International Trade and Labour Markets

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Abstract

This dissertation consists of four essays that contribute to the literature on international trade and labour markets. The first essay studies the interaction between economic integration, product and process innovation, and relative skill demand in a model of international oligopoly. As trade barriers are dismantled foreign competition intensifies. Competing enterprises respond by investing more aggressively in both product and process innovation. The relative demand for unskilled workers decreases as a result. The second essay studies labour market outcomes in a model of intra-industry trade between a rigid-wage Europe and a flexible-wage America. Firms can choose to serve the foreign market either through exports or through local subsidiaries. The essay demonstrates that the adverse employment effects of a unilateral wage floor increase significantly when trade barriers are removed. Multinational firms mitigate the adverse employment effects of one-sided wage rigidity. The third essay analyses how different unionisation structures affect firm productivity and firm performance in a monopolistic competition model with heterogeneous firms and free entry. While centralised bargaining induces tougher selection among heterogeneous producers and increases average productivity and profit levels, firm-level bargaining allows less productive entrants to remain in the market. The positive effect of centralised bargaining on average productivity can, however, be overturned when firms face international low-wage competition. Finally, the fourth chapter analyses empirically the effect of offshoring on workers' labour market transitions in Germany. The results suggest that the effects of offshoring are strongly age- and skill-specific and also vary between sectors. While offshoring does not affect overall job stability in the manufacturing sector, it is associated with an increase in overall job stability in the service sector.

Keywords:
International trade, labour markets, offshoring, multinational firms, worker flows, innovation, productivity, trade unions, wage rigidity

Zusammenfassung

Die vorliegende Dissertation besteht aus vier Aufsätzen, die sich mit Fragen des Außenhandels und der Arbeitsmarktökonomie auseinandersetzen. Der erste Aufsatz untersucht in einem internationalen Oligopol die Interaktion zwischen Handelsliberalisierung, Produkt- und Prozessinnovationen und der relativen Nachfrage nach niedrig qualifizierten Arbeitnehmern. Der Abbau von Handelsschranken führt zu einer Verschärfung des Wettbewerbs, auf die die konkurrierenden Firmen reagieren, indem sie ihre Investitionen in Produkt- und Prozessinnovationen ausweiten. Infolgedessen sinkt die Nachfrage nach niedrig qualifizierten Arbeitnehmern. Der zweite Aufsatz analysiert die Wirkung eines einseitigen Mindestlohnes in einem Zwei-Länder-Modell, in dem Firmen den ausländischen Markt entweder durch Exporte oder durch lokale Tochterfirmen bedienen. Eine Liberalisierung des Handels erhöht die negativen Beschäftigungseffekte von Mindestlöhnen. Dagegen begrenzt die Existenz von multinationalen Unternehmen den durch Mindestlöhne verursachten Arbeitsplatzabbau. Der dritte Aufsatz untersucht, wie sich kollektive Tarifverhandlungen bei freiem Marktzutritt auf die Produktivität und den wirtschaftlichen Erfolg von heterogenen Firmen auswirken. Zentrale Lohnverhandlungen verschärfen den Auswahlprozess und erhöhen die durchschnittliche Produktivität und den Gewinn überlebender Firmen. Stattdessen begünstigen dezentrale Tarifverhandlungen weniger produktive Firmen. Sind die Firmen internationalem Wettbewerb ausgesetzt, so können auch zentrale Tarifverhandlungen die Produktivität reduzieren. Der vierte Beitrag untersucht empirisch die Auswirkungen von Offshoring auf Arbeiterflüsse in Deutschland. Während Offshoring die Stabilität von Beschäftigungsverhältnissen in der verarbeitenden Industrie nicht beeinflusst, geht es einher mit einer Zunahme der Beschäftigungsstabilität im Dienstleistungssektor. Die Effekte von Offshoring hängen ferner stark vom Alter und der Bildung des einzelnen Arbeitnehmers ab.

Schlagwörter:
Außenhandel, Arbeitsmärkte, Offshoring, multinationale Firmen,
Arbeiterflüsse, Innovationen, Produktivität, Gewerkschaften, Lohnrigidität

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Chapter 1

Introduction and Overview

1.1 Introduction

Economic globalisation, broadly defined as the process of integrating national economies into a world economy or a single marketplace, has elevated the importance of trade for developing and developed economies alike. Over the past four and a half decades total world trade (exports and imports of goods and services) as a percentage of global GDP more than doubled from 24 percent in 1960 to almost 57 percent in 2006 (World Bank, 2009). While Germany remained the world's biggest exporter in 2007, with China a country comes second that was virtually isolated from the world economy until 1978. But not only is international trade growing, its nature has changed as well. For centuries countries exchanged final goods and raw materials. In contrast, trade now increasingly involves bits of value being added in many different locations around the globe. Firms decompose their various stages of production geographically and set up production sites abroad or subcontract production processes to foreign suppliers.

The ongoing economic integration of the world economy has sparked significant policy debate in developed countries about the associated effects on labour market outcomes. Recent reforms of labour market institutions in OECD countries that aimed at increasing labour market flexibility have been justified by the challenges posed by economic globalisation. Intensified foreign competition, the rise in offshoring and the occurrence of footloose multinational enterprises (MNEs) are widely feared to bring down wages, endanger jobs and increase inequality in Western societies. In an opinion poll recently released by the German Marshall Fund, 54 percent of the respondents named 'outsourcing to a foreign country' as the factor 'most responsible for the loss of German jobs' (German Marshall Fund of the United

States, 2007). Proponents of free trade, in contrast, argue that trade can actually result in more jobs by expanding export markets and thus the demand for domestic products. They also point to the benefits to consumers, as materialised in lower prices and greater product variety, and argue that domestic firms are bound to offer competitive prices and improve production efficiency when faced with international competition.

My purpose in this thesis is to contribute to our understanding of how the globalisation process affects labour market outcomes and interacts with national labour market institutions. More precisely, the following four chapters of this thesis attempt to answer the following questions:

1. How does economic integration affect the incentives of firms to innovate? What are the subsequent effects on relative labour demand for the unskilled?

2. How do regulations that add to the rigidity of national labour markets affect wages and unemployment in a global world economy?

3. What do unions do to productivity, firm performance and consumer welfare? Do these effects change when firms face international non-unionised competitors?

4. How does international outsourcing affect labour market dynamics in Germany? Does the effect differ between sectors, worker groups and labour market transitions?

My work blends insights from international trade theory and labour economics. For a long time, these two fields have evolved independently from one another. The separation is particularly evident in the debate on globalisation and unemployment. While the effects of international competition on domestic employment are controversially discussed in the media and are a source of great anxiety for many citizens, most economists seem to believe that the employment effects of international trade are negligible. International trade theory has, until recently, largely ignored micro-founded models of unemployment and relied on long-run general equilibrium models, in which fully flexible labour markets allow the economy to sustain full employment.[1]

[1]There are some early exceptions that considered trade under less than full employment. Brecher (1974), for instance, has extended the traditional Heckscher-Ohlin theory to allow for a binding (worldwide) minimum wage. And Magee (1976) has surveyed the effects of various factor market distortions in traditional trade models. Instead of focusing on imperfections in the labour market, Mussa (1978) postulated positive adjustment costs for moving capital from one sector to another and analysed how a (small) open economy adjusts when relative commodity prices change.

Trade and trade policy can then, by assumption, neither affect short-run nor long-run unemployment. Instead, economists have invested a great deal of effort in analysing the effect of international trade on the distribution of income.

Most existing studies on the link between global goods markets and national factor markets are based on one of the two traditional workhorse models of international trade. The first is the Heckscher-Ohlin, which predicts that the owners of abundant production factors gain from trade while the owners of scarce factors lose. The second is the Ricardo-Viner model, which predicts that opening up to trade harms factors specific to the import-competing sector, but benefits factors tied to the export sector. Crucially, both models assume that production factors are fully employed at all times and therefore leave no room to address many of the issues raised in the public debate on trade and labour markets. In fact, many economists view international trade as a microeconomic sub-discipline that is concerned with the allocation of resources while regarding unemployment as a macroeconomic issue unrelated to trade and trade policy (Davidson and Matusz, 2004). Krugman (1993), for instance, has argued that 'it should be possible to emphasize to students that the level of employment is a macroeconomic issue (...) depending in the long run on the natural rate of unemployment, with microeconomic policies like tariffs having little effect' (p.25).

Only recently have economists begun to incorporate micro-based models of unemployment into traditional trade models (see, for instance, Kreickemeier and Nelson, 2006; Davidson et al., 2008; Egger and Kreickemeier, 2009). There are at least three good reasons for analysing – not only theoretically but also empirically – the interactions between global goods markets and imperfect factor markets.

First, the labour market consequences of globalisation, and in particular the effect on domestic jobs, are a source of public anxiety. Economists could address these concerns – whether justified or not – much more convincingly if there was a significant body of empirical evidence on the issue, and their arguments relied on formal models of trade and unemployment. Chapter 3 makes a step in this direction by studying the effects of a one-sided minimum wage in a two-country model of intra-industry trade with multinational firms.

Second, labour market regulations do not only affect employment but also other economic variables of interest which are in turn often influenced by the globalisation process. Trade economists have, for instance, stressed the productivity-enhancing effect of trade integration (cf. Melitz, 2003; Melitz and Ottaviano, 2008). At the same time, the effect of unions on productivity is a classic research topic in labour economics (cf. Metcalf, 2003; Hirsch, 2004, for recent surveys). But it is very difficult to know a priori how the

union effect on productivity changes when a country opens up to trade – in particular when labour market characteristics differ among trading partners. Chapter 4 studies the interaction between unionisation structures, firm productivity, and firm performance in both a closed and in an open economy model, and detects significant differences between the effects of unionisation in the two settings.

Third, even the most ardent supporters of free trade acknowledge that trade liberalisation not only entails welfare gains but also implies adjustment costs in the short-run. Intensified foreign competition or the rise in offshoring will almost certainly displace the jobs of some workers (while potentially securing those of others). The globalisation process thus creates winners and losers, thereby creating a powerful challenge to the welfare state. To avoid a new social divide and to stave off protectionism, the state has to enable a sufficient number of voters to benefit from globalisation. But for doing so, it is important to identify those groups of the society that bear the burden of adjustment. Chapter 5 of this thesis investigates empirically how workers' labour market transitions are affected by offshoring, and shows that the effects vary strongly with worker characteristics.

Blending insights from international trade theory and labour economics can also prove useful in the vigorous debate on wage inequality. Since the integration of China and other emerging economies into the world economy has coincided with an increase in wage inequality in the United States and other developed countries, some writers have linked these two developments. After all, basic Heckscher-Ohlin theory predicts that the integration of a low-skilled labour abundant economy with a developed economy abundant in skilled labour leads to an increase in the relative price of skill in the developed economy.[2] The consensus view, however, suggests that technological and institutional change rather than international trade have been the major causes of increased inequality in advanced countries (see Berman et al., 1998; Desjonqueres et al., 1999; DiNardo et al., 1996, to name just a few studies). However, the question of whether trade or technological change has been behind recent developments in the labour market may be misleading. In fact, trade can induce technical change. Recent empirical evidence by Bloom et al. (2008) suggests that Chinese import competition is associated with a significant increase in the adoption of new technology and the generation of innovation. Chapter 2 of this thesis contributes to the debate by

[2]Intuitively, developed and emerging economies, by exchanging goods produced with different factor (skill) intensities, are effectively trading factors of production. Developed countries mainly import low-skilled labour intensive goods from emerging economies and export high-skilled labour intensive goods in return. Trade with emerging economies therefore increases the effective supply of unskilled labour in developed economies.

exploring theoretically the interaction between trade liberalisation, product and process innovation, and the relative demand for unskilled workers.

Globalisation has changed and is still changing the world we are living in. Harsher international competition and a finer international division of labour are likely to increase efficiency and benefit consumers through lower prices and increased product variety. Yet many people view globalisation with scepticism and fear, with the labour market consequences being a prime source of anxiety. Since the labour market impinges directly on the well-being of every individual, it is important for society at large to understand how the ongoing integration process affects labour market outcomes. But in order to gain a thorough understanding of the interactions between globalisation and the labour market, economists have to cross the dichotomy between labour economics and international trade and combine insights from the two fields. This thesis makes some headway in this direction.

