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Julian Emami Namini

International Trade and Multinational Activity

Heterogeneity of Firms, Incentives for Foreign Direct Investment, and International Business Cycle Dynamics

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With 37 Figures
and 1 Table

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Meinen Eltern

Preface

This book is a revised version of my doctoral thesis which was accepted by the Department of Economics at the University of Duisburg–Essen, Campus Essen, Germany.
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Finally, I would like to thank several colleagues at my department as well as friends for their overall support during my doctoral studies. I will list these individuals alphabetically. Regrettably, due to limited space, I cannot explain the individual help of each of them. Nevertheless, I can guarantee that my doctoral studies would definitely have been much more arduous without them: Thomas Abels, Susanne Al Hanbali, Philipp Ballhausen, Gabriele Berghoff, Claus Christian Breuer, Ralf Dewenter, Daniel Emami, Erika Greczmiel, Sahin Kilicaslan, Sascha Mertins, Jana Richter, Anzelika Rieck, Hans Rieck, Jörg Stank, Jutta Stevens and Volker Stevens.

Essen, March 2006 *Julian Emami Namini*

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1

Introduction

Both the actual mode of international economic integration and the way trade theorists analyze international economic integration has changed considerably in the recent past. Until the early 1980s, goods trade was the main engine of globalization. At least since the mid–1980s, however, foreign direct investment as a means of international economic integration grew much faster than goods trade. During the period 1990–2001, for example, the sum of goods exports and imports as a value share of a country's gross domestic product increased by 17.5 per cent for high income countries and by 43 per cent for middle income countries. The sum of foreign direct investment inflows and outflows as a value share of gross domestic product, in contrast, increased by 76.6 per cent for high income countries and by 330 per cent for middle income countries during the same period.[1] Furthermore, multinational firms are often regarded as dominant with respect to their employment shares and their contribution to total production, at least within their own sector.[2] Trade theory accordingly started to incorporate multinational firms in mostly neoclassical trade models. Early theoretical analyses of horizontal or vertical multinational activity are, i. a., Helpman [24] and Markusen [32]. Further theoretical and empirical research on multinational activity lead to the knowledge–capital model (Markusen [33], [34], Markusen et al. [38]), which integrates the horizontal and the vertical model of the multinational enterprise. Several subsequent analyses empirically estimated the knowledge–capital model (Carr et al. [16]) or tested it against its competitors, the horizontal and the vertical model of the multinational enterprise (Markusen/Maskus [37], Blonigen et al. [14]).

[1] Cf. World Bank [47], table 6.1 for these figures

[2] Cf. Hanson/Slaughter [23], pp. 135–6, for an assessment of the relative dominance of multinational firms.

However, increasing worldwide economic integration also raised the fear of the end of the "nation state" (Panić [42]). Both industrialized and less developed countries often hold the world business cycle responsible for their own economic downturns. Empirical research predominantly confirms the view that larger openness to international markets leads to more synchronized business cycles across countries (Imbs [26], Kose et al. [28]). However, previous theoretical general equilibrium analyses, which specify the trade pattern between countries exogenously, often have difficulties in explaining the empirically observed correlation of macroeconomic variables between countries. Output correlation in the theoretical models is considerably smaller than in reality, while consumption correlation is much larger than in reality (Backus et al. [5], Ambler et al. [1]). Endogenizing the trade pattern between countries with the help of neoclassical trade theory or linking countries by multinational firms might resolve weaknesses of the previous theoretical models on international business cycle transmission (Kose/Yi [27], Hanson/Slaughter [23]).

Finally, trade empiricists substantiated that, on the one hand, firms within narrowly defined industries exhibit considerable heterogeneity with respect to the technology they use. On the other hand, it has been documented that only firms with more advanced technologies actually engage in trade or foreign direct investments (Bernard et al. [12]). Trade theorists accordingly incorporated firm heterogeneity into Krugman's [30] 'new trade' model. Previous theoretical research demonstrated that heterogeneity across firms provides an alternative source for gains from trade (Melitz [40], Falvey et al. [19]).

