Essays on Firms and Globalisation

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Lincoln College

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A thesis submitted for the degree of

Doctor of Philosophy in Economics

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Abstract

This dissertation consists of three stand-alone substantive chapters. It examines how various aspects of globalisation — openness to international trade, inflows of foreign direct investment and exposure to foreign demand shocks — affect economic performance through their impact on individual firms.

The first substantive chapter presents a theoretical model of international trade with heterogeneous firms that differ not only by their productivity but also by the distortions they face. For a particular distribution of productivity and distortions, it shows that the distortions which affect the domestic and export sales in the same way and are correlated with productivity reduce the welfare gains from trade, while the distortions affecting only domestic sales tend to increase them. In addition, it documents that correlated distortions lead to a bias in an influential recent method for estimating the gains from trade.

The following chapter empirically examines the link between the presence of multinational companies and the export sophistication of domestic firms in an emerging economy. The analysis is based on the matched firm and customs panel data from Romania covering the period 2005-11. The results show a positive relationship between the unit values of goods exported and imported by Romanian firms and the multinational companies' presence in downstream (input sourcing) industries. These results are consistent with quality upgrading being an additional channel through which local suppliers benefit from contacts with their multinational customers.

The last chapter examines how Romanian manufacturing firms reacted to a dramatic drop in the export demand during the global trade collapse of 2008 and 2009. The exogenous effect of a fall in exports is identified by instrumenting exports with a firm-specific index of foreign demand. The results indicate that exporting firms were unable to redirect their sales to the domestic market and were forced to abruptly reduce their employment, material expenditure and investment, passing the shock to their suppliers. The results suggest that the export status of a firm may be a poor predictor of its vulnerability to a negative foreign demand shock.

Word Count

The approximate number of words in this thesis is 41,000 excluding the bibliography. This is calculated using the number of words on page 2, 395, multiplied by the number of pages, 105, and rounded to the nearest thousand.

Declaration

I declare that this thesis represents my own work, and that none of it has yet been accepted, or is currently being submitted, for any degree or diploma or certificate or other qualification in this University or elsewhere. Chapter 3 is based on a paper which I have written jointly with Beata Javorcik. We have contributed towards it equally.

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Writing this dissertation has been the most challenging thing which I have done so far, and I would not have been able to complete it without the generous support of a large number of people.

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I am grateful to all those who have contributed to this thesis with ideas and feedback. I would like to thank Ferdinand Rauch and Adrian Wood who acted as my Transfer of Status and Confirmation of Status examiners and have provided some excellent comments on the

first two substantive chapters of this thesis. During my MSc, Adrian Wood also inspired me to pursue a research in international trade and his praises on Beata Javorcik fuelled my very best decision to ask her to become my supervisor. I would also like to thank Juan Carluccio, María García De La Vega, Alejandro Riaño, Andrei Victor Potlogea and Pawel Goła, who have read and insightfully commented on various parts of this dissertation. Moreover, discussions with Peter Neary, Dave Donaldson, Pete Klenow and Costas Arkolakis have played an important role in shaping the chapter on the effects of firm-level distortions. My special thanks belong to Kalina Manova, who made some of the above mentioned discussions possible by hosting me at Stanford, and who herself made some excellent suggestions for the first two substantive chapters of this thesis. Finally, I am grateful to all the others with whom I have discussed the ideas contained in this thesis.

I am indebted to Kamilė Vaupšaitė, who has invested many hours of her time into making sure that this dissertation is in line with the good use of the English language.

The main reason why I have now reached the submission of my thesis, in good health and in high spirits, is my great friends. In particular, I would like to thank Maruška, Barbora, Tamás, Kubo, Marcela, Gerhard, Anisha, Will, Petr B., Petr J., Margherita and Ondra, on whose shoulders I wept when my research or personal life were not progressing in the way I had hoped they would.

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I am extremely grateful to the examiners, Kalina Manova (internal) and Rocco Macchiavello (Warwick), for their careful reading of my dissertation and for their helpful comments and suggestions. Many of their suggestions are already reflected in this version of the dissertation, and others will guide my future work.

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Chapter 1

Introduction

This dissertation consists of an introduction and three stand-alone substantive chapters. It examines how various aspects of globalisation — openness to international trade, inflows of foreign direct investment and exposure to foreign demand shocks — affect economic performance through their impact on individual firms. It builds on three prominent strands of recent literature in the field of international economics: (i) the theoretical works examining the impact of international trade on aggregate productivity and welfare in the presence of heterogeneous firms;[1] (ii) the empirical analyses of exporting and non-exporting firms;[2] and (iii) the empirical literature analysing spillovers from foreign direct investment to domestic firms.[3]

The dissertation contributes to these strands of literature by highlighting novel mechanisms that can alter the impact of globalisation on economic performance. First, it theoretically demonstrates that the effect of international trade on welfare in an economy with heterogeneous firms can be significantly affected by the presence of firm-level policy distortions. Second, it shows through detailed Romanian data that the presence of foreign-owned firms in buying and supplying sectors benefits domestic firms not only by boosting their productivity, as found by earlier studies, but also by increasing the quality of their exports. Finally, it documents, using the same data, that rapid reduction in employment, material expenditure and

[1] Melitz (2003); Bernard et al. (2003, 2007b); Melitz and Ottaviano (2008); Arkolakis et al. (2012).

[2] Bernard and Jensen (1995); Pavcnik (2002); Tybout (2003); Trefler (2004); Bernard et al. (2007a).

[3] Aitken and Harrison (1999); Javorcik (2004); Blalock and Gertler (2008); Keller and Yeaple (2009); Havranek and Irsova (2011).

investment by exporting firms is an important mechanism through which an exogenous fall in exports is transmitted to the domestic economy. Through these contributions, the dissertation ultimately aims to improve our understanding of the long-term and short-term drivers of economic growth, particularly in the emerging economies.

Although the three substantive chapters vary significantly both in terms of the analysed phenomena and of the applied methods, they nevertheless share a number of common features. Firstly, they focus on individual firms, rather than on industries or countries, as the basic unit of analysis. This focus is in line with much of the recent literature in the field of international trade. It acknowledges the fact that firms differ dramatically in terms of their productivity (Syverson, 2011), the policy distortions they face (Hsieh and Klenow, 2009), the quality of their production (Kugler and Verhoogen, 2012), their ownership (Arnold and Javorcik, 2009) and their exposure to foreign markets (Bernard et al., 2007a), and that all these characteristics have, in turn, important implications as to how each firm is affected by various shocks and policy changes.

Secondly, the key role in all three chapters is played by exporting firms. Chapter 3 analyses exclusively exporters, and although chapters 2 and 4 also feature non-exporting firms, the examined mechanisms are again primarily driven by exporters. Thirdly, across different sectors of the economy, the presented analysis is most relevant to manufacturing. The core estimation in the empirical chapters 3 and 4 is restricted to manufacturing. The theoretical Chapter 2 does not explicitly distinguish sectors, but much of the empirical literature that motivates it also has a manufacturing focus.

Lastly, although the results in each chapter have implications for a broad range of countries, they are particularly relevant to the emerging economies such as China, Indonesia or Mexico. One reason for this is that manufacturing, which is the focus of chapters 3 and 4, tends to play an outsize role in these economies. Furthermore, these economies are technologically less advanced than the economies of the richest countries, meaning that there is a large potential for spillovers from the foreign direct investment, analysed in Chapter 3. These economies also tend to have heavily distorted markets, hence the mechanisms discussed in Chapter 2 affect them particularly strongly. Last but not least, Romania, from which the data for chapters 3 and 4 comes, is itself an emerging economy.

Chapter 2 examines the welfare effects of international trade in the presence of firm-level policy distortions. I formulate a model of international trade with heterogeneous firms that differ not only by their productivity but also by the distortions they face. I derive the comparative statics of the model for a particular joint distribution of productivity and distortions. I show that the distortions which affect the domestic and export sales in the same way and are either negatively or positively correlated with productivity reduce the welfare gains from trade. I also show that the distortions affecting only domestic sales tend to increase the gains from trade while the distortions affecting only exports tend to reduce them. Simulations suggest that these effects are qualitatively robust to a number of alternative assumptions, and that they could potentially make the gains from trade negative or three times as large as they would be without distortions. I further show that the presence of the distortions that affect the domestic and export sales equally and are negatively (positively) correlated with productivity makes the methodology by Arkolakis et al. (2012) underestimate (overestimate) the overall gains from trade relative to a closed economy.

Chapter 3, based on a paper written jointly with Beata Javorcik, examines the link between the presence of multinational companies and the export sophistication of domestic firms in an emerging economy. The analysis is based on the matched firm and customs panel data from Romania covering the period 2005-11. The results show a positive relationship between the unit values of goods exported and imported by Romanian firms and the multinational companies' presence in downstream (input sourcing) industries. The effect on export unit values is present primarily in industries producing intermediate goods and in industries with a greater scope for quality improvements. It is strongest for the most productive and the most sophisticated domestic producers. These results are consistent with quality upgrading being an additional channel through which local suppliers benefit from contacts with their multinational customers.

Chapter 4 examines how Romanian manufacturing firms reacted to a dramatic drop in the export demand during the global trade collapse of 2008 and 2009. The exogenous effect of a fall in exports is identified by instrumenting exports with a firm-specific index of foreign demand. The results indicate that exporting firms facing a drop in their export demand abruptly reduced their employment, material expenditure and investment, but not wages. A 10% fall

in exports was associated with a 3.5% reduction in employment, a 7% cut in material expenditure and a 10% reduction in investment. Moreover, the struggling exporters appeared to be unable to redirect part of their sales to the domestic market. The chapter documents that also the non-exporting firms were affected, as their sales fell at least proportionally to a decline in exports of industries to which they supply inputs. The results describe an important channel through which a negative export demand shock is transmitted to the domestic economy, and they indicate that the export status of a firm may be a poor predictor of its vulnerability to negative foreign demand shocks.

Chapter 2

Gains from Trade in a Distorted Economy

2.1 Introduction

Whether, how and by how much international trade increases the welfare of the trading nations has always been the central question of international economics. In the past fifteen years, trade economists have devoted much of their attention to exploring one particular channel through which trade affects welfare. When firms differ in their productivity, trade allows the most productive firms to expand into export markets while forcing the less productive ones to shrink or even exit. This in turn leads to a greater aggregate productivity and higher welfare.[1] In the real world, however, productivity is not the only thing that determines which firms are large and profitable and which are small and struggling. Taxes, subsidies and labour regulations often affect different firms differently. So do, by their very nature, distribution of public contracts, expropriation and extortion of bribes. All these factors distort the relationship between firm productivity and firm success, and help some firms grow while keeping others small and unprofitable. Importantly, by doing so, they also alter which firms benefit or lose when a country becomes increasingly open to international trade. This can, in turn, significantly change the welfare gains from trade.

[1]The seminal studies include in particular Melitz (2003), Bernard et al. (2003) and Melitz and Ottaviano (2008).

To see this, imagine a country where inefficient state-owned enterprises (SOEs) remain large and prosperous due to subsidies on credit, land, energy and raw materials. At the same time, red tape and heavy taxation prevent productive private companies from growing. When such a country opens up to trade, the SOEs will start selling their heavily subsidised products not only at home but also abroad, and their growing sales will necessitate even more subsidies. The overburdened private firms, on the contrary, will not be able to compete in the foreign markets and will become even smaller. Like in the standard models, trade leads to a reallocation of the factors of production between firms, but now the reallocation does not happen in the direction of the most productive ones. Intuitively, the welfare gains from trade in such an economy should be smaller than they would be if the SOEs did not receive any subsidies and taxes were spread equitably across all firms.

As a different example, imagine a country where both the necessary and the sufficient condition for business success is having strong connections to the political elite. The large and profitable contracts for government agencies, SOEs, the army and the largest industrial conglomerates, do not go to the most productive firms but to a handful of companies owned by well-connected individuals. Although such an economy is as plagued by distortions and inefficiencies as the previous one, trade can be expected to have a very different impact here. Opening to trade will allow the productive private firms lacking political connections to succeed in the global markets, where success is determined by price and quality rather than by close ties with crony politicians. In this case, trade not only has the welfare effects predicted by the standard models, but it also reduces the inefficiencies by shifting the economy's centre of gravity away from the distorted domestic market and towards the 'impartial' world markets.

The aim of this chapter is to explore the mechanisms implicit in the above examples through a formal model of international trade with heterogeneous firms. It studies how the presence of firm-specific distortions changes the impact of trade on welfare, and, in particular, how this change depends on the nature of the distortions existing in a given economy.

This chapter uses the term 'distortions' very broadly as any government interventions that make some firms larger and other firms smaller than they would otherwise be.[2] They may take many different forms and be due to many different causes. One common source of

[2]This approach was pioneered by Restuccia and Rogerson (2008) and followed by many others.

firm-specific distortions is the preferential treatment of politically connected firms. Its large importance in many countries is evidenced by the studies documenting high value of political connections for the connected firms (Fisman, 2001; Chekir and Diwan, 2012), and the studies showing that the connections lead to increased market shares (Faccio, 2010). The connections can translate into advantages for the connected firms through many different channels, including input subsidies (Johnson and Mitton, 2003; Diwan et al., 2015), preferential access to credit (Khwaja and Mian, 2005; Leuz and Oberholzer-Gee, 2006; Claessens et al., 2008), licenses for imports of raw materials (Mobarak and Purbasari, 2006), protection from competition by foreign affiliates (Rijkers et al., 2014), capture of law enforcement (Diwan et al., 2015), regulations tailored to favour certain firms over others (Rijkers et al., 2014) and awarding government contracts (Goldman et al., 2013).

Another important source of distortions is the state-owned enterprises. In China and many other countries, SOEs account for a substantial share of large firms while often being less efficient than their privately-owned competitors (Hsieh and Klenow, 2009; Brandt and Zhu, 2010). This is made possible by the preferential treatment they receive in the form of, for instance, soft budget constraints, subsidised loans, cheap energy, monopoly in some products or access to export quota (Lin et al., 1998; Tan and Lin, 1999; Khandelwal et al., 2013; Hsieh and Song, 2015). While support for SOEs tends to play a bigger role in the developing world, many developed countries offer preferential treatment to the small and medium enterprises (Guner et al., 2008).

The examples so far involve deliberate support to certain firms. However, even standard policies such as taxes and business regulations can affect different firms differently and lead to misallocation. For instance, the effect of many policies depends on firm size, either due to variation in the applicable laws, or due to uneven intensity in the level of enforcement (World Bank, 2004; Pierre and Scarpetta, 2006; Aterido et al., 2007). Firm size and firm profitability can also determine which firms are more likely to face extortion of bribes or risk confiscation by those in power (World Bank, 2004; Aterido et al., 2007).

While the effect of any single individual distortion may be limited (Restuccia and Rogerson, 2013), recent studies have suggested that the combined effect of the many diverse, mutually interacting distortions that exist in many countries is substantial. Hsieh and Klenow

(2009) estimate that if labour and capital in India and China were reallocated so that the dispersions of the marginal revenue products were brought down to the US level, it would lead to aggregate productivity gains of 40%-60% for India and 30%-50% for China.[3] Jones (2011) then shows that in a combination with capital and intermediate input multipliers, and allowing for reasonable differences in human capital and mean productivity, Hsieh and Klenow's results can comfortably account for the fifty-fold differences in per capita incomes that exist, for example, between the United States and Tanzania. If distortions can have such a large direct effect on welfare, they could also radically alter the welfare implications of international trade. Such a possibility is the central theme of this chapter.

I start by characterising an extended version of the seminal model by Melitz (2003) where, in addition to the standard productivity draw, each firm receives two distortion draws that affect the profitability of its sales in the domestic and export markets. I then study the comparative statics properties of this extended model under the standard assumption that firm productivity follows the Pareto distribution, and an additional assumption of a particular functional form for distortions. I find that the effect of distortions on the gains from trade depends crucially on two of their properties. First, it depends on whether distortions affect domestic sales or exports, or both. Among the sources of distortions discussed above, government contracts are an example of distortions affecting only domestic sales, export quotas are an example of distortions affecting only export sales and energy subsidies or preferential access to credit are an example of distortions affecting both domestic and export sales. Second, it depends on the correlation between productivity and distortion draws, where negative correlation would mean that the more productive firms are disadvantaged by distortions, as is the case of the support for inefficient SOEs, and positive correlation would correspond to 'picking winners', that is, to subsidising the most productive firms.[4] I structure my theoretical findings along three scenarios defined by combinations of these two properties.

[3] Other studies have estimated similarly large effects of the distortions on the aggregate total factor productivity in other countries. See Neumeyer and Sandleris (2010) for Argentina, Gustavo and Cristobal (2012) for Bolivia, Camacho and Conover (2010) for Colombia, Oberfield (2011) for Chile and Yang (2014) for Indonesia.

[4] I use the word 'distortion' to describe the entire term that multiplies the gross profits in order to give the net profits. As a result, 'distortions negatively correlated with productivity' mean that firms with higher productivity receive a *worse* distortion draw, corresponding to a higher tax or a lower subsidy. Some other researchers, such as Hsieh and Klenow (2009), use the word to refer to the corresponding tax rate, so that the gross profits need to be multiplied by one minus the distortion in order to arrive at the net profits. As a result, they would refer to the mentioned case as positive correlation between distortions and productivity.

The results are as follow. First, the distortions that affect both domestic and export sales and are uncorrelated with productivity reduce welfare but do not alter the welfare effects of international trade compared to the Melitz (2003) model without distortions. Second, the distortions that affect both domestic and export sales and are negatively or positively correlated with productivity reduce the total welfare gains from trade, relative to autarky, for any given level of trade costs. If the correlation is positive, trade can even reduce welfare. The intuition behind this result is that negatively (positively) correlated distortions make the dispersion of firm size inefficiently small (large). Since trade benefits the largest firms, it alleviates (aggravates) this inefficiency. Firms do not take this additional effect of trade into account, so it amounts to a positive (negative) externality. Consequently, the amount of trade is inefficiently small (large), and this reduces the welfare gains that trade generates. Finally, the distortions that affect domestic sales and export sales differently have two different effects on the gains from trade. The first effect, which I call the *market misallocation effect*, stems from the fact that distortions can act as an export tax or an export subsidy (homogeneous across firms) and, thus, can make exports take up an inefficiently small or large share of the total revenues. The second effect, which I call the *firm misallocation effect*, is due to the fact that trade shifts sales between the more and the less distorted markets. When distortions are not excessively domestic- or export-biased, the latter effect dominates. Distortions to domestic sales then increase the gains from trade while distortions to export sales reduce them.

I use simulations to test the robustness of the outlined results to a number of alternative assumptions. In the first test, I relax the assumption that the trading countries are symmetrical, and instead assume that they differ in size and in the presence of distortions. In the second test, I assume that productivity follows the lognormal rather than the Pareto distribution. In the last test, I assume a different functional form for generating distortions. The relative size of the gains from trade with and without the various distortion types turns out to be rather robust to the different changes in the assumptions. Interestingly, under the alternative specification of distortions which allows distortions to change the size ranking of firms, even negatively correlated distortions can cause trade to reduce welfare. Additionally, I tentatively calibrate the simulated model to see if the effect of distortions on the gains from trade could potentially be large. I find that under plausible assumptions, the negatively correlated

distortions affecting both domestic and foreign sales can bring the gains from trade close to, or below, zero, while the negatively correlated distortions affecting only domestic sales can lead to the gains from trade that are almost three times as large as without distortions.

The comparative statics analysis addresses the important question whether benefits of international trade are particularly large, or, on the contrary, rather limited, in countries with highly distorted markets. Yet, another important question is what the presence of distortions implies for the existing estimates of the absolute size of the gains from trade. In an influential recent article, Arkolakis et al. (2012) (ACR) show that the size of the gains from trade predicted by a number of standard models of international trade can be calculated using a simple formula involving the share of expenditure on domestic goods and the elasticity of relative imports with respect to variable trade costs. I analyse how their results are affected by the presence of distortions in the three scenarios discussed above. When uncorrelated with productivity, the distortions affecting domestic and export sales in the same way do not affect the size of the gains from trade and leave the ACR formula unscathed. I find, however, that whenever they are negatively (positively) correlated with productivity, they cause the ACR formula underestimate (overestimate) the size of the gains from trade. Additionally, when distortions are not correlated with productivity but affect domestic and export sales differently, only the *market misallocation effect* affects the ACR formula. In particular, the distortions leading to too little (much) trade will cause the ACR formula underestimate (overestimate) the total gains from trade.

This study is to my knowledge the first to link two important recent branches of literature. The first involves the studies on the effects of international trade when firms differ in their productivity.[5] They argue that international trade leads to a reallocation of the factors of production from the low-productivity firms to the high-productivity ones, consequently increasing the aggregate productivity. Importantly, these studies implicitly assume that markets are undistorted, and, therefore, firm productivity, possibly together with other measures of firm performance such as the product quality or market-specific experience, is the sole determinant of firm profitability and size. This chapter extends these studies by relaxing this assumption and emphasizing that trade leads to reallocation towards the firms which are best

[5] See Redding (2011) and Melitz and Redding (2014) for reviews.

suited to succeed in the export market *given the existing distortions*, which need not necessarily be the most productive ones.

The other recent branch of literature to which this chapter is related studies the aggregate effects of misallocation across firms with heterogeneous producitivity. Starting with the simulations by Restuccia and Rogerson (2008) and the empirical estimates by Hsieh and Klenow (2009), a number of studies have suggested that firm-specific policy distortions, leading to a misallocation of the factors of production, often account for large reductions in the aggregate productivity or welfare.[6] However, to the best of my knowledge, all models in this line of research describe closed economies. The aim of this chapter is to fill this gap.

In addition, the chapter falls within the rich literature on the theory of second best — dating from the classical study by Lipsey and Lancaster (1956) — which emphasizes that in the presence of multiple distortions, reducing one of them can harm rather than improve welfare. A notable example in the field of international trade is the paper by Anderson and Neary (2007), who study the welfare effects of a tariff reduction when there are tariffs on many goods. The present chapter can be seen as the first application of the theory of second best to the interaction of international trade and general firm-specific policy distortions.

Several interesting recent studies also look at the interaction between distortions and the effects of international trade. Khandelwal et al. (2013) show that the welfare costs of the quotas on Chinese textile exports under the Multifibre Arrangement were significantly aggravated by the fact that the quotas were disproportionately allocated towards the low-productivity firms. Similar to this chapter, the authors study how misallocation across firms with heterogeneous productivity may lead to larger than expected gains from trade liberalisation. However, they focus on a specific type of distortions — allocation of export quotas to the low-productivity firms — while my analysis encompasses a broad range of distortions. The research by Dhingra and Morrow (2014) is related to my analysis in that they, too, analyse the interaction between domestic distortions and trade liberalisation in a monopolistically competitive framework. However, the distortions they study stem directly from the imperfect competition, not from the exogenous policies that are the subject of this chapter. Swiecki (2014) also analyses how the gains from trade are altered by the presence of distortions. His

[6] See also Bartelsman et al. (2013), Xu and Midrigan (2009), Hsieh and Klenow (2014),Yang (2014) and Fattal Jaef (2015).

conclusion that removing distortions would be particularly beneficial in a country highly open to international trade is similar to my model's implications for the case with distortions that effect both domestic and export sales. However, he focuses on the inter-sectoral distortions, whereas I study the distortions leading to misallocation across firms within the same sector.

This chapter emphasizes the need not to examine individual policies separately but to analyse their joint implications. In particular, it shows that in countries where taxes and subsidies on firms' production help unproductive firms and hinder the productive ones, governments need to remove these distortions in order to reap the full benefits of opening to international trade. On the contrary, opening to trade should be the highest priority in countries where opportunities in the domestic market are open only to a handful of well-connected firms and where exporting represents the only channel through which the unconnected but highly productive firms can grow.

In the following section, I introduce the general model of an open economy with heterogeneous firms and firm-specific distortions. In section 2.3, I then analyse how distortions alter the welfare effects of trade when productivity follows the Pareto distribution and the distribution of the distortions, conditional on productivity, falls within several special cases. In section 2.4, I employ simulations to test the robustness of these results to alternative assumptions and to obtain rough estimates of the potential magnitudes of the effects. In section 2.5, I analyse the implications of the firm-specific distortions for estimating the gains from trade using the method developed by Arkolakis et al. (2012). Finally, section 2.6 concludes.

2.2 Model

The model I introduce here closely follows the Melitz (2003) model as presented by Melitz and Redding (2015).[7] The distinctive feature of my analysis is that in addition to a productivity draw, each firm obtains two distortion draws which affect its decisions about output and the prices in the domestic and export markets.

For the purpose of this exposition, I assume there are two symmetric countries.[8] Con-

[7] Following Melitz and Redding (2015) and much of the related literature, I focus on the static version of the model with no exit.

[8] I allow for asymmetric countries in the simulations later in the chapter.

sumers have constant elasticity of substitution (CES) preferences with elasticity $\sigma > 1$ over goods produced by a continuum of firms that differ by their productivity $\varphi \in (0, \varphi^{max})$, by their domestic distortion draw $\delta_d \in (0, \delta_d^{max})$ and by their exporting distortion draw $\delta_x \in (0, \delta_x^{max})$. Homogeneous workers represent the only factor of production, and the supply of labour is fixed at L.[9] Firms hire workers for gross wage w_r, and they need $1/\varphi$ units of labour to produce one unit of output. Writing d for the domestic market, x for the export market, and $m \in \{d, x\}$, each firm that decides to sell in market m also has to pay the market-specific fixed costs $w_r f_m$.[10] In addition, exporting is subject to iceberg trade costs $\tau \geq 1$ such that $1+\tau$ units of output have to be shipped abroad for each unit that reaches the destination. Firms then maximise profits in each market, given by

$$\pi_m(\varphi, \delta_m) = RP^{\sigma-1} p_m^{-\sigma} \left(\delta_m p_m - \frac{w_r \tau_m}{\varphi} \right) - w_r f_m, \tag{2.1}$$

where R stands for the aggregate gross revenues, p_m is the price that a firm charges in market m, P represents the CES price index, $\tau_d = 1$ and $\tau_x = \tau$.

Strictly speaking, the domestic distortion draw, δ_d, is equivalent to one plus the net subsidy rate that each firm receives on its domestic revenues. More broadly, it may represent any proportional subsidies or taxes on revenues or inputs related to domestic sales. Analogously, the exporting distortion draw, δ_x, is equivalent to one plus the net subsidy rate on export revenues. The *production distortions*, discussed in the introduction, are equivalent to net subsidies on all revenues and consequently enter δ_d and δ_x in the same way. When only *production distortions* are present, $\delta_d = \delta_x$ for each firm.

The net subsidies to firms, represented by distortion draws, are financed by a flat tax on all wages,[11] which has two important and related implications. First, no money appears

[9] Studies analysing firm-specific distortions sometimes assume multiple factors of production, which allows them to examine distortions to factor use as well as distortions to firm output (Hsieh and Klenow, 2009; Bartelsman et al., 2013). I choose to focus on a single factor of production in this chapter because the principal mechanisms driving gains from trade in most trade models with heterogeneous firms are related to reallocation of output across firms rather than to changes in relative factor use. Nevertheless, studying the interaction of factor-specific distortions and international trade is an interesting avenue for future research. Such interactions could arise, for example, if financial constraints play an important role for exporting (Minetti and Zhu, 2011; Manova, 2013; Manova et al., 2015), if exporters tend to specialize in products with different capital intensity (Ma et al., 2014), or, more generally, if trade is driven by differences in factor abundance across countries (Bernard et al., 2007b).

[10] Similar to Melitz (2003), I assume that the fixed costs take the form of overhead labour.

[11] If the sum of all net subsidies paid out to firms is negative, there is instead a flat wage subsidy.

out of thin air or gets lost in a black hole, and, therefore, all welfare effects in the present chapter come from efficiency losses and gains due to a reallocation of labour across firms.[12] Second, only the relative size of distortion draws across firms affects welfare — an identical proportional change in the distortion draws of all firms leaves welfare unchanged.[13]

The optimal net revenues $n_m(\varphi, \delta_m)$ and the optimal gross revenues $r_m(\varphi, \delta_)$ in market m are given by

$$n_m(\varphi, \delta_m) = \delta_m r_m(\varphi, \delta_m) = R\left(P \frac{\sigma - 1}{\sigma} \frac{\varphi \delta_m^{\frac{\sigma}{\sigma-1}}}{w_r \tau_m} \right)^{\sigma-1}. \tag{2.2}$$

These expressions imply that it is possible to define *pricing draws* $\nu_m = \varphi \delta_m$ and *profit draws* $\mu_m = \varphi \delta_m^{\frac{\sigma}{\sigma-1}}$ such that the gross revenues can be written as functions of pricing draws, $r_m(\nu_m)$, and net revenues as functions of profit draws, $n_m(\mu_m)$.

When a new firm is established, it has to pay sunk costs of entry $w_r f_e$ and only then it is assigned its productivity and distortion draws. The draws come from a joint distribution with cummulative distribution function $F(\varphi, \delta_d, \delta_x)$, and this distribution also determines the cumulative distribution functions $G_m(\mu_m)$. Due to the market-specific fixed costs, there are threshold profit draws $\underline{\mu}_m$ such that firms decide to sell in market m only if $\mu_m > \underline{\mu}_m$.[14]

[12] In reality, direct theft or outflow of resources can be as important as efficiency losses due to a misallocation of factors of production. For example, Boyce and Ndikumana (2012) estimated that illicit outflows of capital from a group of 33 Sub-Saharan African countries between 1970 and 2010 exceeded both FDI and aid inflows to these countries over the same period.

[13] This result is due to the assumption that the supply of labour is completely inelastic. I discuss the result in more detail at the end of the present section.

[14] The threshold profit draws can also be interpreted as the threshold productivities that a firm receiving zero net subsidy needs to cross in order to sell in the given market.