The rest of this introductory chapter is organised as follows: I first review some empirical facts about the globalisation process. In particular, I briefly discuss some of the characteristics that distinguish the current wave of globalisation from earlier periods of economic integration. The main body of the thesis will refer to these features of the modern world economy. I then summarise the main contributions and findings of the dissertation.

1.2 The Growth of World Trade: Some Empirical Facts

Trade Volumes. The global economy is not an invention of our times. In fact, globalisation experienced its first heyday between the end of the Napoleonic wars and the outbreak of World War I. As shown in Table 1.1, merchandise exports as a share of GDP grew from 1.0 to 7.9 percent between 1820 and 1913. The growth in world trade was spurred by two major innovations in transportation technologies: steamships and railroads. These transport innovations drastically decreased the cost of moving goods between (and within) countries. British ocean freight rates, for instance, remained fairly constant between 1740 and 1840 but dropped by 70 percent between 1840 and 1910 (Harley, 1988). Furthermore, the growth in world trade was promoted by a reduction in tariffs. Britain abolished the Corn Laws, a tariff on grain introduced after the Napoleonic wars, in 1846. Other countries followed Britain's move towards free trade in a series of reciprocal trade agreements, beginning with the Cobden Chevalier Treaty between Britain and France in 1860. Even though the trend towards liberalising trade was

Country	1820	1870	1913	1950	1973	1998
France	1.3	4.9	7.8	7.6	15.2	28.7
Germany	na	9.5	16.1	6.2	23.8	38.9
Japan	na	0.2	2.4	2.2	7.7	13.4
UK	3.1	12.2	17.5	11.3	14.0	25.0
USA	2.0	2.5	3.7	3.0	4.9	10.1
World	1.0	4.6	7.9	5.5	10.5	17.2

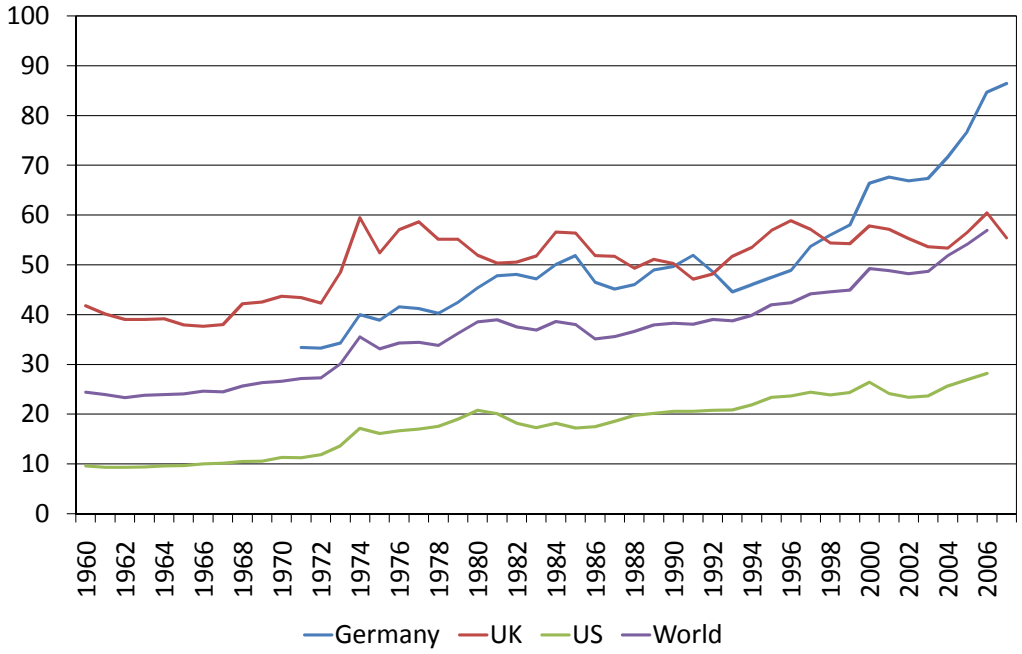
Source: Maddison (1995), Maddison (2001)
na: not available

Table 1.1: Merchandise Exports as a Share of GDP, 1820 - 1998 (in Percent)

reversed after 1879, when the German Chancellor Otto von Bismarck raised tariffs on agricultural and industrial products, the level of effective protection remained relatively low in most countries until the eve of World War I (with the United States being the principal exception).

The first era of globalisation ended badly with World War I, the Great Depression and World War II. In fact, most countries turned inwards between 1913 and the early post-World War II period. Between 1913 and 1950 merchandise exports as a share of GDP plummeted from 16.1 to 6.2 percent in Germany and from 17.5 to 11.3 percent in the UK. Overall, in 1950 merchandise exports amounted to just 5.5 percent of global GDP. While world trade grew considerably in the aftermath of World War II, much of the increase just represented a recovery to former levels. By 1973, the United Kingdom, which was a highly trade-dependent economy already during the Victorian Era, had still not reached its pre-World War I level.

Since the 1970s, however, the growth in world trade truly represents a new degree of integration. Figure 1.1 provides a detailed overview of how the degree of trade openness – measured as total exports and imports of goods and services over GDP – evolved in the US, the UK, and Germany between 1960 and 2007. All three countries witnessed a strong increase in economic integration but the trend increase was particularly pronounced in Germany and the US. German trade openness increased by as much as 51.3 percentage points from 33.4 percent in 1971 to 84.7 in 2006. In the US the share of exports and imports in GDP has almost tripled since 1960 although the USA remains considerably less dependent on trade than both Germany and the UK. Figure 1.1 also documents the steep increase in worldwide exports and imports since the 1960s. Today the world economy has indeed become integrated to a degree unprecedented in history, not least because emerging



Source: World Bank (2009)

Figure 1.1: Exports and Imports as a Share of GDP, 1960 - 2007

economies, and most notably Brazil, China and India, have become more and more integrated into the global economy. China's share in world merchandise exports, for instance, approached 9 percent in 2007 compared to just 2.5 percent 14 years earlier (World Trade Organization, 2008).

While international trade has been an ever increasing part of economic activity since the 1960s, the outlook for the near future is bleak. The financial crisis that began in 2007 and continues to this day has turned into a trade crisis. In an increasingly interdependent global economy, economic shocks quickly spill-over national boundaries and a downturn in one country translates more rapidly to a downturn elsewhere. Consequently, countries that are heavily dependent on trade are hit particularly hard by the collapse in global demand. In fact, the World Trade Organization (2009) forecasts that the volume of world trade will plummet by around 9 percent in 2009, the largest drop since World War II. In the near future, the looming danger of trade protectionism could further reduce world trade. The current crisis thus reminds us of the fact that the globalisation process is not irreversible; countries can turn inward again – and they tend to do so in time of crisis.

Intra-Industry Trade It is not only and not even primarily the sheer volume of trade that distinguishes modern times from the first golden age of globalisation. Historically, the UK and Northwest Europe were net importers of primary products and net exporters of manufactured goods. In 1913 manufactured goods made up more than three quarters of British exports, while the share of manufactures in British imports just reached 20.2 percent (Mitchell, 1988). Nowadays, in contrast, trade in goods is dominated by exports and imports of manufactured products; in 2007 their share was 76.8 percent of total UK exports and 74.2 percent of total imports (Eurostat, 2009). At the same time, primary products accounted for only 18.4 percent of UK exports and 21.1 percent of UK imports.[3] At the beginning of the 20th century Britain mainly traded with overseas producers of raw materials, whereas today the country predominately trades with other European countries. In 2007, intra-EU trade accounted for 58.2 percent of British exports and for 54.7 percent of British imports (Eurostat, 2009). These numbers are indicative of the rise in intra-industry trade – two-way trade in goods of the same commodity class that to a large extent takes place between similar countries.

Intra-industry trade can involve similar, horizontally differentiated products or vertically differentiated products that differ, e.g., in terms of their quality and price level (cf. Fontagné and Freudenberg, 2002, for a detailed classification). Horizontal intra-industry trade is generally explained by love-of-variety preferences and economies of scale in the production of differentiated products (cf. Helpman and Krugman, 1985). Vertical intra-industry trade, in contrast, can also be driven by cross-country differences, e.g., in the qualification of the labour force (OECD, 2002; Fontagné and Freudenberg, 2002). The extent of intra-industry trade is particularly high for complex manufactured goods that are easily differentiated and often require the input of specialized intermediate goods (and are thus more likely to benefit from economies of scale in production). The OECD (2002) has estimated that between 1996 and 2000 intra-industry trade accounted for 72 percent of total German manufacturing trade (see Table 1.2). Likewise, for the UK and the USA the share of intra-industry trade in total manufacturing trade was 73.7 and 68.5 percent, respectively.[4] In all three countries the relative

[3]The figures do not sum up to 100 percent since some traded products could not be classified. Primary products can be further broken down into food and beverages with a share in exports and imports of 5.3 and 8.4 percent, respectively, energy (10.6 and 9.4 percent) and crude materials (2.5 and 3.2 percent). Eurostat (2009) does not consider trade in services.

[4]The extent of intra-industry trade is commonly measured by the Grubel-Lloyd index (Grubel and Lloyd, 1975). For any particular product class i and a trading partner r, an

Country	1988-1991	1992-1995	1996-2000
France	75.9	77.6	77.5
Germany	67.1	72.0	72.0
Japan	37.6	40.8	47.6
UK	70.1	73.1	73.7
USA	63.5	65.3	68.5

Source: OECD (2002)

Table 1.2: Manufacturing Intra-Industry Trade as a Share of Total Manufacturing Trade

importance of intra-industry trade increased over the 1990s (see Table 1.2).

The Rise in Offshoring Between the mid-nineteenth century and World War I, when the global integration of goods markets thrived for the first time, production of manufactured goods involved only a few steps, leaving little room for the unbundling of production stages. The production of modern manufactures, in contrast, involves a number of different production stages that can, in principle, be decomposed geographically. Not only the fall in transportation costs but also recent advances in information and communication technology (ICT) and the sharp decline in communication costs have fostered the diffusion of production stages across national boundaries. These developments enable firms to take advantage of international cost differences and allow for a finer international division of labour. Moreover, as ICT permits the electronic transmission of output and communications costs have recently dropped to almost zero, many service tasks that were once considered to be largely impervious to international competition are almost freely tradable today. A frequently discussed example in this regard is the movement of US call centres to India. As a result, not only material but also service offshoring is thriving.

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index of the extent of intra-industry trade can be calculated as one minus the absolute value of exports minus imports divided by the sum of exports and imports:

$$IIT_{i,r} = 1 - \frac{|Exports_{i,r} - Imports_{i,r}|}{Exports_{i,r} + Imports_{i,r}}.$$

This measure is bounded by zero and one. If there are no commodities in the same product class i that are both exported and imported, the index takes on a value of zero. In contrast, the index is one when exports and imports in product class i are balanced. To obtain an index of intra-industry trade with all trading partners, for each partner country r the bilateral index is weighted by the share of trade with partner r in total trade.