It is the aim of this thesis to contribute to these three recent strands in the trade theoretic literature. All three chapters of this thesis are based on a two country and two factors general equilibrium model. This benchmark model is subsequently extended into three distinct directions since all three chapters differ with respect to the assumptions on households' preferences, the number of goods and the way in which countries are economically connected.

Chapter 2 assumes Dixit–Stiglitz preferences of households and, for analytical tractability, an infinity of varieties of a single differentiated good. Both countries are completely identical. Consequently, the households' desire to increase the mass of available varieties leads to goods trade between countries. Chapter 2 analyzes dynamic gains from trade in the presence of heterogeneity across firms. Chapter 3 assumes that households consume three goods, which are regarded to be homogeneous across all producers. Furthermore, chapter 3 introduces hor-

izontal and vertical multinational firms into the benchmark general equilibrium model. Depending on the difference in the relative factor endowments, both countries are either connected by Heckscher–Ohlin trade or by trade in headquarter services within multinational firms. Chapter 3 analyzes the incentives for foreign direct investment under differing assumptions on both countries' relative factor endowments. Finally, chapter 4 assumes that both countries produce two homogeneous goods. Therefore, chapter 4 extends the standard $2 \times 2 \times 2$ Heckscher–Ohlin model to a neoclassical growth model with endogeneous capital accumulation. Trade between both countries therefore results from differences in relative factor endowments. Chapter 4 analyzes the role of neoclassical trade in the international transmission of business cycles.

2

Gains from trade with firm heterogeneity

2.1 Introduction

Standard new trade theory excludes heterogeneity across firms. Consequently, the welfare effects of international trade are unambiguous: removing trade barriers increases a country's welfare due to either economies of scale or a love of variety effect. Very recently, however, 'new new' trade models were developed. These models extend the new trade models by including heterogeneity across firms into Krugman's [30] intra-industry trade model. Two further assumptions are central to these 'new new' models: first, firms do not come to know their productivity until they enter the market and pay a fixed market entry cost. Second, it is presumed that additional fixed production and export costs exist. These two assumptions trigger an endogenous firm selection mechanism when a country opens up to international trade. As exporting is costly, only the more productive firms will export. The less productive firms produce only for the home market. In addition, exposure to trade leads to an increasing demand for resources. Real factor rewards rise and force the least productive firms to exit the market. Trade liberalization accordingly leads to an increase in a country's average productivity. This productivity gain provides an alternative source for gains from trade.

Moreover, these 'new new' trade models are able to explain certain empirical regularities. Recent econometric studies have shown that firms producing identical or similar goods exhibit substantial heterogeneity with respect to the technologies they use. In this context, exporters are shown to generally use more advanced technologies.[1]

Previous theoretical analyses of trade with heterogeneous firms assume

[1] See, among others, Bernard/Jensen [10], Aw et al. [4] and Girma et al. [22].

labor as the single factor of production.[2] 'More advanced' technologies is interpreted as producing with a higher labor productivity. This chapter, in contrast, assumes two factors of production, capital and labor. A 'more advanced' technology now denotes a higher capital intensity at given relative factor prices. If the analyzed countries are capital rich in the sense that the relative price of labor exceeds unity, it is still true that only firms with more advanced technologies self-select into the export market.

Furthermore, this chapter assumes endogenous capital accumulation: while the countries' capital endowments are fixed in the short run, they may change in the long run. More specifically, the steady state of a neoclassical growth model with heterogeneous firms and intra-industry trade between two identical countries will be analyzed.

All the other central components of the model are adopted from Melitz [40], Baldwin/Forslid [7] and Falvey et al. [19]. Most importantly, firms face uncertainty about their capital intensity before entering the market. Market entry leads to one-time fixed costs, serving the home market and exporting to per period fixed costs.