The thresholds are defined by the zero-profit conditions[15]

$$\frac{n_m(\underline{\mu}_m)}{\sigma} = w_r f_m. \tag{2.3}$$

The two zero-profit conditions allow the domestic cutoff profit draw to be written as a constant multiple of the foreign cutoff profit draw,

$$\underline{\mu}_x = \left(\frac{f_x}{f_d}\tau^{\sigma-1}\right)^{\frac{1}{\sigma-1}} \underline{\mu}_d = \zeta^{\frac{-1}{\sigma-1}} \underline{\mu}_d, \tag{2.4}$$

where the statistic $\zeta = \left(\frac{f_d}{f_x}\tau^{1-\sigma}\right)$ reflects the (inverse) relative costs of exporting as compared to selling domestically. Using bars to mark averages, free entry implies that firms enter up to the point where the expected profit from entry equals the sunk entry costs, or

$$\left[1 - G_d(\underline{\mu}_d)\right]\bar{\pi}_d + \left[1 - G_x(\underline{\mu}_x)\right]\bar{\pi}_x = w_r f_e, \tag{2.5}$$

which I can rewrite as

$$\sum_m f_m \left[1 - G_m(\underline{\mu}_m)\right]\left[\left(\frac{\tilde{\mu}_m}{\underline{\mu}_m}\right)^{\sigma-1} - 1\right] = f_e, \tag{2.6}$$

where

$$\tilde{\mu}_m = \left[\int_{\underline{\mu}_m}^{\infty} \mu_m^{\sigma-1} \frac{dG_m(\mu_m)}{1 - G_m(\underline{\mu}_m)}\right]^{\frac{1}{\sigma-1}} \tag{2.7}$$

are the weighted average profit draws. Both summands on the left side of equation (2.6) are

[15] Above, I assume that there are no fixed costs of production that each operating firm would have to pay irrespective of where it sells its output. If, instead, there were fixed costs of production $w_r f'_p > 0$, fixed costs of domestic sales $w_r f'_d > 0$, and fixed costs of exporting $w_r f'_x > 0$, there would be not only zero-profit condition for domestic sales $\frac{n_x(\underline{\mu}_x)}{\sigma} = w_r f'_x$ and zero-profit condition for exporting $\frac{n_x(\underline{\mu}_x)}{\sigma} = w_r f'_x$, but also zero-profit conditions for production. These would be given by $\frac{n_d(\underline{\mu}_d)}{\sigma} = w_r(f'_p + f'_d)$ for firms that sell only domestically, and $\frac{n_x(\underline{\mu}_x)}{\sigma} = w_r(f'_p + f'_x)$ for firms that only export, but it would not be possible to write them for firms that both sell domestically and export, because the threshold level of μ_d would depend on μ_x and vice versa. When there are only *production distortions*, that is, if $\delta_d = \delta_x$ for all firms, the assumption of $f'_p = 0$ does not play an important role, because the ranking of firms in terms of their profitability is the same in both markets and all zero-profit conditions can be collapsed into (2.3), reinterpreting $f_d = f'_p + f'_d, f_x = f'_x$ if all firms sell domestically but only a subset of firms export, or, less plausibly, $f_d = f'_d, f_x = f'_p + f'_x$ if all firms export but only a subset of firms sell domestically. The assumption is, however, necessary for obtaining clearly defined profit-draw thresholds when $\delta_d \neq \delta_x$, because then the rankings of firm profitability differ between the domestic and export markets.

monotonically decreasing functions of the threshold profit draws, and, as in the undistorted case, it holds that as the thresholds converge to zero, the summands converge to infinity, and as the thresholds converge to infinity, the summands converge to zero. Using the relationship between the thresholds (2.4), the free-entry condition then provides a unique solution for $\underline{\mu}_d$.

Given $\underline{\mu}_d$, it is also possible to define the weighted average pricing draws. Define $f_m(\varphi, \delta_m)$ as the marginal probability density functions corresponding to the joint distribution $F(\varphi, \delta_d, \delta_x)$. Further define the marginal probability density functions $l_m(\varphi, \delta_m)$ as

$$l_m(\varphi, \delta_m) = \begin{cases} \frac{f_m(\varphi, \delta_x)}{1 - G_m(\underline{\mu}_m)} & \text{if } \varphi\delta_m > \underline{\mu}_m \\ 0 & \text{otherwise.} \end{cases} \tag{2.8}$$

Then the weighted average pricing draws can be defined as

$$\tilde{\nu}_m = \left[\int_0^\infty \int_0^\infty (\varphi\delta_m)^{\sigma-1} l_m(\varphi, \delta_m) d\varphi d\delta_m \right]^{\frac{1}{\sigma-1}}. \tag{2.9}$$

The mass of domestic firms selling in market m equals the product of the mass of entrants M_e and the share of entrants that sell in the market, $M_m = \left[1 - G_m(\underline{\mu}_m)\right] M_e$, and the aggregate net revenues N and aggregate gross revenues R are respectively given by $N = M_d \bar{n}_d + M_x \bar{n}_x$ and $R = M_d \bar{r}_d + M_x \bar{r}_x$. There is a fixed supply of labour, L. The total costs of labour used for production are given by the difference between the aggregate net revenues and the aggregate profits, and the total costs of labour used for market entry equal the mass of entrants multiplied by the fixed costs of entry. The labour market clearing, therefore, implies $N - (M_d \bar{\pi}_d + M_x \bar{\pi}_x) + M_e w_r f_e = w_r L$. The free-entry condition (2.5) means that the aggregate profits exactly offset the total sunk costs of entry, $M_e w_r f_e = M_d \bar{\pi}_d + M_x \bar{\pi}_x$, and the general equilibrium condition can consequently be simplified to

$$N = w_r L. \tag{2.10}$$

The aggregate net revenues are, therefore, pinned down in the same way as the aggregate

revenues in Melitz (2003). The aggregate gross revenues are subsequently given by

$$R = \frac{w_r L}{\frac{N}{R}} = \frac{w_r L}{\tilde{\delta}(\underline{\mu}_d)}, \tag{2.11}$$

where

$$\tilde{\delta}(\underline{\mu}_d) = \frac{[1 - G_d(\underline{\mu}_d)]\tilde{\mu}_d^{\sigma-1} + [1 - G_x(\underline{\mu}_x)]\tilde{\mu}_x^{\sigma-1}\tau^{1-\sigma}}{[1 - G_d(\underline{\mu}_d)]\tilde{\nu}_d^{\sigma-1} + [1 - G_x(\underline{\mu}_x)]\tilde{\nu}_x^{\sigma-1}\tau^{1-\sigma}} \tag{2.12}$$

is the weighted average distortion,[16] and it is fully determined by the joint distribution $F(\varphi, \delta_d, \delta_x)$, the threshold profit draw $\underline{\mu}_d$ and the variable trade costs τ.

The welfare is given by the real net wage, $W = \frac{w_n}{P}$, where w_n is the net wage that workers have available for consumption after financing the net subsidies to firms. Since the net subsidies to firms are given by $N - R$, and the taxes collected from workers by $(w_r - w_n)L$, it must hold that

$$N - R = (w_r - w_n)L. \tag{2.13}$$

Substituting (2.10) and (2.11) into (2.13), setting labour as the numeraire, so that $w_r = 1$, and rearranging gives

$$w_n = \frac{1}{\tilde{\delta}(\underline{\mu}_d)}. \tag{2.14}$$

Also, using the results so far, the CES price index can be written as

$$P = \frac{\sigma}{\sigma - 1}\left[M_e\left([1 - G_d(\underline{\mu}_d)]\tilde{\nu}_d^{\sigma-1} + [1 - G_x(\underline{\mu}_x)]\tau^{1-\sigma}\,\tilde{\nu}_x^{\sigma-1}\right)\right]^{\frac{1}{1-\sigma}}, \tag{2.15}$$

where the mass of entrants is given by

$$M_e = \frac{L}{\sigma\left(f_e + [1 - G_d(\underline{\mu}_d)]f_d + [1 - G_x(\underline{\mu}_x)]f_x\right)}. \tag{2.16}$$

Finally, using the zero-profit condition (2.3) for domestic sales and the expression for

[16] In a closed economy, $\tilde{\delta}(\underline{\mu}_d)$ would correspond to a weighted mean of the domestic distortion draws δ_d with weights equal to the gross domestic revenues of each firm. For the open economy case, first define for each firm the overall distortion draw as $\delta_{overall}(\varphi, \delta_d, \delta_x) = \frac{\delta_d r_d(\varphi,\delta_d) + \delta_x r_x(\varphi,\delta_x)}{r_d(\varphi,\delta_d) + r_x(\varphi,\delta_x)}$, that is as a weighted mean of the domestic and the exporting distortion draws, with the weights given by the share of domestic and export gross revenues in the total revenues. Then $\tilde{\delta}$ can be interpreted as a weighted mean of $\delta_{overall}$ across firms, with the weights equal to the total gross revenues of each firm.

aggregate gross revenues in (2.11), welfare can be expressed as

$$W = \frac{w_n}{P} = \frac{\sigma - 1}{\sigma} \left(\frac{L}{\sigma f_d} \right)^{\frac{1}{\sigma-1}} \left(\tilde{\delta}(\underline{\mu}_d) \right)^{\frac{\sigma}{\sigma-1}} \underline{\mu}_d. \tag{2.17}$$

This expression is similar to the corresponding expression for the undistorted case shown in Melitz and Redding (2015), but it includes the additional term $\left(\tilde{\delta}(\underline{\mu}_d) \right)^{\frac{\sigma}{\sigma-1}}$ due to the fact that the net wage is now different from the gross wage. Note that distortions now also affect the profit draw threshold $\underline{\mu}_d$. Finally, note that, as mentioned earlier, an identical proportional change in both the domestic and the exporting distortion draws of all firms by some factor of Δ will leave welfare unaffected.[17]

2.3 Pareto distribution

In this section, I study how the presence of distortions affects the gains from trade if productivity draws are Pareto distributed and the distribution of distortion draws takes a particular functional form that allows me to find explicit solutions for the aggregate welfare as a function of model parameters. As already noted, the effect of distortions crucially depends on whether they affect domestic or export sales, and whether, and if so, in what ways, they are correlated with productivity. I begin this section by presenting the assumptions common to all scenarios. In subsection 2.3.2, I then focus on the case of pure *production distortions*, which affect domestic and export sales in the same way, and I document how the effect of such distortions varies depending on their correlation with productivity. In subsection 2.3.3, I subsequently allow distortions to affect domestic and export sales differently. In this case, I do not solve the model for correlated distortions, but both intuition and the subsequent simulation reveal that their effect is qualitatively similar to the uncorrelated distortions, yet with quantitatively

[17] To see this, assume for a moment that the new domestic profit draw threshold is Δ-times higher than the original one. Under this assumption, the shares of entrants selling in each market remain the same as before, and the free-entry condition (2.5) is clearly satisfied. Further note two observations. First, the mass of entrants remains the same, all pricing draws increase by a factor of Δ, and the price index, therefore, decreases by the same factor. Second, the weighted average distortions also increase by a factor of Δ, therefore the aggregate gross revenues decrease by this factor. These two observations, together with the expression for net revenues (2.2), mean that the zero-cutoff profit conditions (2.3) are also satisfied. Since the assumed new profit draw threshold satisfies both equilibrium conditions and there is a unique solution, the assumed new domestic profit draw threshold is indeed the new solution for $\underline{\mu}_d$. The decreases in the aggregate price index and the net wage rate exactly offset each other and welfare remains unaffected.

more pronounced effects.

2.3.1 Assumptions

I assume that the joint distribution $F(\varphi, \delta_d, \delta_x)$ is such that the marginal cumulative distribution function of the productivity draws φ is of the Pareto form $F_\varphi(\varphi) = \frac{\varphi^{min}\, k}{\varphi}$, where $k > \sigma - 1$ is the shape parameter and $\varphi^{min} > 0$ is the scale parameter. I further assume that conditional on the productivity draw φ, the distortion draws corresponding to market m can be written as

$$\delta_m = \alpha_{mv} \varphi^\gamma. \tag{2.18}$$

The distortion draws multiplicatively combine two components. The first component, α_{mv}, is a draw from a finite set of positive values, each drawn with a corresponding fixed probability P^v.[18] This component drives a variation in distortions that is uncorrelated with productivity.[19] For the sake of clarity and without changing the key results, I assume α_{mv} to take only two values, α_{mh} and α_{ml}, $\alpha_{mh} > \alpha_{ml}$, with corresponding respective probabilities H_m and $1 - H_m$.[20]

The second component, φ^γ, introduces a correlation between distortion draws and productivity. The sign and the size of the correlation depend on the parameter γ: when $\gamma < 0$, the more productive firms receive the worse distortion draws; when $\gamma > 0$, their distortion draws are better. I assume that $\gamma \in (-\frac{\sigma-1}{\sigma}, \frac{k-(\sigma-1)}{\sigma})$, where the lower bound ensures that distortions do not reverse the ranking of firms in terms of their profit draws and consequently size,[21] and the upper bound ensures that a single firm does not take over the entire market.[22]

Modelling correlation between productivity and distortions is important for two reasons. First, in reality, many distortions are such that more productive firms receive worse distortion draws. This is likely to be the case of policies supporting SMEs, regulations applying more

[18] Formally, $\alpha_{mv} > 0 \;\forall\; v \in \{1, 2, ..., v^{max}\}$, $Prob(\alpha_{mv}) = P^v$, $\sum_v P^v = 1$.

[19] The fact that P^v's do not depend on productivity means that conditional on α_v, productivity is still Pareto distributed, which allows aggregating productivity across firms in a similar way as in the undistorted model.

[20] It is possible to think about firms with α_{mh} as politically connected firms and firms with α_{ml} as firms without political connections.

[21] $\gamma < -\frac{\sigma-1}{\sigma}$ would lead to an unrealistic situation with few small firms and many large firms, and it would make the analysis intractable.

[22] The upper bound corresponds to assuming $k > \sigma - 1$ in the undistorted Melitz (2003) model with Pareto distribution.

strictly to large firms or more successful firms being more frequent targets of an extortion of bribes (World Bank, 2004; Aterido et al., 2007). It is also the case when well-connected firms are relatively inefficient, as is likely true, for example, for many state-owned enterprises(Brandt and Zhu, 2010; Hsieh and Klenow, 2009). Hsieh and Klenow (2007) indeed find strong negative correlation between productivity and the distortion draws of -0.65, although the value is imprecisely estimated. Second, considering the effect of distortions negatively correlated with productivity on the impact of international trade is also important because such distortions tend to have more dramatic welfare effects than uncorrelated distortions (Restuccia and Rogerson, 2008; Jones, 2011; Bartelsman et al., 2013).

Finally, note that the specification of distortions used here implies that conditional on α_{mv}, distortions are Pareto distributed with the shape parameter k/γ and the scale parameter $\alpha_{mv}\varphi^{min}$, and they are perfectly correlated in logarithms with φ. While the specification is admittedly restrictive, it has the virtue of encompassing both an uncorrelated and a correlated variation in distortions within a simple and tractable formula.

2.3.2 Production distortions

In this subsection, I study distortions which enter domestic and export revenue functions in the same way, so that

$$\delta_d = \delta_x = \delta \tag{2.19}$$

for each firm, and it is also possible to write $\alpha_{mv} = \alpha_v$.

The profit draws are then given by $\mu = \alpha_v{}^{\frac{\sigma}{\sigma-1}}\varphi^{\frac{\sigma(1+\gamma)-1}{\sigma-1}}$ and the pricing draws by $\nu = \alpha_v\varphi^{1+\gamma}$. The net and gross revenue shares of firms with a high uncorrelated distortion draw α_h are respectively

$$h_n = \frac{H\alpha_h{}^{\frac{k\sigma}{\sigma-1}}}{H\alpha_h{}^{\frac{k\sigma}{\sigma-1}} + (1-H)\alpha_l{}^{\frac{k\sigma}{\sigma-1}}} \tag{2.20}$$

and

$$h_r = \frac{H\alpha_h{}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}}{H\alpha_h{}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}} + (1-H)\alpha_l{}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}}. \tag{2.21}$$

$\alpha_h > \alpha_l$ implies $h_n > h_r$, which is a natural observation that the more subsidised firms account for a larger share of net revenues than of gross revenues.

Keeping the normalisation $w = 1$ and using the zero-profit conditions 2.3, it is possible to express the average profits from market m as

$$\bar{\pi}_m = f_m \frac{\sigma(1+\gamma)-1}{k-(\sigma(1+\gamma)-1)}. \tag{2.22}$$

It turns out that the average profits are not affected by the uncorrelated distortions α_v, but they become smaller with negative γ and larger with positive γ. The reason is that negative and positive γ respectively decrease and increase the dispersion of the profit draws and, thus, also the ratio of average profits to those of a marginal firm.

Equations (2.4) and (2.5) then determine the threshold profit draw for selling in the domestic market as

$$\underline{\mu_d} = \left[\left[\frac{\sigma(1+\gamma)-1}{k-(\sigma(1+\gamma)-1)} \frac{f_d}{f_e} \left(1 + \zeta^{\frac{k}{\sigma(1+\gamma)-1}} \frac{f_x}{f_d} \right) \theta_n \right]^{\frac{1}{k}} \varphi^{min} \right]^{\frac{\sigma(1+\gamma)-1}{\sigma-1}}, \tag{2.23}$$

where $\theta_n = H\alpha_h^{\frac{k\sigma}{\sigma-1}} + (1-H)\alpha_l^{\frac{k\sigma}{\sigma-1}}$ is the denominator from the expression for the net revenue share of firms with the high uncorrelated distortion draw. The expression $\zeta^{\frac{k}{\sigma(1+\gamma)-1}}$ corresponds to the ratio of the number of exporting firms and the number of firms that sell domestically, and $\zeta^{\frac{k}{\sigma(1+\gamma)-1}} \frac{f_x}{f_d}$ represents the ratio of the total export net revenues to the total domestic net revenues. Negative and positive γ respectively increase and decrease the elasticity of this ratio to proportional changes in the relative costs of exporting ζ, because as negative γ makes the profit draws less dispersed, a smaller proportional change in ζ suffices to move a given share of firms between exporting and non-exporting. This also explains why the equation (2.23) shows that for any particular α_v, the pure productivity threshold required for production decreases as γ decreases. The reason is that the less dispersed profit draws and the resulting smaller chance of obtaining a very favourable profit draw discourage entry and make it easier for new entrants to survive. This intuition is in line with the observation that the total mass of entrants,

$$M_e = \frac{L(\sigma(1+\gamma)-1)}{k\sigma f_e}, \tag{2.24}$$

decreases as the correlation parameter γ decreases.

Finally, welfare is given by

$$W = \frac{\sigma-1}{\sigma}\left(\frac{L}{\sigma f_d}\right)^{\frac{1}{\sigma-1}}\left(\frac{k-(\sigma(1+\gamma)-1)}{k-(\sigma-1)(1+\gamma)}\frac{1+\zeta^{\frac{k+\gamma}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}{1+\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}\frac{\theta_r}{\theta_n}\right)^{\frac{\sigma}{\sigma-1}} \left(\frac{\sigma(1+\gamma)-1}{k-(\sigma(1+\gamma)-1)}\frac{f_d}{f_e}\left(1+\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}\right)\theta_n\right)^{\frac{1}{k}}\varphi^{min}, \tag{2.25}$$

where $\theta_r = H\alpha_h^{\frac{k\sigma-(\sigma-1)}{\sigma-1}} + (1-H)\alpha_l^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}$ is the denominator from the expression for the gross revenue share of firms with the high uncorrelated distortion draw. Importantly, the parameters capturing uncorrelated and correlated distortions enter welfare in a multiplicatively separable way. This allows me to make the analysis more lucid by looking at their effects separately.

Before moving to the two separate cases, I define two terms that I will use in the subsequent analysis.

Definition. *Welfare under autarky, W_A, is the level of welfare when exporting is infinitely costly, and, therefore, $\zeta = 0$.*

Definition. *Gains from trade are defined as the current welfare relative to the welfare under autarky, $\frac{W}{W_A}$. The gains from trade are positive when $\frac{W}{W_A} > 1$ and negative when $\frac{W}{W_A} < 1$.*

Uncorrelated production distortions

The distortions uncorrelated with productivity imply $\gamma = 0$, which simplifies the expression for welfare to

$$W = \frac{\sigma-1}{\sigma}\left(\frac{L}{\sigma f_d}\right)^{\frac{1}{\sigma-1}}\left(\frac{\theta_r}{\theta_n}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{\sigma-1}{k-(\sigma-1)}\frac{f_d}{f_e}\left(1+\zeta^{\frac{k}{\sigma-1}}\frac{f_x}{f_d}\right)\theta_n\right)^{\frac{1}{k}}\varphi^{min}. \tag{2.26}$$

Distortions affect welfare in two ways. First, an increase in distortion draws, that is in net subsidies to firms, increases the net tax on labour and, thus, decreases the net wage. Second, higher distortion draws make entry more attractive, and, by the free-entry condition, they increase the threshold profit draw and decrease the price index. As pointed out earlier, these effects exactly offset each other in response to a proportional increase in all distortion

draws; only the dispersion of distortions affects welfare. Letting α_h increase while keeping α_l constant introduces misallocation and leads to the following proposition:

Proposition 1. *When assumptions in subsection 2.3.1 hold, $\delta_d = \delta_x = \delta$ for each firm, and $\gamma = 0$, then increasing the difference between α_h and α_l*

(i) reduces welfare under autarky,

(ii) keeps the gains from trade unchanged and always positive,

(iii) keeps the effect of a marginal reduction in variable trade costs on welfare unchanged and always positive.

Part (i) of the proposition comes from

$$\frac{\partial \log W_A}{\partial \log \alpha_h} = -\frac{\partial \log W_A}{\partial \log \alpha_l} = -\frac{\sigma(k\sigma - (\sigma-1))}{(\sigma-1)^2}(h_n - h_r) < 0, \tag{2.27}$$

and the already noted fact that $h_n > h_r$ whenever $\alpha_h > \alpha_l$. It is the standard result that even uncorrelated distortions lead to misallocation, as they induce some firms to produce too much and other firms to produce too little. Part (ii) of the proposition is based on a straightforward observation that

$$\frac{W}{W_A} = \left(1 + \zeta^{\frac{k}{\sigma-1}} \frac{f_x}{f_d}\right)^{\frac{1}{k}} \tag{2.28}$$

is always greater than one and does not depend on distortions. Finally, part (iii) of the proposition comes from

$$\frac{\partial \log W}{\partial \log \tau} = -\frac{\zeta^{\frac{k}{\sigma-1}} \frac{f_x}{f_d}}{1 + \zeta^{\frac{k}{\sigma-1}} \frac{f_x}{f_d}} = -\lambda_n^x = -\lambda_r^x < 0, \tag{2.29}$$

where λ_n^x and λ_r^x are respectively the share of the net export revenues in the total net revenues and the share of the gross export revenues in the total gross revenues, and they equal each other in the case of uncorrelated *production distortions*. The minus sign before the expression corresponds to a positive effect of a *reduction* in variable trade costs.

The results in Proposition 1 are not particularly surprising, although it is interesting to learn that the beneficial reallocation due to opening to international trade is completely unaffected by uncorrelated distortions, at least when assuming the Pareto distribution of productivity. In any case, the results serve as a useful benchmark for comparison with the effect of

distortions that are correlated with productivity, which I analyse next.

Perfectly correlated production distortions

I now focus on the case where $\alpha_h = \alpha_l$, so that the logarithm of distortions is perfectly correlated with the logarithm of productivity.[23] I can then simplify the expression for welfare to

$$W = \frac{\sigma-1}{\sigma}\left(\frac{L}{\sigma f_d}\right)^{\frac{1}{\sigma-1}}\left(\frac{k-(\sigma(1+\gamma)-1)}{k-(\sigma-1)(1+\gamma)}\frac{1+\zeta^{\frac{k+\gamma}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}{1+\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}\right)^{\frac{\sigma}{\sigma-1}} \left(\frac{\sigma(1+\gamma)-1}{k-(\sigma(1+\gamma)-1)}\frac{f_d}{f_e}\left(1+\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}\right)\right)^{\frac{1}{k}}\varphi^{min}. \tag{2.30}$$

Similar to the previous case, distortions affect welfare through their impact on the net wage and on the threshold profit draw. The effects of the correlated distortions are summarized in the following proposition:

Proposition 2. *When assumptions in subsection 2.3.1 hold and $\alpha_h = \alpha_l = 1$ for all firms, then*

(i) both reducing γ below zero and increasing γ above zero reduces welfare under autarky,

(ii) both reducing γ below zero and increasing γ above zero reduces the gains from trade; the gains from trade are always positive with negative γ, but they can be positive or negative with positive γ,

(iii) the effect of a marginal reduction in variable trade costs on welfare is always positive with negative γ but ambiguous with positive γ.

Part (i) of the proposition holds because

$$\frac{\partial \log W^A}{\partial \gamma} = -\frac{\gamma\sigma[k\sigma-(\sigma-1)]}{(\sigma-1)[k-(\sigma(1+\gamma)-1)][k-(\sigma-1)(1-\gamma)][\sigma(1+\gamma)-1)]}, \tag{2.31}$$

[23] In a scatter plot of the two logarithms, all observations would lie on a straight line with the slope γ. This may seem like an excessively restrictive assumption, but note that rather than analysing a separate, special type of distortions, this subsection analyses the *correlated component* of a more general class of distortions, drawing on the fact that the correlated and uncorrelated components enter the welfare expression (2.25) in a multiplicatively separable way.

which has an opposite sign to the sign of γ. Negative γ corresponds to a situation where unproductive firms are subsidised at the expense of the productive ones. As a result, the firm size distribution becomes less dispersed than would be efficient, leading to a welfare loss. On the contrary, positive γ corresponds to 'picking winners', whereby the most productive firms are subsidised. Positive γ, too, reduces welfare, because it makes the firm size distribution excessively dispersed and the number of varieties available to consumers inefficiently small. While the welfare loss from supporting the 'good' firms is somewhat less intuitive than loss from subsidising the inefficient ones, the result is not surprising in the light of the fact that undistorted monopolistic competition with the CES preferences and the Pareto distribution of productivity leads to efficient outcomes (Dhingra and Morrow, 2014).

Unlike the uncorrelated distortions, the correlated distortions also affect the reallocation resulting from opening to trade. As noted earlier, the ratio of the total export net revenues to the total domestic net revenues is given by $\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}$, and its elasticity with respect to changes in relative costs of exporting ζ, therefore, increases as γ decreases. In the corresponding ratio for gross revenues, the γ additionally enters the numerator of the exponent on ζ, which captures the fact that while the correlated distortions change the dispersion of gross revenues r_m in the same direction as they change the dispersion of the net revenues n_m,[24] they do so to a lesser extent. The overall gains from trade compared to autarky are given by

$$\frac{W}{W^A} = \frac{\left(1+\zeta^{\frac{k+\gamma}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}\right)^{\frac{\sigma}{\sigma-1}}}{\left(1+\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}}}. \tag{2.32}$$

When the variable or the fixed trade costs are very high and there is no trade, it trivially holds that $\frac{W}{W^A}=1$ irrespective of distortions. When trade is no more costly than domestic sales, that is, when $\tau=1$ and $f_x=f_d$, $\frac{W}{W^A}=2^{\frac{1}{k}}$ independently of distortions.[25] However, for all cases that are intermediate between autarky and no trade costs, the overall gains from trade with correlated distortions are smaller that what they would be without them. This can be seen by

[24] $\frac{\partial\frac{k+\gamma}{\sigma(1+\gamma)-1}}{\partial\gamma}<0$.

[25] More generally, $\frac{W}{W^A}$ does not depend on distortions whenever $\zeta=1$.

calculating the semi-elasticity of this expression with respect to γ,

$$\frac{\partial \log \frac{W}{W^A}}{\partial \gamma} = \frac{\log \zeta \sigma(k\sigma - (\sigma-1))}{(\sigma-1)(\sigma(1+\gamma)-1)^2}\left(\lambda_n^x - \lambda_r^x\right), \tag{2.33}$$

where the export shares of net and gross revenues are now given respectively by $\lambda_n^x = \frac{\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}{1+\zeta^{\frac{k}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}$ and $\lambda_r^x = \frac{\zeta^{\frac{k+\gamma}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}{1+\zeta^{\frac{k+\gamma}{\sigma(1+\gamma)-1}}\frac{f_x}{f_d}}$. As long as $0 < \zeta < 1$, this expression has an opposite sign to the sign of γ. That means that both positively and negatively correlated distortions reduce the gains from trade compared to autarky, which is the first statement in part (ii) of Proposition 2. Since $\frac{\partial \log W}{\partial \gamma} = \frac{\partial \log W^A}{\partial \gamma} + \frac{\partial \log \frac{W}{W^A}}{\partial \gamma}$, it also means that the proportional welfare gains from removing distortions are larger in a trading economy than in autarky.

The second statement in part (ii) of the proposition describes the overall sign of the gains from trade. With negative γ, the numerator of the expression 2.32 contains the powers over both ζ and the entire parentheses that are larger than in the denominator. The gains from trade are, therefore, always positive with negative γ.[26] With positive γ, on the contrary, the sign of the gains from trade is ambiguous — welfare with trade can actually be lower than in autarky even under the present assumptions. The intuition behind this result is that trade makes the most productive firms larger. When these firms are already inefficiently large due to subsidies, making them even larger can reduce welfare.

The effect of a marginal reduction in trade costs on welfare is

$$\frac{\partial \log W}{\partial \log \tau} = -\lambda_n^x - \frac{\sigma(k+\gamma)}{\sigma(1+\gamma)-1}(\lambda_r^x - \lambda_n^x). \tag{2.34}$$

The first term has the same form as the term without distortions, although distortions affect the size of λ_n^x. The key difference is the second term, which formally captures the intuition described at the end of the previous paragraph. Trade leads to a reallocation towards the firms with higher profit draws, and can, therefore, alleviate or exacerbate the pre-existing

[26] An important qualification is that the negatively correlated distortions discussed in this section reduce the dispersion of firm revenues, but preserve the ranking of firms in terms of profit draws and, therefore, also size. Values of γ which reverse the ranking make the analysis unrealistic and intractable (see footnote 21). In the next section, I use simulations to show that the gains from trade can be negative with negatively correlated distortions if the distortions break the perfect rank-correlation between productivity and profit draws, that is, if they make some less productive firms more profitable and larger than some more productive firms.

inefficiently small or high dispersion of firm size. With negative γ, $\lambda_r^x > \lambda_n^x$, and the additional second term is positive (after a negative sign). This means, first, that a marginal reduction in variable trade costs always increases welfare, as stated in part (iii) of the proposition. Second, the second term illustrates the fact that there is inefficiently little trade — more trade would have the extra benefit of increasing the inefficiently small dispersion of firm size. On the contrary, with positive γ, the additional term is negative (after a negative sign), and the overall effect of a reduction in variable trade costs is ambiguous, again as stated in part (iii) of the proposition. There is then too much trade, in the sense that trade has the extra negative effect of further increasing the already too high dispersion of firm size.

2.3.3 Market-specific distortions

Some important distortions are likely to affect domestic sales but not export sales. These distortions exist wherever an ability to obtain large, profitable contracts with the government, state-owned enterprises or large private clients depends not exclusively on the quality of a firm, but also, or even primarily, on political connections, bribes or family ties. At the same time, some distortions, such as awarding export licences or quotas, can affect only export sales. In this subsection, I allow δ_d and δ_x to differ, and I assume that their draws are independent from each other. I keep the assumptions from subsection 2.3.1, but I simplify the analysis by assuming that both domestic and export distortions are uncorrelated with productivity, assuming $\gamma = 0$.