Country	1995	2000
Germany	0.34	0.44
Japan	0.10	0.12
USA	0.14	0.19
UK	0.44	0.50

Source: OECD (2007)

Table 1.3: Index of Offshoring, 1995 and 2000

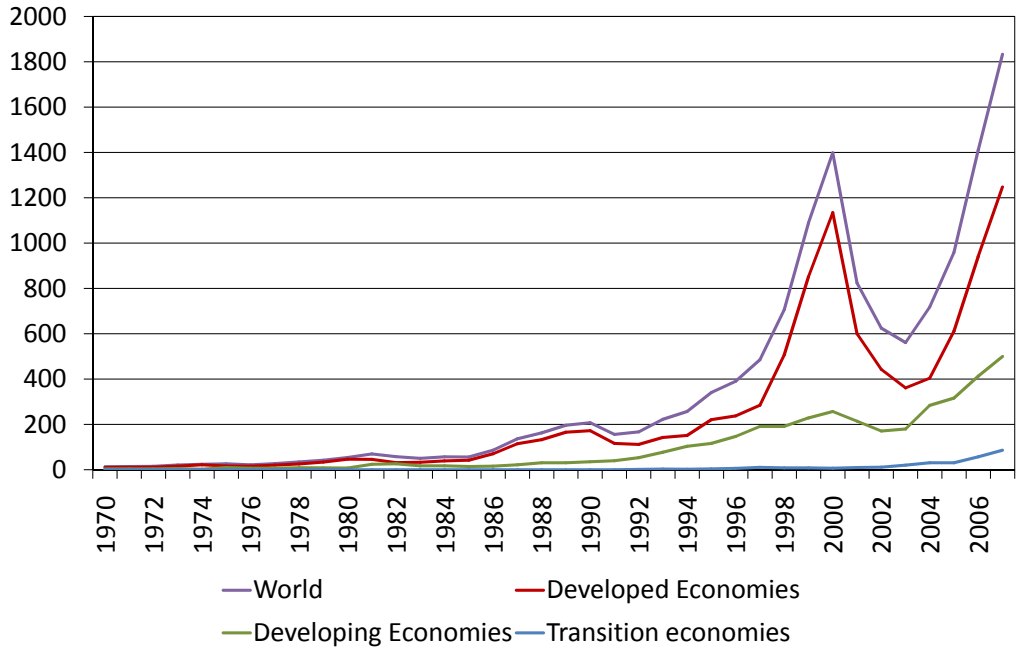
Broadly speaking, two types of offshoring can be distinguished between. Offshore in-house sourcing describes the relocation of a production process to a foreign affiliate of the firm, i.e. production remains within the boundaries of a firm but takes place in a foreign country. Offshore in-house sourcing thus concerns multinational enterprises (MNEs) and involves foreign direct investment (FDI). Offshore outsourcing, in contrast, designates the contracting-out of production activities to a foreign non-affiliated supplier. While offshoring is notoriously difficult to measure, the share of imported intermediate products in total inputs gives a reasonable approximation.[5] Harmonised input-output tables provided by the OECD then allow for a cross-country comparison of the offshoring intensity. Table 1.3 shows that in 2000 the UK and Germany imported 50 and 44 percent, respectively, of all intermediate (non-energy) inputs from abroad.[6] The share was considerably lower in Japan and the USA. Since offshoring is a relatively new phenomenon and harmonised input-output tables were – at the time of writing – only available for 1995 and 2000, Table 1.3 can only provide a very limited overview of how offshoring evolved over time. Yet in all four countries considered, the degree of offshoring increased considerably between 1995 and 2000.

Foreign Direct Investment and Multinational Enterprises. Multinational firms[7] are key players in the globalised world economy. In 2007, the value added of the estimated 79,000 MNEs and their 790,000 foreign affiliates accounted for 11 percent of global GDP. Multinational enterprises employed

[5]See Chapter 5 for a more detailed discussion of the offshoring indicator and a detailed review of recent trends in Germany.

[6]Since a direct measure of imported inputs does not exist for every country, the OECD (2007) approximated the value of imported inputs by multiplying the purchases of an input j with the import share in total absorption of the intermediate.

[7]MNEs are defined as firms that own a significant equity share (typically 50 percent or more) of another company operating in a foreign country.



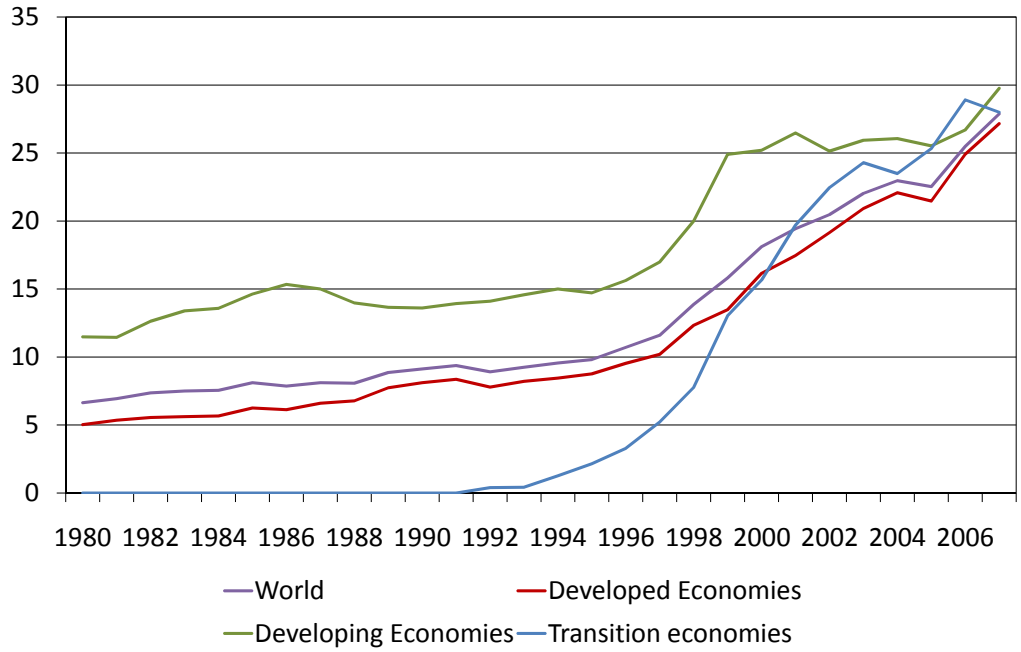
Source: UNCTAD (2008)
FDI inflows are measured in current prices.

Figure 1.2: Inward FDI Flows in Millions of US Dollars, by Host Region, 1970 - 2007

82 million people and sold goods and services worth 31 trillion US dollars (UNCTAD, 2008).

The dramatic increase in foreign direct investment in the last two decades or so documents the important role that multinational firms play in the globalisation process. FDI is an investment made to acquire a lasting management interest – usually at least 10 percent of the voting stock – in a foreign company. MNEs undertake foreign direct investment to create, acquire or expand foreign subsidiaries. Figure 1.2 graphs the development of annual FDI inflows since the 1970s. After the sharp decline at the turn of the millennium, global FDI inflows rose to an all-time high of 1,833 billion US dollars in 2007. Between 1985 and 2007 FDI inflows achieved an average annual growth rate of 17.2 percent. Global GDP, in contrast, has increased by only 7 percent per annum over the same time period.[8] Figure 1.3 furthermore shows that the worldwide inward FDI stock as a percentage of GDP increased from 6.6 percent in 1980 to 27.9 percent in 2007. From a European perspective, the fall of the iron curtain and the European integration process have significantly

[8]The figures relate to FDI inflows and GDP measured in current prices.



Source: UNCTAD (2008)

Figure 1.3: Inward FDI Stock as a Percentage of GDP, by Host Region, 1980 - 2007

increased the attractiveness of Eastern European countries as FDI destinations – with Western European countries being among the leading sources of FDI outflows. The FDI stock of German enterprises in Poland, Hungary and the Czech Republic, for instance, amounted to 45.4 billion euros in 2007 – compared to just 9.5 billion euros ten years earlier (Deutsche Bundesbank, 2009).

Since the relocation of production processes to a foreign affiliate (offshore in-house sourcing) involves FDI, the rise in offshoring and the increasing importance of MNEs are to some extent related. In fact, MNEs exploit international cost differences by decomposing their production stages geographically (so-called vertical FDI). However, multinational firms also invest in foreign countries so as to serve the local market directly through a local subsidiary and save on trade costs. In that case, the production process is not unbundled but the same product or service is produced in multiple countries (horizontal FDI). Thus, FDI can either be driven by cost-saving or market-seeking motives. Available data do not allow to distinguish directly between the two types of FDI. Cost-saving (or vertical) FDI should, however, mainly flow from developed to developing countries, whereas market-seeking FDI can be expected between home and host countries that are similar in

country sizes and relative endowments (cf. Markusen, 2002). Since FDI flows mainly originate in developed countries and also predominately flow to developed countries, the bulk of FDI appears to be horizontal rather than vertical. In fact, developed countries accounted for 84.8 percent of FDI outflows and received 68.1 percent of FDI inflows in 2007.

1.3 Outline of Thesis

My thesis consists of four main chapters that pick up different aspects of the globalisation process characterised in the previous subsection and analyse their interactions with the labour market. Chapters 2 to 4 comprise theoretical work; Chapter 5 presents an empirical study.

The starting points of Chapter 2 that has been published in a slightly modified version in the *Review of International Economics* 16(5), pages 864-873, are two empirical observations. First, in the USA spending on industrial research and development (R&D) have increased sharply since the 1980s. Second, paralleling the rise in R&D expenditures, the USA (and other industrialised countries) experienced a breakdown in the relative demand for unskilled workers. Against this background, Chapter 2 examines whether (i) economic integration – in the form of lower trading barriers – have been a driving force behind the large increase in industrial R&D funding and whether (ii) these higher investments in R&D have contributed to the decline in the demand for unskilled labour.

These questions are studied in a simple model of international oligopoly, in which firms can invest in both process and product innovation. Process innovation decreases marginal production costs, whereas product innovation reduces the substitutability between competing product varieties. In order to conduct R&D, firms hire skilled workers; production, in contrast, requires unskilled workers. Economic integration intensifies international competition and induces competing firms to invest more aggressively in both product and process innovation. The relative demand for skilled workers increases as a result.

The paper presented in Chapter 2 is most closely related to a study by Neary (2002). He demonstrates that a reduction in import barriers induces firms to increase their strategic investment in process R&D in order to blockade entry of foreign competitors. Assuming R&D to be skilled-labour intensive, dismantling trading barriers then increases the wage premium of skilled workers. While Neary (2002) focuses on the threat of import competition into the home market, I analyse the decision process of a firm that simultaneously serves the home and the foreign market and concentrate on

situations in which intra-industry trade actually occurs. More importantly, I extend Neary's work to allow for product R&D, which is - at least in the USA - quantitatively more important than process R&D (cf. Scherer and Ross, 1990).

Chapter 3 is motivated by a widely noticed paper of Davis (1998a) that studies the labour market consequences of trade between a flexible-wage Europe and a rigid-wage America. With free trade factor prices are equalised across countries and the minimum wage in Europe pins down wages in both countries. Europe then has to endure the full unemployment level of the integrated economy. Opening up trade between the two countries therefore props up American wages and sharply increases European unemployment. Davis (1998a) thus concludes that national factor markets cannot be considered in isolation when goods markets are linked globally.

The results of Davis (1998a) and also related findings by a number of follow-up studies (see, e.g., Meckl, 2006; Kreickemeier and Nelson, 2006) are derived in a Heckscher-Ohlin setting with factor price equalisation. Existing studies therefore focus on inter-industry trade and – since they invoke the factor price equalisation theorem – rest on stark assumptions such as free trade, common technologies and diversified production. Chapter 3, in contrast, analyses labour market outcomes in a model of intra-industry trade between a rigid-wage Europe and a flexible-wage America. Firms can choose to serve the foreign market either through exporting or through local subsidiaries. Trade costs are non-negligible and the paper therefore concentrates on the empirically important case where factor prices do not equalise across trading partners.

Within this model framework I find the adverse employment and welfare effects of an asymmetric minimum wage to be significantly larger when goods markets are not isolated but linked globally. In contrast to public perception, multinational firms can actually help to alleviate the negative effects arising from global competition in the presence of one-sided labour market rigidities. I furthermore show that – even though factor prices are not equalised across countries – the introduction of a (binding) minimum wage in Europe increases American wages. Chapter 3 also illustrates that America is insulated from any shocks caused by European factor accumulation, while the reverse is not true.