This chapter shows that the key result of Melitz [40] with respect to the welfare effects of exposure to trade fails to be robust in a neoclassical growth model with endogeneous capital accumulation. First of all, if firms differ with respect to the factor intensity in this two-factor model instead of the labor productivity in the previous single-factor models, exposure to trade does not change the total amount the technologically more advanced exporting firms produce: each single exporting firm produces more, but their total mass decreases proportionately with the exposure to trade. Depending on the magnitude of fixed and variable export costs, opening a country up to international trade therefore may increase or decrease the average firm's total profit over the entire model horizon. Since fixed market entry costs exist, the probability of a successful market entry has to adjust accordingly such that the average firm's free entry and exit condition holds again. It is shown that this probability of a successful market entry is directly linked to the average firm's capital intensity. However, as the average firm's capital intensity directly influences welfare, a country may lose from the exposure to trade *due to* heterogeneity across firms.

The rest of the chapter is organized as follows. Section 2.2 describes the setup of the model. Section 2.3 derives the equilibrium for the closed economy. Section 2.4 deals with the open economy. Subsection 2.4.1 describes the aggregation of all heterogeneous firms to average firms. It

[2] See Melitz [40], Baldwin/Forslid [7] and Falvey et al. [19].

emphasizes the crucial difference between the aggregation procedure in Melitz [40] and in the present model. Subsections 2.4.2 and 2.4.3 analyze the equilibrium in the open economy and the welfare consequences of the exposure to trade. Section 2.5 provides a numerical analysis of the model. Section 2.6 discusses the results and concludes.

2.2 Basic model

The steady states of two countries, the home country H and the foreign country F, are analyzed. Both countries are endowed with two factors of production, labor L and capital K, which are used to produce one differentiated good. The labor endowment is assumed to be constant over time. As countries H and F are completely identical, the country index is initially omitted. Furthermore, since only the steady state is analyzed, the time index is also dropped for the time being. The market for the differentiated good is characterized by Dixit-Stiglitz monopolistic competition.

2.2.1 Production

A single firm i produces a unique variety of the differentiated good with the following modified *CES* production function

$$q_i = \left(\phi_i^{\alpha} \cdot L_i^{\alpha} + (1-\phi_i)^{\alpha} \cdot K_i^{\alpha}\right)^{1/\alpha}, \tag{2.1}$$

where L_i and K_i denote the labor and capital inputs for firm i. This modified *CES* production function has the advantage that it translates into the calibrated share form of the per unit cost function if all absolute prices are equal to unity in the benchmark equilibrium. This calibrated share form of the cost function is taken from applied general equilibrium theory and simplifies further calculations considerably since only the firms' cost functions will be used. The parameter ϕ_i denotes different technologies across firms. Firm i accordingly has the per unit cost function

$$c_i = \left(\phi_i \cdot w^{1-\sigma} + (1-\phi_i) \cdot r^{1-\sigma}\right)^{1/(1-\sigma)}, \tag{2.2}$$

with w and r denoting the wage rate and the capital rental rate. The parameter σ represents the elasticity of substitution in production, which is given by $\sigma = 1/(1-\alpha)$. Furthermore, serving the domestic market leads to fixed costs f, which are produced with the same technology as

the good itself. The magnitude of these fixed costs is identical across all firms. Given Dixit-Stiglitz preferences for the representative household, the profit maximizing price of firm i is given by

$$p_i \cdot (1 - 1/\sigma) = c_i(\phi_i), \tag{2.3}$$

where σ stands for the elasticity of substitution in the representative household's utility function. For simplicity, the firms' production functions and the household's utility function share an identical value for the parameter σ.

2.2.2 Demand

Intratemporal preferences of the representative household are described by a *CES* love of variety utility function over the varieties of the differentiated good. This utility function leads to the following revenue function for a single firm i:

$$r_i(\phi_i) = P \cdot Q \cdot \Big(p_i(\phi_i)/P\Big)^{1-\sigma}, \tag{2.4}$$

where $P = (\int_i p_i(\phi_i)^{1-\sigma} d\phi_i + \int_j (p_j(\phi_j) \cdot \tau)^{1-\sigma} d\phi_j)^{1/(1-\sigma)}$ denotes the aggregate price index and $Q = (\int_i q_i(\phi_i)^{\alpha} d\phi_i + \int_j (q_j(\phi_j)/\tau)^{\alpha} d\phi_j)^{1/\alpha}$ the aggregated consumption good. The index j stands for the foreign varieties supplied to the home market and τ, $\tau \geq 1$, denotes iceberg transport costs. Furthermore, this utility function indicates that no preference for any variety or either country exists.