The profit draws are now given by $\mu_m = \varphi \alpha_{mv}^{\frac{\sigma}{\sigma-1}}$ and the pricing draws by $\nu_m = \varphi \alpha_{mv}$. In each market, the net and gross revenue shares of firms with the high distortion draw α_{mh} are respectively

$$h_n^m = \frac{H_m \alpha_{mh}^{\frac{k\sigma}{\sigma-1}}}{H_m \alpha_{mh}^{\frac{k\sigma}{\sigma-1}} + (1-H_m)\alpha_{ml}^{\frac{k\sigma}{\sigma-1}}} \tag{2.35}$$

and

$$h_r^m = \frac{H_m \alpha_{mh}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}}{H_m \alpha_{mh}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}} + (1-H_m)\alpha_{ml}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}}, \tag{2.36}$$

and the average profits from market m are the same as in the undistorted case

$$\bar{\pi}_m = f_m \frac{\sigma-1}{k-(\sigma-1)}. \tag{2.37}$$

Similar to the previous subsection, I define $\theta_n^m = H_m \alpha_{mh}^{\frac{k\sigma}{\sigma-1}} + (1-H_m)\alpha_{ml}^{\frac{k\sigma}{\sigma-1}}$ and $\theta_r^m = H_m \alpha_{mh}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}} + (1-H_m)\alpha_{ml}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}$, but now the expressions have become market-specific. Using these definitions, the ratio of net export revenues to the net domestic revenues is now $\zeta^{\frac{k}{\sigma-1}} \frac{\theta_n^x f_x}{\theta_n^d f_d}$, the threshold profit draw for selling in the domestic market becomes

$$\underline{\mu_d} = \left[\frac{\sigma-1}{k-(\sigma-1)} \frac{f_d}{f_e} \left(\theta_n^d + \zeta^{\frac{k}{\sigma-1}} \frac{\theta_n^x f_x}{f_d} \right) \right]^{\frac{1}{k}} \varphi^{min}, \tag{2.38}$$

and the mass of entrants is the same as without distortions. Welfare is given by a similar expression as in the case with uncorrelated *production distortions*, but the new expression shows clearly that different distortions now affect sales in different markets:

$$W = \frac{\sigma-1}{\sigma} \left(\frac{L}{\sigma f_d} \right)^{\frac{1}{\sigma-1}} \left(\frac{\theta_r^d + \zeta^{\frac{k}{\sigma-1}} \theta_r^x \frac{f_x}{f_d}}{\theta_n^d + \zeta^{\frac{k}{\sigma-1}} \theta_n^x \frac{f_x}{f_d}} \right)^{\frac{\sigma}{\sigma-1}} \left(\frac{\sigma-1}{k-(\sigma-1)} \frac{f_d}{f_e} \left(\theta_n^d + \zeta^{\frac{k}{\sigma-1}} \theta_n^x \frac{f_x}{f_d} \right) \right)^{\frac{1}{k}} \varphi^{min}. \tag{2.39}$$

The export shares in the total net and gross revenues are now respectively $\lambda_n^x = \frac{\zeta^{\frac{k}{\sigma-1}} \frac{\theta_n^x f_x}{\theta_n^d f_d}}{1+\zeta^{\frac{k}{\sigma-1}} \frac{\theta_n^x f_x}{\theta_n^d f_d}}$ and $\lambda_r^x = \frac{\zeta^{\frac{k}{\sigma-1}} \frac{\theta_r^x f_x}{\theta_r^d f_d}}{1+\zeta^{\frac{k}{\sigma-1}} \frac{\theta_r^x f_x}{\theta_r^d f_d}}$, and the corresponding domestic shares can be defined as $\lambda_n^d = 1-\lambda_n^x$ and $\lambda_r^d = 1-\lambda_r^x$.

The overall gains from trade compared to autarky are given by

$$\frac{W}{W^A} = \frac{\left(1+\zeta^{\frac{k}{\sigma-1}} \frac{\theta_r^x f_x}{\theta_r^d f_d}\right)^{\frac{\sigma}{\sigma-1}}}{\left(1+\zeta^{\frac{k}{\sigma-1}} \frac{\theta_n^x f_x}{\theta_n^d f_d}\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}}}. \tag{2.40}$$

Importantly, the earlier observation that an identical proportional change in the distortion draws of all firms leaves welfare unchanged only holds when both the domestic *and* the export distortion draws change. Any change in the domestic distortions draws relative to export distortions draws affects welfare even if it the same for all firms. The reason is that an increase in the export distortion draws relative to the domestic distortion draws is equivalent to an increase in a net export subsidy, which naturally affects the amount of trade and its effect on

welfare. Whether distortions overall favour domestic sales or exports can be seen from the relative size of λ_n^x and λ_r^x. When $\lambda_n^x > \lambda_r^x$, exports represent a larger share in net revenues than in gross revenues, and they are, therefore, subsidised relative to domestic sales. $\lambda_r^x > \lambda_n^x$, on the contrary, means that domestic sales are subsidised relative to exports. I summarize this in the following definition, which will be useful for expressing the effect of distortions in the current setup in the form of propositions:

Definition. *Distortions are biased towards exports if $\lambda_n^x > \lambda_r^x$, neutral if $\lambda_n^x = \lambda_r^x$ and biased towards domestic sales if $\lambda_r^x > \lambda_n^x$.*

I now turn to analysing first the effects of changes in the domestic distortions, and then the effects of changes in the export distortions, in each case possibly in the presence of the other type of distortions.

Domestic distortions

The effect of domestic distortions can then be summarized in the following proposition:

Proposition 3. *When assumptions in subsection 2.3.1 hold and $\gamma = 0$, then*

(i) increasing the difference between α_{dh} and α_{dl} reduces welfare under autarky,

(ii) (a) increasing α_{dh} while keeping α_{dl}, α_{xh} and α_{xl} constant increases the gains from trade whenever distortions are biased towards exports, neutral or weakly biased towards domestic sales, and it reduces the gains from trade whenever distortions are sufficiently strongly biased towards domestic sales,

(b) reducing α_{dl} while keeping α_{dh}, α_{xh} and α_{xl} constant increases the gains from trade whenever distortions are biased towards domestic sales, neutral or weakly biased towards exports, and it reduces the gains from trade whenever distortions are sufficiently strongly biased towards exports,

(c) simultaneously increasing α_{dh} and reducing α_{dl} in such a way that λ_r^x remains constant, while keeping α_{xh} and α_{xl} constant, increases the proportional gains from trade,

(d) the gains from trade are always positive when the distortions are neutral or biased towards domestic sales, but they can be positive or negative when the distortions are biased towards exports,

(iii) the effect of a marginal reduction in variable trade costs on welfare is always positive when the distortions are neutral or biased towards domestic sales, but it is ambiguous when the distortions are biased towards exports.

Part (i) of Proposition 3 follows straightforwardly from the fact that, in autarky, domestic distortions are equivalent to the *production distortions* discussed earlier,

$$\frac{\partial \log W_A}{\partial \log \alpha_{dh}} = -\frac{\sigma(k\sigma-(\sigma-1))}{(\sigma-1)^2}(h_n^d - h_r^d) < 0. \tag{2.41}$$

Part (ii)(a) of the proposition is based on the expression for the effect of an increase in the high domestic distortion draw on the gains from trade:

$$\frac{\partial \log \frac{W}{W_A}}{\partial \log \alpha_{dh}} = \frac{\sigma(k\sigma-(\sigma-1))}{(\sigma-1)^2}\left(\lambda_n^x h_n^d - \lambda_r^x h_r^d\right). \tag{2.42}$$

The expression combines two effects, which together determine its sign and size. The first effect is captured by the relative size of λ_n^x and λ_r^x and represents the fact that increasing one of the domestic distortions draws makes domestic sales more attractive relative to export sales. I call this effect the *market misallocation effect*, because it is related to misallocation across domestic and export markets. When $\lambda_n^x > \lambda_r^x$ and exports are subsidised relative to domestic sales, increasing the domestic distortion draw is beneficial for welfare because it mitigates the pro-export bias in sales. The *market misallocation effect* goes in the opposite direction when $\lambda_n^x < \lambda_r^x$. Increasing the domestic distortion draws then further aggravates misallocation due to having to much exports. The second effect is captured by the relative size of h_n^d and h_r^d, and it represents the misallocation due to the presence of domestic distortions that is reduced as a larger share of sales is made in the export rather than domestic markets. I call this effect the *firm misallocation effect*, because it is related to misallocation across firms. To illustrate it, assume that distortions are neutral, so that $\lambda_n^x = \lambda_r^x = 1 - \lambda^d$. Results 2.41 and 2.42 then together allow me to express the overall effect of the increased domestic distortions on

welfare in a trading economy as the effect in autarky multiplied by the share of the aggregate sales that are made in the domestic market,

$$\frac{\partial \log W}{\partial \log \alpha_{dh}} = \lambda^d \frac{\partial \log W_A}{\partial \log \alpha_{dh}}. \tag{2.43}$$

When $\lambda_n^x > \lambda_r^x$, the two effects go in the same direction and increasing α_{dh} increases the gains from trade. When $\lambda_r^x > \lambda_n^x$ but the difference is small, the *firm misallocation effect* dominates over the *market misallocation effect*, and increasing α_{dh} again increases the gains from trade. These two results together lead to the first claim in the part (ii)(a) of Proposition 3. The second claim is then based on the fact that when $\lambda_r^x > \lambda_n^x$ and the difference is sufficiently large, the *market misallocation effect* dominates, and increasing α_{dh} reduces the gains from trade.

Part (ii)(b) of Proposition 3 is based on a similar analysis as part (ii)(a).

$$\frac{\partial \log \frac{W}{W_A}}{\partial \log \alpha_{dl}} = \frac{\sigma(k\sigma-(\sigma-1))}{(\sigma-1)^2}\left(\lambda_n^x(1-h_n^d)-\lambda_r^x(1-h_r^d)\right). \tag{2.44}$$

The *firm misallocation effect* of reducing α_{dl} again leads to higher gains from trade. However, the *market misallocation effect* of reducing α_{dl} increases the gains from trade when distortions are biased towards domestic sales but reduces them when distortions are biased towards exports. The interaction between the two effects then leads to the results in Part (ii)(b) of Proposition 3.

Part (ii)(c) of the proposition represents another way of highlighting the *firm misallocation effect*. It states that increasing the dispersion of domestic distortions in a way that is neutral to the *market distortions effect* in the sense that it leaves the share of exports in the aggregate gross revenues unchanged increases the gains from trade. The proof proceeds in a number of steps. First note that when α_{xh} and α_{xl} are fixed, keeping $\lambda_r^x = 1-\lambda_r^d$ unchanged requires that θ_r^d is fixed at some constant C. This allows α_{dl} to be written as a function of α_{dh}

$$\alpha_{dl}(\alpha_{dh}) = \left(\frac{C - H_d \alpha_{dh}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}}{1-H_d}\right)^{\frac{\sigma-1}{k\sigma-(\sigma-1)}}, \tag{2.45}$$

and plugging this into the expression for θ_n^d gives

$$\theta_n^d(\alpha_{dh}) = H_d \alpha_{dh}^{\frac{k\sigma}{\sigma-1}} + (1-H_d)\left(\frac{C - H_d \alpha_{dh}^{\frac{k\sigma-(\sigma-1)}{\sigma-1}}}{1-H_d}\right)^{\frac{k\sigma}{k\sigma-(\sigma-1)}}. \tag{2.46}$$

The derivative of this function is positive,

$$\theta_n^{d\prime}(\alpha_{dh}) = \frac{(k\sigma-(\sigma-1))H_d \alpha_h^{d\,\frac{k\sigma}{\sigma-1}}}{(\sigma-1)\alpha_{dh}^{\,2}}(\alpha_{dh}-\alpha_{dl}) > 0, \tag{2.47}$$

so as the domestic distortions become more dispersed, θ_n^d increases. The expression for the gains from trade 2.40 then clearly shows that when θ_r^d is fixed and θ_n^d increases, the gains from trade increase.

Part (ii)(d) of the proposition then follows from 2.40 and the fact that $\lambda_r^x > \lambda_n^x$ if, and only if, $\zeta^{\frac{k}{\sigma-1}} \frac{\theta_r^x f_x}{\theta_r^d f_d} > \zeta^{\frac{k}{\sigma-1}} \frac{\theta_n^x f_x}{\theta_n^d f_d}$.

Finally, part (iii) of Proposition 3 comes from

$$\frac{\partial \log W}{\partial \log \tau} = -\lambda_n^x - \frac{k\sigma}{\sigma-1}(\lambda_r^x - \lambda_n^x), \tag{2.48}$$

When distortions are biased towards domestic sales, a fall in variable trade costs increases welfare. However, when distortions are strongly biased towards exports, a fall in variable trade costs can actually reduce welfare, as it exacerbates an already high misallocation of sales towards the export market.

Export distortions

The effect of distortions specific to exports can in turn be summarized in the following proposition:[27]

Proposition 4. *When assumptions in subsection 2.3.1 hold and $\gamma = 0$, then*

(i) changing α_{xh} or α_{xl} does not affect welfare under autarky,

(ii) (a) increasing α_{xh} while keeping α_{xl}, α_{dh} and α_{dl} constant reduces the gains

[27] Although Proposition 4 is mostly symmetrical to Proposition 3, it does not include parts (ii)(d) and (iii), because these results are not specific to either domestic or export distortions and have, therefore, been exhausted by Proposition 3.

from trade whenever distortions are biased towards exports, neutral or weakly biased towards domestic sales, and it increases the gains from trade whenever distortions are sufficiently strongly biased towards domestic sales,

(b) reducing α_{xl} while keeping α_{xh}, α_{dh} and α_{dl} constant reduces the gains from trade whenever distortions are biased towards domestic sales, neutral or weakly biased towards exports, and it increases the gains from trade whenever distortions are sufficiently strongly biased towards exports,

(c) simultaneously increasing α_{xh} and reducing α_{xl} in such a way that λ_r^x remains constant, while keeping α_{dh} and α_{dl} constant, reduces the proportional gains from trade,

Part (i) of the proposition follows easily from the observation that distortions specific to export sales are by definition irrelevant in autarky,

$$\frac{\partial \log W_A}{\partial \log \alpha_{xh}} = 0. \tag{2.49}$$

Part (ii)(a) is due to a similar expression as in the case of domestic distortions,

$$\frac{\partial \log \frac{W}{W_A}}{\partial \log \alpha_{xh}} = -\frac{\sigma(k\sigma-(\sigma-1))}{(\sigma-1)^2}\left(\lambda_n^x h_n^x - \lambda_r^x h_r^x\right). \tag{2.50}$$

The expression again combines two effects. The *market misallocation effect* is due to the fact that when $\lambda_n^x > \lambda_r^x$ and distortions are biased towards exports, increasing one of the export distortion draws further aggravates the consequences of the pro-export bias, while when $\lambda_r^x > \lambda_n^x$, it alleviates the bias towards domestic sales. The *firm misallocation effect* is due to the natural observation that introducing distortions in exports reduces their benefits. This effect can again be best illustrated by assuming that distortions are neutral and $\lambda_n^x = \lambda_r^x = \lambda^x$. The effect of export distortions on welfare is then again similar to the effect of domestic distortions in autarky but proportional to the share of exports in the aggregate sales. When $\lambda_n^x > \lambda_r^x$, the two effects point in the same direction and mean that increasing α_{xh} unambiguously reduces the gains from trade. When $\lambda_r^x > \lambda_n^x$ but the difference is small, the *firm misallocation effect*

dominates and the effect on gains from trade is again negative. These results explain the first claim in the part (ii) of Proposition 4. However, when $\lambda_r^x > \lambda_n^x$ and the difference is large, then the *market misallocation effect* dominates and increasing α_{xh} increases welfare. Part (ii)(b) then analogously follows from

$$\frac{\partial \log \frac{W}{W_A}}{\partial \log \alpha_{xl}} = -\frac{\sigma(k\sigma-(\sigma-1))}{(\sigma-1)^2}\left(\lambda_n^x(1-h_n^x)-\lambda_r^x(1-h_r^x)\right). \tag{2.51}$$

Finally, the proof of part (ii)(c) of Proposition 4 is analogous to the proof of the corresponding part of Proposition 3. As before, it is possible to express θ_n^x as a function of (α_{xh}) and show that its first derivative is positive. The only difference is that increasing θ_n^x while θ_r^x is fixed reduces rather than increases the gains from trade as given by 2.40.

2.4 Simulations

The analysis in the previous section provided a number of theoretical results for the special but important case where productivity is Pareto distributed and distortions are either uncorrelated with productivity or correlated with it in such a way that they preserve the ranking of firms in terms of both net and gross revenues. In particular, I have shown that under these assumptions, the *production distortions* uncorrelated with productivity do not change the gains from trade, the *production distortions* negatively correlated with productivity reduce the gains from trade, and the distortions to domestic sales which are not too strongly biased towards exports increase the gains from trade. In this section, I use simulations to extend the analysis in two ways. First, I test how the ranking of the different distortions scenarios in terms of the size of the gains from trade changes when the assumptions change in one of the following three ways: the trading countries are asymmetrical; the correlated distortions are such that they change the ranking of firms in terms of size; or the productivity is distributed according to the lognormal rather than the Pareto distribution. Second, I use estimates from the previous research to calibrate the model and to obtain a preliminary assessment on the quantitative relevance of the analysed effects.

As the discussion so far has already revealed, distortions may come in many shapes and sizes — they can be uncorrelated, negatively correlated, positively correlated; they can affect

domestic sales, exports or all production; and they can be biased towards domestic sales or exports. The number of the possible combinations of these properties is rather large. In order to focus the subsequent analysis and to keep the presented graphs intelligible, I concentrate on four scenarios which may be particularly important in the real world and which together represent the key novel mechanisms described in this chapter: no distortions; *production distortions* uncorrelated with productivity; *production distortions* negatively correlated with productivity; and distortions to domestic sales which are uncorrelated with productivity and which are not strongly biased towards exports.[28]

2.4.1 Robustness to alternative assumptions

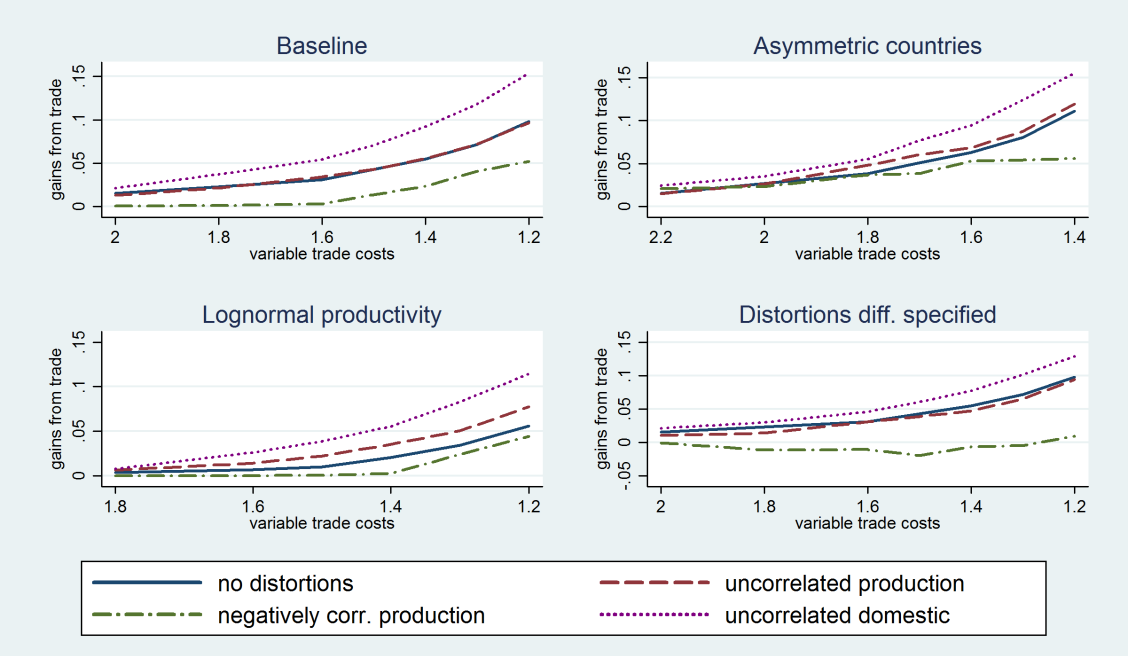
In this subsection, I analyse how the relative size of the gains from trade with different types of distortions changes when the assumptions change. As a default, I keep the assumptions stated in section 2.3.1. To calibrate the model, I partly follow Melitz and Redding (2015). Like these authors, I set the shape parameter of the Pareto distribution to be $k = 4.25$ and the elasticity of substitution to be $\sigma = 4$. Determining the scale parameter of the Pareto distribution is equivalent to determining the unit in which productivity is measured, so I normalise it to $\varphi^{min} = 1$. Scaling the fixed costs, the entry costs and labour supply by the same proportion affects average firm size but not the cutoff profit draws, so I normalize the domestic fixed costs to $f_d = 1$. Changes in labour supply then affect the mass of entrants and the level of welfare, but they do not alter the proportional changes in welfare in response to changes in trade costs. I, therefore, also normalize labour supply to $L = 1$. In this subsection, I also arbitrarily set the fixed costs of exporting as $f_x = 1$ and the sunk costs of entry as $f_e = 1$.[29]

In the first scenario, there are no distortions. In the second scenario, there are *production distortions* uncorrelated with productivity such that $H = 0.5$, $\alpha_{dh} = \alpha_{xh} = 1.05$ and $\alpha_{dl} =$

[28] One case discussed earlier but not analysed in the simulations is the case of distortions positively correlated with productivity. I instead focus on the negatively correlated distortions because the literature tends to suggest that they are more relevant in practice (Restuccia and Rogerson, 2008; Bartelsman et al., 2013) and find that they better fit the data (Hsieh and Klenow, 2009; Yang, 2014). I also omit the case of distortions affecting only export sales and instead focus on distortions specific to domestic sales. First, the two cases are largely symmetric, so it makes sense to analyse only one of them. Second, a situation with a highly distorted domestic market but undistorted export market resembles the reality of most countries much more than a situation with undistorted domestic market but strongly distorted export market. Lastly, I do not include the case of distortions to domestic sales which are strongly biased towards exports. This is because the result that export subsidies reduce the gains from trade is not specific to models with heterogeneous firms, on which I focus in this chapter.

[29] Changing these parameters does not qualitatively alter the findings presented below.

Figure 2.1: Distortions and gains from trade under different assumptions



$\alpha_{xl} = 0.6$. In the third scenario, distortions are perfectly correlated with productivity, with $\gamma = -0.5$. Finally, the fourth scenario is the same as the second, but only domestic sales are distorted, so $H_d = 0.5$, $\alpha_{dh} = 1.05$ and $\alpha_{dl} = 0.6$.[30]

Figure 2.1 shows the results. Each of the four panels plots the size of the gains for trade in each scenario against the variable trade costs for all four scenarios. The top left panel shows the results under the baseline assumptions. The gains from trade are highest with the distortions affecting only domestic sales, and they are lowest with the negatively correlated production distortions. Uncorrelated production distortions lead to the same gains from trade as in a situation without distortions, except for some random simulation noise.

The top right panel relaxes the assumption that trading countries are symmetric. Instead, the foreign country has 3 times larger supply of labour, and its firms do not face any distortions. The results are qualitatively the same as before. The gains from trade are again similar with the uncorrelated production distortions as without any distortions, and they are largest with the distortions only affecting domestic sales and smallest with the negatively correlated

[30]The subsidised firms are ex post larger than the taxed firms, so in order for the domestic distortions to be biased neither towards domestic sales nor towards exports, the subsidy rate $\alpha_{dh} - 1$ needs to be smaller than the tax rate $1 - \alpha_{dl}$.

production distortions.

The bottom left panel returns to the symmetricity, but it assumes that productivity is distributed according to the lognormal rather than the Pareto distribution.[31] The ranking of the gains from trade in different scenarios is again similar. The only difference is that with the lognormal distribution, the presence of uncorrelated production distortions increases the gains from trade relative to the case with no distortions.

Finally, the bottom right panel shows the gains from trade corresponding to the case when production distortion draws are not generated as before, but instead they are drawn according to the formula $\delta_d = \delta_x = \epsilon + \rho \frac{\log\varphi - mean(\log\varphi)}{sd(\log\varphi)}$, where ϵ is a random variable following the normal distribution with a mean of one and some standard deviation ϕ, and ρ is a parameter determining the correlation between distortions and productivity such that $\rho < 0$ corresponds to negatively correlated distortions.[32] The bottom right panel shows that the relative size of the gains from trade in the different scenarios is similar to the relative size of the gains from trade in previous cases, although the gains with uncorrelated distortions affecting domestic sales are now not much above those in the scenario without distortions. Importantly, the negatively correlated production distortions now make some highly productive firms small while making some unproductive firms big. As a result, the gains from trade with such distortions can actually be negative.

2.4.2 Magnitude of the effects

Using simulations, the previous subsection documented that the relative size of the gains from trade with different types of distortions, derived analytically in section 2.3, is quite robust to a number of modifications in the assumptions. A key question at this point is how important the discussed effects are quantitatively. Finding a precise and reliable answer to this question is very difficult, because it requires observing the distortions, which are by their nature largely unobservable. While it is sometimes possible to observe individual distortions such as taxes on firms of a particular size or subsidies for state-owned enterprises, the effect of any one distortion is likely to be rather small. Moreover, some distortions can work in opposite

[31] I arbitrarily set both the mean and the standard deviation of the corresponding normal distribution to 0.24.

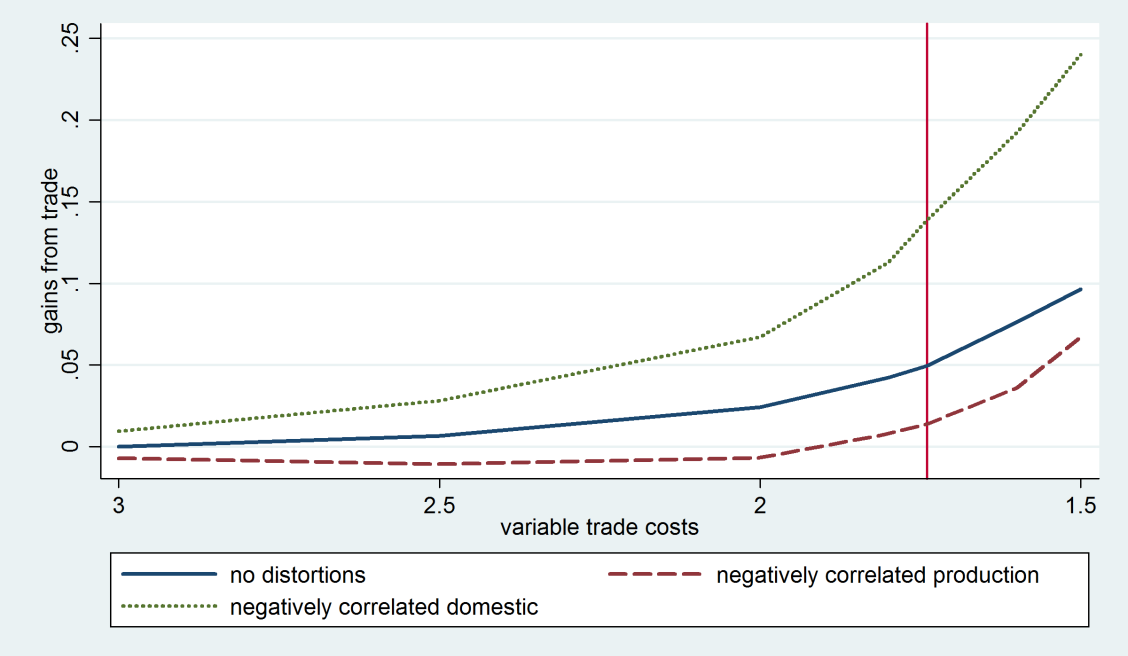
[32] I arbitrarily set $\phi = 0.3$ and $\rho = 0$ for uncorrelated scenarios and $\phi = 0.2$ and $\rho = 0.3$ for the negatively correlated scenario.

directions and offset each other. What is, therefore, required is measuring the aggregate effects of a number of distortions rather than of any single distortion. The aggregate effects can be inferred only indirectly as in Hsieh and Klenow (2009) or Yang (2014), applying rather strong identifying assumptions. I leave a rigorous calibration of the model presented in this chapter for future work and instead ask in this subsection whether the discussed effects can, potentially, be large. To address this question, I focus on the distortions negatively correlated with productivity because, as discussed earlier, they are likely to be empirically relevant, and, in particular, because they seem to lead to particularly pronounced effects on welfare and on the gains from trade. I tentatively calibrate the size of distortions and their correlation with productivity according to the results by Hsieh and Klenow (2007). I then look at the two cases with opposite effects on the gains from trade — the case when distortions affect both domestic and export sales and the case when they affect only domestic sales.

The setting is as follows. There are two countries — the home country and the rest of the world. They have the same distribution of productivity which follows the Pareto distribution. The economy of the home country can suffer from distortions, while the rest of the world is undistorted. I assume the home country is very large (e.g. China or India), so that its population forms one sixth of the global population. I again set $k = 4.25$ and $\sigma = 4$ and normalize the scale parameter of the Pareto distribution, the domestic fixed costs and labour supply respectively to $\varphi^{min} = 1$, $f_d = 1$ and $L = 1$. The sunk costs of entry determine the survival rate, and I set them in such a way that in a closed undistorted economy, the survival rate is 55%, which is the number reported for 5-year-old US firms by Bartelsman et al. (2013). I then set the fixed costs of exporting so that with the variable trade costs found by Anderson and van Wincoop (2004), $\tau = 1.74$, 28% firms export, as reported by Defever and Riaño (2012) for China. This procedure leads to $f_e = 1.25$ and $f_x = 0.9$.

In order to match the pronounced welfare effects found by Hsieh and Klenow (2009), I let distortions be generated according to the process corresponding to the bottom right panel of figure 2.1. I calibrate ϕ and ρ so that the correlation between the δ and the φ is -0.65, as reported by Hsieh and Klenow (2007), and the welfare loss from the distortions in a closed economy amounts to 37%, which is close to the estimates that Hsieh and Klenow (2009) report for the potential welfare gains that China in 2001 or India in 1987 could have achieved

Figure 2.2: Potential magnitude of the effects



by removing the distortions.

Figure 2.2 plots the gains from trade against the variable trade costs in the two distorted scenarios as well as in the scenario without distortions. The vertical line marks the benchmark level of trade costs, 1.74. It turns out that the proportional change in the gains from trade due to distortions can be substantial. On one hand, at the benchmark level of variable trade costs, the negatively correlated distortions affecting both domestic and export sales reduce the 5% gains from trade that would accrue without distortions by more than two thirds, and, at somewhat higher variable trade costs, such distortions even make the gains from trade marginally negative. On the other hand, when distortions affect only domestic sales, the gains from trade are almost three times as large as without distortions. While these results need to be taken with more than a grain of salt, they suggest that the firm-specific distortions analysed in this chapter can potentially have a first-order impact on the size of the gains from trade.

2.5 Arkolakis, Costinot and Rodriguez-Clare (2012)

The previous two sections have analysed how changes in the underlying parameters of the model, and, in particular, changes that are related to firm-specific distortions, affect the welfare implications of international trade. However, the influential study by Arkolakis et al. (2012) showed that even models that differ dramatically in their microfoundations and seem to contain additional, or different, sources of the gains from trade, can actually predict an identical total amount of welfare gains from trade conditional on certain observable parameters. In particular, the authors showed that the change in welfare in response to any foreign shock can be written as[33]

$$\hat{W} = \left(\hat{\lambda}_r^d\right)^{\frac{1}{\epsilon_r}}, \tag{2.52}$$

where $\epsilon_r = \frac{\partial \log(\lambda_r^x/\lambda_r^d)}{\partial \log \tau}$ is the elasticity of the ratio of exports and domestic sales with respect to variable trade costs,[34] and the hat marks a ratio of the new and the old value of a variable. One of the models that fall within the class of the models studied by ACR is the Melitz (2003) model with productivity following the Pareto distribution, on which my analysis is based. If the results by ACR hold even in the presence of distortions, considering distortions will be of limited importance for the purpose of evaluating the gains from trade. An important question is, therefore, whether, and if so, in what ways, the ACR formula changes in a distorted economy. In the following analysis, I keep the assumptions stated in subsection 2.3.1, and I attempt to answer this question in turns for uncorrelated production distortions, perfectly correlated production distortions and uncorrelated market-specific distortions.

As I have shown in subsection 2.3.2, uncorrelated production distortions such that $\delta_d = \delta_x$ and $\gamma = 1$ do not change the effect of trade on welfare under the present assumptions. It is, therefore, not surprising that the trade elasticity is the same as in the model without distortions, $\epsilon_r = -k$, and the ACR formula holds in its original form. However, when production

[33] Here, I present the ACR results using the notation from my model. Importantly, in line with Hsieh and Klenow (2009) and related studies, I assume that the domestic and export sales observed in the data correspond to the gross rather than the net revenues as defined in the model.