Next, Chapter 4 turns towards a classical question in labour economics, namely what unions do to productivity and firm performance. Conventional wisdom suggests that unionised firms earn lower profits – simply because they have to pay higher wages. However, an equivalent positive union effect on productivity could, in principle, make up for higher union wages. Theoretically, unionisation has an ambiguous effect on the incentives of firms to

innovate. On the one hand, unionisation is associated with a classical hold-up problem. Once a firm has incurred the sunk costs of investment, unions can capture part of the innovation rent by demanding higher wages. Unionised firms thus have lower incentives to innovate than their non-unionised competitors (Grout, 1984). On the other hand, unionised enterprises may enjoy a strategic advantage over their non-unionised competitors if R&D is undertaken for strategic reasons (see, e.g., Ulph and Ulph, 1998, for a discussion). Existing studies on the relation between unionisation and innovation incentives have focused on oligopolistic markets, characterised by a small and fixed number of firms. Unionisation, however, is likely to also influence the market structure, i.e. the number and characteristics of firms, which in turn determine average productivity and firm performance more generally. Moreover, the existing literature has mainly concentrated on firm-level bargaining and thus has neglected sector-wide wage agreements that are still widespread in continental Europe.

My objective in Chapter 4 is to analyse the interactions between bargaining structures, the market environment and firm performance. For doing so, I set up a monopolistic competition model with heterogeneous firms and free entry. The model incorporates both differences in firm productivity and endogenous mark-ups that respond to the intensity of competition in a market. Within this model framework I contrast the effects of centralised and decentralised wage bargaining on productivity and firm performance and compare the results to the benchmark case of a perfectly competitive labour market.

The study identifies two channels through which unionisation affects productivity and firm performance that have been largely overlooked in previous work. First, sector- but not firm-level bargaining induces tougher selection among heterogeneous producers and increases average productivity. Second, the increase in wages associated with both bargaining regimes discourages entry and decreases competitive pressures. With competition being less intensive surviving firms can charge higher mark-ups and thus ceteris paribus earn higher profits. Overall, I find centralised bargaining to result in higher average levels of productivity and profits than either decentralised bargaining or a competitive labour market. Extending the model to an open economy setup, I furthermore show that the positive effect of centralised bargaining on average productivity can be overturned when firms face international low-wage competition. Thus, I again find that the effects of national labour market institutions can change markedly when product markets become global in scope.

Finally, Chapter 5, which is a joint work with Ronald Bachmann, analyses empirically the effect of offshoring on workers' labour market transitions in Germany. For doing so, we combine an administrative micro data set con-

taining daily information on individual workers' employment histories with offshoring indicators at the industry level. Although the empirical literature on the issue is very thin (and theoretical studies virtually non-existent), we are not the first to study the effects of offshoring on transitional labour market dynamics in Germany. However, while the only other existing study for Germany (Geishecker, 2008) is concerned with job stability only, we additionally distinguish between three different worker flows that can result from the separation of an employer-employee match: direct job-to-job transitions, the flow from employment to unemployment, and the flow from employment to non-participation. Since these different transitions can have very different reasons and welfare implications, the distinction is crucial for a thorough assessment of the effects offshoring has on transitional labour market dynamics. Furthermore, we not only consider the manufacturing sector as other studies do, but also analyse the service sector and thus take into account the fact that offshoring increasingly affects services.

Our results suggests that the effects of offshoring on labour market transitions are not uniform but vary between sectors and across skill levels and age groups. While offshoring does not affect overall job stability in the manufacturing sector, flows from employment in manufacturing to non-participation display a negative correlation with offshoring. In the service sector, in contrast, we find offshoring to be associated with an increase in overall job stability. Furthermore, the effects of offshoring vary strongly by age and skill level, especially in the manufacturing sector. Here, while overall job stability remains unaffected by offshoring, older workers experience a significant decline in their job stability.

Chapter 2

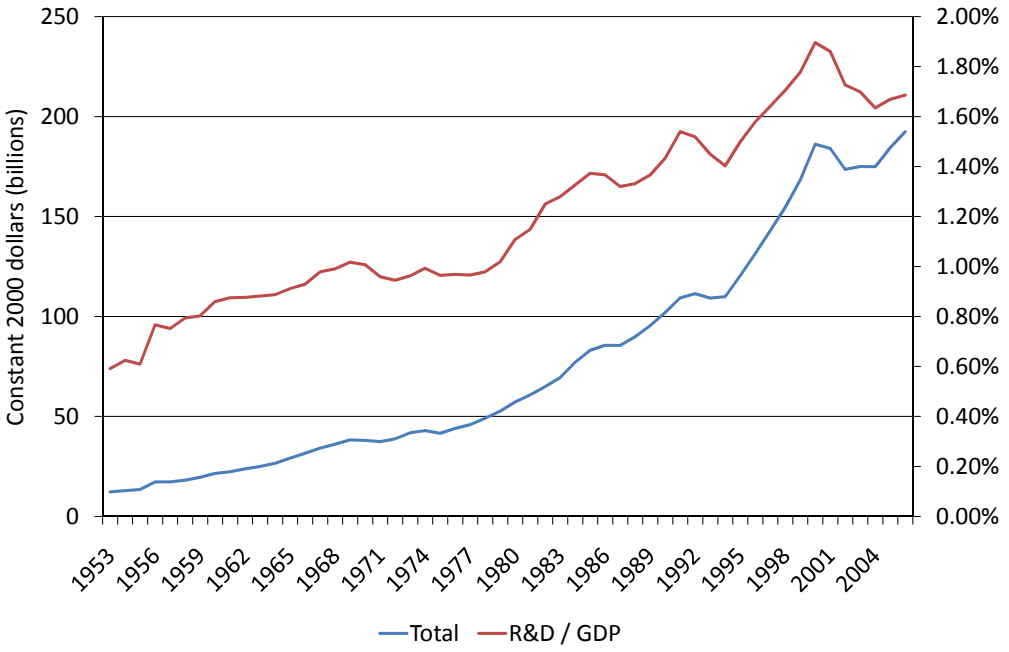
Economic Integration, Process and Product Innovation, and Relative Skill Demand

Abstract. The interaction between economic integration, product and process innovation, and relative skill demand is analysed in a model of international oligopoly. Lower trading barriers increase the degree of foreign competition. The competing enterprises respond by investing more aggressively in lowering marginal costs of production. Moreover, firms reduce the substitutability of their products through additional investment in product innovation. The paper also shows that the relative demand for skilled workers may increase as a result.

2.1 Introduction

Data for the USA show that industrial R&D funding increased sharply in the 1980s and 1990s (see Figure 2.1). In 2006, R&D expenditures of the business sector amounted to 192.4 billion US dollars compared to just 52.7 billion in 1979 (measured in constant 2000 US dollars). While the ratio of industrial R&D expenditures to GDP remained fairly constant throughout the 1960s and 1970s, it rose from about 1 percent in 1979 to 1.43 percent in 1990 and 1.69 percent in 2006 (down from 1.90 in 2000). Paralleling the rise in industrial R&D spending, the USA (and other industrialised countries) experienced a breakdown in the relative demand for unskilled workers.[1]

[1]For a recent paper that reviews the ongoing academic debate in this area and provides detailed empirical evidence on trends in US wage inequality see Autor et al. (2008).



Source: National Science Foundation
Total expenditures are measured in constant 2000 US dollars.

Figure 2.1: Industrial R&D Expenditures, Total and Relative to GDP, USA 1960 - 2004

Against this background, the purpose of the present paper is twofold. First, to provide an analysis of the effects of lower trading barriers on the incentives of firms to undertake R&D investment. Second, to explore the subsequent effect on firms' demand for skilled relative to unskilled workers. By doing so, the study provides some insights into the question of whether (i) economic integration might have been a driving force of the large increase in industrial R&D funding and whether (ii) higher investments in R&D may have contributed to the aforementioned developments in the labour market. Towards this aim, a simple model of international oligopoly is set up. Firms operate in segmented markets and can invest in both process and product innovation. Process innovation allows firms to produce at lower marginal production costs. Product innovation is understood as a means of reducing the substitutability between goods. Therefore, the focus lies on innovation within a given product life-cycle (rather than on the invention of new products). Firms hire skilled workers for performing R&D while production requires solely unskilled workers.[2]

[2]One could also assume that R&D is relatively more skill-intensive than production.

Economic integration is then modelled as a reduction in trading costs between segmented markets. Competitive pressures increase and induce firms to invest more in lower marginal production costs and a greater degree of product differentiation. In fact, investing in one type of R&D also provides additional incentives to invest in the other. Thus, process and product innovations are found to be complementary. Higher investments in R&D raise relative skill demand both directly through higher demand for skilled workers and indirectly through a reduction in the requirements of unskilled workers per unit of production. For conventional functional form assumptions these effects will outweigh the positive effect on the demand for unskilled workers resulting from an increase in total output following a reduction in trading barriers.

There exists a small theoretical literature that focuses on both process and product innovation at the same time. Lin and Saggi (2002) investigate the relationship between process and product R&D in a three-stage model. Before production takes place, firms decide first on product R&D and then on the level of process R&D. In contrast, Rosenkranz (2003) analyses the strategic decision of oligopolists that simultaneously choose product and process innovation. Weiss (2003) examines the effect of changes in the degree of competition on firms' decision to engage in either process or product R&D. Finally, Bandyopadhyay and Acharyya (2004) study the complementarity between process and product innovation in a vertically differentiated monopolistic market. However, neither the issue of economic integration nor any labour market effects are considered in these studies. Instead of focusing on a single market the present work analyses the effects of a change in the competitive environment on (the interplay of) the two types of innovation in an international oligopoly.

The paper at hand is more closely related to studies by Neary (2002) and Haaland and Kind (2008). Neary (2002) demonstrates that a reduction in import barriers will induce firms to increase their strategic investment so as to block the entry of foreign competitors. Assuming investment to be skilled-labour intensive (relative to production), lower trading barriers increase the wage premium of skilled workers as well as the ratio of skilled to unskilled workers employed. Haaland and Kind (2008) analyse the interaction between trading costs, process innovation and R&D subsidies. Among other things their study illustrates that trade liberalisation may increase private and social incentives to invest in cost-saving R&D.

The present paper shares some similarities with these two studies but

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The extreme assumption of skilled and unskilled workers being the only inputs in R&D and production, respectively, just simplifies the model.

crucial differences exist. While Neary (2002) studies the *threat* of import competition in the home market, the focus of the present study is on the decision process of a firm that simultaneously serves the home *and* the foreign market, and on situations in which intra-industry trade actually occurs. The model abstracts from the strategic value of investment and shows that economic integration increases the *efficiency* of R&D investments. Haaland and Kind (2008), on the other hand, do not consider labour market effects of the interaction between trading costs and R&D investments. More importantly, neither Neary (2002) nor Haaland and Kind (2008) deal with product innovation, but concentrate on process innovation only. Given the fact that in the USA product R&D seems to be quantitatively more important than process R&D,[3] extending the analysis to incorporate both types of R&D is of great importance.

The rest of the paper is organised as follows. Section 2.2 presents the basic model. The interaction between economic integration and the incentives of firms to invest in process and product innovation is analysed in Section 2.3. Section 2.4 then studies the subsequent effects on the relative skill demand of firms. Finally, Section 2.5 offers some concluding remarks and briefly describes how the setting could be implemented into a general equilibrium framework.

2.2 The Model Setting

There are two identical countries, Home (H) and Foreign (F), and two firms. Firm 1 is located in Home, while firm 2 is located in Foreign. Given the symmetry of the model, we shall only present equations for Home. Analogous equations exist for Foreign as well.

Each of the two firms produces a differentiated good. The utility of the representative consumer is a function of the two goods and the numeraire good m and is given by

$$U\left(e, q_{1H}, q_{2H}, m\right) = a\left(q_{1H} + q_{2H}\right) - \frac{1}{2}\left(q_{1H}^2 + q_{2H}^2 + 2eq_{1H}q_{2H}\right) + m, \quad (2.1)$$

where $e \in [0, 1]$ is an inverse measure of product differentiation and q_{1H} and q_{2H} denote consumption of the good produced by firm 1 and 2, respectively. Utility maximisation then gives rise to the following linear inverse demand

[3] Scherer and Ross (1990) suggest that at about three-quarters of R&D investment by firms in the USA is devoted to product innovation.

functions:

$$p_{1H}\left(e, q_{1H}, q_{2H}\right) = a - \left(q_{1H} + eq_{2H}\right), \tag{2.2}$$

$$p_{2H}\left(e, q_{1H}, q_{2H}\right) = a - \left(eq_{1H} + q_{2H}\right), \tag{2.3}$$

where p_{iH} is the price of firm i's good in Home.

