutch micro database on firms over the years 2002-2010. We analyse four different profitability indicators with fixed effects panel regressions and separate the analyses for main sectors and firm size categories. The empirical results show that internationalization of firm activities is not heavily correlated with profit rates. We find largely insignificant or significantly negative trade premia of small magnitude, which thus aligns with theoretical expectations. The negative trade premia seem to be related mainly to exporting rather than to importing and particularly to micro, small and medium sized firms.

Last, the results from propensity score matching support also the hypothesis that exporting firms have lower or equal profit rates than domestic firms. Overall, the results indicate that new exporters seem to be willing to fully explore the possibilities that foreign markets provide even at the cost of

(temporarily) materializing lower profit rates. Since exporting is associated with higher revenues as a result of the access to larger (foreign) markets, the final profit level of exporting firms is most likely higher than the profit level of domestic firms, even if the profit margins would be slightly lower, but especially if there is no significant difference between the profit margins of exporting and domestic firms.

To summarize, in general our results imply that caution is needed regarding policy suggestions based on (theoretical) models with a homogeneous mark-up assumption. The assumptions of varying mark-ups and/or elasticities between sectors and countries and preferably also within sectors seem to match better our results. Further, based on the theoretical analysis, empirical estimations on the income inequality effects of both trade liberalization and competition increases would be good to conduct before policy changes in order to see if any undesired distribution effects are to be expected and how to potentially correct for them.

Further research could be conducted also on service sector exporters and services exporters, on analysing the effects of internationalization on micro-sized and small firms and on the general distributional effects of both trade liberalizations and competition increases.

# Curriculum Vitae

Saara Tamminen (born in 1983 in Tampere, Finland) obtained a Bachelor of Science in Business and Economics degree from the Helsinki School of Economics, Finland, in 2006. In 2007 she graduated as a Master of Science in Business and Economics (with distinction, i.e. *cum laude*) from Erasmus University, Rotterdam, the Netherlands, with a specialization in International Economics. She became a PhD in Economics candidate at Utrecht University School of Economics in 2010 while working for Ecorys Nederland BV, after which she conducted research for this dissertation next to her work duties and completed the degree in 2014. She has been working since the year 2011 in the Government Institute of Economic Research, Finland, as a researcher in the Policy Analysis and Modelling unit. Her main research areas include international economics, computable general equilibrium (CGE) modelling, micro data analyses, firm heterogeneity, the sustainability of public budgets and economic structures in general. Earlier, from the year 2006 to 2011, she worked as a researcher for Ecorys Nederland BV in the Netherlands, where she participated on various economic research projects conducted e.g. for the European Commission related to trade agreements' effects, industrial and sectoral competitiveness, and economic development. She worked also briefly in 2011 in the Prime Minister's Office in Finland to conduct a Spending Review Project.

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