[34] The authors define the trade elasticity using the ratio of imports, rather than exports, to domestic sales. However, I assume balanced trade, so exports equal imports.

distortions are correlated with productivity, the trade elasticity becomes

$$\epsilon_r = -\frac{(k+\gamma)(\sigma-1)}{\sigma(1+\gamma)-1}, \tag{2.53}$$

which, in absolute value, is greater than the elasticity without distortions with $\gamma < 0$ and smaller with $\gamma > 0$. The intuition behind this result is that when $\gamma < 0$, the distribution of profit draw becomes less dispersed and, as a result, a given change in variable trade costs and, therefore, also in the profit draw threshold for exporting leads to a larger share of firms switching between non-exporting and exporting. The opposite is true when $\gamma > 0$. The expression for the change in welfare with perfectly correlated production distortions is then

$$\hat{W} = \left(\hat{\lambda}_r^d\right)^{\frac{1}{\epsilon_r}\frac{(k+\gamma)(\sigma-1)}{k[\sigma(1+\gamma)-1]}} \left(\frac{\hat{\lambda}_n^d}{\hat{\lambda}_r^d}\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}}. \tag{2.54}$$

This expression differs from the original ACR formula in two ways. The first difference is the elasticity-correcting term $\frac{(k+\gamma)(\sigma-1)}{k[\sigma(1+\gamma)-1]}$, which is greater than one when $\gamma < 0$ and smaller than one when $\gamma > 0$. In the ACR approach, the trade elasticity serves to determine how large terms-of-trade change, and therefore also welfare change, can be inferred from a given change in the share of domestic sales in total sales. With $\gamma < 0$, the elasticity-correcting term accounts for the fact that the elasticity is higher than it would be without distortions. Without this correction, the high estimated elasticity would be mistakenly interpreted as suggesting that a given change in the domestic share implies only a relatively small change in terms of trade and welfare. This mechanism alone would thus make the ordinary ACR formula underestimate the welfare changes with $\gamma < 0$ and overestimate them with $\gamma > 0$.

The second difference in the ACR formula with correlated distortions is the term $\left(\hat{\lambda}_n^d/\hat{\lambda}_r^d\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}}$, capturing the fact that with correlated distortions, trade can, in addition to the usual welfare effects, aggravate or alleviate the inefficiently large or small dispersion of firm size. This term can in general be larger or smaller than one, depending on the particular two levels of trade costs that the expression is comparing. However, when comparing a situation with trade to autarky, the expression becomes $\left(\lambda_n^d/\lambda_r^d\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}}$, which is greater than one for $\gamma < 0$ and smaller than one for $\gamma > 0$. On its own, this mechanism would, therefore, make the standard

ACR formula underestimate the overall gains from trade compared to autarky for $\gamma < 0$ and overestimate them for $\gamma > 0$.

The two mechanisms mean that the original ACR formula no longer holds when correlated distortions are present. While it is not possible to say in general whether the formula will underestimate or overestimate the welfare change between two arbitrary situations, the two mechanisms point in the same direction when the gains from trade relative to autarky are concerned. The original formula will underestimate the gains from trade when $\gamma < 0$ and overestimate them when $\gamma > 0$.

Finally, with uncorrelated market-specific distortions, that is, when $\gamma = 0$ and the draws of δ_d and δ_x are independent from each other, the trade elasticity is again $\epsilon_r = -k$, as in the undistorted model. However, the expression for changes in welfare becomes

$$\hat{W} = \left(\hat{\lambda}_r^d\right)^{\frac{1}{\epsilon_r}} \left(\frac{\hat{\lambda}_n^d}{\hat{\lambda}_r^d}\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}} . \tag{2.55}$$

It differs from the standard ACR formula by the term $\left(\hat{\lambda}_n^d / \hat{\lambda}_r^d\right)^{\frac{k\sigma-(\sigma-1)}{k(\sigma-1)}}$. Interestingly, whether this term is greater or smaller than one does not depend on how distorted either domestic or export sales are, but only on whether the changes make distortions more biased towards exports or towards the domestic sales. In particular, when distortions are becoming more biased towards domestic sales, that is, when $\hat{\lambda}_n^d > \hat{\lambda}_r^d$, then the standard ACR formula will underestimate the change in welfare. On the contrary, when distortions are becoming more biased towards export sales, and $\hat{\lambda}_n^d < \hat{\lambda}_r^d$, then the standard formula will overestimate the change in welfare. This result also implies that when distortions are overall biased towards domestic sales, the original ACR formula will underestimate the gains from trade, and when distortions are biased towards exports, it will overestimate them. The reason for this result is that when distortions are biased towards domestic sales, a reduction in trade costs has an added benefit of alleviating the efficiency due to exports being too low, and when distortions are biased towards exports, it has an extra cost of aggravating the inefficiency due to exports being too high. The original formula does not take this into account, which leads to the documented biases.

2.6 Conclusion

This chapter investigates the impact of international trade on welfare in the presence of policy distortions leading to a misallocation of the factors of production across heterogeneous firms. I formulate a model of international trade where firms differ not only by their productivity but also by their distortion draws. Assuming a particular joint distribution of productivity and distortions, I then analyse how the presence of different types of distortions affects the welfare gains from trade. Distortions that affect all sales of firms do not change the gains from trade when they are uncorrelated with productivity, but they reduce the gains from trade whenever their correlation with productivity is either negative or positive. When distortions affect domestic and export sales differently, then as long as they do not lead to an excessively large share of exports in the total sales, they increase the gains from trade whenever domestic sales are more distorted than exports. Simulations show that these results are potentionally quantitatively important and robust to a number of changes in the assumptions.

The chapter clearly demonstrates that firm-level policy distortions can significantly alter how countries benefit from international trade, and it shows that the sign and the size of this effect crucially depends on the type of distortions. However, the present chapter does not provide a definite answer regarding the type and magnitude of the distortions that are likely to exist in real economies. There are two possible reactions to this apparent limitation of the chapter. The first is not to take it as a limitation but rather to focus on the fact that different types of distortions are going to be dominant in different contexts. My results can then be combined with the knowledge of the particular context to provide guidance regarding the effects of international trade in that context. While some countries with intensive industrial policies subsidising heavy or hi-tech industries may be well described by the production distortions negatively correlated with productivity, the case where exporting serves the productive firms as a way of sidestepping the distortions stifling the domestic market may be a much better description of China's dual-track liberalisation. An alternative reaction to the lack of a clear statement regarding the type of distortions prevailing in the real world is to fill this gap. That will require a combination of a theoretical structure and detailed micro-economic data, and it represents an exciting avenue for future research.

In addition to bringing the model to micro-economic data, the analysis could also be extended by modifying some of the assumptions taken in this chapter. For example, this chapter models distortions as a net subsidy on revenues, and modelling them as a net tax on all variable costs would lead to identical results. This approach is in line with the most influential studies on aggregate effects of firm-level distortions (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Bartelsman et al., 2013). In reality, however, some distortions may affect fixed, rather than variable, costs of production or exporting. For example, priviledged firms may find it easier to obtain licences to operate in certain industries (Aghion et al., 2008) or receive export quota allocation (Khandelwal et al., 2013). The effects of subsidies aimed at preventing struggling firms from closing down can also correspond more closely to fixed-cost distortions than distortions to revenues or variable cots. As yet another example, access to credit can influence the ability of different firms to start exporting.[35]

Distortions to fixed costs would affect which firms sell in which market but not how much they sell in a particular market conditional on the sales being positive. Mechanisms related to market-specific distortions would be similar as those outlined in this chapter. On one hand, distortions making it hard for politically unconnected firms to enter certain segments of the domestic market would make opening up to trade particularly beneficial, as it would open up opportunities for firms which might not even exist in a closed economy. On the other hand, distortions related to export entry would decrease the gains from trade, as they would encourage some low-productivity firms to export while preventing exporting by some high-productivity firms.[36] On the contrary, distortions to fixed costs of production would likely have only a very small effect on gains from trade, unless they were extremely strong. The reason is that the productivity cut-off for exporting tends to be substantially more demanding than the cut-off for production,[37] and, as a result, most of the firms that would export without distortions would also operate and export with such distortions, and vice versa.

Another crucial characteristic of my model, as well as of much of the related literature, is that it treats firm-level productivity as exogeneous. Every new firm is assigned a productivity draw and then stays at the same productivity level forever. In reality, however, firms can

[35] See, for example, Minetti and Zhu (2011), Manova (2013) and Manova et al. (2015).

[36] The quota allocations analysed by Khandelwal et al. (2013) represent an example of such distortion.

[37] Eaton et al. (2011a) document that less than 1% French firms export without simultaneously selling in the domestic market.

make conscious decisions about their productivity, and these decisions can be systematically related to international trade. Trade economists have modeled endogenous firm-level productivity mainly in one of two ways.[38] The first approach allows each firm to produce multiple products. Trade makes firms specialize in their core products, which, in turn, increases their productivity.[39] The second approach is to allow firms to upgrade to a new technology. Such upgrade increases their productivity but it requires initial investment. The effect of trade in models taking this approach is driven by the fact that as trade allows highly productive firms to grow, it becomes more profitable for them to invest in new technologies.[40]

Incorporating endogenous productivity would be an interesting extension of the model presented in this chapter. Intuitively, to the extent that productivity improvements due to international trade are driven by within-firm productivity increases rather than by reallocation, the gains from trade should not be dampened by the presence of *production distortions*. The reason for this is somewhat different for each of the potential mechanisms for endogenous productivity improvements. In the case of multi-product firms, it stems from the observation that distortions leading to misallocation across firms are less likely to lead to misallocation across products within each firm.[41] In the case of technology upgrading, the mechanism where trade makes large firms even larger and, thus, encourages them to invest in innovation should operate similarly whether the largest firms are actually also the most productive ones or whether they are largest due to favourable distortions draws. The most interesting interaction, therefore, seems to be the one between endogenous productivity and market-specific distortions. In particular, with endogenous productivity, distortions in the domestic market that prevent high-productivity firms from growing also make these firms invest too little into productivity-enhancing innovations.[42] When an economy opens up to trade, these firms may

[38] See Melitz and Redding (2014) for an overview.

[39] See Bernard et al. (2011), Eckel and Neary (2010) and Mayer et al. (2014) for influential studies of international trade with multi-product firms.

[40] For models with endogenous productivity due to innovation decisions, see Atkeson and Burstein (2010) and Bustos (2011). Similar mechanisms can also arise, for example, with decisions about financing choices (Manova, 2013), importing intermediate inputs (Lileeva and Trefler, 2010; Amiti and Davis, 2012; Gopinath and Neiman, 2014) or firm organisation (Caliendo and Rossi-Hansberg, 2012).

[41] Requiring firms to obtain licenses in order to produce certain products is an example of a regulation that *would* also lead to misallocation across products.

[42] Hsieh and Klenow (2014) find that Indian and Mexican firms exhibit much slower growth over their life cycle than their US counterparts and they invest less into process efficiency, quality and accessing new markets. The authors argue the underinvestment is related to distortions such as taxes, weak contract enforcement and financial constraints, and they estimate that it can have a large negative effect on aggregate productivity.

then be unable to even enter export markets. In this scenario, bad distortion draws translate into low equilibrium productivity, ultimately harming the firms' chance to benefit from the opportunities offered by trade.

Chapter 3

Climbing the Rungs of the Quality Ladder: FDI and Domestic Exporters in Romania

3.1 Introduction

Economic development is strongly related to the sophistication and quality of a country's exports, both in a cross-section and over time (Schott, 2004; Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Mattoo and Subramanian, 2009). From the perspective of an individual firm, reaching a certain quality threshold is a precondition for successful exporting (Brooks, 2006; Verhoogen, 2008; Hallak and Sivadasan, 2013; Sutton, 2012; Iacovone and Javorcik, 2012). Given the observed close correlation between the sophistication of exports and economic prosperity, it is not surprising that upgrading of industrial structure, and in particular exports, is a major objective of industrial policies in many countries around the world.

In this chapter, we explore one way in which countries may be able to increase the sophistication of their exports. Namely, we examine whether the presence of multinational enterprises (MNEs) leads to a higher quality of exports by local firms in an emerging economy. There are several channels through which this may be happening.

First, many studies suggest that domestic firms improve their productivity as a result of

interactions with the MNEs they supply.[1] This may happen because in their quest for higher quality inputs, MNEs may provide their local suppliers with expertise, training and incentives for quality improvement, and possibly even cooperate on development of new and higher quality products. Many MNEs subject their potential suppliers to technical audits and require improvements to performance or product quality as a pre-condition for receiving a contract. As domestic firms improve their performance and product quality, they may then not only supply the MNEs but may also start exporting these products. There is substantial anecdotal evidence suggesting that these effects indeed take place. A survey among Czech manufacturing firms analysed by Javorcik (2008) shows that 40% of domestic suppliers receive some kind of assistance from their MNE customers, including personnel training (19%), provision of inputs (10%), help with quality assurance (10%) and help with finding export opportunities (7%). Even more remarkably, 50% of domestic firms selling to MNEs report they have had to improve product quality in order to become suppliers. Within each industry, the most capable domestic firms are most likely to supply MNEs and consequently benefit from such knowledge transfer. Moreover, domestic firms producing intermediates should be more likely to benefit from downstream FDI than domestic producers of final goods.

Second, reports on Romania written by World Bank consultants claim that "new technology and modern machinery [are] available only from Western Europe or Japan" as opposed to being produced locally. The presence of foreign firms in the upstream industries may provide Romanian firms with higher quality intermediates and capital goods and in this way allow them to upgrade the quality of their products.[2] This effect is likely to be more important for smaller firms which will find it difficult to cover the potential fixed costs of importing inputs from the world markets.

Finally, domestic firms may learn from MNEs operating in the same industry. Either by observing the foreign firms or through hiring former MNE employees, they may learn about procedures which improve the quality and standardization of their products, their marketing

[1] E.g., Javorcik (2004), Blalock and Gertler (2008) or Javorcik and Spatareanu (2008). For a meta analysis of studies on productivity spillovers from FDI through backward linkages, see Havranek and Irsova (2011). These studies are unable to identify suppliers to MNEs and instead rely on national input-output matrices to proxy for linkages between industries. An exception is a study by Javorcik and Spatareanu (2009) which concludes that while the most productive local firms self-select into becoming MNE suppliers, they also improve their performance as a result of the supplying relationship.

[2] Amiti and Konings (2007) and Kugler and Verhoogen (2012) document the importance of access to high quality inputs for firm performance.

skills and reliability of their shipments.[3] Domestic firms may also learn about the profitability of various export opportunities by observing their foreign peers' exports, and this knowledge may persuade them to make investments into quality upgrading.[4]

To test these hypotheses more formally, we relate the quality of exported products to the foreign presence in the downstream and upstream industries as well as own industry. We draw on an annual panel of Romanian firms matched with detailed the customs data recording Romanian exports at the level of the firm, 8-digit HS (Harmonized System) product classification, destination country and year. Thus our analysis is conducted at the firm-product-destination-year level. We focus on the period 2005-2011, which is determined by the data availability. We use unit values to proxy for the quality of exported products.[5] Our empirical strategy follows the literature on FDI spillovers and relies on the assumption that domestic firms are more likely to supply MNEs when foreign firms account for a larger share of output in their downstream industries, i.e., the industries to which they sell inputs. Similarly, we assume that domestic firms are more likely to buy inputs from MNEs if MNEs account for a larger share of the domestically sold output in the upstream industries, i.e., the industries from which the domestic firms source inputs according to the Romanian input-output tables. All explanatory variables are lagged by one year. We control for any time-invariant unobservables specific to a particular firm exporting a particular product to a particular destination, and we allow for region-year fixed effects and industry-region-specific trends.[6]

[3] A number of studies have estimated the impact of FDI inflows on productivity of domestic firms in the same industry. Haskel et al. (2007) and Keller and Yeaple (2009) find positive effects, while Aitken and Harrison (1999), Javorcik (2004), Javorcik and Spatareanu (2008, 2011) find an insignificant or a negative relationship. Using matched employer-employee data from Brazil, Poole (2013) shows that when domestic firms employ former employees of multinationals, wages of incumbent workers in these firms increase. Using the same type of data from Norway, Balsvik (2011) finds a positive correlation between the share of workers with multinational experience and the productivity of non-multinationals. Both findings are consistent with knowledge spillovers through labour mobility.

[4] Aitken et al. (1997) demonstrate that the presence of exporting multinationals in the same region reduces the costs of exporting for Mexican firms. Using detailed Chinese trade statistics that identify the type of exporters and their location, Chen and Swenson (2007) find that the presence of foreign affiliates in the same sector is associated with more and higher unit value trade transactions by Chinese firms. Swenson (2008) shows that the positive association between the presence of foreign affiliates and new export connections by private Chinese exporters may be driven by information spillovers. Greenaway et al. (2004) study the impact of MNE presence on export participation and the exported share of output of UK firms. They find positive effects on both variables, and their results suggest that the MNEs' domestic activities rather than their export activities are a stronger source of spillovers.

[5] Although such proxy is imperfect, it has been extensively used in the literature (Schott, 2004; Hallak, 2006; Bas and Strauss-Kahn, 2015).

[6] Given the rich set of fixed effects that we include in all specifications, our results are identified based on industry-specific variation that is time-varying, cannot be captured by linear trends and is not driven by broad

Our results show a positive relationship between the unit values of goods exported by Romanian firms and the presence of MNEs in downstream (input sourcing) industries. This relationship is robust across a number of specifications. It is not only statistically significant, but also economically meaningful. The estimated coefficients suggest that the average increase in the foreign presence in downstream industries over the period studied corresponds to a 15% increase in unit values of exports. As expected, the results are stronger for products with a large scope for quality improvement. They are driven by the most productive firms, firms with the highest initial unit values of exports, and firms producing intermediate inputs. We also find a positive, albeit less robust, correlation between the unit values of exports and the presence of MNEs in input supplying sectors. Finally, we document a positive relationship between the MNE presence in downstream and upstream industries and unit values of *imported* inputs. We interpret it as suggesting that our results capture product quality rather than increased mark-ups.

In sum, our main finding is consistent with Romanian firms upgrading their exports as a result of interactions with their multinational customers operating in Romania.[7] It is also suggestive of quality upgrading being an additional channel through which linkages between MNEs and local firms benefit the host country. Although we consider a different outcome variable, this result echoes the conclusion of the large literature on productivity spillovers from FDI which points to interactions between MNEs and the local suppliers as the main channel through which FDI spillovers take place.[8]

Despite a considerable interest on the part of policy makers, the research on the firm-level sources of upgrading of the production and export structure is still limited. In this chapter, we

regional factors. While we are unable to pin down the exact sources of this variation, they are likely to consist mostly of idiosyncratic location decisions by MNEs made against the background of broad trends such as Romania's EU entry, the economic crisis and government policy in Romania and in countries with which Romania competes for FDI.

[7] Our data do not allow us to pin down whether this result is due to the possibility of becoming a supplier acting as an incentive for quality upgrading or whether it is driven by assistance from MNEs to their domestic suppliers. However, such distinction may not be very relevant in reality. For instance, an MNE sending a techology audit to their would-be supplier represents both a pressure on the supplier to upgrade the quality of its products and a concrete help in the form of advice on what to improve.

[8] Productivity and quality are tightly related concepts, and their exact relationship depends on the particular theoretical model used. In the seminal model of heterogenous firms by Melitz (2003), productivity and quality are isomorphic. A number of later models treat productivity and quality as separate concepts but feature a unique ordering in equilibrium, where higher-productivity firms choose to produce at higher quality (Verhoogen, 2008; Baldwin and Harrigan, 2011; Johnson, 2011). Some recent models, however, allow some firms to have a high productivity while producing at low quality, and vice versa (Hallak and Sivadasan, 2013; Eckel et al., 2015).

study FDI inflows as one such source and argue that FDI promotion is potentially a feasible and actionable strategy for moving a country up the quality ladder.[9] To the best of our knowledge, this is the first study that identifies the effect of MNE presence specifically on quality upgrading by domestic firms rather than on the average quality of aggregate exports.[10] It is also the first study on quality of exports that separates the effect of FDI through vertical and horizontal channels.[11] Finally, in contrast to the earlier work, our data allow us to bring more detailed evidence on the type of products and firms that are most likely to benefit from MNE presence.

This chapter is structured as follows. The next section introduces the context of the study, giving a brief overview of trends in FDI and export unit values of Romania in the period considered. The data and the empirical strategy are described in Section 3.3. Section 3.4 presents the results. We start by presenting the baseline results, then we discuss possible alternative explanations for the patterns observed. We then further examine how the results depend on various product and firm characteristics and undertake several robustness checks. Section 3.5 presents the conclusions.

3.2 FDI and export unit values in Romania

Romania is an interesting country for studying the effect of FDI on manufacturing firms for at least three reasons.

First, manufacturing plays a comparatively large role in the Romanian economy. In fact, the share of manufacturing value added in Romanian GDP in 2004 (the last year available in the World Development Indicators) was at 30% the largest in the EU, 5 percentage points ahead of the second largest figure found in the Czech Republic.

Second, Romania entered the European Union in 2007, and its entry was accompanied with the highest inflows of FDI in the country's modern history. Appendix Table 3.6.12 shows the evolution of FDI inflows for ten post-communist members of the EU for years 2003-2012.

[9] See Harding and Javorcik (2011) for evidence on effectiveness of FDI promotion efforts.

[10] A notable exception is the study by Chen and Swenson (2007). However, these authors focus on new export transactions and only observe exports on the level of cities and not individual firms.

[11] A related study by Harding and Javorcik (2012) takes advantage of cross-country data on sectors targeted by national investment promotion agencies. The study finds that exports in targeted sectors in developing countries enjoy an 11% unit value premium. Unfortunately, the authors are unable to pinpoint the exact channels through which FDI affects exporting, and, in particular, to distinguish between the direct effect of multinationals' own exports and spillovers to domestic exporters.

Table 3.1: Share of output due to foreign-owned firms (%)

Year	Industries	Own FDI		Downstream FDI		Upstream FDI	
		Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2005	58	55.2	27.0	56.1	15.0	54.4	13.2
2006	58	54.7	26.3	56.0	15.7	53.3	13.4
2007	58	57.4	24.9	57.3	14.7	55.9	12.3
2008	58	58.8	24.3	59.1	14.4	57.6	12.8
2009	58	61.1	24.3	61.6	13.9	59.0	12.7
2010	58	62.5	24.1	62.3	13.7	60.9	12.3

Downstream and upstream FDI output shares are defined based on equations (3.2) and (3.3) in Section 3.3. SD stands for standard deviation.

Between 2004 and 2008 the average annual FDI inflows amounted to over 7% of Romanian GDP. Our data cover most of the high-inflow period as well as the crisis years 2009 and 2010, when the FDI inflows fell below 3% of GDP. The only two countries in the region with higher proportional FDI inflows in the studied period are Estonia and another EU entrant from 2007, Bulgaria.

A substantial part of FDI inflows entered the manufacturing sector. This is reflected in Columns 2 and 3 of Table 3.1, which summarizes the share of output due to foreign-owned firms in 58 manufacturing industries during our sample period. In line with the aggregate data, the average share of output due to foreign firms increased over the period from 55% in 2005 to 62% in 2010. It was a significant increase, although smaller than for example in Lithuania in the 1996-2000 period analysed by Javorcik (2004), where the average foreign share increased from 12% to 31%. The increase is smaller in the Romanian case, despite larger inflows of FDI as a share of GDP, because the foreign presence in the Romanian manufacturing was already relatively strong at the beginning of the period studied.

Seventeen of 58 manufacturing industries in our sample saw an increase of foreign output share of more than 10 percentage points. As illustrated in Figure 3.6.1 in the appendix, the increase was largest for computers and office means (79 percentage points), other chemicals (52), agricultural machinery (39), foundry (34) and basic chemicals (32). Large industries with a significant increase in foreign presence included electric machinery (18), textiles (15) and metal structures and products (14). The only industry with a large decrease in foreign

presence was stone processing, representing less than 0.1% of the aggregate manufacturing output. For the evolution of foreign presence in all sectors, see Figure 3.6.2 in the appendix.

The third reason for Romania being an interesting case to study is that with the GDP per capita (adjusted for the purchasing power parity) at only 36% of the EU average, it has a large potential for improvement of its manufacturing performance. Column 2 of Table 3.2 shows that in 2006 a typical product exported by a typical Romanian industry was sold at only 81% of the unit values of the same product exported by the 15 old members of the EU. But Romania has been catching up. In the median Romanian industry the unit values of exports (relative to the corresponding figures for EU15) have increased by 4.5 percentage points between 2006 and 2011, or by about a quarter of the initial gap.[12] Interestingly, Table 3.2 shows that the catching up was faster for domestically-owned exporters (columns 4-6) than for foreign owned ones (columns 7-9).[13] While in 2005 exports by domestic firms showed a 10-percentage point larger unit-value gap behind EU15 than foreign-owned firms, by 2011 the difference had shrunk to 3 percentage points.[14]

Figure 3.6.3 in the appendix shows the 5-year change in the median relative unit values of exports by domestic firms for industries where the change exceeded 10 percentage points in either direction. Important export industries with significant increases in the relative unit values included: radio, TV and ICT equipment; wood products; motor vehicles; footwear; metal structures and products; and apparel.

To summarize, Romania is an emerging economy with a strong manufacturing focus. In the period under study, it has received large FDI inflows, which have coincided with a significant increase in the export unit values relative to the EU15. The latter phenomenon was particularly pronounced in the case of exports by domestic firms. In the following sections, we examine the connection between the two phenomena.

[12]The means presented in column 1 suggest an even sharper catch-up of about 8 percentage points, provided we ignore the high figure found in 2006 which is driven by the unrealistically high relative unit values in three industries — bikes and motorcycles (350%), trains (223%) and computers 190%). The relative unit values in all these industries fall by 100 percentage points or more in 2007 and remain at the lower level in the subsequent years.

[13]In columns 1-3, the unit values for both EU15 and Romania are calculated from the same data source. These columns therefore represent a more reliable measure of the level of Romania's lag behind EU15. In columns 4-9, Romanian unit values are calculated from firm-level customs data, which allows separating exports by domestic and foreign-owned firms.

[14]Lower labour costs prevailing in Romania may be partially responsible for lower unit values.

Table 3.2: Unit values relative to EU15 (%)

	Aggregate data			Domestically-owned			Foreign-owned		
Year	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2006	88.2	80.7	46.3	80.5	69.7	48.8	89.6	81.2	48.8
2007	80.8	82.4	26.3	83.2	73.9	46.2	86.5	85.9	31.0
2008	84.2	84.8	26.0	78.3	75.2	37.0	87.6	83.6	37.2
2009	87.1	81.6	34.3	93.5	78.6	78.6	92.2	79.4	63.8
2010	84.1	82.5	23.9	86.3	82.8	48.0	88.6	80.4	47.6
2011	89.1	85.1	34.0	90.2	82.3	47.8	92.8	85.2	46.2

For each industry, the relative unit values are calculated as median (across products exported by the industry) of the ratio of Romanian unit values to unit values of exports by EU15. Each product is assigned to the industry with highest number of exporter-destination pairs for that product. Only CN 8-digit products exported throughout the period are included. Industries which at any point in time show relative unit values below 20% or above 500% are dropped as outliers. All EU15 unit values are based on product-level aggregate data from Eurostat. In columns 1-3, Romanian unit values also come from Eurostat. In columns 4-9, Romanian unit values come from detailed customs data aggregated across all domestic firms (columns 4-6) and across foreign-owned firms (columns 7-9).

3.3 Data and empirical strategy

3.3.1 Data

Our analysis is based on the rich firm-level data for Romania compiled from two sources. The first source, the Structural Business Statistics (SBS), is available for 2005-2010. It is an annual survey conducted by the Romanian National Statistical Institute among all Romanian firms with at least 20 employees and a subsample of smaller firms. Each firm is sent a questionnaire which it is obliged to fill in. The questionnaire covers the standard variables pertaining to firm's operations, profits and losses. All monetary variables are reported in current Lei. The ownership information collected in the survey allows us to distinguish between purely domestic firms, wholly foreign-owned firms, and firms with mixed ownership. We do not observe the exact ownership shares among the mixed firms. Fortunately, national tax identifiers assigned to individual firms allow us to match our data to the commercial database Amadeus compiled by the Bureau van Dijk. It is possible to match the data for about three quarters of the firms. We follow the standard practice by defining a firm as foreign if the share of foreign ownership exceeds 10%. A vast majority of firms appearing as mixed in the SBS data have foreign ownership above this threshold. Therefore, the mixed ownership cases for which it is

not possible to find information in the Amadeus are treated as foreign.

The SBS data are matched with the Romanian customs data for years 2005-2011 using the firm tax identifiers. The customs data contain information on annual exports at the firm-product-destination level. The data cover all exports to countries outside the EU and over 95% of exports to EU member countries. Starting from 2007, when Romania joined the EU, intra-EU exports are not processed at the customs but instead have to be reported to the Intrastat. Firms with annual exports below 900,000 Lei (approx. $250,000) are exempt from the reporting obligation and therefore do not appear in the customs data. Products are defined in terms of the 8-digit EU Combined Nomenclature (CN8), which is based on the 6-digit Harmonized System classification and is further disaggregated with two additional digits. Export values are recorded in current Lei. Besides export values, there are two variables measuring the physical quantity of exports. One measures it in kilograms and the other in supplementary units. Supplementary units may represent pieces, litres, square metres or other units. Where both measures of physical quantity are available, we use supplementary units.[15]

We construct some of our variables with the help of the Romanian input-output tables for 2002 prepared by the National Statistical Institute. They use Lei at current prices as units, and they are defined in terms of the Romanian industrial classification where each manufacturing industry corresponds to one or several 3-digit NACE (rev. 1.1) industries. The SBS data state the 4-digit NACE codes, which allows us to match the firm-level data with the input-output tables. We use words 'industry' and 'sector' as synonyms in our analysis, and we use them to refer to the 58 manufacturing industries as defined in the Romanian industrial classification.[16]

To compare Romanian export unit values to those of EU15 and to control for fluctuations in international prices of individual products, we use EU trade data from Eurostat. They include country-level export flows for each CN8 product in each year.

3.3.2 Empirical strategy

Our goal is to examine the link between export upgrading by Romanian firms and the presence of MNEs in the same, downstream and upstream sectors. Following the literature on FDI

[15] See subsection 3.6.1 in the appendix for more details on the construction of unit values.