On the supply side, the two firms are assumed to compete as Cournot duopolists in segmented markets. Firms incur symmetric trading costs of t per unit of exports. Trading costs are exogenously given and incorporate a wide range of costs, including, for instance, transportation expenditures, tariffs or costs of border formalities.

In order to produce one unit of its respective good, firm i has to employ $\alpha(k_i) \in [0, a]$ units of unskilled labour. Unit costs of production are then given by $\alpha(k_i)w$ with w being the (exogenous) wage rate of the unskilled.[4] By increasing the investment in process R&D, denoted by k_i, firms can lower their unit requirements in unskilled labour. I assume that $\frac{\partial \alpha}{\partial k_i} < 0$, $\frac{\partial^2 \alpha}{\partial^2 k_i} \geq 0$. Moreover, the competitors determine the extent of product differentiation, $e(d_1, d_2)$ with $\frac{\partial e}{\partial d_i} < 0$ and $\frac{\partial^2 e}{\partial^2 d_i} \geq 0$, through investment in product innovation d_i. Note that product R&D shifts outward not only the demand function of the innovating firm but also the one of its competitor.

The costs of R&D investment are incurred in terms of wages for skilled workers. In order to undertake process and product R&D investment, firms have to hire $S^k(k_i)$ and $S^d(d_i)$ skilled workers, respectively, with $\frac{\partial S^k}{\partial k_i} > 0$, $\frac{\partial S^d}{\partial d_i} > 0$ and $\frac{\partial^2 S^k}{\partial^2 k_i} > 0$, $\frac{\partial^2 S^d}{\partial^2 d_i} > 0$. To obtain interior solutions, it is further imposed that $S^k(0) = 0$, $S^d(0) = 0$, and $\lim_{k_i \to k_i^*} S^k(k_i) = \infty$ (with $\alpha(k_i^*) = 0$), $\lim_{d_i \to d_i^*} S^d(d_i) = \infty$ (with $e(d_1^*, d_2^*) = 0$). Skilled workers are paid an exogenous wage rate r. The profit of the firm located in Home is then given by

$$\begin{aligned}\Pi_1 =& p_{1H}\left(e, q_{1H}, q_{2H}\right) q_{1H} + \left[p_{1F}\left(e, q_{1F}, q_{2F}\right) - t\right] q_{1F} - \left(q_{1H} + q_{1F}\right) \alpha(k_1) w \\ & - \left[S^k(k_1) + S^d(d_1)\right] r,\end{aligned} \tag{2.4}$$

where the subscript F is used to mark variables referring to Foreign. Firms maximise profits by choosing simultaneously their output levels in the two markets as well as their investments in process and product innovation.[5]

[4] Section 5 briefly describes how the setting could be implemented into a general equilibrium framework with endogenous factor prices.

[5] In an alternative setup, investment decisions might be made before production takes places. Then firms also face strategic motives to undertake R&D investment. However, this would not change the results of the paper. The strategic motives for R&D investment are also well understood and discussed in, for instance, Lin and Saggi (2002), Neary (2002) and Rosenkranz (2003).

2.3 Economic Integration and R&D Investment

The optimal levels of process and product R&D are considered first. Taking the first derivative of profits with respect to the investment in process innovation yields the following first-order condition:

$$\frac{\partial S^k(k_1)}{\partial k_1} r = -\frac{\partial \alpha(k_1)}{\partial k_1}(q_{1H} + q_{1F})w. \tag{2.5}$$

Marginal costs equal the incremental increase in wages paid to skilled workers, while benefits are given in terms of the marginal reduction in production costs. The first-order condition for the optimal level of product innovation reads

$$\frac{\partial S^d(d_1)}{\partial d_1} r = -\frac{\partial e(d_1, d_2)}{\partial d_1}(q_{2H} q_{1H} + q_{2F} q_{1F}). \tag{2.6}$$

Again, marginal costs of investing in process innovation equal the marginal increase in the employment of skilled workers times the wage rate. Marginal benefits are given by the resulting increase in product prices in the two markets multiplied by the respective output level.

Holding R&D investments fixed, one can further derive the optimal output decisions as

$$q_{1H} = \begin{cases} \frac{1}{2}[a - \alpha(k_1)w] & \text{for } \Gamma \leq 0 \\ \frac{1}{4-e^2}[(2-e)a + et - 2\alpha(k_1)w + e\alpha(k_2)w] & \text{otherwise} \end{cases} \tag{2.7}$$

$$q_{1F} = \begin{cases} 0 & \text{for } \Gamma \leq 0 \\ \frac{1}{4-e^2}[(2-e)a - 2t - 2\alpha(k_1)w + e\alpha(k_2)w] & \text{otherwise} \end{cases} \tag{2.8}$$

with $\Gamma = \frac{2}{4-e^2}\left(e\alpha(k_2)w - 2\alpha(k_1)w - 2t\right) + \frac{2}{2+e}a$.

In the (symmetric) Cournot equilibrium, it further holds that $q_{1H} = q_{2F}$, $q_{1F} = q_{2H}$ as well as $d_1 = d_2 = d$, $k_1 = k_2 = k$. Equations (2.5) - (2.8) can now be used to analyse the link between economic integration, i.e. a decrease in trading costs t, and firm's investment in product and process innovation.

Consider first the case, in which trade barriers will prevent firms from exporting. The competitors act as unconstrained monopolists in their national markets. While the monopolists will invest in process innovation to reap the benefits of reducing production costs, they refrain from investing in product innovation.[6] The reason is simply that a monopolist does not profit from differentiating its product from the one of a non-existing competitor.

[6]Formally, this can seen from equation (2.6) and the fact that $q_{1F} = q_{2H} = 0$.

Marginal decreases in trading barriers will not alter the equilibrium outcome as long as exports are not profitable. Hereafter, attention is restricted to the more interesting case of positive levels of intra-industry trade.[7]

Equations (2.7) and (2.8) show that for any given level of R&D investment and with positive exports, economic integration has two competing effects on the optimal output level of a firm: On the one hand, protection of the domestic market and, hence, domestic sales decline; on the other hand, reducing trading barriers will increase exports. It is easily verified that due to the increase in competitive pressures in both markets the positive effect on output has to prevail (i.e. $\frac{\partial(q_{1H}+q_{1F})}{\partial t} < 0$). This, in turn, will affect the incentives of firms to undertake R&D investments.

First, a higher level of total output increases the benefits of reducing marginal production costs thereby inducing additional investment in process R&D.[8] Second, the pro-competitive effect of lower trading barriers also provides additional incentives to invest in product innovations. In the domestic market, intensified foreign competition makes product differentiation more valuable since it now has a stronger impact on market prices. This effect dominates the negative effect that the reduction in domestic output has on the incentives to invest in product innovations. In the export market, the ability to charge higher prices (for a given level of output) pays off more with low levels of trading costs because of the rise in production for the foreign market. The effect exceeds the negative one resulting from lower output of the domestic firm (leading to lower benefits in terms of the impact that product differentiation has on the market price).

Formally, the positive effect of economic integration on product innovation can be shown by differentiating the marginal benefit of product R&D with respect to t. Using $q_{1H} = q_{2F}$, $q_{1F} = q_{2H}$ and equations (2.7) and (2.8), I find

$$\begin{aligned}\frac{\partial\left(-\frac{\partial e(d_1,d_2)}{\partial d_1}(q_{2H}q_{1H}+q_{2F}q_{1F})\right)}{\partial t} &= -2\frac{\partial e(d_1,d_2)}{\partial d_1}\left(\frac{\partial q_{1H}}{\partial t}q_{1F}+\frac{\partial q_{1F}}{\partial t}q_{1H}\right)\\ &= -2\frac{\partial e(d_1,d_2)}{\partial d_1}\left(\frac{eq_{1F}}{4-e^2}-\frac{2q_{1H}}{4-e^2}\right), \quad (2.9)\end{aligned}$$

which has to be negative given that $\frac{\partial e}{\partial d_i} < 0$, $2 > e$ and $q_{1H} > q_{1F}$.
Now consider the subsequent effect of increasing the investment in (process and product) R&D. Not surprisingly, lower marginal production cost will induce firms to raise the output for both markets. With $k_1 = k_2 = k$ the

[7] A sufficient but not necessary condition for positive levels of intra-industry trade is $a - \alpha(0)w > 2t$.

[8] This effect has also been found by Haaland and Kind (2008).

derivatives of output with respect to the investment in product R&D are given by

$$\frac{\partial q_{1H}}{\partial k} = \frac{\partial q_{1F}}{\partial k} = -\frac{1}{4-e^2}(2-e)\frac{\partial \alpha(k)}{\partial k}w > 0. \tag{2.10}$$

Thus, process innovation will expand output levels. Equations (2.5) and (2.6) show that this will lead to further investments in process *and* product R&D (remember that $q_{1H} = q_{2F}$ and $q_{1F} = q_{2H}$ in equilibrium). In particular, note that there are two reasons why higher equilibrium levels of k provide additional incentives for a firm to invest in product R&D. First, the production of the competitor increases and, hence, product differentiation yields higher marginal benefits in terms of the positive effect on market prices. Second, the firm's own output increases and the higher market prices apply to a higher level of production.

A similar result can be established for investment in product R&D. A higher degree of product differentiation ($\Delta e < 0$) extends the market size[9] and increases total production. With $k_1 = k_2 = k$ I obtain

$$\frac{\partial (q_{1H} + q_{1F})}{\partial e} = -\frac{1}{(2+e)^2}[2a - t - 2\alpha(k)w] < 0. \tag{2.11}$$

Hence, product innovation leads to higher output levels and provides further incentives for process innovation. The subsequent effect on product R&D depends on the product rather than on the sum of the two output levels and is less obvious. While a higher degree of product differentiation unambiguously raises exports, the marginal effect on domestic output is undetermined and depends on the level of trading barriers. Taking the first derivatives of equations (2.7) and (2.8) with respect to e (and imposing $k_1 = k_2 = k$) yields

$$\frac{\partial q_{1H}}{\partial e} = -\frac{a - \alpha(k)w}{(2+e)^2} + \frac{(4+e^2)t}{(4-e^2)^2}, \tag{2.12}$$

$$\frac{\partial q_{1F}}{\partial e} = -\frac{a - \alpha(k)w}{(2+e)^2} - \frac{4et}{(4-e^2)^2} < 0. \tag{2.13}$$

Inserting the upper and lower bounds of t for positive trading volumes (as given by $(1 - 0.5e)[a - \alpha(k)w]$ and 0) into equation (2.12) shows that the derivative might take either sign.[10] For high trading costs the domestic firm gains little from product differentiation in the domestic market. Export volumes are low and a reduction in e leads to relatively small gains in terms

[9] Note that demand for a given price level is increasing in the degree of product differentiation.

[10] Inserting the upper bound of t reveals that the resulting expression is positive for $2e - 0.5e^3 > 0$. This condition is fulfilled in the relevant range of $0 < e < 1$.

of higher market prices. The exporter, in contrast, can charge considerably higher prices when e is reduced and therefore expands exports significantly. Since output levels are strategic substitutes, the domestic firm responds by cutting output levels. For high levels of protection the latter effect might well outweigh the positive effect and domestic output shrinks.