2.2.3 Aggregation

In each country, there exists a continuum of heterogeneous firms in the differentiated goods sector. In order to keep the model still tractable, the continuum of firms is aggregated to a mass of average firms. Aggregation proceeds in two steps:
First, the production side is analyzed. The mass of active firms accordingly can be fixed for the moment since no love of variety effect exists with respect to the production side. The general equilibrium factor prices and total factor income do not depend on the mass of active firms. They solely depend on the total amount produced by each firm type. Therefore, it can be shown that the following two versions of the model with an infinity of firms lead to identical absolute factor prices and total factor income:[3]

[3] See Appendix A of this thesis for a detailed description of the aggregation procedure.

Version 1 — the disaggregated model

A mass N of heterogeneous firms demands labor and capital according to the following per unit factor demand functions:

$$a_{Li} = \phi_i \cdot w^{-\sigma} \cdot \left(\phi_i \cdot w^{1-\sigma} + (1-\phi_i) \cdot r^{1-\sigma}\right)^{\sigma/(1-\sigma)}, \quad \forall\, i$$

$$a_{Ki} = (1-\phi_i) \cdot r^{-\sigma} \cdot \left(\phi_i \cdot w^{1-\sigma} + (1-\phi_i) \cdot r^{1-\sigma}\right)^{\sigma/(1-\sigma)}, \quad \forall\, i,$$

while the demand for each single variety is given by $q_i^D = P \cdot Q \cdot P^{\sigma-1} \cdot p_i^{-\sigma}$;

Version 2 — the aggregated model

A mass $\widetilde{N}$ of average firms demands labor and capital according to the following average per unit factor demand functions:

$$a_L = \widetilde{\phi} \cdot w^{-\sigma} \cdot \left(\widetilde{\phi} \cdot w^{1-\sigma} + (1-\widetilde{\phi}) \cdot r^{1-\sigma}\right)^{\sigma/(1-\sigma)},$$

$$a_K = (1-\widetilde{\phi}) \cdot r^{-\sigma} \cdot \left(\widetilde{\phi} \cdot w^{1-\sigma} + (1-\widetilde{\phi}) \cdot r^{1-\sigma}\right)^{\sigma/(1-\sigma)},$$

$$\text{with} \quad \int_0^1 \phi \cdot g(\phi) d\phi = \widetilde{\phi},$$

where $g(\phi)$ is the distribution function for ϕ, which is assumed to be uniformly distributed over the interval $[0,1]$. The demand for each average firm's good is given by $q^D = M_C/(\widetilde{N} \cdot p(\widetilde{\phi}))$, with M_C denoting total factor income which is available for consumption and $p(\widetilde{\phi})$ the average firm's price.

Obviously, the factor share parameters $\widetilde{\phi}$ and $1-\widetilde{\phi}$ of a single average firm are given by the expected value of these parameters across all active firms. The share parameters $\widetilde{\phi}$ and $1-\widetilde{\phi}$ will be labelled in the following as average labor intensity and average capital intensity, respectively.

Second, if both versions of the model lead to identical general equilibrium factor prices and total factor income, the aggregated model has to be extended by a separate Dixit-Stiglitz demand side to give an identical welfare level W as the disaggregated model. As total welfare is given by $W = M/P$ in the disaggregated model, a mass $\widetilde{N}$ of average firms in the aggregated model has to be determined, such that $P = \widetilde{P}$, where $\widetilde{P} = \widetilde{N}^{1/(1-\sigma)} \cdot p(\widetilde{\phi})$. The equilibrium mass of average firms $\widetilde{N}$ is determined by a free entry and exit condition of the average firm,