[16] See subsection 3.6.1 in the appendix for more details on how we determine the industry affiliation of each firm.

spillovers, we measure the presence of foreign firms in an industry (Own FDI) with their share in the total industry output. Let J_{st} denote the set of all manufacturing firms operating in Romania in sector s in year t, f_{jt} a dummy for whether firm j is foreign-owned in year t and Y_{jt} the total output of the firm. Then we define own-sector FDI as

$$OwnFDI_{st} = \frac{\sum_{j \in J_{st}} f_{jt} Y_{jt}}{\sum_{j \in J_{st}} Y_{jt}}. \tag{3.1}$$

In order to identify vertical spillovers from multinationals in downstream sectors, we rely on the assumption that a domestic firm is more likely to supply multinationals and benefit from vertical spillovers if foreign firms account for a larger share of output in the downstream industries, i.e., industries supplied by the industry of the domestic firm. Define α_{sd} as the share of intermediate inputs supplied by industry s which is sold to downstream industry d, according to the input-output matrix. Define further S as the set of all manufacturing sectors. Then the proxy for downstream FDI is defined as

$$DownstreamFDI_{st} = \sum_{d \in S} \alpha_{sd} OwnFDI_{dt}. \tag{3.2}$$

Similarly, we proxy for access to inputs produced by MNEs by assuming that a domestic firm is more likely to buy inputs from an MNE if foreign firms account for a larger share of output in the upstream industries, i.e. industries from which the industry of the domestic firm sources inputs. Define α_{us} as the share of the intermediate inputs purchased by industry s from the upstream industry u. In addition, define $OwnFDI^*_{st}$ in the same way as $OwnFDI_{st}$ but only counting domestically sold output. Then the upstream FDI is defined as

$$UpstreamFDI_{st} = \sum_{d \in S} \alpha_{us} OwnFDI^*_{ut}. \tag{3.3}$$

Equation (3.4) represents the baseline model to be estimated. The outcome variable is the log of the unit value of product p exported by firm i to country c in year t. The explanatory variables are the lagged proxies for FDI presence in the same, downstream and upstream sectors. The specification controls for firm-product-destination fixed effects, which addresses the issue that a kilogram of caviar has a different value from a kilogram of flour. It also

takes into account any characteristics specific to firms, products or destinations which are time invariant. In addition, the model controls for any effects that are common to all firms in a given region[17] in a particular year.

$$\log(UV)_{ipct} = \beta_1 OwnFDI_{s,t-1} + \beta_2 UpstreamFDI_{s,t-1} + \beta_3 DownstreamFDI_{s,t-1} + \gamma_{ipc} + \gamma_{rt} + \epsilon_{ipt} \tag{3.4}$$

While we report estimates of equation (3.4) in levels, in most of the subsequent analysis we estimate a specification in differences, as in equation (3.5). Estimation in differences not only controls for the same time-invariant firm, product and destination characteristics as the specification in levels, but it also allows each combination of an industry and a region to have an idiosyncratic trend by including industry-region fixed effects. We then identify the effect of FDI on deviations from these trends. We employ first to fourth differences, where n-th difference for variable X in time t is defined as $\Delta X_t = X_t - X_{t-n}$. This specification also includes region-year fixed effects.

$$\Delta \log(UV)_{ipct} = \beta_1 \Delta OwnFDI_{s,t-1} + \beta_2 \Delta UpstreamFDI_{s,t-1} + \beta_3 \Delta DownstreamFDI_{s,t-1} + \gamma_{rt} + \gamma_{sr} + \epsilon_{ipt} \tag{3.5}$$

We estimate the equation on a sample of domestically owned firms. In all specifications, we lag the FDI indices by one year. This allows for some time gap between the increase of foreign presence and its effect taking place. It also somewhat mitigates the concern, discussed in the next section, that reverse causality is driving our results. Our observations represent firm-product-destination-year combinations, but the FDI indices vary only with industry and year. We, thus, cluster standard errors to allow for correlation between error terms within the same industry and year.

[17] By regions, we understand eight Romanian NUTS 2 regions.

3.4 Results

3.4.1 Baseline results

We report our baseline results in Table 3.3.[18] Column 1 shows the results of an estimation in levels, while the following columns show the results from estimation in first to fourth differences. The strongest and the most robust finding is that the unit values of domestic firms' exports are positively related to the foreign presence in downstream industries. The estimated coefficients on *Downstream* FDI_{st} are positive and statistically significant at the one percent level in four specifications and at the five percent level in one case. As expected, the magnitude of the estimated coefficient increases with longer differencing. It is economically meaningful. Over the studied period, foreign presence in downstream industries grew on average by 6.5 percentage points. According to the estimates from column (5), this corresponds to a 15% increase of the unit values of domestic exports.

FDI in upstream industries is also positively correlated with export unit values of domestic firms, although the effect is not statistically significant in the second and fourth differences. Depending on the specification, our results are consistent with the 6-percentage-point increase in upstream FDI (i.e., the actual increase observed over the studied period) leading to 1-3.5% increase in unit values of domestic exporters.

In line with some earlier studies on horizontal productivity spillovers, we find that the effect of foreign presence on domestic firms in the same industry is, if anything, negative. We are not able to exactly pinpoint the reasons for this negative effect.[19] However, in the interviews conducted by the World Bank consultants, representatives of MNE subsidiaries and local experts repeatedly mentioned and emphasized competition for a limited pool of skilled labour as the key constraint on firm performance and growth in export sectors. Therefore, we interpret the negative sign on the own-sector FDI as consistent with possibility that foreign firms tend to pull skilled workers away from the domestic firms. This is a plausible scenario, given the well-known fact that foreign affiliates pay higher wages than domestic firms do in

[18] By default, we cluster standard errors at the industry-year level. When clustering is instead done for each industry, the results remain unchanged except for the following: effect of downstream FDI becomes significant only at the 10% level in 1st differences and only at the 5% level in 3rd and 4th differences; effect of upstream FDI becomes significant at the 1% level in 1st differences; effect of own-industry FDI becomes significant only at the 10% level in 4th differences.

[19] As we discuss later in the text, this result is not driven by multicolinearity. See Section 3.4.4.

Table 3.3: Unit values and FDI - levels and first to fourth differences

	(1) Levels	(2) First diff.	(3) Second diff.	(4) Third diff.	(5) Fourth diff.
(Δ) Downstream FDI (s,t-1)	0.842***	0.390**	0.902***	1.143***	2.340***
	(0.188)	(0.168)	(0.284)	(0.380)	(0.788)
(Δ) Upstream FDI (s,t-1)	0.226***	0.267**	0.210	0.556**	0.352
	(0.082)	(0.104)	(0.153)	(0.218)	(0.224)
(Δ) Own FDI (s,t-1)	-0.261***	-0.043	-0.318**	0.091	-0.553**
	(0.084)	(0.096)	(0.131)	(0.268)	(0.225)
Region-year FE	Yes	Yes	Yes	Yes	Yes
Firm-product-destination FE	Yes	No	No	No	No
Industry-region FE	No	Yes	Yes	Yes	Yes
R-squared	0.086	0.011	0.015	0.010	0.013
N	65052	50717	25579	9469	4891

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in levels or first to fourth differences as stated in the column headers. The n-th difference for variable X in time t is defined as $X_t - X_{t-n}$.

emerging markets (see, for instance, Aitken et al. (1996)).[20]

3.4.2 Potential alternative explanations

While we tend to interpret our results on downstream and upstream FDI as knowledge spillovers from supplying MNEs and access to better inputs, respectively, there exists a possible alternative explanation. One could potentially argue that there is reverse causality, where FDI flows to industries with access to high quality domestic inputs and demand for high quality foreign inputs. Insofar as these location factors are time-invariant from the MNEs' point of view, we control for them with firm-product-market fixed effects in the specification in levels and by allowing for industry-specific and region-specific trends in the differenced specifications. The potential problem is also mitigated by lagging the explanatory variables. However, reverse causality could still be a problem if MNEs enter Romania in industries where high quality domestic suppliers are increasingly becoming available or where there is a growing demand from domestic firms for high quality inputs. To shed light on this possibility we perform the strict exogeneity test suggested by Wooldridge (2010). It entails estimating a specification where

[20] Our interpretation is consistent with the study by Hale and Long (2011) who find that presence of foreign firms in the same industry and region in China leads to higher wages of skilled workers and lower observed quality of engineers in both state-owned and private domestic enterprises. Alfaro and Chen (2012) also document inflows of FDI as having a substantial impact on domestic firms through an increase in factor prices.

Table 3.4: Strict exogeneity test

	(1)
	First differences
Δ Downstream FDI (s,t-1)	0.525
	(0.343)
Δ Downstream FDI (s,t)	1.032**
	(0.449)
Δ Downstream FDI (s,t+1)	0.150
	(0.276)
Δ Upstream FDI (s,t-1)	0.255***
	(0.092)
Δ Upstream FDI (s,t)	-0.421***
	(0.129)
Δ Upstream FDI (s,t+1)	-0.037
	(0.138)
Δ Own FDI (s,t-1)	-0.210
	(0.146)
Δ Own FDI (s,t)	-0.327*
	(0.188)
Δ Own FDI (s,t+1)	-0.009
	(0.158)
Region-year FE	Yes
Industry-region FE	Yes
R-squared	0.016
N	30546

**** 1%, ** 5%, * 10%*. The table reports strict exogeneity test described by Wooldridge (2010). Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first differences.

in addition to the lagged FDI variables we include their contemporaneous and lead values. If foreign firms' entry into Romania is a consequence of quality upgrading in upstream and downstream industries, the coefficients on the lead values should be statistically significant.

Table 3.4 shows the results of the test. The positive coefficient on downstream FDI seems to be driven by the contemporaneous variable, while the effect of upstream FDI seems to come from the lagged variable. Most importantly, the leads for all three FDI measures bear very small and insignificant coefficients, suggesting that reverse causality is not driving our results.

Another potential alternative explanation is that a shock in the international market is driving both FDI inflows to Romania and unit values of Romanian exports. Imagine there is a global positive shock in demand for automobiles. As a result foreign car manufacturers decide to expand their production and invest in Romania. At the same time, demand for inputs to

Table 3.5: Controlling for international prices

	First differences		Second differences	
	(1) Baseline	(2) Int. prices control	(3) Baseline	(4) Int. prices control
Δ Downstream FDI (s,t-1)	0.390**	0.401**	0.902***	0.944***
	(0.168)	(0.166)	(0.284)	(0.287)
Δ Upstream FDI (s,t-1)	0.267**	0.266**	0.210	0.199
	(0.104)	(0.105)	(0.153)	(0.155)
Δ Own FDI (s,t-1)	-0.043	-0.046	-0.318**	-0.320**
	(0.096)	(0.095)	(0.131)	(0.131)
Δ Log UV of EU exports (p,t)		0.003		0.009**
		(0.002)		(0.004)
Region-year FE	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes
R-squared	0.011	0.011	0.015	0.015
N	50716	50716	25579	25579

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. International unit values are based on exports of 26 EU countries (excl. Romania) as reported by Eurostat. For each product and year, they are calculated by summing export value and quantity over all countries and then dividing value by quantity.

car production increases, leading to higher international prices including the ones faced by Romanian exporters. It would then be incorrect to interpret the resulting correlation between unit values of Romanian exporters and the downstream foreign investments as evidence of spillovers. Fortunately, we can easily test for this case by including the international price of each product as a control. Table 3.5 shows the results of an estimation, where we control for unit values of exports by the other EU members. Somewhat puzzlingly, the relationship between the changes in the EU and Romanian unit values seems to be relatively weak. But crucially, controlling for international prices has virtually no effect on the estimated coefficients for FDI variables. So an international shock driving both foreign investment to Romania and unit values of Romanian firms does not seem to explain our results.

3.4.3 Additional results

To better understand our results and cross-check their validity, we decompose them according to several product, firm and FDI characteristics. We start by splitting all products into intermediate and capital inputs on one side and into final products on the other.[21] If the strong

[21] We rely on a stage-of-processing classification prepared by the WTO Trade Policies Review Division.

Table 3.6: Unit values and FDI by stage of production

	First differences		Second differences	
	(1)	(2)	(3)	(4)
	Non-final	Final	Non-final	Final
Δ Downstream FDI (s,t-1)	0.746***	-0.098	1.187***	1.259***
	(0.257)	(0.237)	(0.376)	(0.434)
Δ Upstream FDI (s,t-1)	0.183	0.327***	0.525**	-0.069
	(0.197)	(0.115)	(0.225)	(0.153)
Δ Own FDI (s,t-1)	-0.290	0.232*	-0.805***	-0.079
	(0.207)	(0.120)	(0.209)	(0.099)
Region-year FE	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes
R-squared	0.008	0.019	0.015	0.021
N	20238	29145	9963	15000

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. The stage of production classification comes from the WTO Trade Policies Review Division. We consider products non-final if they are classified as intermediary inputs or capital goods.

positive results for downstream FDI are due to exporters supplying inputs to MNEs located in Romania, we should see the effect only for the non-final products (i.e., intermediate inputs and capital goods). Table 3.6 shows that this is indeed the case. The effect of downstream FDI is more robust for non-final products, whereas for final products it is not significantly different from zero in first differences. There is no clear pattern for the proxies for own and upstream FDI. Obtaining the expected result on this more nuanced prediction gives us more confidence that the link between the quality of exports and the presence of FDI in downstream sectors captures the effects of interactions between Romanian firms and their MNE suppliers.

We do not directly observe quality and instead rely on unit values. If our results capture the effect on quality, they should be stronger for products with larger scope for quality improvements. To test whether this is the case, we rely on the quality ladders estimated by Khandelwal (2010).[22] In Table 3.7, we split our sample into a subsample of products with the below-median length of the quality ladder and a subsample of products where the length of the quality latter is above the median. The estimates show that our results on the effects of downstream FDI are driven by products with a large scope for quality improvement. This

[22]Khandelwal (2010) estimates a demand system for US imports and infers the quality at which different countries export each product to the United States. For each product, he is then able to calculate the length of the quality ladder, defined as the difference between the highest quality and lowest quality observed for each product.

Table 3.7: Unit values and FDI by scope for quality improvement

	First differences		Second differences	
	(1)	(2)	(3)	(4)
	Long	Short	Long	Short
Δ Downstream FDI (s,t-1)	0.566***	-0.207	0.818***	1.003
	(0.169)	(0.374)	(0.313)	(0.655)
Δ Upstream FDI (s,t-1)	0.271**	0.285*	0.520***	0.006
	(0.129)	(0.155)	(0.155)	(0.174)
Δ Own FDI (s,t-1)	-0.106	0.159	-0.414***	-0.281
	(0.134)	(0.156)	(0.150)	(0.232)
Region-year FE	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes
R-squared	0.008	0.016	0.015	0.017
N	23943	24396	11736	12823

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. The quality ladders come from Khandelwal (2010). A ladder is classified as long if it is longer than that the median in our sample.

is consistent with our estimates capturing the effects of downstream FDI on the quality of exports by Romanian firms.

Foreign presence in downstream and upstream industries should not affect all domestic exporters in the same way. If spillovers from interaction with MNE buyers are the source of the effect of downstream FDI, only the domestic firms which actually become suppliers to MNEs should benefit. We do not observe directly which firms supply MNEs, but we expect that the strongest firms with the highest productivity and product quality are most likely to become suppliers (Javorcik and Spatareanu, 2009). The effect of access to inputs produced by MNEs in upstream industries, on the other hand, could depend on firm size. For the largest firms it should pay off to cover the potential fixed costs of importing inputs from abroad, so they should have access to high quality inputs even without FDI. Upstream FDI should, therefore, matter more for medium-sized firms wishing to increase their quality.

Table 3.8 in the text (which is an abbreviated version of Table 3.6.13 in the appendix) shows that the data are consistent with these conjectures. We decompose observations into four quartiles in terms of the unit values, total factor productivity (TFP) and revenue size. Each firm (TFP and size quartiles) or firm-product-destination cell (unit values quartiles), is assigned to a quartile based on the values of the respective variables in the first year it appears

Table 3.8: Unit values and FDI by initial quartiles of unit values, TFP and size

	First differences			Second differences		
	(1) UV	(2) TFP	(3) SIZE	(4) UV	(5) TFP	(6) SIZE
Δ Downstream FDI (s,t-1) * Top quartile	0.976***	0.272	0.356*	1.730***	0.713*	0.631**
	(0.263)	(0.216)	(0.184)	(0.543)	(0.416)	(0.301)
Δ Downstream FDI (s,t-1) * Quartile 2	0.646	0.872***	0.262	1.651***	0.598	2.179***
	(0.403)	(0.330)	(0.543)	(0.594)	(0.410)	(0.703)
Δ Downstream FDI (s,t-1) * Quartile 3	0.415	0.760*	1.233*	0.385	1.754***	2.787**
	(0.306)	(0.389)	(0.690)	(0.759)	(0.669)	(1.229)
Δ Downstream FDI (s,t-1) * Quartile 4	-0.251	0.321	3.155*	-0.174	1.120	7.388**
	(0.335)	(0.258)	(1.642)	(0.770)	(0.684)	(3.506)
Δ Upstream FDI (s,t-1), by quartiles	Yes	Yes	Yes	Yes	Yes	Yes
Δ Own FDI (s,t-1), by quartiles	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry, region and quartile FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.014	0.011	0.013	0.018	0.017	0.018
N	39033	47908	48661	20599	24210	24626

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. The quartiles are calculated in the first year in which each firm (TFP and size quartiles) or firm-product-destination (unit value quartiles) is observed. Unit value quartiles are determined relative to exports of the same product by all firms and to all destinations. TFP is estimated with the method due to Ackerberg et al. (2006). Size is measured by total firm revenues. For each firm-product-destination, table includes only observations from 2 and more (columns 1-3) or 3 and more (columns 4-6) years after initial exports. Table 3.6.13 in the appendix shows the results also for upstream and own-sector FDI variables.

in our sample. The observations from the year when this assignment is made and the following year are then excluded from the regression. As expected, we observe the strongest quality upgrading linked to downstream FDI among domestic firms which, while not necessarily being very large, started in the top two unit-value and TFP quartiles. Upstream FDI seems to have affect firms in the middle quartiles of the size distribution, rather than the largest firms.

In Table 3.9 we recalculate the FDI variables as the weighted average across eight Romanian regions, where we weight each region by the inverse of the distance between the capital of that the region and the capital of the region where the domestic firm is located. In other words, we give more weight to MNEs located close to each domestic exporter. This modification does not affect our conclusions with respect to downstream FDI.[23] Taking into account geography, however, makes the results for upstream FDI lose their statistical significance or

[23] Unlike other regressions in the chapter, the regressions reported in Table 3.9 are clustered on industry-region-year level.

Table 3.9: Unit values and FDI - regional weighting

	First differences		Second differences	
	(1)	(2)	(3)	(4)
	Baseline	Regionally weighted	Baseline	Regionally weighted
Δ Downstream FDI (s,t-1)	0.390**	0.338***	0.902***	0.512***
	(0.168)	(0.111)	(0.284)	(0.195)
Δ Upstream FDI (s,t-1)	0.267**	0.052	0.210	-0.279*
	(0.104)	(0.103)	(0.153)	(0.158)
Δ Own FDI (s,t-1)	-0.043	-0.100	-0.318**	-0.354***
	(0.096)	(0.094)	(0.131)	(0.118)
Region-year FE	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes
R-squared	0.011	0.011	0.015	0.015
N	50716	50716	25579	25579

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each combination of an industry and a region in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. Foreign presence is calculated separately for each industry-region, and the FDI variables then equal weighted mean across all regions, where the weights are inversely proportional to the distance between the capitals of the region of the domestic firm and the region with FDI.

even become negative. The reason may be that the domestic firms are able to source their inputs from all parts of Romania and the exact region where MNEs are located does not play a role in this respect. The regional weighting may then introduce noise in the data, especially if FDI is heavily concentrated in a handful of regions.

Finally, we check whether the effect of FDI varies according to its country of origin. First, it is possible that only multinationals from highly developed countries require high quality of inputs and consequently help their suppliers achieve it.[24] Second, Javorcik and Spatareanu (2011) suggest that investors from outside the EU, who are more likely to source inputs locally, generate stronger productivity spillovers for their Romanian suppliers.[25] Table 3.6.14 in the appendix shows results of regressions exploring these two hypotheses.[26] The effect of FDI on unit values of domestic exports seems to be similar regardless of the origin of FDI. The potential explanation is that even though some multinationals come from emerging economies,

[24]Our list of rich countries consists of OECD members, excluding Czech Republic, Hungary, Poland, Slovakia, Slovenia, Chile, Mexico and Turkey.

[25]This is because they can source inputs duty-free from their suppliers in home countries.

[26]Approximately 8% of the output in an average manufacturing industry is due to foreign firms for which we do not observe the country of the investor. When constructing variables for FDI from different groups of countries, we assume that these firms have the same composition in terms of the country of investor as the firms in the same year and industry for which the country of investor is observed.

the fact that they are multinationals means that they adhere to the same international quality standards as their developed-country peers.

3.4.4 Robustness checks

We estimate several further specifications to test the robustness of our results (see Table 3.10). To save space, we report only results in first differences. In column 1, we show our baseline estimates as a benchmark, and we report new specifications in the subsequent columns.

One potential concern is that because the downstream, upstream and own-industry FDI variables tend to be correlated with each other, our results are driven by their interaction and multicollinearity issues. We test this in columns 2-4, where we include each FDI variable separately. The results remain qualitatively similar, and the coefficients become larger and more precisely estimated. In column 5, we test whether the results could be driven by developments specific to different destinations. The results remain unchanged even if we control for the destination-specific fixed effects, which in our differenced specification can be interpreted as destination-specific trends. In columns 6 and 7, we control for industry- and firm-level imports, respectively. While the latter seem to matter little in our specification, the former are positively correlated with export unit values of domestic firms and their inclusion seems to reduce the coefficient on upstream FDI. Finally, in column 8, we repeat our estimation aggregating over all destinations to which each firm exports a particular product. This adjustment, which effectively gives larger weight to the more important destinations, seems to strengthen our results.

Table 3.10: Robustness checks

	First differences							
	(1) Baseline	(2) One by one	(3) One by one	(4) One by one	(5) Dest. fixed effects	(6) Ind. imports control	(7) Firm imports control	(8) Firm-prod. level
Δ Downstream FDI (s,t-1)	0.390**	0.487***			0.397**	0.468***	0.426**	0.824**
	(0.168)	(0.115)			(0.167)	(0.176)	(0.168)	(0.320)
Δ Upstream FDI (s,t-1)	0.267**		0.361***		0.274***	0.156	0.274**	0.299**
	(0.104)		(0.095)		(0.104)	(0.102)	(0.111)	(0.142)
Δ Own FDI (s,t-1)	-0.043			0.166**	-0.050	-0.041	-0.075	0.038
	(0.096)			(0.083)	(0.095)	(0.098)	(0.099)	(0.127)
Δ Log industry imports (st)						0.094***		
						(0.022)		
Δ Log firm imports (it)							0.003	
							(0.004)	
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination FE	No	No	No	No	Yes	No	No	No
R-squared	0.011	0.011	0.011	0.011	0.011	0.012	0.012	0.009
N	50717	50717	50717	50779	50717	50717	47102	32331

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first differences. Column 5 allows for destination-specific fixed effects. Columns 6 and 7 control respectively for industry-level and firm-level imports. Column 8 reports estimation at the firm-product-year level, i.e. aggregating across destinations.

3.4.5 Import unit values

Although the decomposition of the sample according to the length of the quality ladder, presented in Table 3.7 above, points towards interpreting our findings as changes in quality, our analysis so far does not allow us to reject the possibility that the observed increases in export unit values represent increased mark-ups rather than quality upgrading. To shed light on this issue, we follow several recent studies which make the observation that high-quality outputs require high-quality inputs, and which interpret input prices as proxies for the input quality.[27] We estimate a version of equation (3.5) where the unit values on the left hand side refer to import unit values, rather than to export unit values. If domestic firms upgrade the quality of their production as a result of supplying inputs to foreign subsidiaries in downstream industries, this may require importing higher-quality inputs.

Presence of foreign firms in upstream industries could also lead to an increase in the quality of imported inputs, if the imported inputs are complements to the higher quality inputs available from the upstream foreign affiliates. Finally, if the presence of foreign-owned firms in the same industry puts competitive pressure on the domestic firms in output and input markets, the domestic firms, in order to cut costs, may start importing cheaper inputs. Importantly, to the extent that the increases in export unit values observed in relation to an increased presence of foreign-owned firms in the downstream and the upstream industries are due to increased mark-ups rather than quality upgrading, input prices should not vary with the FDI variables.

In order to obtain higher-quality inputs, firms are likely to switch countries from which they source their inputs.[28] We, therefore, collapse the import data across origin countries, so that each observation is defined by a firm, an imported product and a year. This allows the increases in the prices that firms pay for imported inputs to capture both buying higher-quality

[27] Kugler and Verhoogen (2012) find that larger Colombian firms not only charge higher prices for their output, but they also pay higher prices for their inputs. The authors interpret these patterns as evidence of quality differences between firms of different size. Goldberg et al. (2010) study Indian trade and firm data, and they also emphasize the importance of inputs for production improvements, although they focus on the number of imported and produced varieties rather than specifically on quality. Manova and Zhang (2012) identify a number of stylized facts about export and import prices of Chinese exporters. They argue that their findings are in line with the high-productivity exporters using higher quality inputs to produce higher quality output. Bas and Strauss-Kahn (2015) establish a causal link from input-tariff reductions in China to increases in both import and export prices of Chinese exporters. They, too, interpret their results as evidence of quality-upgrading by Chinese firms.

[28] Bas and Strauss-Kahn (2015) show that when Chinese firms became able to afford higher quality inputs, they increased the share of their imported inputs that were sourced from developed countries.

Table 3.11: Import unit values and FDI by scope for quality improvement

	First differences		Second differences	
	(1)	(2)	(3)	(4)
	Exporters	All firms	Exporters	All firms
Δ Downstream FDI (s,t-1)	0.292**	0.235**	0.373*	0.376*
	(0.135)	(0.116)	(0.223)	(0.225)
Δ Upstream FDI (s,t-1)	0.147*	0.217***	0.226	0.315**
	(0.086)	(0.075)	(0.152)	(0.132)
Δ Own FDI (s,t-1)	-0.207**	-0.190**	-0.378**	-0.372**
	(0.105)	(0.086)	(0.159)	(0.156)
Region-year FE	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes
R-squared	0.005	0.005	0.005	0.005
N	110924	135144	70638	84709

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of import unit values in first or second differences as stated in the column headers. The observations are defined at the firm-product-year level.

inputs from the same country and switching to source countries that offer higher quality.

The results are shown in Table 3.11. Columns 1 and 3 contain results for exporters, while columns 2 and 4 show estimates based on the full sample of all manufacturing firms that import inputs. As was the case with export unit values, import unit values seem to be positively related to the presence of foreign-owned firms in the downstream industries. The effect of foreign presence in upstream industries also appears to be positive. Again similar to export unit values, presence of foreign-owned firms in the same industry appears to be related to a fall in import unit values. Overall, these results strongly point towards interpreting the previous findings as quality upgrading rather than as increased mark-ups.

3.5 Conclusion

Economic development is inseparably related to structural change and in particular to upgrading the sophistication and quality of industrial production and exports. Most countries employ industrial and trade policies aiming at such upgrading, but our knowledge of factors which can contribute to this goal is limited.

Our study suggests that foreign direct investment can be such a factor, as it may lead to quality upgrading of exports of domestically-owned firms. Using a panel covering all Roma-

nian firms with more than 20 employees matched with the detailed customs data, we find evidence consistent with the view that supplying multinationals, as proxied by their presence in downstream industries, helps domestic exporters improve the quality of their exports. Our results indicate that the increase in foreign presence in downstream manufacturing sectors in Romania over period 2005-2010 corresponds to an increase in the export unit values of domestic manufacturing firms of about 15%. While we do not claim that FDI is the only, or even the most important contributor, to export upgrading in Romanian manufacturing, this increase is of a similar order of magnitude as the total catching up of Romanian export unit values with those of the developed European countries over the same period. Consistent with our interpretation of the results, the estimated effect of downstream FDI on import unit values is also positive, and its effect on export unit values is stronger for non-final products and products with a large scope for quality improvement as well as for firms which are initially relatively productive and exporting at relatively high quality. In addition, *import* unit values also appear to be positively related to the MNE presence in downstream industries, suggesting that our findings capture quality upgrading rather than increased mark-ups.

Our results also suggest that Romanian domestic exporters may benefit from an improved access to high quality inputs thanks to MNE presence in upstream industries, albeit this finding is less robust. The increase in FDI presence in an average manufacturing industry over our sample period corresponds to up to 3.5% increase in unit values of domestic exporters. Foreign presence in the same industry, on the contrary, has if anything a negative effect on unit values of domestic exporters, in line with the literature on horizontal productivity spillovers which documents the possibility of negative intra-industry spillovers.

Overall, our findings indicate that when policy makers are looking for effective and actionable policies aimed at quality upgrading among domestic exporters, they should consider FDI promotion, and in particular efforts to bring foreign investors into industries which are likely to buy inputs from domestic firms. FDI promotion efforts could be complemented by policies facilitating establishment of supplier-buyer relationships between domestic firms and MNEs.

3.6 Appendix

3.6.1 Construction of variables

Unit values

We calculate unit value as the monetary value of an export flow divided by its physical quantity. The key question is which measure of physical quantity to use. We proceed as follows. First, we drop observations with export values equal to zero or with both measures of physical quantity equal to zero. Second, we use supplementary units as measure of physical quantity for all products which have supplementary units available for over 90% of the observations, and we use kilograms as measure of physical quantity for the remaining observations. Finally, we drop observations where the measure of physical quantity chosen for the given product is equal to zero. Using this procedure, we measure physical quantity in supplementary units for 34% observations and in kilograms for 66% observations, and we drop unit values for 0.2% observations.

Some values of unit values and their fluctuations within firm and product over time are too extreme to be likely to be true. We deal with the suspected outliers in three steps. First, to eliminate extreme levels of unit values, we demean each log unit value by the corresponding product-year-specific mean and then drop the 1% smallest and 1% largest observations. Second, to eliminate extreme unit value fluctuations over time within firm-product-destination combinations, we drop the 1% firm-product-destination combinations with highest variation of unit values over time. Finally, to eliminate extreme unit value year-to-year-changes, we drop the 1% largest year-to-year changes within a firm-product-destination combination.