However, it can be shown that even if product innovation led to decreasing levels of domestic output, the positive effect on exports would be large enough to increase the marginal benefits of product R&D even further. A formal proof of this finding is provided in Appendix A.1. The main results of this section are summarised in

Proposition 1. *For positive levels of intra-industry trade lower trading barriers (lower values of t) will increase total output and the investment of firms in both process and product R&D. Higher investment in process and product innovations will translate into further changes in output, which induce firms to invest even more in both types of R&D. Thus, process and product R&D are found to be complementary.*

2.4 Economic Integration and Relative Labour Demand

After having analysed the effects of economic integration on the choice of output levels and R&D investments, the subsequent impact on relative labour demand is examined now. Demand for skilled workers S is the sum of workers required for the chosen level of process and product R&D, respectively. Demand for unskilled workers U is given by total output multiplied by $\alpha(k_i)$, the requirement of unskilled workers per unit of production. Relative labour demand of firm 1 can therefore be written as

$$\left(\frac{S}{U}\right)^{Demand} = \frac{S^k(k_1) + S^d(d_1)}{(q_{1H} + q_{1F})\alpha(k_1)}. \tag{2.14}$$

Differentiating with respect to t yields the effect of a marginal change in trading costs on relative skill demand:

$$\begin{aligned}\frac{\partial \left(\frac{S}{U}\right)^{Demand}}{\partial t} =& \frac{\left[\frac{\partial S^k(k_1)}{\partial t} + \frac{\partial S^d(d_1)}{\partial t}\right](q_{1H}+q_{1F})\alpha(k_1)}{[(q_{1H}+q_{1F})\alpha(k_1)]^2} \\ &- \frac{\frac{\partial \alpha(k_1)}{\partial t}[S^k(k_1)+S^d(d_1)](q_{1H}+q_{1F})}{[(q_{1H}+q_{1F})\alpha(k_1)]^2} \\ &- \frac{\frac{\partial (q_{1H}+q_{1F})}{\partial t}[S^k(k_1)+S^d(d_1)]\alpha(k_1)}{[(q_{1H}+q_{1F})\alpha(k_1)]^2}. \end{aligned} \tag{2.15}$$

The analysis of equation (2.15) leads directly to

Proposition 2. *Economic integration has three competing effects on relative skill demand. First, lower trading barriers increase the investment in product and process innovation, which translates into higher demand for skilled workers. Second, investment in process innovation reduces the per-unit requirements of unskilled labour in production. Hence, for any given level of output demand for the unskilled declines. The third effect works in the opposite direction. Economic integration increases output and raises the demand for unskilled workers holding $\alpha(k_i)$ constant.*

Without additional functional form assumptions the sign of equation (2.15) cannot be determined. In order to learn more about the interaction between economic integration, investment in R&D, and relative skill demand, specific functional forms are considered now. Following the relevant literature[11] R&D investment is assumed to reduce production costs and increase product differentiation in a linear way. The degree of product differentiation is then given by $e = 1 - (d_1 + d_2)$ with $d_i \in [0, 0.5]$, while the requirement of unskilled labour per unit of output is determined as $\alpha(k_i) = \bar{c} - k_i$ with $k_i \in [0, \bar{c}]$. Furthermore, investment costs are assumed to be quadratic, i.e. $S^k(k_i) = 0.5k_i^2$ and $S^d(d_i) = 0.5d_i^2$. With these functional form assumptions, the first-order conditions for the optimal levels of investment in process and product investment for firm 1 read

$$k_1 r = (q_{1H} + q_{1F})w, \tag{2.16}$$

$$d_1 r = q_{2H}q_{1H} + q_{2F}q_{1F}. \tag{2.17}$$

Now, one can solve for R&D investments, which then determine skilled labour demand given the functional form assumptions. Substituting into equation

[11] See for instance, Neary (2002) and Haaland and Kind (2008) for process R&D as well as Lin and Saggi (2002) for process and product R&D.

(2.14), imposing $q_{1H} = q_{2F}$, $q_{1F} = q_{2H}$ and also replacing $\alpha(k_1)$ by $\bar{c} - k_1$ yield

$$\left(\frac{S}{U}\right)^{Demand} = \frac{\frac{w^2}{2r^2}(q_{1H} + q_{1F})^2 + \frac{2}{r^2}(q_{1H}^2 q_{1F}^2)}{(q_{1H} + q_{1F})(\bar{c} - k_1)}. \tag{2.18}$$

This expression allows us to find an unambiguous effect of economic integration on relative skill demand. In fact, differentiating with respect to trading barriers and some calculus reveal

Proposition 3. *With quadratic investment costs and linear effects of R&D investments on production cost and the degree of product differentiation, lower trading costs will raise skill demand. In fact, the first effect identified in proposition 2 (i.e. the direct positive effect on skilled labour demand) suffices to outweigh the third (i.e. the positive effect on unskilled labour demand resulting from the rise in output levels).*

The proof is relegated to Appendix A.2.

2.5 Conclusion

This paper has set up a simple model of international oligopoly to study the interaction between lower trading barriers and the investment of firms in process and product innovation. Increased competition following economic integration induces firms to bring down production costs by investing more aggressively in process R&D. At the same time, competitors expand their investments in product innovation in order to reduce the substitutability of their products. Assuming R&D to be intensive in skilled-labour (relative to production), the paper further illustrates that economic integration may increase the relative demand for skilled workers.

In order to study the effects of the interaction between economic integration and R&D investment on aggregate labour markets more thoroughly, a relevant path for further research is the integration of the model into a general equilibrium framework. A promising way to proceed could be the development of a General Oligopolistic Equilibrium Model (GOLE) as proposed by Neary (2003). The key idea of this class of models is to think of firms as being large in their sectors but small in the economy as a whole. Consumers have additively separable preferences defined over a continuum of goods produced in a continuum of industries. Since firms are then small in comparison to the economy they take aggregate variables such as factor prices and aggregate income as given. Hence, the approach avoids the usual problems of modelling oligopolistic competition in general equilibrium.

Applying the concept to the present paper, one might think of a model with two symmetric countries. Each country hosts a continuum of sectors. Abstracting from differences across sectors, each sector can be modelled as described in section 2.2. Economic integration then raises skill demands in all sectors. On the labour market, the relative supply of skilled to unskilled workers may increase with relative factor prices. Increasing skill demands (following a decline in trading costs) would translate into a higher skill premium and also increase the aggregate relative supply of skilled labour. These findings correspond well with the empirical observations for the US labour market.

Chapter 3

Foreign Competition, Multinational Firms, and One-Sided Wage Rigidity

Abstract. The paper studies the effects of a one-sided minimum wage in a two-country model of intra-industry trade, in which multinational firms arise endogenously. With positive levels of intra-industry trade the adverse employment and welfare effects of an asymmetric minimum wage are significantly larger than in a non-trading economy. Multinational firms generally mitigate the effect somewhat. Even though factor prices are not equalised across countries, a (binding) wage floor in one country will prop up wages in the other. The flexible-wage country is insulated from shocks caused by factor accumulation in the rigid-wage country, while an increase in the labour supply of the latter economy may have profound impacts on labour market outcomes in both countries.

3.1 Introduction

The closer economic integration of the world economy is viewed with fear and scepticism by many. In particular, the effects on employment and wages of workers in developed countries are controversially discussed in the public debate on the consequences of globalisation. International competitive pressures and footloose multinational enterprises (MNEs) are widely feared to bring down wages and endanger jobs in the Western world.[1]

[1]Scheve and Slaughter (2001) provide a comprehensive summary of the perceptions of American workers about globalisation.

In this context, national regulations that add to the rigidity of the labour market have come under growing pressures. Increasing labour market flexibility has been one of the major goals of recent reforms in OECD countries. The political debates surrounding these reforms frequently discuss the necessity of a flexible labour market for coping successfully with the challenges of globalisation.[2] In this regard, the relatively rigid labour markets in Continental Europe have been contrasted with those of the UK and the US characterised by a high degree of flexibility. In particular, it has been suggested that globalisation may result in systematically different labour market outcomes depending on the characteristics of national labour market institutions (Davis, 1998a; Krugman, 1995).

In his widely discussed contribution, Krugman (1995) analyses the effect on OECD countries of opening up trade with low-wage developing countries and distinguishes between a flexible-wage 'American' model and a 'European' model with fixed wages. While Krugman applies a general-equilibrium framework separately to the two regimes of wage flexibility, Davis (1998a) allows for economic linkages between the two economies. He considers trade between a flexible-wage 'America' and a rigid-wage 'Europe' in a Heckscher-Ohlin framework. The European labour market is characterised by a minimum wage of the sort analysed by Brecher (1974).

Davis (1998a) shows that factor markets cannot be considered in isolation when goods markets are linked globally. In his paper, the global equilibrium is characterised by factor price equalisation (FPE) across countries. The minimum wage in Europe pins down wages in both countries. European workers have to absorb the full unemployment level of the integrated economy. Hence, a move from autarky to free trade will prop up American wages and will sharply increase European unemployment. Davis (1998a) also shows that the fixed minimum wage in Europe will insulate American wages against shocks originating from factor accumulation in Europe while an increase in the American labour supply increases European unemployment. Hence, in his model divergent wage trends cannot be explained by cross-county differences in the evolution of labour supply.

Meckl (2006) extends the model by accounting for individual productivity differences. Individual workers then also differ in their educational decisions and labour supply is endogenous. Although the factor-price-equalisation

[2]For instance, the Kok (2004) report, designed to monitor the achievements towards the Lisbon goals of the European Union, identifies increased global competition as a major challenge for European labour markets and calls for finding a new balance between flexibility and security. And in a recent report the academic advisory council at the German Federal Ministry of Economics and Technology concludes that globalised markets require additional labour market flexibility in Germany (BMWi, Wissenschaftlicher Beirat, 2006).

property is preserved, the model does not share the insulation property with Davis (1998a). However, European unemployment still props up American wages. In a more recent paper, Kreickemeier and Nelson (2006) consider somewhat less stark institutional assumptions. They postulate the existence of fair wage constraints in both economies. Asymmetries arise due to different attitudes towards wage inequality. The paper develops an integrated equilibrium concept for this type of model and shows that while the central message of Davis persists, some results depend on the specific model framework.

The major results of the papers mentioned have been derived in a Heckscher-Ohlin framework, in which the countries considered replicate an integrated equilibrium with factor price equalisation. While the approach clearly contributes to the transparency of the results, it rests on stark assumption such as free trade, common technologies and diversified production.[3] Moreover, the studies focus on inter-industry trade.[4] However, trade flows between developed countries and regions, such as Europe and the US, are largely characterised by simultaneous exports and imports of similar products. A second distinctive feature of the modern world economy is the widespread importance of foreign direct investment (FDI). Over the last two decades or so FDI has increased sharply, both in absolute terms but also relative to the levels of GDP and trade (see Figures 1.2 and 1.3).[5] In this context, concerns have been raised that multinational activities of firms could have detrimental effects on the regulatory capacities of countries competing for FDI.

Against this background, the present paper adds to the scarce existing literature by studying labour market outcomes in a model of intra-industry trade with non-zero trading costs between a rigid-wage Europe and a flexible-wage America, in which multinational enterprises arise endogenously.[6] The contributions of the study are thus twofold. First, trade costs are non-

[3]Davis himself is upfront on that point and also underline 'the value of pursuing extensions to the present study in which local factor supplies do matter' Davis (1998b, p. 1616), in particular for improving our understanding of the divergent wage experiences in the US and (continental) Europe.

[4]In a footnote, Davis (1998a) sketches how his results could in principle also be established by applying an integrated equilibrium approach to a monopolistic competition model with heterogeneous goods along the lines of Helpman and Krugman (1985).

[5]For an detailed overview of stylised facts on FDI see, for instance, Chapter 1 of Navaretti and Venables (2004).

[6]The paper is not the first to consider the effect of multinational enterprises in a model with labour market imperfections. For instance, Skaksen and Sorensen (2001) and Zhao (1995, 1998) analyse the effect of multinational activity for the bargaining outcome in an unionised labour market. However, none of the papers consider a general equilibrium framework with asymmetric labour market institutions.

negligible in the model and the paper therefore concentrates on the empirically important case where factor prices do not equalise across trading partners.[7] The paper explicitly considers intra-industry trade and examines whether the stark results established by Davis (1998a) carry over to a framework without factor price equalisation. Second, it analyses the labour market effects of multinational firms in a general equilibrium framework with asymmetric wage rigidities. The paper therefore sheds light on the role of multinational enterprises for labour market developments in an increasingly integrated world.