Industry classification

The SBS data define the main activity of each firm in terms of 4-digit NACE industries. Data for years 2005-2007 use NACE (rev. 1.1) and data for years 2008-2010 NACE (rev. 2). In order to make the SBS data compatible with our input-output table, we first convert all observations to NACE rev. 1.1. There is no unambiguous concordance between rev. 1.1 and rev. 2, so we derive our own concordance from the data so as to maximize the continuity in NACE within firms across time. For each observation from 2008 or later, we define pre-revision NACE as

Table 3.6.12: FDI inflows into central and eastern European countries (percent of GDP)

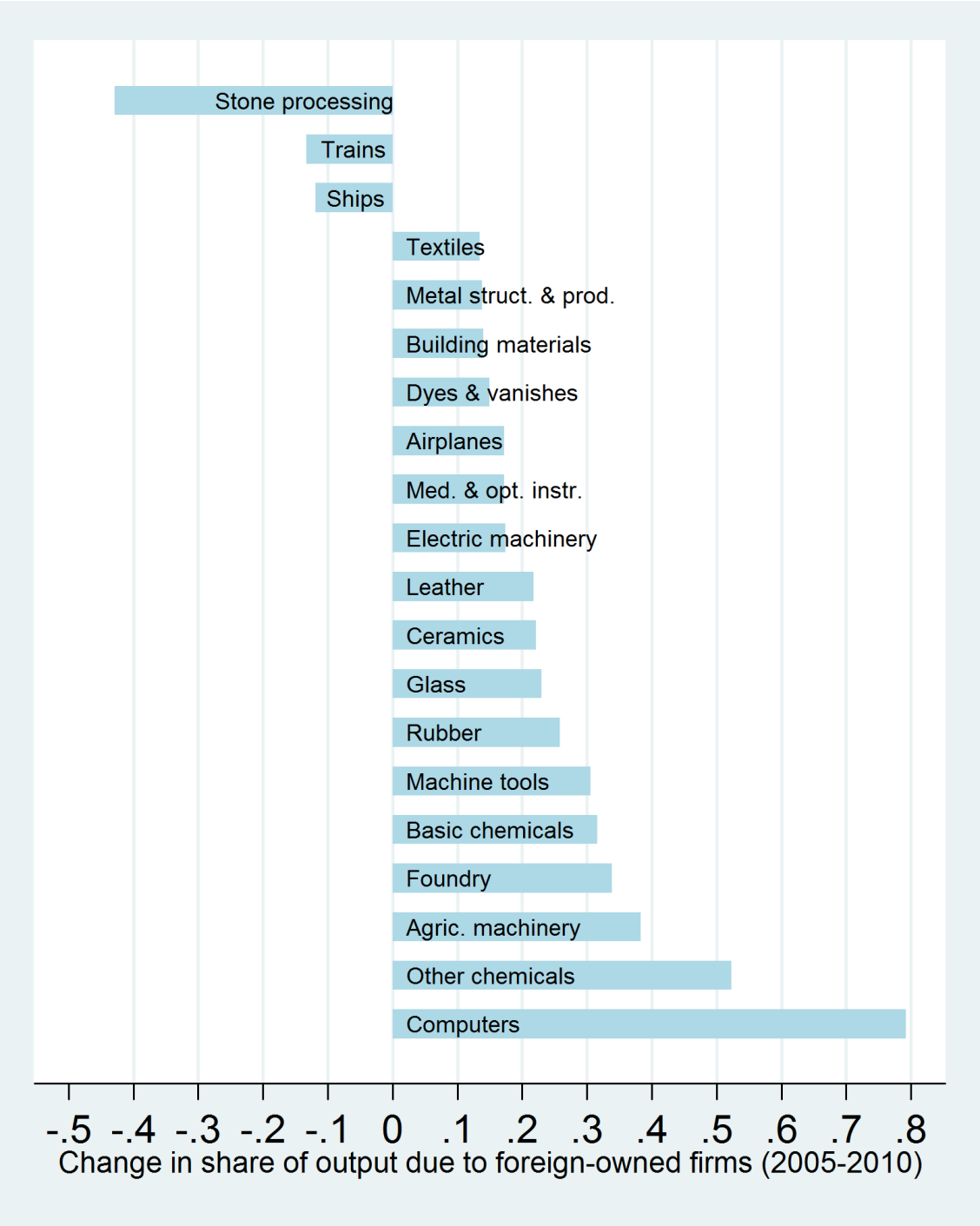
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Bulgaria	10.1	13.4	13.6	23.5	29.4	19.0	7.0	3.2	3.4	3.7	15.9
Czech Republic	2.2	4.4	9.0	3.7	5.8	2.9	1.5	3.1	1.1	5.4	4.3
Estonia	9.4	8.0	20.6	10.7	12.4	7.3	9.6	8.4	1.2	6.7	11.5
Hungary	2.6	4.2	7.0	6.1	2.9	4.1	1.6	1.7	4.2	10.6	3.9
Latvia	2.7	4.6	4.4	8.4	8.1	3.8	0.4	1.6	5.1	3.5	4.4
Lithuania	1.0	3.4	3.9	6.0	5.1	4.1	-0.0	2.2	3.4	2.0	3.6
Poland	2.1	5.1	3.4	5.7	5.5	2.8	3.0	3.0	3.7	0.7	3.9
Romania	3.7	8.5	6.5	9.3	5.8	6.8	2.9	1.8	1.3	1.3	5.5
Slovakia	8.9	9.6	6.5	10.4	5.4	5.2	-0.0	2.0	2.2	3.1	4.9
Slovenia	1.0	2.4	1.6	1.7	3.2	3.6	-1.3	0.8	2.0	0.3	1.6

UNCTAD. Underlined years appear in our data. Column Average represents the average over that period 2005-2010.

the NACE of the same firm in 2007 (or earlier if we do not observe the firm in 2007). We create a concordance where each 4-digit NACE rev. 2 code corresponds to the most common pre-revision NACE among observations with the same 4-digit NACE rev. 2 code. Then, we convert NACE for years 2008 and later to NACE rev. 1.1 using this concordance. Validity of this method is supported by the fact that on the 2-digit level where our subsequent analysis takes place, the number of firms which change NACE between 2007 and 2008 is very similar to the corresponding numbers for other years. Once we know the 4-digit NACE (rev 1.1) for each firm in each year, we use a concordance table to convert the NACE industries into the Romanian industrial classification in which the input-output table is defined. Finally, to ensure that variation over time in FDI presence in different industries is not driven by firms changing their reported industrial affiliation, we make the affiliation time-invariant by setting it to the mode value for each firm. This procedure modifies NACE for less than 4% of firm-year observations.

3.6.2 Additional tables and figures

Figure 3.6.1: Industries with the largest changes in foreign presence (2005-2010)

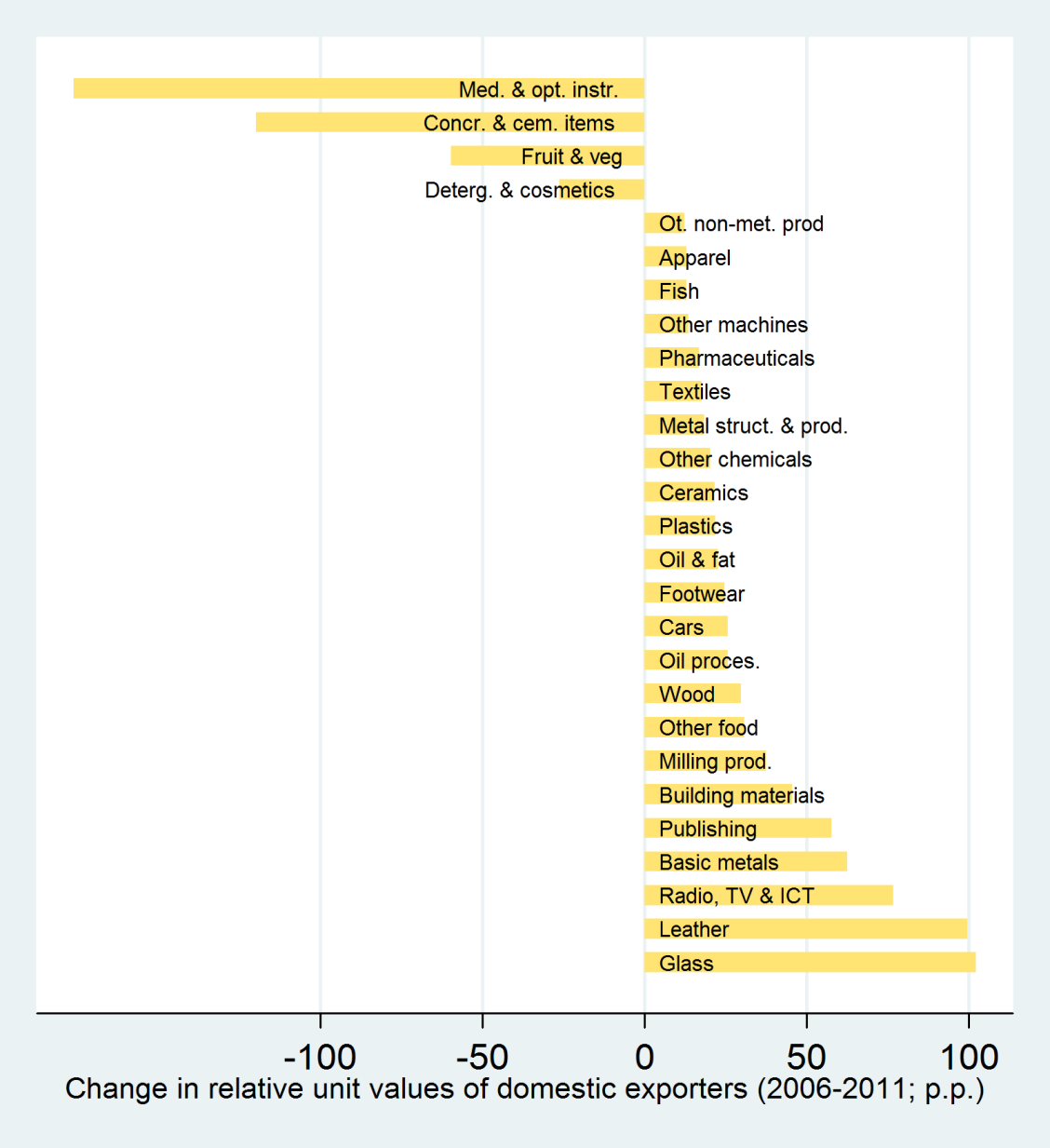


Only industries with an increase or a decrease of more than 10 percentage points are included.

Figure 3.6.2: Evolution of foreign presence in individual industries (2005-2010)

The x-axis represents time and the y-axis represents the share of output due to foreign firms. Each graph represents one 2-digit manufacturing industry.

Figure 3.6.3: Industries with largest changes in unit values relative to EU15 (2005-2010)



Data come from Eurostat. For each industry, the relative unit values are calculated as median (across products exported by the industry) of the ratio of Romanian unit values to unit values of exports by EU15. Each product is assigned to the industry with highest number of exporter-destination pairs for that product. Only CN 8-digit products exported by both Romania and EU15 in all years and only industries with increase or decrease of more than 10 percentage points are included.

Table 3.6.13: Unit values and FDI by initial quartiles of unit values, TFP and size

	First differences			Second differences		
	(1)	(2)	(3)	(4)	(5)	(6)
	UV	TFP	SIZE	UV	TFP	SIZE
Δ Downstream FDI (s,t-1) * Top quartile	0.976***	0.272	0.356*	1.730***	0.713*	0.631**
	(0.263)	(0.216)	(0.184)	(0.543)	(0.416)	(0.301)
Δ Downstream FDI (s,t-1) * Quartile 2	0.646	0.872***	0.262	1.651***	0.598	2.179***
	(0.403)	(0.330)	(0.543)	(0.594)	(0.410)	(0.703)
Δ Downstream FDI (s,t-1) * Quartile 3	0.415	0.760*	1.233*	0.385	1.754***	2.787**
	(0.306)	(0.389)	(0.690)	(0.759)	(0.669)	(1.229)
Δ Downstream FDI (s,t-1) * Quartile 4	-0.251	0.321	3.155*	-0.174	1.120	7.388**
	(0.335)	(0.258)	(1.642)	(0.770)	(0.684)	(3.506)
Δ Upstream FDI (s,t-1) * Top quartile	0.132	0.439***	0.093	-0.353	0.585**	0.270
	(0.190)	(0.150)	(0.123)	(0.267)	(0.243)	(0.176)
Δ Upstream FDI (s,t-1) * Quartile 2	0.231	0.307*	0.725***	0.001	0.116	0.285
	(0.197)	(0.182)	(0.256)	(0.211)	(0.208)	(0.253)
Δ Upstream FDI (s,t-1) * Quartile 3	-0.107	0.185	1.212***	-0.114	0.066	0.660
	(0.226)	(0.133)	(0.414)	(0.237)	(0.207)	(0.504)
Δ Upstream FDI (s,t-1) * Quartile 4	0.481***	0.242	-0.165	0.432	0.395	-1.876***
	(0.179)	(0.157)	(0.566)	(0.358)	(0.293)	(0.657)
Δ Own FDI (s,t-1) * Top quartile	-0.125	-0.144	0.121	-0.143	-0.641***	-0.172
	(0.156)	(0.156)	(0.104)	(0.260)	(0.204)	(0.154)
Δ Own FDI (s,t-1) * Quartile 2	-0.251	-0.175	-0.929**	-0.584***	-0.134	-1.119***
	(0.175)	(0.135)	(0.426)	(0.196)	(0.193)	(0.310)
Δ Own FDI (s,t-1) * Quartile 3	-0.083	-0.353*	-0.528	-0.262	-0.316	-1.441***
	(0.147)	(0.200)	(0.403)	(0.223)	(0.238)	(0.540)
Δ Own FDI (s,t-1) * Quartile 4	0.082	0.268	-0.866	0.034	-0.096	-1.811*
	(0.207)	(0.223)	(0.600)	(0.382)	(0.321)	(1.007)
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry, region and quartile FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.014	0.011	0.013	0.018	0.017	0.018
N	39033	47908	48661	20599	24210	24626

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. The quartiles are calculated in the first year in which each firm (TFP and size quartiles) or firm-product-destination (unit value quartiles) is observed. Unit value quartiles are determined relative to exports of the same product by all firms and to all destinations. TFP is estimated with the method due to Ackerberg et al. (2006). Size is measured by total revenues. For each firm-product-destination, table includes only observations from 2 and more (columns 1-3) or 3 and more (columns 4-6) years after initial exports.

Table 3.6.14: Unit values and origin of FDI

	First differences		Second differences	
	(1)	(2)	(3)	(4)
	Rich	EU	Rich	EU
Δ Downstream FDI from ... countries (s,t-1)	0.441***	0.385**	0.930***	0.864***
	(0.168)	(0.163)	(0.316)	(0.290)
Δ Upstream FDI from ... countries (s,t-1)	0.204**	0.246**	0.264*	0.227
	(0.101)	(0.103)	(0.147)	(0.154)
Δ Own FDI from ... countries (s,t-1)	-0.048	-0.042	-0.293**	-0.231
	(0.097)	(0.096)	(0.132)	(0.146)
Δ Downstream FDI from non-... countries (s,t-1)	0.501***	0.431***	1.038***	0.897***
	(0.171)	(0.164)	(0.363)	(0.278)
Δ Upstream FDI from non-... countries (s,t-1)	0.107	0.196	0.189	-0.062
	(0.122)	(0.124)	(0.211)	(0.306)
Δ Own FDI from non-... countries (s,t-1)	-0.038	-0.031	-0.537***	-0.389**
	(0.102)	(0.094)	(0.187)	(0.168)
Region-year FE	Yes	Yes	Yes	Yes
Industry-region FE	Yes	Yes	Yes	Yes
R-squared	0.011	0.011	0.015	0.015
N	50717	50717	25579	25579

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry in each year. The dependent variable is the logarithm of export unit values in first or second differences as stated in the column headers. Countries are considered rich if they are members of OECD and they are not Czech Republic, Hungary, Poland, Slovakia, Slovenia, Chile, Mexico or Turkey. EU countries include the 26 EU members other than Croatia, which joined after the sample period, and Romania.

Chapter 4

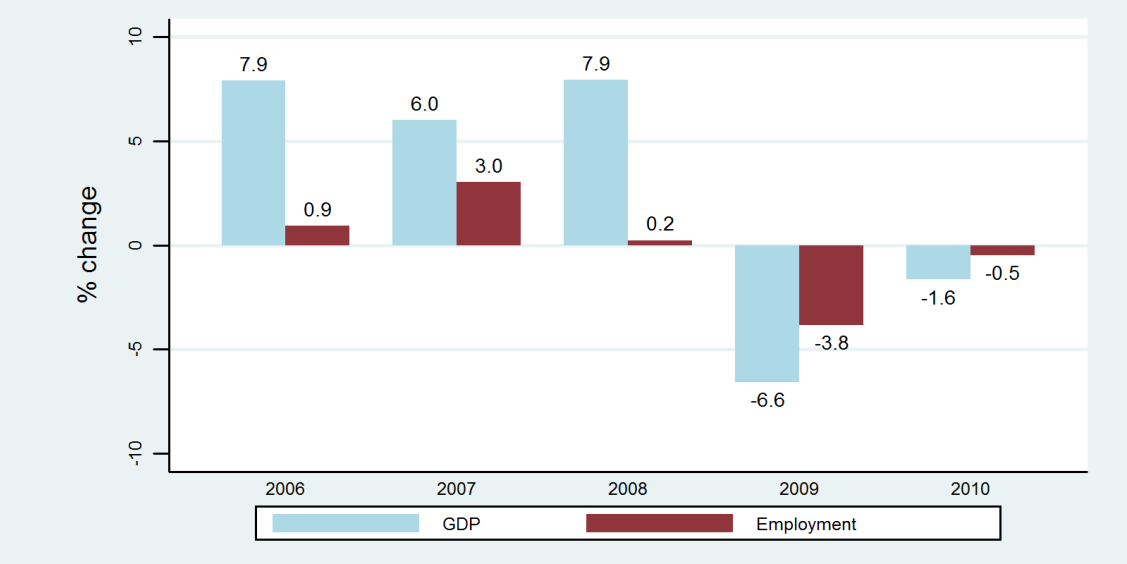
Romanian Manufacturers during the Great Trade Collapse

4.1 Introduction

The Romanian economy grew by 8% in 2008 and shrank by almost 7% in 2009. Only five countries in the world suffered from a greater year-on-year reduction in GDP growth in the year following the Lehman Brothers bankruptcy. The fall in Romania's GDP was accompanied by a 4% drop in aggregate employment (see Figure 4.1.1). At the same time, the Romanian manufacturing exports, alongside the rest of the global trade, plummeted in what Baldwin (2009) called the "Great Trade Collapse". They started falling at the end of 2008, and they dropped by 25% in 2009 (see Figure 4.1.2).

This chapter studies the relationship between the collapse of Romanian exports and the crash of the Romanian economy as a whole. Through these dramatic events, it aims to explore three broader questions. First, how do exporting manufacturing firms adjust to a sudden and sharp drop in their exports? Second, if a firm does not export, is it less vulnerable to negative foreign demand shocks such as the one which happened in 2009? Finally, how can microeconomic data be used to understand the origins of macroeconomic events? I approach these questions using matched firm and customs data from Romania, combined with information on country- and product-specific trade flows between other countries. To study how Romanian manufacturing exporters reacted to an exogenous drop in their exports, I implement an

Figure 4.1.1: Annual changes in real GDP and aggregate employment (2006-2010)



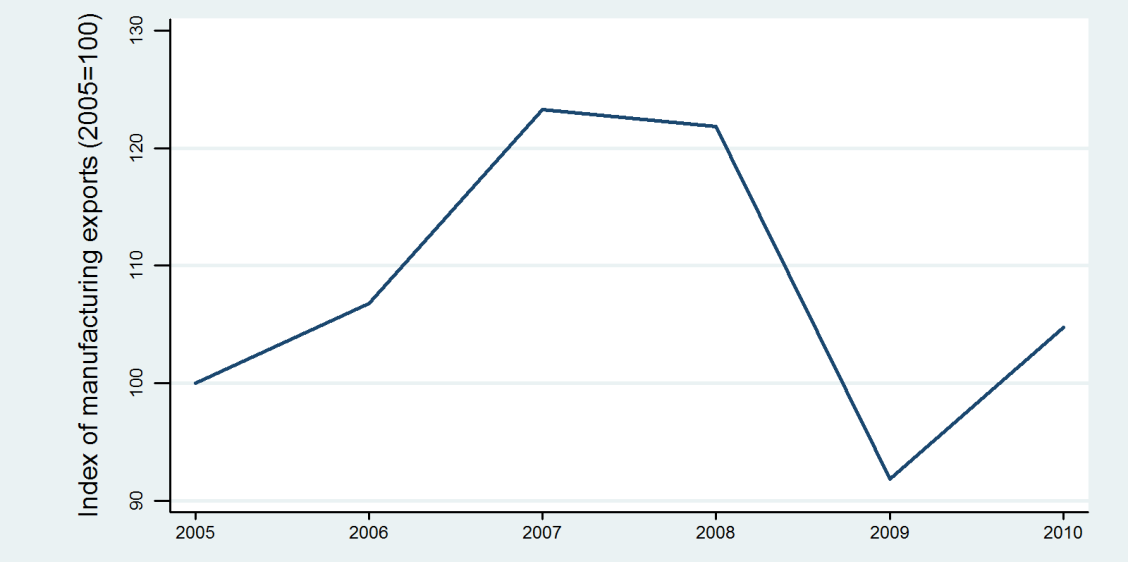
World Development Indicators; Romanian Statistical Yearbooks. Employment is measured as civil employment (see Section 4.2 for more detail).

instrumental variable approach, instrumenting exports with firm-specific measures of foreign demand. In addition, I analyse the impact of the shock on non-exporters using an input-output matrix and industry-level exports, again instrumented with indices of foreign demand.

I find that manufacturing exporters responded to a fall in their exports by rapidly reducing their employment, material costs and investment, but not wages. On average, a 10% reduction in export sales led to a 3.5% reduction in employment, a 7% cut in material expenditure and a 10% reduction in investment. Investment, thus, appears to be the most flexible margin of adjustment for exporting firms, followed, in descending order, by material expenditure, employment and wages. In addition, I document that the struggling exporters were unable to redirect their sales to the domestic market; on the contrary, and in line with recent evidence, reduced exports were actually associated with *reduced* domestic sales (Berman et al., 2015).

Remarkably, the fall in foreign demand seems to have hit the non-exporting manufacturers as hard as it hit the exporters. Reduced exports in the industries to which non-exporting manufacturing firms were supplying inputs led to an at least proportional fall in the sales of these non-exporting firms. As for the other variables, a 10% drop in aggregate exports of the

Figure 4.1.2: Evolution of real manufacturing exports (2005-2010)



Exports by firms whose principal activity is manufacturing. Exports are deflated by output deflators specific to each 2-digit NACE (rev. 2) industry. See Section 4.2 for more information on the data.

downstream (input sourcing) industries was associated with a 6% drop in employment, a 2% drop in average wages, and a 12% drop in material expenditures of the non-exporting firms in the upstream (supplying) industries. Relative flexibility of various margins of adjustment, thus, appears to be similar for non-exporting suppliers as for exporters, and the absolute pace of their adjustment to falling exports seems to be, if anything, greater.

Overall, the results suggest that Romanian manufacturing firms rapidly cut costs in response to the falling exports, but, with the exception of investment, the adjustment was not as fast as the fall in exports. Even so, simple back-of-the-envelope calculations suggest that the observed fall in exports can account, in absolute terms, for a large drop in employment in both exporting firms and their suppliers, and that it can potentially explain a large part of the overall decline in Romanian manufacturing employment over the period 2007-2009.

Romania is home to 20 million people, and, as an open emerging economy where manufacturing constitutes a large share of GDP, it shares important structural features with some of largest countries in the world. Understanding the role of exporting in the collapse of Romanian economy in 2009 is, therefore, important in its own right. However, beyond the

immediate interest in the studied events, this chapter aims to make contributions in several other directions. While a vast theoretical and empirical literature analyses the role of firms in generating gains from trade[1] and the firm-level reallocation following policy reforms or external shocks,[2] this research focuses predominantly on detailing equilibrium outcomes and comparing different equilibria. For empirical studies, this focus means that analysing firm output or, in some cases, firm employment or physical capital stock, is sufficient for characterising firm-level reallocation. An explicit analysis of other firm-level variables, such as material expenditure, investment or wages, is not required, because these variables are determined in the background in an optimising process done by each firm. However, a trade-related adjustment between equilibria is neither instantaneous nor costless.[3] Indeed, Trefler (2004) argues that the conflict between the short-term adjustment costs and the long-term benefits of trade liberalisation is the root cause of popular disagreements about the desirability of free trade. By studying firms' reaction, along several margins, to a sharp exogenous reduction in demand for their products, this chapter helps to shed more light on the short-term adjustment process taking place in response to trade-related shocks.

Another common concern regarding trade is that it could make economies more volatile (di Giovanni and Levchenko, 2009, 2012). This chapter contributes to the ongoing debate about the increased economic vulnerability stemming from trade openness by taking a firm-level perspective on the issue and by comparing the vulnerability of exporting firms with that of their non-exporting suppliers. By doing so, this chapter also extends the previous findings on the systematic differences between exporting and non-exporting firms (Bernard and Jensen, 1995, 1999).

This chapter is also closely related to the studies about firm-level effects of economic crises.[4] These studies tend to focus on the impact of crises on exit and entry by firms with varying productivity, leading to a beneficial 'cleansing' of low-productivity firms (Caballero

[1] For theoretical works, see Melitz (2003); Bernard et al. (2003, 2007b); Melitz and Ottaviano (2008) and surveys by Redding (2011) and Melitz and Redding (2012); for an overview of empirical studies driving theoretical work, see Bernard et al. (2007a) and Bernard et al. (2012).

[2] See, for example, Topalova and Khandelwal (2011) on a unilateral tariff reduction, Trefler (2004) on a bilateral free-trade agreement, Khandelwal et al. (2013) on a removal of import quotas and Aghion et al. (2008) on delicensing

[3] See Porto and Hoekman, eds (2010) for a recent overview.

[4] Papers studying the Great Trade Collapse are reviewed in Section 4.3.1. For other examples, see Barlevy (2002, 2003), Nishimura et al. (2005) and Hallward-Driemeier and Rijkers (2013).

and Hammour, 1994) or detrimental 'scarring' effects (Eslava et al., 2010) due to aggravating market imperfections and destroying high-productivity firms.[5] I, instead, concentrate on the short-run intensive margin adjustments made by the affected firms, which have been shown to be quantitatively more important than exporter entry and exit during the event I study (Bricongne et al., 2012).

The increasing availability of comprehensive microeconomic data gives researchers the previously unavailable opportunity to empirically study macroeconomic phenomena not as movements of aggregate indicators but as combined actions of individual agents.[6] This chapter provides an example of how firm-level variation, jointly with heterogeneous developments in other markets, can be used to identify a source of a large macroeconomic shock.[7]

This chapter is structured as follows. The next section introduces the data. Section 4.3 summarizes key information about the Great Trade Collapse, describes the macroeconomic context of the 2009 recession in Romania and presents several stylised facts that point towards the causes of the recession — in particular, the role of the manufacturing sector. Section 4.4 examines the reaction of exporting firms to the fall in their exports, first introducing the methodology and then presenting the results. Section 4.5 focuses on the effect of reduced exports in downstream industries on the non-exporting firms which supply inputs to those sectors. Section 4.6 summarizes the previous results and provides a simple calculation of the share in the aggregate economic slowdown that can be explained by the reduced foreign demand for Romanian exports.

4.2 Data

I combine data from three principal sources. The first source is Structural Business Statistics (SBS). It is a firm survey conducted by the Romanian National Statistical Institute and cover-

[5] See Hallward-Driemeier and Rijkers (2013) for further discussion.

[6] A notable example involves the research on granularity and macroeconomic volatility (Gabaix, 2011; di Giovanni and Levchenko, 2012).

[7] Two studies which are methodologically related to this chapter are Hummels et al. (2014) and Berman et al. (2015). Hummels et al. (2014) study the impact of positive export shocks on employment and wages of Danish firms, while Berman et al. (2015) estimate the effect of export shocks on domestic sales. This chapter differs from these studies by focusing on a crisis period and by examining a broader range of firm-level adjustment margins. See also Ekholm et al. (2008), who use a differential exposure of Norwegian firms to an exchange rate appreciation to study the effect of the exchange rate appreciation on firm restructuring.

ing all sectors of the Romanian economy except agriculture and mining. It contains a balance sheet and ownership information on all firms and organisations with more than 20 employees and a sub-sample of the smaller enterprises. I restrict the analysis to manufacturing firms, thus, excluding, among others, wholesalers. Unless otherwise stated, 'industries' refer to the 58 manufacturing industries defined by a Romanian industrial classification where each manufacturing industry corresponds to one or several 3-digit NACE (rev. 1.1) industries.[8] The SBS data available to me span the years 2005-2010. However, in order to focus on the reaction of the firms to a sharp drop in exports rather than to export fluctuations in normal times, I mostly restrict my analysis to the years 2007-2009 — the time of the Great Trade Collapse and also of the period when Romanian manufacturing exports were falling.[9] I deflate the key variables by the price indices reported in the Statistical Yearbook 2011. The domestic sales and exports are deflated by the output deflators specific to each 2-digit NACE (rev. 2) industry; materials by the material deflators equal to weighted means of the industry-specific output deflators, weighted by the elements of an input-output matrix; investment into fixed capital by an aggregate capital-good deflator; and wages by the Consumer Price Index.

The second source of information is detailed records on Romanian exports reported for each combination of a firm, an 8-digit product, a destination country and a year. Firm-identifiers allow matching this data to the SBS dataset. Manufacturing firms accounted for 78% of the total Romanian exports over the period 2007-2009,[10] and observations successfully matched to the manufacturers in the SBS dataset accounted for 99% of the total exports by manufacturing firms.

The final data source is BACI: International Trade Database at the Product Level, constructed by the French research centre CEPII (Gaulier and Zignago, 2010). BACI is based on

[8]The data record the 4-digit industry of the primary activity for each firm in each year. Industries are classified according to NACE (rev. 1.1) in 2005-2007 and NACE (rev. 2) in 2008-2010. I determine the industry of each firm in several steps. First, I convert industries reported in the later years into NACE (rev. 1.1). For firms that already operated before 2008, I use the industry from the latest available year before 2008. I also construct a concordance based on the reported codes of these firms before and after the change in the classification and use the concordance to convert the codes of the firms which only appear in 2008 or later. Second, I use a concordance prepared by the Romanian National Institute of Statistics to convert the NACE codes into the Romanian classification. The reason I use this classification rather than the original NACE is that it matches the most disaggregated input-output table that is available to me and, thus, enables a more precise estimation of the effects of exports in industries to which firms sell their output. Third and finally, I make the industry of each firm time-invariant by using the mode value over the period 2005-2010.

[9]The main regression results are very similar when the year 2010 is included.

[10]The business registry provides industry codes even for the observations not matched to the SBS data.

the same raw data as the COMTRADE database, but CEPII researchers combine information reported by exporting and importing countries to improve the data reliability. Trade flows are reported on exporter-importer-product-year level, and I aggregate them over exporters, so that I observe each country's imports of each product from Romania and from all other countries combined.[11]

After dropping a few problematic observations,[12] there are 24,784 manufacturing firms that appear in the SBS survey at least once during the period 2007-2009. In the chapter, the main estimating equations are defined in terms of annual first differences, and differencing the dataset leads to an unbalanced panel with 24,106 observations. Exporters form an unbalanced panel with 7,086 unique exporters, and 8,174 first-differenced observations.[13] In addition, the way exporter-specific instruments are constructed requires that the exporters be observed in the customs data in 2007, which further reduces the sample size for exporters to 7,014 first-differenced observations.

For two reasons, the actual numbers of observations used for the reported regressions are slightly smaller than those identified in the previous paragraph. First, to reduce the risk that my results are driven by data errors or extreme outliers, I drop the bottom and top 1% of all first-differenced firm-level variables used in each regression. Second, there are zero or missing values of some outcome variables — in particular, of investment in fixed capital.

Before concluding this section, it is worth pointing out that I use two different measures of aggregate employment reported in the Romanian Statistical Yearbooks. The first type, *civil employment*, includes, with a few exceptions such as military personnel, "all persons who,

[11] While products in the Romanian customs data are defined using each year's EU 8-digit Combined Nomenclature (CN8), the BACI data follow the 6-digit Harmonised System (HS6) classification of the 2002 revision. In order to make the two data sources compatible, I first utilise the fact that the first 6 digits of CN8 correspond to HS6, and I then apply the concordance methodology by Beveren et al. (2012) to convert the resulting HS6 codes into the codes of the 2002 revision. Together with a few minor adjustments to the country codes used in each dataset, such a process allows me to merge the detailed customs data with BACI.

[12] I drop the 69 observations in the sector "Garment and ammunition" which does not appear in the input-output table, and the 116 observations with reported output equal to 0.

[13] I count as exporting all observations with positive exports in either the SBS or the customs data. 16% exporter observations report positive exports in the survey data but do not appear in the customs records. This is mostly due to the fact that firms are not required to report intra-EU exports below an annual threshold of 900,000 Lei (approx. $250,000). These observations represent less than 0.8% of the total exports reported by manufacturing firms in the SBS data. At the same time, 16% exporter observations appear in the customs data but report zero exports in the SBS. Finally, even when the export figures from both sources are available, they do not match perfectly (sample correlation coefficient 0.96). The exports reported in the SBS seem to be less noisy, so I use them as the primary source of information on the total exports of each firm in each year, but when they are missing, I use the customs data to fill the gap. I also use the customs data whenever I need export information decomposed by destinations or products, as such information is not provided by the firm survey.

during the reference year, carried out a socio-economic lucrative activity" (INS, 2012). The second type, the *average number of employees*, represents "represents a simple arithmetic mean resulted from the sum of daily employees number" (INS, 2012), and, importantly, it does not included employees on an unpaid leave and only counts part-time workers in proportion to the number of hours they work. The former measure is representative of all Romanian workers, so I use it to construct the aggregate employment measures in Figures 4.1.1 and 4.3.1. The latter measure captures only about half of the workers counted in terms of civil employment, and, in particular, it severely undercounts the number of agricultural workers. However, firm-level employment reported in the SBS data uses this measure. In addition, this measure is useful because it captures not only the number of hired and dismissed workers, but also the reduced number of working hours, which might have provided an important margin of adjustment for firms struggling during the crisis.

4.3 Context

4.3.1 The Great Trade Collapse

Starting in the second half of 2008, world trade experienced the fastest and deepest drop in the past 40 years (Crowley and Luo, 2011). Between the second quarters of 2008 and 2009, global trade fell by 17.2% (Crowley and Luo, 2011), faster and almost as much as during the Great Depression (Eichengreen and O'Rourke, 2009). Studies analysing the Great Trade Collapse have identified the following features. First, both commodities and manufacturing products were affected. While commodity trade declined primarily due to the fall in prices, the drop in manufacturing trade was almost entirely due to a fall in trade volumes (Baldwin, 2009). Second, the collapse happened concurrently in almost all countries and sectors (Baldwin, 2009; Crowley and Luo, 2011). Third, in most countries, the fall in trade was several times larger than the concurrent fall in the overall economic activity (Levchenko et al., 2010; Crowley and Luo, 2011). Fourth, the collapse was particularly strong in intermediate goods (Levchenko et al., 2010). Fifth, while some, particularly smaller, exporters stopped exporting or reduced the number of destinations they served, the bulk of the aggregate trade decline was due to firms selling less of each product, or fewer products, within each destination (Bricongne

et al., 2012).

Regarding the causes of the collapse, the consensus view now seems to be that the primary factor behind the downfall was the fall in aggregate demand related to the financial crisis and the market panic ensuing from the bankruptcy of the Lehman Brothers. This negative demand shock was magnified by the global supply chains, in which intermediate products cross the border several times before they are embedded in the final product, and by the differences between the composition of GDP and trade (Baldwin, 2009; Crowley and Luo, 2011; Eaton et al., 2011b). Credit constraints may also have played a role for some exporters (Chor and Manova, 2012; Bricongne et al., 2012), but they do not seem to have been very important in aggregate because the affected firms tended to be rather small (Bricongne et al., 2012; Levchenko et al., 2010). Similarly, while there might have been some cases of increased trade protection, quantitatively it played a minor role (Evenett, 2009; Crowley and Luo, 2011).

4.3.2 Macroeconomic context

During the period 2001-2008, Romania's GDP grew by 6.5% per year on average. This growth was driven mainly by a strong aggregate demand: massive inflows of foreign direct investment, financial capital inflows and pro-cyclical fiscal policy boosted investment by local firms and consumer spending (IMF, 2009; European Commission, 2015). Although market confidence, related to Romania's accession to the European Union in 2007, certainly played a role, the growth was strongly associated with a rapid expansion of the banking activity, led by local subsidiaries of foreign-owned banks. Between 2003 and 2008, the private credit experienced an annual growth of about 50%, and almost two thirds of the lending were denominated in foreign currencies (IMF, 2010). The ferocious investment activity also led to an accumulation of a current account deficit of 11.5% GDP (European Commission, 2015).

As the global credit crunch hit Romania, capital inflows dried up at the same time when the demand for Romanian exports tumbled. The Romanian currency depreciated against the Euro by about 15%, which further aggravated the situation for the companies and consumers holding the foreign-denominated debt. The banks, although initially well-capitalised, struggled with an increased number of non-performing loans and frozen inter-bank liquidity and a lack of access to external funds (IMF, 2010). Romanian imports collapsed and fell even more

than Romanian exports. The Romanian government, which had previously run substantial budget deficits during a period of high growth, had little space left to support the economy when the crisis hit, and in March 2009, it agreed with the IMF and with other international institutions on a financial assistance package worth 20 billion euros.

Eventually, the assistance programme, together with a reduction in the current account deficit related to the depreciation of the currency and with a revival in global trade, helped to balance the economy, to reduce the country risk premium and stabilise the currency. While the economy shrank slightly in 2010, it returned to growth in 2011.

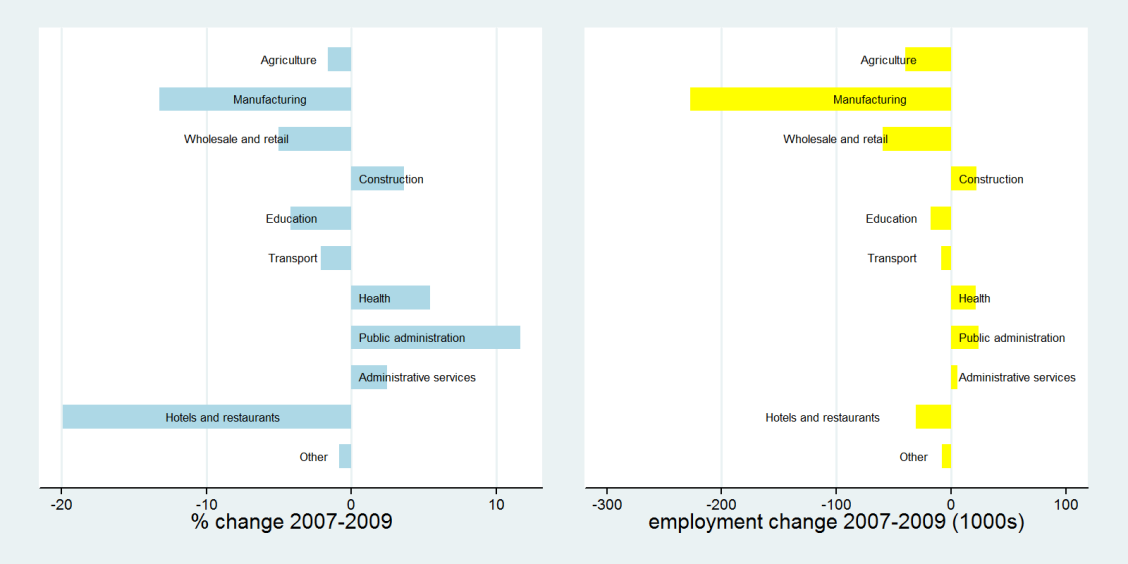
4.3.3 Descriptive statistics

In order to understand the Romanian economic downturn in 2009, it is useful to first see which sectors of economy saw the largest drop in employment, and, in particular, what role was played by manufacturing. Figure 4.3.1 shows that over the period 2007-2009, civil employment in manufacturing declined by about 13%, and the average worked hours taking into account also the unpaid leave and shortened working hours by 19%. Across the 10 NACE sections with the largest employment, only hotels and restaurants saw a larger proportional decline. Furthermore, the large share of manufacturing in aggregate employment meant that, in absolute numbers, manufacturing accounted for 71% of the aggregate net fall in employment over the period. Understanding the evolution of manufacturing employment will, therefore, go a long way towards explaining the changes in the employment as a whole.

Another way to examine the importance of manufacturing in the crisis is to ask to what extent the initial importance of manufacturing in each of the 42 Romanian counties predicted the subsequent employment change. Figure 4.3.2 shows that the share of manufacturing in county employment in 2008 was an important predictor of the subsequent change in total employment. This again underlines the dominant role of manufacturing in explaining the macroeconomic development in Romania over the studied period.

The ensuing question is to what extent the fall in manufacturing employment is attributable to the fall in exports. Figure 4.3.3 shows the first test before a more rigorous analysis in the subsequent sections. It plots the employment change against the change in exports for the 58 manufacturing industries. It shows that sectors with a larger proportional net export change

Figure 4.3.1: Change in employment by NACE sections (2007-2009)

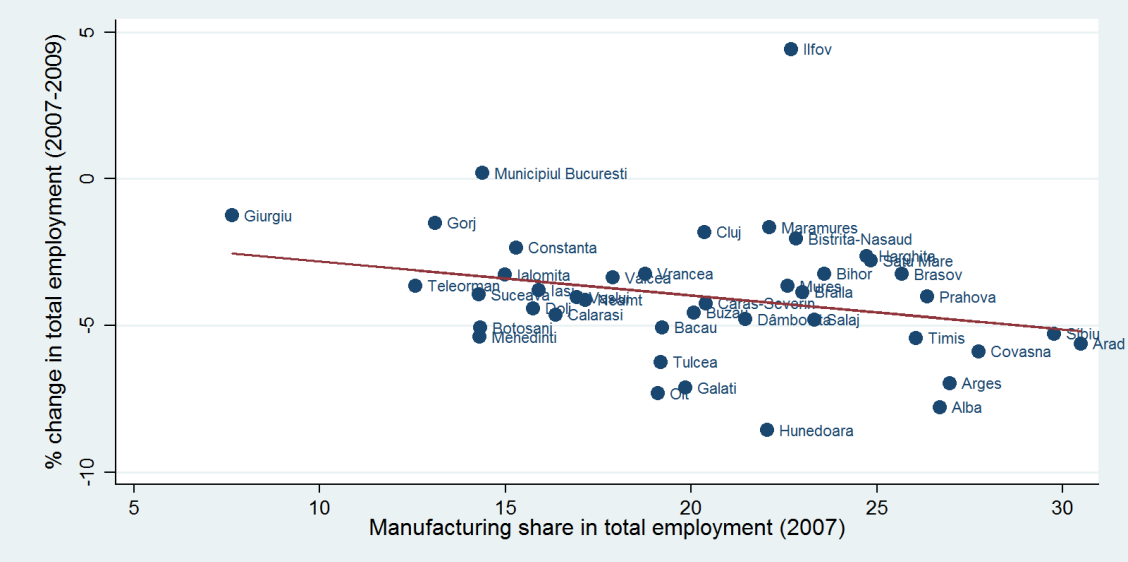


Romanian Statistical Yearbook; own calculations. The figure shows relative and absolute changes in the total employment for the 10 NACE (rev. 2) sections which had the largest employment in 2007. Employment is measured as civil employment (see Section 4.2 for more detail).

also experienced a larger proportional net employment change.

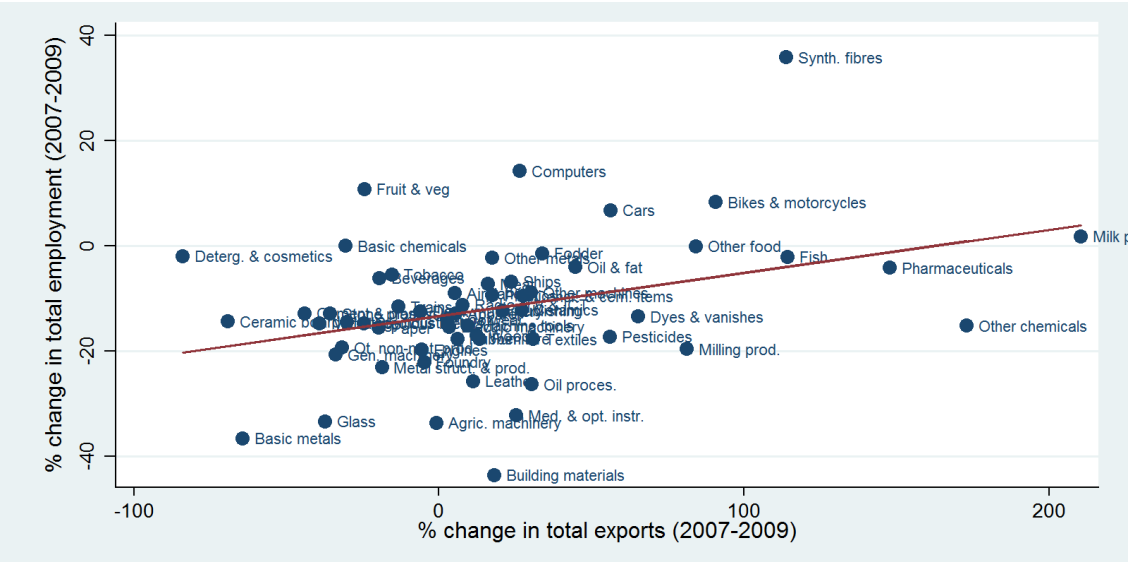
Does the relationship between employment and exports on the aggregate level imply that exporters did worse than non-exporters during the crisis? Were any other firm characteristics related to the performance of manufacturing firms during the crisis? Table 4.3.1 shows the results of regressing annual first differences in the logarithms of firm output or employment on several firm characteristics, used on their own or interacted with a crisis dummy defined as 1 in the years 2008-2009 and 0 in the years 2006 and 2007. The firm characteristics are time-invariant and measured in the first year in which each firm appears in the sample. All regressions include controls for industry-year effects, and the standard errors are clustered on industry level. Columns 1 and 2 include only the crisis years 2008 and 2009. Surprisingly, exporters did not perform worse than non-exporters during the crisis, and the high-intensity exporters actually experienced a smaller fall in output than other firms. Foreign-owned firms did better than domestic-owned ones during this period, yet this fact may simply reflect substantial investments made by foreign investors during the preceding years. Larger firms, on

Figure 4.3.2: Manufacturing and employment change in Romanian counties (2007-2009)



Romanian Statistical Yearbook; own calculations. The line represents fitted values from a linear regression. Its slope equals -0.12 and is significantly different from zero at the 5% level using robust standard errors. Dropping Ilfov county means the slope becomes -0.14 and statistically significant at the 1% level. Employment is measured as civil employment (see Section 4.2 for more detail).

Figure 4.3.3: Employment and export changes in manufacturing industries (2007-2009)



SBS, own calculations. The line represents fitted values from a linear regression. Its slope equals 0.08 and is significantly different from zero at the 5% level using robust standard errors. Employment is measured as average hours worked (see Section 4.2 for more detail).

Table 4.3.1: Initial firm characteristics and output and employment during the crisis

	2008-2009		2006-2009	
	(1)	(2)	(3)	(4)
	Δ log(output)	Δ log(emp.)	Δ log(output)	Δ log(emp.)
Exporter	-0.011	0.003	-0.008	0.003
	(0.010)	(0.008)	(0.011)	(0.009)
Exporter x crisis year			-0.003	0.000
			(0.011)	(0.011)
Exp. share > 50th percentile	0.041**	0.007	-0.040**	-0.025**
	(0.016)	(0.010)	(0.018)	(0.010)
Exp. share > 50th percentile x crisis year			0.081***	0.033***
			(0.015)	(0.011)
FDI firm	0.039***	0.028***	0.019	0.032***
	(0.014)	(0.009)	(0.012)	(0.010)
FDI firm x crisis year			0.021	-0.004
			(0.013)	(0.009)
Emp. > 50th percentile	-0.008	-0.063***	0.011	-0.032***
	(0.009)	(0.007)	(0.008)	(0.007)
Emp. > 50th percentile x crisis year			-0.019	-0.030***
			(0.012)	(0.008)
Industry-year FE	Yes	Yes	Yes	Yes
N	23637	23668	46677	46700

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. Export status, export intensity, foreign ownership and size are measured in the first year when each firm appears in the sample, which is 2005 for a majority of firms. Firms are considered as exporters if they exported a strictly positive share of their output in their initial year in the sample. The FDI firms are defined as those where the share of foreign ownership exceeded 10% in that year. The export-share and size percentiles are calculated in relation to other firms in the initial year of each firm in the sample.

the contrary, saw a larger proportional fall in employment than other firms. Columns 3 and 4 also include the years 2006 and 2007. The uninteracted variables now effectively control for pre-crisis trends, while the interactions capture the performance during the crisis. There is again no difference between the low-intensity exporters and non-exporters, but the performance advantage of intensive exporters becomes even greater and is now visible also in terms of employment. The better performance of foreign-owned firms, indeed, seems to be driven by overall trends rather than by extra resilience during the crisis, while the relatively worse performance of larger firms is partly driven by initial trends and partly specific to the crisis.

Does the fact that exporters, as it seems, were not affected by the crisis more than non-exporters mean that the decline in manufacturing employment had little to do with the fall in exports? The next section inquires into the causal effect of the fall in exports on exporting

firms, while the section that follows it examines the effect of the fall on non-exporters.

4.4 Exporters during the trade collapse

4.4.1 Methodology

This section examines how Romanian manufacturing exporters reacted to an abrupt drop in their exports due to a fall in foreign demand for their products. The aim is to estimate the coefficient β_1 in the reduced form equation

$$\Delta Y_{it} = \beta_1 \Delta \log(exports_{it}) + \beta_2 \Delta \log(DD_{it}) + \gamma_{st} + \epsilon_{it}. \tag{4.1}$$

$\Delta X_{it} = X_{it} - X_{i,t-1}$ marks annual changes, ΔY_{it} is the outcome variable of interest for firm i in year t, γ_{st} represents any factors specific to industry s in year t, ϵ_{it} is an error term. Variable $\Delta \log(DD_{it})$ represents the domestic import demand for products exported by firm i, and it is included to control for the domestic demand for these products.

Most outcome variables serve to understand how exporters with falling export revenues reduce their expenditures. They include employment as measured by the average number of employees, average wage, raw materials and investment in the fixed capital. The last outcome variable involves domestic sales, and it examines whether exporters with falling exports are able to redirect their sales to the domestic market, or, on the contrary, their domestic sales fall alongside their exports, as found by Berman et al. (2015).

Estimating equation (4.1) by ordinary least squares (OLS) is likely to yield inconsistent estimates, since the same firm-specific factors are likely to drive both exports and other performance measures. In order to identify the effect of the exogenous fall in exports, I estimate the equation by two-stage least squares (2SLS). As an instrument, I use the change in foreign demand, which I make firm-specific on the basis of he initial structure of each firm's exports in terms of products and destination countries. I define the foreign demand for exports of firm i, as

$$FD_{it} = \sum_c \sum_p (s_{icp} M_{cpt}), \tag{4.2}$$

where s_{icp} is the share of exports of product p to country c in the total exports by firm i in the year 2007, and M_{pdt} are the total imports by country c of product p in time t from all other countries except Romania. The first stage can then be written as

$$\Delta \log(exports_{it}) = \alpha_1 \Delta \log(FD_{it}) + \alpha_2 \Delta \log(DD_{it}) + \delta_{st} + \nu_{it}. \tag{4.3}$$

The instrument, $\Delta \log(FD_{it})$, is valid only if it affects firm performance solely through its influence on firms' exports. This may not be the case if foreign and domestic demand are correlated across products. In order to check for this possibility, I follow Berman et al. (2015) and control for changes in domestic demand, $\Delta \log(DD_{it})$, in both the first- and second-stage equations. The index of domestic demand is constructed analogously to the foreign demand by products, but it is based on Romania's rather than on other countries' imports. Substituting $M_{pt}^{Romania}$ for Romanian imports of product p in time t, I write the domestic demand as

$$DD_{it} = \sum_{p} (s_{ip} M_{pt}^{Romania}). \tag{4.4}$$

I estimate the equation (4.1) on the sample consisting of exporting manufacturing firms. All regressions control for industry-year fixed effects and cluster standard errors on the level of industries.

4.4.2 Results

Table 4.4.1 shows the first stage results for an estimation with the logarithm of employment as the outcome variable.[14] Foreign demand seems to be a highly statistically significant predictor of exports, and the first stage F-statistics for the employment regression is 11. Table 4.4.2 contains the main results. For each outcome variable, it first reports results of a simple OLS regression and then the second stage results from the 2SLS estimation. The coefficient on exports is positive in all cases but one, in line with the idea that a fall in exports is related to a worsening in other performance indicators. The only exception is the negative OLS estimate with domestic sales as the outcome variable, which suggests that firms, to some extent, make

[14] Although the first stage should in principle be the same irrespective of the outcome variable, samples slightly differ due to the data cleaning procedure where the top and bottom 1% observations of each differenced outcome variable are set as missing, and due to zero or missing values in some outcome variables.

Table 4.4.1: Exogenous changes in exports and exporter performance - first stage (2007-2009)

	(1)
	Δ log(exports)
Δ log(FD)	0.393***
	(0.120)
Δ log(DD)	0.020
	(0.092)
Industry-year FE	Yes
N	6522
F-stat.	10.65

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. The sample consists of exporting manufacturing firms.

a choice between selling a given amount of output at home and abroad.

The 2SLS results suggest that firms facing an exogenous fall in their exports substantially reduce their wage bill, and that they do so through reduced employment rather than wages. A 10% exogenous fall in exports seems to lead to a 3.5% fall in employment, while there appears to be no effect on wages. In addition, exporters adjust to an exogenous fall in exports by a sharp reduction in their raw material expenditure and investment. A 10% reduction in exports is associated with an almost 7% reduction in raw material purchases and a 10% reduction in investment, although the coefficient on investment is rather imprecisely estimated and is, therefore, statistically significant only on the 10% level.

Table 4.4.2: Exogenous changes in exports and exporter performance - second stage (2007-2009)

	Δ log(empl.)		Δ log(mean ω)		Δ log(raw mat.)		Δ log(invest.)		Δ log(dom. sales)	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS	(5) OLS	(6) 2SLS	(7) OLS	(8) 2SLS	(9) OLS	(10) 2SLS
Δ log(exports)	0.098***	0.344***	0.013***	0.001	0.212***	0.681***	0.079***	1.040*	-0.143***	0.410**
	(0.009)	(0.106)	(0.003)	(0.057)	(0.020)	(0.222)	(0.023)	(0.602)	(0.027)	(0.165)
Δ log(DD)	0.007	-0.007	0.007	0.007	0.064	0.036	0.045	0.011	0.097	0.053
	(0.021)	(0.032)	(0.011)	(0.012)	(0.039)	(0.065)	(0.089)	(0.141)	(0.063)	(0.064)
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6522	6522	6511	6511	6480	6480	5525	5525	5775	5775
F-stat.	.	10.65	.	6.48	.	10.56	.	5.17	.	7.03

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. The sample consists of exporting manufacturing firms.

If firms adjusted to the fall in their exports fully and instantaneously, all coefficients would be equal to one. This seems to be the case only for investment. If, on the contrary, the firms were not able to adjust at all and instead bore all the costs in terms of reduced profits, all coefficients would be equal to zero, as they seem to be for wages. The adjustment for employment and material expenditure appears to be partial, with material expenditure being significantly more flexible than employment. However, even a partial adjustment can lead to a large reduction in aggregate employment and in aggregate demand for intermediate inputs when driven by a drop in aggregate exports as dramatic as it was in the studied period.

The results for domestic sales clearly contradict the hypothesis that the struggling exporters were able to shift their sales to the domestic market. Instead, the results are in line with the findings of Berman et al. (2015) which can be summarized as 'when something goes wrong, everything goes wrong'. A 10% exogenous fall in exports appears to also lead to a 4% fall in domestic sales. Such a steep reduction in domestic sales in response to a fall in exports suggests an important interaction of the demand shock with supply-side factors at least for some of the exporters, possibly due to liquidity constraints (Berman et al., 2015).

Somewhat surprisingly, the OLS estimates are substantially smaller than the 2SLS estimates. One potential explanation for this is that a measurement error in the export variable biases the OLS results towards zero. In particular, as explained in Section 4.2, exports reported in the SBS data and in the customs data do not match each other perfectly, which indicates some imprecisions in one of the data sources, or both. If these imprecisions drive the difference between the OLS and 2SLS results, the difference should become smaller when I drop the observations which are more likely to suffer from the measurement error. In Table 4.7.1 in the appendix, I, therefore, report estimates based on a sample from which I exclude observations when the key explanatory variable — change in the logarithm of export — may not be reliable. In particular, I exclude observations for which the first-differenced exports are observed in only one of the two data sources, and 10% of the remaining observations where the difference between the first-differenced exports in the two data sources is most positive or most negative. Table 4.7.1 indeed shows that using the trimmed sample makes the OLS estimates — in particular, those for employment and material expenditure — substantially larger than they are with the full sample, although they are still smaller than the 2SLS esti-

mates. Importantly, the 2SLS estimates are very similar with both samples. Table 4.7.1, thus, suggests that the measurement error explains, in part, the difference between the OLS and the 2SLS estimates.

Another potential explanation of the difference between OLS and 2SLS results is related to domestic sales. Table 4.4.2 shows a negative OLS estimate but a positive 2SLS estimate for the relationship between exports and domestic sales. Consequently, with OLS, growing domestic sales partly counterbalance the impact of falling exports on employment or material expenditure, while with 2SLS, falling domestic sales further reinforce the impact of falling exports on these variables. Yet another potential explanation is that there is a heterogeneity in firms' responses to falling exports and that the firms which were most effected by the drop in foreign demand were also those which tend to cut costs in response to falling exports most sharply. If this is the case, the 2SLS estimates need to be interpreted as local average treatment effects.

4.5 Non-exporters during the trade collapse

4.5.1 Methodology

The analysis in the previous section has revealed that exporters sharply reduce employment in response to a fall in their export sales. This result seems to be at odds with the earlier observation that non-exporting manufacturers struggled during the crisis at least as much as exporters. A hint for reconciling these seemingly contradictory results may be hidden in another result from the previous section — exporters facing a negative export shock rapidly reduce their demand for intermediate inputs which may negatively affect firms providing these inputs. In this section, I explore this hypothesis by estimating the effect of an exogenous fall in exports in the downstream (input sourcing) industries on non-exporting firms in the upstream (supplying) industries.[15]

[15]Like the non-exporters, the exporting firms which sell part of their output domestically could also be affected by the reduced demand for the inputs they sell to downstream industries. However, analysing this is difficult, because some firms supply inputs to other firms in their own industry, and downstream exports, thus, also reflect exports of each firm's own industry. Consequently, attributing the correlation between the downstream exports and the exporters' performance solely to the input channel could be problematic due to the omitted-variable bias. I, therefore, restrict the analysis of the effect of the downstream exports to firms which do not export.

I identify the supplier-buyer relationships between the 58 manufacturing sectors of the Romanian economy using the input-output table from the year 2002.[16] Specifically, I define exports in downstream sectors as

$$exports_{st}^{down} = \sum_{d} (w_{sd} exports_{dt}). \tag{4.5}$$

The terms w_{sd} come from the input-output table and represent the share of all intermediate products supplied by firms in industry s that is sold in industry d, and $exports_{dt}$ represent all exports by firms in industry d in year t. I also define foreign demand in industry d as[17]

$$FD_{dt} = \sum_{p} (s_{dp} M_{pt}) \tag{4.6}$$

where s_{dp} is the share of product p in the total exports of industry d in the year 2007, and M_{pt} are the total imports of the product in time t by all countries except Romania. Using the previous definition, I write the foreign demand in downstream industries as

$$FD_{st}^{down} = \sum_{d} (w_{sd} FD_{dt} \frac{exports_{d,2007}}{FD_{d,2007}}). \tag{4.7}$$

The normalizing ratio $\frac{exports_{d,2007}}{FD_{d,2007}}$ ensures that the importance of each downstream sector in the formula reflects its weight in the Romanian exports rather than its weight in the global trade.

Using the above definitions, I estimate the equation

$$\Delta Y_{it} = \beta \Delta \log(exports_{st}^{down}) + \gamma_t + [\gamma_s] + \epsilon_{it}. \tag{4.8}$$

The outcome variables Y_{it} are firm-specific, and they include domestic sales, employment, wages, material expenditure and investment. Since downstream exports and downstream foreign demand vary only by industries and by time, I cannot control for industry-year fixed effects as in the previous section. Instead, I always include dummies for each year, γ_t, and

[16] 2002 is the latest year for which I have access to an input-output table decomposed into 58 manufacturing sectors.

[17] The variation in terms of export destinations is rather limited when exports are aggregated to an industry-level. In this section, I, therefore, rely only on variation in terms of products exported by each industry.

I also report results for an additional specification that includes dummies for each industry, γ_s, which, given the first-differenced specification, correspond to industry-specific time trends. However, it is important to keep on mind that it is rather demanding to allow for industry time trends with such a short panel where the identifying variation comes only from industries and time.

As in the previous sections, estimating equation (4.8) by the OLS would likely lead to inconsistent estimates. In particular, since downstream industries include each firm's own industry, the same industry-specific time-varying factors could drive both export performance and domestic sales. I, therefore, again employ the 2SLS estimation, instrumenting the change in downstream exports with the change in downstream foreign demand, $\Delta \log(FD_{st})$, so that the first stage equation is given by

$$\Delta \log(exports_{st}) = \alpha \Delta \log(FD_{st}) + \delta_t + \delta_s + \nu_{it}. \tag{4.9}$$

I estimate the equation (4.8) on the sample consisting of non-exporting manufacturing firms. As before, the standard errors are clustered on the level of 58 manufacturing industries in all regressions.

4.5.2 Results

Table 4.5.1 reports the first-stage estimates. The foreign demand variable is a strong predictor of exports in downstream sectors with relatively tightly estimated coefficients on the change in foreign demand in downstream sectors and with large F-statistics. Table 4.5.2 contains the second-stage results as well as the OLS results for comparison. Similar to the previous section, the instrumented estimates are in all cases larger than the OLS estimates. The 2SLS results suggest that the exogenous fall in exports in the downstream (input sourcing) sectors led to a fall in the sales of the non-exporting firms in the upstream (supplying) sectors that was just as great or even greater. For the other outcome variables, the estimates are similar to those found for exporters in the previous section, although they tend to be slightly larger. Mean wages seem to also be related to downstream exports, although the estimated coefficient is significantly different from zero only at the 10% level. The coefficient on investment is smaller

Table 4.5.1: Exogenous changes in exports and supplier performance - first stage (2007-2009)

	(1) Δ log(exports^{down})	(2) Δ log(exports^{down})
Δ log(FD^{down})	0.680***	0.620***
	(0.099)	(0.116)
Year FE	Yes	Yes
Industry FE		Yes
N	14483	14483
F-stat.	46.22	27.99

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. The sample consists of non-exporting manufacturing firms.

than in the case of exporters and statistically not significant. A 10% fall in downstream exports seems to be, on average, associated with a 6% fall in employment, a 2% relative fall in average wages, and a 12% fall in raw material expenditure.

Table 4.7.2 in the appendix reports the second-stage results from an estimation that includes controls for industry fixed effects. As can be expected, the 2SLS estimates of the effect of downstream exports are somewhat smaller (except for investment) and less precisely estimated than in the less demanding specification, yet the overall picture remains the same — a fall in downstream exports is associated with a one-to-one fall in sales by non-exporting firms in upstream industries, and this fall leads a large reduction in upstream firms' employment, and, possibly, also material expenditure and investment.

The similarity between, on one hand, the reaction of exporters to a fall in foreign demand for their exports, and, on the other hand, the reaction of non-exporting firms to a fall in downstream exports and the consequent fall in their own domestic sales, is rather remarkable, particularly given that the identifying variation is different in each case — while the estimates for exporters in the previous section were identified on the basis of within-sector variation, the estimates in this section are based the variation across sectors.