The basic framework is adopted from Markusen and Venables (1998) who study the model under perfectly competitive factor markets. As in Davis (1998a) downward wage rigidity is simply modelled as a lower bound on wages and might reflect various institutions such as explicit minimum wages, unemployment benefits, unions, etc. Firms can either enter as national enterprises producing in one country and possibly exporting to the other. Alternatively, multinational enterprises will set up their headquarters in one country but maintain production facilities in both. Hence, the focus lies on horizontal direct investment which represents the bulk of FDI and is of particular importance to the analysis of similar developed countries.

The effects of divergent national labour market institutions in the globalised economy are contrasted with those derived in a closed economy setting and those without allowing for the presence of multinational firms. The results suggest that the negative effect of a one-sided wage floor on unemployment in Europe is much larger with positive levels of intra-industry trade than in a closed economy framework. Domestic production is substituted by imports from America. Hence, labour demand falls more rapidly and unemployment soars. The problem exacerbates itself as income and, hence, demand will fall more rapidly with higher unemployment rates causing a further decline in European production.[8]

[7] Oslington (2002) analyses asymmetric wage rigidity in a Heckscher-Ohlin model in which Europe is specialised in the skill-intensive industry. FPE then also breaks down and Europe is left with a lower skill premium than America. The paper shows that some of Davis' results will no longer hold in that case but confirms the overarching message that factor markets cannot be considered in isolation when goods markets are global. In contrast to the present paper, Oslington (2002) considers inter-industry trade and abstracts from MNEs. Moreover, in a model of two developed countries (Europe and America) non-negligible trade frictions may arguably be a more important reason for factor prices not to be equalised than dissimilar endowments.

[8] This result resembles earlier findings established by Pflüger (2004) in a two-country monopolistic competition model with exogenous wage differentials. Among other things, the paper finds that in the absence of agglomeration forces a push in union wages in one country induces firms to relocate to the other. The relocation effect is stronger the more

Interestingly, multinational firms do not worsen this effect but generally help to mitigate it. They are less affected by the one-sided minimum wage than European national firms as parts of their costs are incurred in terms of foreign labour. This allows them to operate for a wider range of (implicit) minimum wages. European labour benefits as consumption is met with local production. Hence, in contrast to public perception the study suggests that (horizontal) MNEs can actually help to alleviate the negative effects arising from global competition in the presence of one-sided labour market institutions. Even though factor prices are not equalised across countries, America sees its wage rate rising in the open economy setting with the introduction of a minimum wage in Europe. Owing to a sort of home market effect, American wages can actually rise above the minimum wage rate even though countries are otherwise identical.

The paper also illustrates that America is indeed insulated from any shocks caused by European factor accumulation. On contrary, factor accumulation in America has marked impacts on both countries with the exact direction depending on the level of the minimum wage and the types of firms active in the corresponding equilibrium. In fact, increases in national labour supply can actually boost domestic wages by enhancing the competitiveness of national firms in a globalised world.

The remainder of the paper is structured as follows. Section 3.2 presents the basic model framework. Partial equilibrium results are derived in Section 3.3, while Section 3.4 presents the numerical simulation of the general equilibrium. Section 3.5 analyses the impact of local factor accumulation on labour market outcomes in the two countries. Finally, Section 3.6 concludes.

3.2 The Model Setting

The model[9] studies two countries, which I call in accordance with Davis (1998a) 'Europe' (e) and 'America' (a), producing two homogeneous goods, X and Y. Two factors of production exist: labour (L) and resources (R). While resources are specific to the Y sector, labour is mobile between sectors. Both production factors are immobile across countries.

In the following, countries will be denoted by subscripts (i, j). Good Y

integrated the two countries are. In contrast to the present paper, the results are derived in a model in which all income effects fall on the good produced by the competitive (outside) sector. More importantly, owing to the exogenous determination of (union) wages in both countries, wage changes in one country cannot, by assumption, affect wages in the other.

[9] As noted earlier, the basic framework is adopted from Markusen and Venables (1998) who study the model with frictionless labour markets.

is freely traded and chosen as the numeraire of the model; consequently its price is normalised to one. Y is sold in a perfectly competitive market and its production function is assumed to be Cobb-Douglas:

$$Y_i = L_{iy}^{\alpha} R_i^{1-\alpha} \text{ with } 0 \leq \alpha \leq 1 \text{ and } i = a, e, \tag{3.1}$$

where R_i is the resource endowment of country i. Provided that prices are fully flexible, the wage rate w_i and the rental rate on R, r_i, are given by their marginal values in production[10]

$$w_i = \alpha \left(\frac{L_{iy}}{R_i} \right)^{\alpha - 1}, \tag{3.2}$$

$$r_i = (1 - \alpha) \left(\frac{L_{iy}}{R_i} \right)^{\alpha}. \tag{3.3}$$

However, while American wages are assumed to be fully flexible, they are subjected to a binding minimum wage in Europe, i.e.

$$w_e = \overline{w}. \tag{3.4}$$

Note that this also implies that the labour demand of the Y sector in Europe is fixed by equation (3.2) and the parameters α, R_e and w_e.

The X good is sold in an imperfectly competitive market. There are four different types of potential entrants in the market: (1) national firms located in America, (2) national firms located in Europe, (3) multinational firms headquartered in America, and (4) multinationals headquartered in Europe. National firms produce in one of the two countries only and potentially export to the other. They are denoted with the superscript n. Horizontal multinationals, marked with the superscript m, have their headquarters in either of the two countries but maintain production facilities in both countries. Fixed costs consist of factor prices for G units of labour for the headquarters and F units of labour for a factory. It is further assumed that producing a unit of X requires c units of labour. Note that production technologies are identical in the two countries. An exporting firm will additionally have to hire t units of labour in order to ship a unit of output across the border.
Let X_{ij}^k denote the amount of output that a type $k = n, m$ firm based in i supplies to country j. Since national enterprises undertake all their production in their base country, the demand of one national firm headquartered in i for country i's labour is

$$cX_{ii}^n + (c + t)X_{ij}^n + G + F \text{ with } i \neq j. \tag{3.5}$$

[10] As pointed out in the original work of Markusen and Venables (1998), R serves to add some convexity to the model. Higher levels of X production will increase the cost of labour in terms of Y. Hence, labour supply to the non-competitive sector is increasing in w_i.

In contrast, a national firm based in j will not demand any labour in i. A multinational based in i will use labour for maintaining the headquarters and a factory in i. Additionally, it requires labour for producing output for the market of country i while supply to market j is met by local production. Hence, labour demand of one multinational based in i for labour of country i can be written as

$$cX_{ii}^m + G + F. \tag{3.6}$$

Finally, a multinational enterprise based in j requires labour from country i to support the local factory as well as to produce for the local market. Demand for country i's labour is then given by

$$cX_{ji}^m + F. \tag{3.7}$$

Let n_i and m_i denote the number of active national firms and multinationals, respectively, with headquarters in country i. The sum of labour demands from the different types of firms plus the unemployed units of labour, U_i, has to equal the factor endowment. Hence, the labour market clearing condition can be written as

$$\begin{aligned} L_i =& U_i + L_{iy} + n_i[cX_{ii} + (c+t)X_{ij}^n + G + F] + m_i(cX_{ii}^m + G + F) \\ &+ m_j(cX_{ji}^m + F), \end{aligned} \tag{3.8}$$

where $U_a = 0$ due to the assumption of fully flexible-wages in America.

Since profits are driven down to zero in the (long-run) equilibrium, national income M_i will solely consist of factor rewards

$$M_i = w_i(L_i - U_i) + r_i R_i, \tag{3.9}$$

which accrue to a representative consumer in each country. The agent faces a Cobb-Douglas utility function in the two goods

$$Z_i = X_{ic}^{\beta} Y_{ic}^{1-\beta} \tag{3.10}$$

with Z_i denoting utility. X_{ic} and Y_{ic} are the respective consumption levels of the two goods. Utility maximisation gives rise to the following demand functions:

$$X_{ic} = \frac{\beta M_i}{p_i}, \tag{3.11}$$

$$Y_{ic} = (1-\beta)M_i, \tag{3.12}$$

where p_i denotes the price of good X in country i. The goods market equilibrium in sector X requires demand X_{ic} to equal total supply. The latter

is given by the sum of output levels of the different firm types multiplied by the respective number of firms active in equilibrium

$$X_{ic} = n_i X_{ii}^n + n_j X_{ji}^n + m_i X_{ii}^m + m_j X_{ji}^m. \tag{3.13}$$

The firms compete in Cournot fashion. Marginal revenue of a type k firm based in i serving the market of country j is given by $p_j \left(1 + \frac{X_{ij}^k}{X_{jC}} \frac{1}{\eta_j}\right) = p_j(1 - s_{ij}^k)$. Here, $\eta_j = -\frac{p_j}{X_{jC}} \frac{\partial X_{jC}}{\partial p_j}$ is the price elasticity of demand while s_{ij}^k denotes the respective proportional markup of prices over marginal costs. With Cobb-Douglas preferences the price elasticity of demand is one, and markups therefore equal the market share of the respective firm:

$$s_{ij}^k = \frac{X_{ij}^k}{X_{jC}} = \frac{p_j X_{ij}^k}{\beta M_j}. \tag{3.14}$$

Profit maximisation implies that marginal revenue equals marginal cost. Written in complementary slackness form, the pricing equations are given as follows:[11]

$$p_i(1 - s_{ii}^n) \leq w_i c, \quad (X_{ii}^n \geq 0), \tag{3.15}$$
$$p_j(1 - s_{ij}^n) \leq w_i (c + t), \quad (X_{ij}^n \geq 0), \tag{3.16}$$
$$p_i(1 - s_{ii}^m) \leq w_i c, \quad (X_{ii}^m \geq 0), \tag{3.17}$$
$$p_j(1 - s_{ij}^m) \leq w_j c; \ (X_{ij}^m \geq 0). \tag{3.18}$$

Free entry will drive profits to zero in the long-run equilibrium. The combination of firm types active is therefore determined by four zero-profit conditions. They simply state for each firm type that markup revenues have to be equal to or less than the fixed costs. Complementary variables are the respective number of firms active in equilibrium.

$$p_e s_{ee}^n X_{ee}^n + p_a s_{ea}^n X_{ea}^n \leq w_e (G + F), \quad (n_e \geq 0), \tag{3.19}$$
$$p_a s_{aa}^n X_{aa}^n + p_e s_{ae}^n X_{ae}^n \leq w_a (G + F), \quad (n_a \geq 0), \tag{3.20}$$
$$p_e s_{ee}^m X_{ee}^m + p_a s_{ea}^m X_{ea}^m \leq w_e (G + F) + w_a G, \quad (m_e \geq 0), \tag{3.21}$$
$$p_a s_{aa}^m X_{aa}^m + p_e s_{ae}^m X_{ae}^m \leq w_a (G + F) + w_e G, \quad (m_a \geq 0). \tag{3.22}$$

[11] Note that firms are assumed to ignore their potential impact on aggregate income and economy-wide factor prices when choosing output levels. Recently, Neary (2003) has argued that these inconsistencies of modelling oligopoly in general equilibrium can be avoided by assuming firms to be large in their own market but small in the economy as a whole. While for simplicity I stick to the formulation in Markusen and Venables (1998), results would remain unchanged when considering a large number of identical sectors instead of a single imperfectly competitive sector.

The general equilibrium of the model is then determined through a system of equalities and inequalities that solve simultaneously for the endogenous variables of the model. Output levels in the X sector are associated with pricing inequalities (3.15) - (3.18) together with the markup formula in (3.14). The zero-profit conditions (3.19)-(3.22) determine the number of each firm type active in equilibrium. Income levels are given by (3.9) while the price of good X is established through equation (3.11) in combination with (3.13). Finally, the wage rate in America and the unemployment rate in Europe are determined by the labour market clearing condition in (3.8) together with labour demand from the Y sector, equation (3.2), while the rental rate of R is associated with equation (3.3).

3.3 Intuition from Partial Equilibrium Analysis

Before calculating the general equilibrium of the model numerically, I start with deriving some results in a partial equilibrium setting. This is meant to provide intuition for the general equilibrium results reported in the following sections.