The results in this section are in line with the hypothesis that during the export collapse, non-exporting manufacturing firms suffered as much as exporters because of the sharply reduced demand for intermediate inputs. Furthermore, non-exporters seem to have adjusted to their falling sales, if anything, even faster than exporters. The observation that non-exporters performed, during the crisis, as poorly as exporters, therefore, does not imply that the large

drop in manufacturing employment was unrelated to the drop in exports, but it is rather an indication that the effect on suppliers is an additional channel through which an abrupt drop in foreign demand is transmitted to the domestic economy.

Table 4.5.2: Exogenous changes in exports and supplier performance - second stage (2007-2009)

	Δ log(dom. sales)		Δ log(empl.)		Δ log(mean ω)		Δ log(raw mat.)		Δ log(invest.)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Δ log(exports^{down})	0.465***	1.316***	0.292***	0.627***	0.005	0.163*	0.383***	1.163***	0.147	0.419
	(0.164)	(0.291)	(0.104)	(0.197)	(0.025)	(0.098)	(0.139)	(0.333)	(0.184)	(0.664)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE										
N	14588	14588	14483	14483	13987	13987	13997	13997	9921	9921
F-stat.	.	45.81	.	46.22	.	45.19	.	45.16	.	36.09

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. The sample consists of non-exporting manufacturing firms.

4.6 Conclusion

This chapter uses a matched firm and customs dataset from Romania, together with product-level import data of other countries, to study how Romanian manufacturing firms reacted to a large fall in their exports during the Great Trade Collapse. It identifies the effect of a fall in exports by instrumenting them with a firm-specific measure of foreign demand, which combines the product and destination structure of each firm's exports with time variation in product-specific imports of other countries.

I find that exporters adjusted to the drop in their export sales by a fully proportional reduction in investment, and a somewhat smaller, but still sizeable, reduction in employment and in material purchases. In addition, I document that a fall in exports in the downstream (input sourcing) sectors was associated with similarly large reductions in sales of non-exporting firms in the upstream (supplying) sectors, and that these non-exporting firms in turn substantially reduced their employment and material purchases. These results have a number of implications.

First, they provide a rough estimate of the extent to which the 2009 crash of the Romanian economy, and, in particular, of the Romanian manufacturing, can be attributed to the trade collapse. Between 2007 and 2009, Romanian manufacturing exports fell by 25%. Simply multiplying this number by the estimated elasticity of exporters' employment to their exports, 0.34, implies an employment fall of 9%. This is a large number in absolute terms, and it amounts to about a half of the total drop in employment by manufacturing firms exporting throughout the period (about 17%). Similarly, multiplying the aggregate fall in manufacturing exports by the estimated elasticity of employment in non-exporting firms to exports in downstream industries, 0.63, then implies an employment fall of approximately 16%, which is even larger and almost as large as the aggregate employment fall across non-exporting manufacturing firms (about 17%). Overall, these coarse calculations suggest that a fall in exports can account for most of the employment reduction in the Romanian manufacturing sector in 2007-2009, and that it played an important role in Romania's economic crash in 2009.

Second, the results make it clearer how a negative export shock is transmitted to the domestic economy. It directly harms exporters and, through reduced demand for inputs, also

their suppliers. Both exporters and their suppliers react by dismissing labour and reducing working hours of the remaining employees, which in turn reduces the purchasing power of consumers and hurts consumer confidence, potentially taking economy to a downward spiral.

Finally, the findings of the chapter suggest that it would be a mistake to expect that a foreign demand shock would only hurt exporters or that non-exporting firms are less vulnerable to global markets. Just like the label "Made in China" on a gadget does not mean that most of its value actually comes from China (Linden et al., 2007), the fact that a firm does not itself export does not mean that it is not strongly dependent on export markets. In its emphasis on the need to consider input-output relationships when analysing the effects of foreign shocks, this chapter is, therefore, pointing in a similar direction as, for example, the recent attempts at measuring trade in value added, which suggest that about a third of the value added contained in manufacturing exports actually comes from the services sector (OECD, 2013).

While this chapter focuses primarily on the transmission of the Great Trade Collapse through a demand shock, an interesting extension of the analysis presented above would examine a potential role of supply-side effects through imported inputs. Accessibility of imported inputs for Romanian firms may have decreased during the crisis due to difficulties experienced by foreign producers, or it may have increased due to the weak global demand putting a downward pressure on prices. The effect of imported input supply on performance of Romanian firms could be estimated with methods parallel to those used in this chapter but applied to information on imports, rather than exports.

4.7 Appendix

Table 4.7.1: Exogenous changes in exports and exporter performance (trimmed sample) - second stage (2007-2009)

	Δ log(empl.)		Δ log(mean ω)		Δ log(raw mat.)		Δ log(invest.)		Δ log(dom. sales)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Δ log(exports)	0.176***	0.327***	0.025***	0.069	0.362***	0.725***	0.132***	0.916	-0.140**	0.244
	(0.020)	(0.083)	(0.006)	(0.076)	(0.034)	(0.218)	(0.034)	(0.638)	(0.053)	(0.257)
Δ log(DD)	0.008	0.002	0.011	0.010	0.067	0.049	0.006	-0.029	0.142**	0.124*
	(0.017)	(0.019)	(0.012)	(0.015)	(0.051)	(0.062)	(0.098)	(0.122)	(0.068)	(0.067)
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4481	4481	4473	4473	4451	4451	3866	3866	3872	3872
F-stat.	.	8.19	.	5.51	.	7.08	.	4.92	.	9.37

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. The sample consists of exporting manufacturing firms, and it excludes the observations for which first-differenced exports are observed in only either SBS or customs data and the 10% of the remaining observations where the difference between first-differenced exports in the two data sources is most positive or most negative.

Table 4.7.2: Exogenous changes in exports and supplier performance (industry fixed effects) - second stage (2007-2009)

	Δ log(dom. sales)		Δ log(empl.)		Δ log(mean ω)		Δ log(raw mat.)		Δ log(invest.)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Δ log(exports^{down})	0.087	0.902*	0.004	0.538**	-0.044	0.092	-0.019	0.685	-0.184	1.115
	(0.222)	(0.500)	(0.112)	(0.212)	(0.069)	(0.181)	(0.198)	(0.529)	(0.378)	(1.105)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	14588	14588	14483	14483	13987	13987	13997	13997	9921	9921
F-stat.	.	27.47	.	27.99	.	26.00	.	27.23	.	20.91

**** 1%, ** 5%, * 10%*. Standard errors in parentheses have been corrected for clustering for each industry. Δ marks annual first differences. The sample consists of non-exporting manufacturing firms.

Bibliography

Ackerberg, Daniel, Kevin Caves, and Garth Frazer, "Structural Identification of Production Functions," MPRA Paper 38349, University of Munich, December 2006.

Aghion, Philippe, Robin Burgess, Stephen J. Redding, and Fabrizio Zilibotti, "The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India," *American Economic Review*, September 2008, *98* (4), 1397–1412.

Aitken, Brian, Ann Harrison, and Robert E. Lipsey, "Wages and Foreign Ownership: A Comparative Study of Mexico, Venezuela, and the United States," *Journal of International Economics*, May 1996, *40* (3-4), 345–371.

_ , Gordon H. Hanson, and Ann E. Harrison, "Spillovers, Foreign Investment, and Export Behavior," *Journal of International Economics*, August 1997, *43* (1-2), 103–132.

Aitken, Brian J. and Ann E. Harrison, "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela," *American Economic Review*, June 1999, *89* (3), 605–618.

Alfaro, Laura and Maggie X. Chen, "Market Reallocation and Knowledge Spillover: The Gains from Multinational Production," Harvard Business School Working Paper 12-111, June 2012.

Amiti, Mary and Donald R. Davis, "Trade, Firms, and Wages: Theory and Evidence," *The Review of Economic Studies*, January 2012, *79* (1), 1–36.

_ and Jozef Konings, "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia," *American Economic Review*, December 2007, *97* (5), 1611–1638.

Anderson, James E. and Eric van Wincoop, "Trade Costs," *Journal of Economic Literature*, September 2004, *42* (3), 691–751.

__ **and J. Peter Neary**, "Welfare versus Market Access: The Implications of Tariff Structure for Tariff Reform," *Journal of International Economics*, March 2007, *71* (1), 187–205.

Arkolakis, Costas, Arnaud Costinot, and Andres Rodriguez-Clare, "New Trade Models, Same Old Gains?," *American Economic Review*, February 2012, *102* (1), 94–130.

Arnold, Jens Matthias and Beata S. Javorcik, "Gifted kids or pushy parents? Foreign direct investment and plant productivity in Indonesia," *Journal of International Economics*, September 2009, *79* (1), 42–53.

Aterido, Reyes, Mary Hallward-Driemeier, and Carmen Pagés, "Investment Climate and Employment Growth: The Impact of Access to Finance, Corruption and Regulations Across Firms," Institute for the Study of Labor (IZA) Discussion Paper 3138, November 2007.

Atkeson, Andrew and Ariel TomÃis Burstein, "Innovation, Firm Dynamics, and International Trade," *Journal of Political Economy*, 06 2010, *118* (3), 433–484.

Baldwin, Richard, "The Great Trade Collapse: What Caused It and What Does It Mean?," in Richard Baldwin, ed., *The Great Trade Collapse: Causes, Consequences and Prospects*, London: Centre for Economic Policy Research, 2009.

__ **and James Harrigan**, "Zeros, Quality, and Space: Trade Theory and Trade Evidence," *American Economic Journal: Microeconomics*, May 2011, *3* (2), 60–88.

Balsvik, Ragnhild, "Is Labor Mobility a Channel for Spillovers from Multinationals? Evidence from Norwegian Manufacturing," *The Review of Economics and Statistics*, February 2011, *93* (1), 285–297.

Barlevy, Gadi, "The Sullying Effect of Recessions," *Review of Economic Studies*, January 2002, *69* (1), 65–96.

__ , "Credit Market Frictions and the Allocation of Resources over the Business Cycle," *Journal of Monetary Economics*, November 2003, *50* (8), 1795–1818.

Bartelsman, Eric, John Haltiwanger, and Stefano Scarpetta, "Cross-Country Differences in Productivity: The Role of Allocation and Selection," *American Economic Review*, February 2013, *103* (1), 305–34.

Bas, Maria and Vanessa Strauss-Kahn, "Input-Trade Liberalization, Export Prices and Quality Upgrading," *Journal of International Economics*, March 2015, *95* (2), 250–262.

Berman, Nicolas, Antoine Berthou, and Jérôme Héricourt, "Export Dynamics and Sales at Home," *Journal of International Economics*, 2015, *96* (2), 298–310.

Bernard, Andrew B. and Bradford J. Jensen, "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-87," *Brookings Papers on Economic Activity: Microeconomics*, 1995, pp. 67–112.

_ and _ , "Exceptional Exporter Performance: Cause, Effect, Or Both?," *Journal of International Economics*, February 1999, *47* (1), 1–25.

_ , J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott, "Firms in International Trade," *Journal of Economic Perspectives*, Summer 2007, *21* (3), 105–130.

_ , _ , _ , and _ , "The Empirics of Firm Heterogeneity and International Trade," *Annual Review of Economics*, July 2012, *4* (1), 283–313.

_ , Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum, "Plants and Productivity in International Trade," *American Economic Review*, September 2003, *93* (4), 1268–1290.

_ , Stephen J. Redding, and Peter K. Schott, "Comparative Advantage and Heterogeneous Firms," *Review of Economic Studies*, January 2007, *74* (1), 31–66.

_ , _ , and _ , "Multiproduct Firms and Trade Liberalization," *The Quarterly Journal of Economics*, August 2011, *126* (3), 1271–1318.

Beveren, Ilke Van, Andrew B. Bernard, and Hylke Vandenbussche, "Concording EU Trade and Production Data over Time," National Bureau of Economic Research Working Paper 18604, December 2012.

Blalock, Garrick and Paul J. Gertler, "Welfare Gains from Foreign Direct Investment through Technology Transfer to Local Suppliers," *Journal of International Economics*, March 2008, *74* (2), 402–421.

Boyce, James K. and Léonce Ndikumana, "Capital Flight from Sub-Saharan African Countries: Updated Estimates, 1970 - 2010," PERI Research Report, University of Massachusetts, Amherst, October 2012.

Brandt, Loren and Xiaodong Zhu, "Accounting for China's Growth," Institute for the Study of Labor (IZA) Discussion Paper 4764, February 2010.

Bricongne, Jean-Charles, Lionel Fontagné, Guillaume Gaulier, Daria Taglioni, and Vincent Vicard, "Firms and the Global Crisis: French Exports in the Turmoil," *Journal of International Economics*, May 2012, *87* (1), 134–146.

Brooks, Eileen L., "Why Don't Firms Export More? Product Quality and Colombian Plants," *Journal of Development Economics*, 2006, *80*, 160–178.

Bustos, Paula, "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms," *American Economic Review*, February 2011, *101* (1), 304–40.

Caballero, Ricardo J and Mohamad L Hammour, "The Cleansing Effect of Recessions," *American Economic Review*, December 1994, *84* (5), 1350–68.

Caliendo, Lorenzo and Esteban Rossi-Hansberg, "The Impact of Trade on Organization and Productivity*," *The Quarterly Journal of Economics*, 2012.

Camacho, Adriana and Emily Conover, "Misallocation and Productivity in Colombia's Manufacturing Industries," Inter-American Development Bank Working Paper 6783, February 2010.

Chekir, Hamouda and Ishac Diwan, "Crony Capitalism in Egypt," Center for International Development Working Paper 250, Harvard University, November 2012.

Chen, Huiya and Deborah L. Swenson, "Multinational Firms and New Chinese Export Transactions," unpublished, University of California, Davis, January 2007.

Chor, Davin and Kalina Manova, "Off the Cliff and Back? Credit Conditions and International Trade During the Global Financial Crisis," *Journal of International Economics*, May 2012, *87* (1), 117–133.

Claessens, Stijn, Erik Feijen, and Luc Laeven, "Political Connections and Preferential Access to Finance: The Role of Campaign Contributions," *Journal of Financial Economics*, June 2008, *88* (3), 554–580.

Crowley, Meredith A. and Xi Luo, "Understanding the Great Trade Collapse of 2008-09 and the Subsequent Trade Recovery," *Economic Perspectives*, 2011, *2*, 44–68.

Defever, Fabrice and Alejandro Riaño, "China's Pure Exporter Subsidies," Centre for Economic Performance Discussion Paper 1182, LSE, December 2012.

Dhingra, Swati and John Morrow, "Monopolistic Competition and Optimum Product Diversity Under Firm Heterogeneity," unpublished, London School of Economics, 2014.

di Giovanni, Julian and Andrei A. Levchenko, "Trade Openness and Volatility," *The Review of Economics and Statistics*, August 2009, *91* (3), 558–585.

_ and _, "Country Size, International Trade, and Aggregate Fluctuations in Granular Economies," *Journal of Political Economy*, December 2012, *120* (6), 1083 – 1132.

Diwan, Ishac, Philip E. Keefer, and Marc Tobias Schiffbauer, "Pyramid Capitalism: Political Connections, Regulation, and Firm Productivity in Egypt," Policy Research Working Paper 7354, The World Bank, July 2015.

Eaton, Jonathan, Samuel Kortum, and Francis Kramarz, "An Anatomy of International Trade: Evidence From French Firms," *Econometrica*, September 2011, *79* (5), 1453–1498.

_ , _ , Brent Neiman, and John Romalis, "Trade and the Global Recession," National Bureau of Economic Research Working Paper 16666, January 2011.

Eckel, Carsten and J. Peter Neary, "Multi-Product Firms and Flexible Manufacturing in the Global Economy," *Review of Economic Studies*, January 2010, *77* (1), 188–217.

_ , Leonardo Iacovone, Beata Javorcik, and J. Peter Neary, "Multi-Product Firms at Home and Away: Cost- versus Quality-Based Competence," *Journal of International Economics*, March 2015, *95* (2), 216–232.

Eichengreen, Barry and Kevin O'Rourke, "A Tale of Two Depressions," VoxEU.org, National Bureau of Economic Research, April 2009.

Ekholm, Karolina, Andreas Moxnes, and Karen-Helene Ulltveit-Moe, "Manufacturing Restructuring and the Role of Real Exchange Rate Shocks," Centre for Economic Policy Research Discussion Paper 6904, July 2008.

Eslava, Marcela, Arturo Galindo, Marc Hofstetter, and Alejandro Izquierdo, "Scarring Recessions and Credit Constraints: Evidence from Colombian Firm Dynamics," Documentos CEDE 007711, Universidad de los Andes, August 2010.

European Commission, "Country Report Romania 2015," Commission Staff Working Document, European Commission, February 2015.

Evenett, Simon J., "Crisis-Era Protectionism One Year After the Washington G20 Meeting," in Richard Baldwin, ed., *The Great Trade Collapse: Causes, Consequences and Prospects*, London: Centre for Economic Policy Research, 2009.

Faccio, Mara, "Differences between Politically Connected and Nonconnected Firms: A Cross-Country Analysis," *Financial Management*, September 2010, *39* (3), 905–928.

Fisman, Raymond, "Estimating the Value of Political Connections," *American Economic Review*, September 2001, *91* (4), 1095–1102.

Gabaix, Xavier, "The Granular Origins of Aggregate Fluctuations," *Econometrica*, May 2011, *79* (3), 733–772.

Gaulier, Guillaume and Soledad Zignago, "BACI: International Trade Database at the Product-Level. The 1994-2007 Version," Working Paper 2010-23, CEPII, October 2010.

Goldberg, Pinelopi Koujianou, Amit Kumar Khandelwal, Nina Pavcnik, and Petia Topalova, "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India," *The Quarterly Journal of Economics*, November 2010, *125* (4), 1727–1767.

Goldman, Eitan, Jörg Rocholl, and Jongil So, "Politically Connected Boards of Directors and The Allocation of Procurement Contracts," *Review of Finance*, January 2013, *17* (5), 1617–1648.

Gopinath, Gita and Brent Neiman, "Trade Adjustment and Productivity in Large Crises," *American Economic Review*, March 2014, *104* (3), 793–831.

Greenaway, David, Nuno Sousa, and Katharine Wakelin, "Do Domestic Firms Learn to Export from Multinationals?," *European Journal of Political Economy*, November 2004, *20* (4), 1027–1043.

Guner, Nezih, Gustavo Ventura, and Xu Yi, "Macroeconomic Implications of Size-Dependent Policies," *Review of Economic Dynamics*, October 2008, *11* (4), 721–744.

Gustavo, Machicado Carlos and Birbuet Juan Cristobal, "Misallocation and Manufacturing TFP in Bolivia during the Market Liberalization Period," *The B.E. Journal of Macroeconomics*, July 2012, *12* (1), 1–45.

Hale, Galina and Cheryl Long, "Did Foreign Direct Investment Put an Upward Pressure on Wages in China?," *IMF Economic Review*, August 2011, *59* (3), 404–430.

Hallak, Juan Carlos, "Product Quality and the Direction of Trade," *Journal of International Economics*, January 2006, *68* (1), 238–265.

_ and Jagadeesh Sivadasan, "Product and Process Productivity: Implications for Quality Choice and Conditional Exporter Premia," *Journal of International Economics*, 2013, *91* (1), 53–67.

Hallward-Driemeier, Mary and Bob Rijkers, "Do Crises Catalyze Creative Destruction? Firm-level Evidence from Indonesia," *The Review of Economics and Statistics*, December 2013, *95* (5), 1788–1810.

Harding, Torfinn and Beata S. Javorcik, "Roll Out the Red Carpet and They Will Come: Investment Promotion and FDI Inflows," *Economic Journal*, December 2011, *121* (557), 1445–1476.

_ and _ , "Foreign Direct Investment and Export Upgrading," *The Review of Economics and Statistics*, November 2012, *94* (4), 964–980.

Haskel, Jonathan E., Sonia C. Pereira, and Matthew J. Slaughter, "Does Inward Foreign Direct Investment Boost the Productivity of Domestic Firms?," *The Review of Economics and Statistics*, August 2007, *89* (3), 482–496.

Hausmann, Ricardo, Jason Hwang, and Dani Rodrik, "What You Export Matters," *Journal of Economic Growth*, 2007, *12* (1), 1–25.

Havranek, Tomas and Zuzana Irsova, "Estimating Vertical Spillovers from FDI: Why Results Vary and What the True Effect Is," *Journal of International Economics*, 2011, *85* (2), 234–244.

Hidalgo, Cesar A. and Ricardo Hausmann, "The Building Blocks of Economic Complexity," *Proceedings of the National Academy of Sciences*, 2009, *106* (26), 10570–10575.

Hsieh, Chang-Tai and Peter J. Klenow, "Misallocation and Manufacturing TFP in China and India," National Bureau of Economic Research Working Paper 13290, August 2007.

_ and _ , "Misallocation and Manufacturing TFP in China and India," *The Quarterly Journal of Economics*, November 2009, *124* (4), 1403–1448.

_ and _ , "The Life Cycle of Plants in India and Mexico," *The Quarterly Journal of Economics*, August 2014, *129* (3), 1035–1084.

_ and Zheng (Michael) Song, "Grasp the Large, Let Go of the Small: The Transformation of the State Sector in China," National Bureau of Economic Research Working Paper 21006, March 2015.

Hummels, David, Rasmus Jorgensen, Jakob Munch, and Chong Xiang, "The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data," *American Economic Review*, June 2014, *104* (6), 1597–1629.

Iacovone, Leonardo and Beata Javorcik, "Getting Ready: Preparation for Exporting," Centre for Economic Policy Research Discussion Paper 8926, April 2012.

IMF, "Romania Receives Support from IMF to Counter Crisis," *IMFSurvey Magazine*, May 2009.

_ , "Romania," IMF Country Report 10/227, International Monetary Fund, July 2010.

INS, *Romanian Statistical Yearbook 2012*, Bucharest: National Institute of Statistics, 2012.

Jaef, Roberto Fattal, "Entry, Exit and Misallocation Frictions," unpublished, IMF Research Department, August 2015.

Javorcik, Beata S., "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages," *American Economic Review*, June 2004, *94* (3), 605–627.

_ , "Can Survey Evidence Shed Light on Spillovers from Foreign Direct Investment?," *World Bank Research Observer*, June 2008, *23* (2), 139–159.

_ **and Mariana Spatareanu**, "To share or Not to Share: Does Local Participation Matter for Spillovers from Foreign Direct Investment?," *Journal of Development Economics*, February 2008, *85* (1-2), 194–217.

_ **and** _ , "Tough Love: Do Czech Suppliers Learn from their Relationships with Multinationals?," *Scandinavian Journal of Economics*, December 2009, *111* (4), 811–833.

_ **and** _ , "Does it Matter Where You Come From? Vertical Spillovers from Foreign Direct Investment and the Origin of Investors," *Journal of Development Economics*, September 2011, *96* (1), 126–138.

Johnson, Robert C., "Trade and Prices with Heterogenous Firms," *Journal of International Economics*, 2011.

Johnson, Simon and Todd Mitton, "Cronyism and Capital Controls: Evidence from Malaysia," *Journal of Financial Economics*, February 2003, *67* (2), 351–382.

Jones, Charles I., "Intermediate Goods and Weak Links in the Theory of Economic Development," *American Economic Journal: Macroeconomics*, April 2011, *3* (2), 1–28.

Keller, Wolfgang and Stephen R. Yeaple, "Multinational Enterprises, International Trade, and Productivity Growth: Firm-Level Evidence from the United States," *The Review of Economics and Statistics*, November 2009, *91* (4), 821–831.

Khandelwal, Amit, "The Long and Short (of) Quality Ladders," *Review of Economic Studies*, October 2010, *77* (4), 1450–1476.

Khandelwal, Amit K., Peter K. Schott, and Shang-Jin Wei, "Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters," *American Economic Review*, October 2013, *103* (6), 2169–95.

Khwaja, Asim Ijaz and Atif Mian, "Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market," *The Quarterly Journal of Economics*, November 2005, *120* (4), 1371–1411.

Kugler, Maurice and Eric Verhoogen, "Prices, Plant Size, and Product Quality," *The Review of Economic Studies*, 2012, *79* (1), 307–339.

Leuz, Christian and Felix Oberholzer-Gee, "Political Relationships, Global Financing, and Corporate Transparency: Evidence from Indonesia," *Journal of Financial Economics*, August 2006, *81* (2), 411–439.

Levchenko, Andrei A., Logan T. Lewis, and Linda L. Tesar, "The Collapse of International Trade During the 2008-2009 Crisis: In Search of the Smoking Gun," National Bureau of Economic Research Working Paper 16006, May 2010.

Lileeva, Alla and Daniel Trefler, "Improved Access to Foreign Markets Raises Plant-level Productivity...For Some Plants," *The Quarterly Journal of Economics*, August 2010, *125* (3), 1051–1099.

Lin, Justin Yifu, Fang Cai, and Zhou Li, "Competition, Policy Burdens, and State-Owned Enterprise Reform," *American Economic Review*, May 1998, *88* (2), 422–27.

Linden, Greg, Kenneth Kraemer, and Jason Dedrick, "Who Captures Value in a Global Innovation System? The case of Apple's iPod," unpublished, University of California, Irvine, August 2007.

Lipsey, R. G. and Kelvin Lancaster, "The General Theory of Second Best," *The Review of Economic Studies*, 1956, *24* (1), pp. 11–32.

Ma, Yue, Heiwai Tang, and Yifan Zhang, "Factor Intensity, product switching, and productivity: Evidence from Chinese exporters," *Journal of International Economics*, 2014, *92* (2), 349–362.

Manova, Kalina, "Credit Constraints, Heterogeneous Firms, and International Trade," *Review of Economic Studies*, April 2013, *80* (2), 711–744.

_ **and Zhiwei Zhang**, "Export Prices Across Firms and Destinations," *The Quarterly Journal of Economics*, February 2012, *127* (1), 379–436.

_ **, Shang-Jin Wei, and Zhiwei Zhang**, "Firm Exports and Multinational Activity Under Credit Constraints," *The Review of Economics and Statistics*, July 2015, *97* (3), 574–588.

Mattoo, Aaditya and Arvind Subramanian, "Criss-Crossing Globalization: Uphill Flows of Skill-Intensive Goods and Foreign Direct Investment," Policy Research Working Paper 5047, The World Bank, September 2009.

Mayer, Thierry, Marc J. Melitz, and Gianmarco I. P. Ottaviano, "Market Size, Competition, and the Product Mix of Exporters," *American Economic Review*, February 2014, *104* (2), 495–536.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, September 2003, *71* (6), 1695–1725.

_ **and Gianmarco I. P. Ottaviano**, "Market Size, Trade, and Productivity," *Review of Economic Studies*, January 2008, *75* (1), 295–316.

_ **and Stephen J. Redding**, "Heterogeneous Firms and Trade," National Bureau of Economic Research Working Paper 18652, December 2012.

_ **and** _ , "Heterogeneous Firms and Trade," in "Handbook of International Economics," Vol. 4, Elsevier, June 2014, chapter 1, pp. 1–54.

__ **and** __ , "New Trade Models, New Welfare Implications," *American Economic Review*, March 2015, *105* (3), 1105–46.

Minetti, Raoul and Susan Chun Zhu, "Credit Constraints and Firm Export: Microeconomic Evidence from Italy," *Journal of International Economics*, March 2011, *83* (2), 109–125.

Mobarak, Ahmed Mushfiq and Denni Puspa Purbasari, "Corrupt Protection For Sale To Firms: Evidence From Indonesia," unpublished, University of Colorado at Boulder, April 2006.

Neumeyer, Pablo Andrés and Guido Sandleris, "Understanding Productivity During the Argentine Crisis," Business School Working Paper 2010-04, Universidad Torcuato Di Tella, November 2010.

Nishimura, Kiyohiko G., Takanobu Nakajima, and Kozo Kiyota, "Does the Natural Selection Mechanism Still Work in Severe Recessions?: Examination of the Japanese Economy in the 1990s," *Journal of Economic Behavior & Organization*, September 2005, *58* (1), 53–78.

Oberfield, Ezra, "Productivity and Misallocation During a Crisis," 2011 Meeting Paper 1328, Society for Economic Dynamics, February 2011.

OECD, *Interconnected Economies: Benefiting from Global Value Chains*, Paris: OECD Publishing, 2013.

Pavcnik, Nina, "Trade Liberalization, Exit, and Productivity Improvement: Evidence from Chilean Plants," *Review of Economic Studies*, January 2002, *69* (1), 245–76.

Pierre, Gaelle and Stefano Scarpetta, "Employment Protection: Do firms' Perceptions Match with Legislation?," *Economics Letters*, March 2006, *90* (3), 328–334.

Poole, Jennifer P., "Knowledge Transfers from Multinational to Domestic Firms: Evidence from Worker Mobility," *The Review of Economics and Statistics*, May 2013, *95* (2), 393–406.

Porto, Guido and Bernard M. Hoekman, eds, *Trade Adjustment Costs in Developing Countries: Impacts, Determinants and Policy Responses*, Centre for Economic Policy Research and World Bank, 2010.

Redding, Stephen J., "Theories of Heterogeneous Firms and Trade," *Annual Review of Economics*, September 2011, *3* (1), 77–105.

Restuccia, Diego and Richard Rogerson, "Policy Distortions and Aggregate Productivity with Heterogeneous Plants," *Review of Economic Dynamics*, October 2008, *11* (4), 707–720.

__ and __ , "Misallocation and productivity," *Review of Economic Dynamics*, January 2013, *16* (1), 1–10.

Rijkers, Bob, Caroline Freund, and Antonio Nucifora, "All in the family: State Capture in Tunisia," Policy Research Working Paper 6810, The World Bank, March 2014.

Schott, Peter K., "Across-product Versus Within-Product Specialization in International Trade," *The Quarterly Journal of Economics*, May 2004, *119* (2), 646–677.

Sutton, John, *Competing in Capabilities: The Globalization Process*, Oxford: Oxford University Press, 2012.

Swenson, Deborah L., "Multinationals and the Creation of Chinese Trade Linkages," *Canadian Journal of Economics*, May 2008, *41* (2), 596–618.

Swiecki, Tomasz, "Intersectoral Distortions and the Welfare Gains from Trade," unpublished, University of British Columbia, 2014.

Syverson, Chad, "What Determines Productivity?," *Journal of Economic Literature*, June 2011, *49* (2), 326–65.

Tan, Guofu and Justin Yifu Lin, "Policy Burdens, Accountability, and the Soft Budget Constraint," *American Economic Review*, May 1999, *89* (2), 426–431.

Topalova, Petia and Amit Khandelwal, "Trade Liberalization and Firm Productivity: The Case of India," *The Review of Economics and Statistics*, February 2011, *93* (3), 995–1009.

Trefler, Daniel, "The Long and Short of the Canada-U. S. Free Trade Agreement," *American Economic Review*, September 2004, *94* (4), 870–895.

Tybout, James R., "Plant- and firm-level evidence on 'New' Trade Theories," in E. Kwan Choi and James Harrigan, eds., *Handbook of International Trade*, Oxford: Blackwell Publishing, 2003, pp. 388–415.

Verhoogen, Eric A., "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, May 2008, *123* (2), 489–530.

Wooldridge, Jeffrey M, *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press, 2010.

World Bank, *World Development Report 2005: A Better Investment Climate for Everyone*, New York: Oxford University Press, 2004.

Xu, Daniel Yi and Virgiliu Midrigan, "Accounting for Plant-level Misallocation," 2009 Meeting Paper 223, Society for Economic Dynamics, February 2009.

Yang, Mu-Jeung, "Micro-Level Misallocation and Selection: Estimation and Aggregate Implications," unpublished, University of Washington, Seattle, March 2014.