Equations (3.2) and (3.8) show that the American wage rate and the unemployment rate in Europe depend crucially on labour demand of the X sector. The latter, in turn, will depend on the type (and number) of firms active in equilibrium as well as the output level of an individual firm. In the flexible-wage setting, expanding X production draws labour from the Y sector thereby increasing the R/L ratio in the competitive sector. Wages will increase as a result. With wages fixed at a (binding) minimum wage, labour demand of the Y sector is fixed by equation (3.2). The units of unemployed labour in Europe are given by the total labour endowment minus labour demands from the Y and X sector.

In the following, I analyse separately the effects of the introduction of a binding (implicit) minimum wage in Europe, i.e. of an increase in w_e, on the two crucial determinants of labour demand in the X sector. First, I treat the number of active firms as exogenously given and study the effect of a one-sided wage increase on output levels. The focus lies solely on the imperfectly competitive sector and I do not consider feedback effects from the labour market. The influence in a closed economy setting is compared to the effect in an open economy setting with and without multinational enterprises. Second, the effects of a one-sided wage increase on (potential) profits of the four types of firms are considered. This will help to understand

what kind of firms are likely to arise in equilibrium and how the introduction of a minimum wage in Europe influences the location decisions of firms.

3.3.1 Effects of an Increase in the European Wage on Output

Suppose first that the types (and the number) of firms active in equilibrium are fixed. For concreteness I will assume that the two countries are identical with respect to the number of active firms.[12] Since demand functions derived from a Cobb-Douglas utility function are not suitable to study monopoly I further assume that $n_i = n_j = n \geq 2$ (and $m_i = m_j = n \geq 2$ if multinationals are present). Now plug equation (3.14) into (3.15)-(3.16) and rearrange to obtain inequalities for the output levels of national firms:

$$X_{ii}^n \geq \beta M_i \left(\frac{p_i - w_i c}{p_i^2} \right), \tag{3.23}$$

$$X_{ij}^n \geq \beta M_j \left[\frac{p_j - w_i (c+t)}{p_j^2} \right]. \tag{3.24}$$

If the right-hand side is positive, the equations hold with equality, otherwise output is zero. Consider first an equilibrium in which only non-exporting national firms are active. I will refer to this scenario as the closed economy setting. Keeping Y sector variables unchanged and abstracting from feedback effects from factor markets, equations (3.9), (3.11), (3.13) and (3.23) allow to solve for production in terms of the then exogenous parameters:

$$X_{ii}^n = \frac{\beta[w_i(L_i - U_i) + r_i R_i](n-1)}{cn^2 w_i}. \tag{3.25}$$

Since just national firms producing for the domestic market are active, only the production level X_{ii}^n is of interest to country i's labour demand. Now consider the effect of an increase in w_e on domestic production X_{ee}^n. An increase in the minimum wage will raise income levels (given unemployment) thereby boosting demand and production while at the same time depressing output by raising marginal production costs. Taking the first derivative of X_{ee}^n with respect to w_e reveals that the negative effect will prevail.[13] The wage elasticity of output, denoted by ε^c, is given by

$$\varepsilon^c \equiv \frac{\partial X_{ee}}{\partial w_e} \frac{w_e}{X_{ee}} = -\frac{r_e S_e}{w_e(L_e - U_e) + r_e R_e}, \tag{3.26}$$

[12] The assumption does not affect the general results of this section but helps to clean up the somewhat messy expressions.

[13] $\frac{\partial X_{ee}^n}{\partial w_e} = \frac{(n-1)\beta(L_e - U_e)}{cn^2 w_e} - \frac{(n-1)\beta(w_e(L_e - U_e) + R_e r_e)}{cn^2 w_e^2} = -\frac{(n-1)\beta r_e R_e}{cn^2 w_e^2} < 0$

which is bounded by zero and minus one.

Next, consider an open economy with positive levels of intra-industry trade. National firms do export but multinational firms are not present. A national firm based in country i produces for both markets and labour demand depends on X_{ii}^n and X_{ij}^n. Equations (3.9), (3.11), (3.13), (3.23) and (3.24) can be solved simultaneously to find

$$X_{ii}^n = \frac{(w_i(L_i - U_i) + r_i R_i)(2n-1)(nw_j(c+t) - c(n-1)w_i)}{\beta^{-1}(nw_j(c+t) + cnw_i)^2}, \tag{3.27}$$

$$X_{ji}^n = \frac{(w_i(L_i - U_i) + r_i R_i)(2n-1)(cnw_i - (n-1)w_j(c+t))}{\beta^{-1}(nw_j(c+t) + cnw_i)^2}. \tag{3.28}$$

Now consider the wage elasticity of output of a national firm based in Europe with respect to European wages w_e. First, note that the elasticity can be decomposed as follows:

$$\begin{aligned}\frac{\partial(X_{ee}^n + X_{ea}^n)}{\partial w_e}\frac{w_e}{X_{ee}^n + X_{ea}^n} &= \frac{\partial X_{ee}^n}{\partial w_e}\frac{w_e}{X_{ee}^n}\frac{X_{ee}^n}{X_{ee}^n + X_{ea}^n} + \frac{\partial X_{ea}^n}{\partial w_e}\frac{w_e}{X_{ea}^n}\frac{X_{ea}^n}{X_{ee}^n + X_{ea}^n} \\ &= \varepsilon^{oe} s_e + \varepsilon^{oa} s_a,\end{aligned} \tag{3.29}$$

where ε^{oi} is the wage elasticity of output produced for market i and s_i denotes the share of production for market i in total production. Calculating the two elasticities explicitly yields the following two expressions:

$$\begin{aligned}\varepsilon^{oe} &\equiv \frac{\partial X_{ee}^n}{\partial w_e}\frac{w_e}{X_{ee}^n} = \frac{cw_e[(n-1)cw_e - (3n-1)w_a(c+t)]}{[nw_a(c+t) - c(n-1)w_e][w_a(c+t) + cw_e]} \\ &\quad + \frac{w_e(L_e - U_e)}{w_e(L-U) + r_e R_e},\end{aligned} \tag{3.30}$$

$$\begin{aligned}\varepsilon^{oa} &\equiv \frac{\partial X_{ea}^n}{\partial w_e}\frac{w_e}{X_{ea}^n} \\ &= \frac{(c+t)w_e[(n-1)tw_e + c(w_a - 3nw_a + (n-1)w_e)]}{[w_e(c+t) + cw_a][c(nw_a - w_e(n-1)) - tw_e(n-1)]}.\end{aligned} \tag{3.31}$$

By comparing the elasticities derived in a closed and in an open economy setting the following result can be established:

Proposition 4. *In an open economy setting with positive levels of intra-industry trade the wage elasticities of production for both markets, ε^{oe} and ε^{oa}, are smaller than the wage elasticity derived in a closed economy setting.*

Proof. See Appendix B.1. □

The proposition shows that in an open economy one-sided changes in the wage rate will have more severe effects on production (and, hence, on labour demand) than in a closed economy. Intuitively, an increase in European wages only affects firms based in Europe. Therefore, firms will have to reduce output not only because of the increase in marginal costs but also due to the deterioration of their competitiveness relative to their American counterparts. The latter effect is clearly absent in a closed economy setting.

Now consider a market in which multinational firms are active. Pricing equations for multinational firms and national firms serving their local markets are exactly identical because both firms have a factory in the country and, hence, face identical marginal costs. Multinational production relevant for the European labour market is given by X_{ee}^m and X_{ae}^m. The wage elasticity of multinational production will be the same as the wage elasticity of production for the market in Europe of a national firm based in Europe. If a multinational competes only with other multinationals or with national firms based in Europe, the output elasticity will therefore equal ε^c, i.e. it will be identical to the case of a closed economy. When competing with exporting firms the elasticity will equal ε^{oe}.[14]

Increasing the European minimum wage may also affect the level of production and thus labour demand in America. American production will obviously be not affected if the two countries are closed economies without any trade taking place. Increases in the minimum wage only influence marginal costs of producers in Europe, and since these firms do not compete with American firms the latter are not affected. In contrast, for the open economy case the following result can be established:

Proposition 5. *In an open economy setting with positive levels of intra-industry trade the output of firms based in America, X_{ae}^n and X_{aa}^n, will be positively affected by increases in the European wage rate w_e.*

Proof. See Appendix B.2. □

Increases in w_e affect marginal costs of firms based in Europe but not those of firms based in America. Consequently, the latter types of firms

[14]However, one difference exists when comparing MNEs to national firms. The multinational has an outside option to produce the output in its overseas facility and then reimport it. It will do so whenever marginal production costs in Europe will exceed those in America, i.e. whenever $w_e c > w_a(c+t)$. Therefore, production in Europe plummets to zero when the minimum wage is set too high. In terms of production, the multinational firm then resembles an exporting firm based in America. Without trading barriers any small positive deviation of w_e from w_a will result in zero production of multinational firms in Europe. Note that in the free-entry equilibrium the case of a multinational with just one factory producing positive output levels will never occur. In fact, the multinational would choose to become a national firm based in the country with lower factor prices.

improve their relative competitiveness and gain ground at the expense of the former. In an open economy setting, in which national firms based in both countries compete with each other, increases in the wage rate in Europe will therefore cause firms based in America to expand their production.

Finally, I am interested in the effect of increases in w_e on the production of multinational enterprises for the American market. Multinationals are again equivalent to national firms based in America that produce for the domestic market only. There will be no effects on their output levels if multinational enterprises only compete with other multinationals or with national firms based in America. When competing with exporters based in Europe their output levels X_{ea}^m and X_{aa}^m will be positively affected as described in proposition 2.[15]

3.3.2 Effects of an Increase in the European Wage on Potential Profits

Up to this point, I have taken the number of firms in the market as given. However, changes in the minimum wage will not only alter the behaviour of active firms but also determine which types of firms enter the market. The decision is governed by free entry conditions. In this section, I will briefly look at the effects of an increase in the wage rate of Europe on potential profits of the four types of firms keeping all other endogenous variables constant. Using equations (3.14) - (3.18), the free entry conditions can be re-written as:

$$\begin{aligned}\Pi_e^n =& \beta\left[M_e\left(\frac{p_e - w_e c}{p_e}\right)^2 + M_a\left(\frac{p_a - w_e(c+t)}{p_a}\right)^2\right] \\ & - w_e(G+F) \leq 0, \quad (n_e \geq 0), \qquad (3.32)\\ \Pi_a^n =& \beta\left[M_e\left(\frac{p_e - w_a(c+t)}{p_e}\right)^2 + M_a\left(\frac{p_a - w_a c}{p_a}\right)^2\right] \\ & - w_a(G+F) \leq 0, \quad (n_a \geq 0), \qquad (3.33)\\ \Pi_e^m =& \beta\left[M_e\left(\frac{p_e - w_e c}{p_e}\right)^2 + M_a\left(\frac{p_a - w_a c}{p_a}\right)^2\right] \\ & - w_e(G+F) - w_a G \leq 0, \quad (m_e \geq 0), \qquad (3.34)\end{aligned}$$

[15] Whenever European wages are such that $w_e c > w_a(c+t)$ the multinational would shift all its production to its American factory and therefore will be similar to an American exporter in terms of production patterns.

$$\Pi_a^m = \beta \left[M_e \left(\frac{p_e - w_e c}{p_e} \right)^2 + M_a \left(\frac{p_a - w_a c}{p_a} \right)^2 \right] - w_a(G+F) - w_e G \leq 0, \quad (m_a \geq 0). \tag{3.35}$$

Now consider an increase in the European minimum wage. It is easy to see that we have the following result

$$\Delta\Pi_e^n < \Delta\Pi_e^m < \Delta\Pi_a^m < \Delta\Pi_a^n = 0. \tag{3.36}$$

This finding suggests that national firms based in Europe will suffer most from an increase in the (implicit) minimum wage. Not only their marginal production costs but also their fixed costs for headquarters and factories will increase. Multinational firms headquartered in Europe are less affected as they produce their output for the American market in America. Multinationals based in America have the additional advantage that fixed costs for their headquarters do not depend on w_e. Finally, potential profits of American exporters are not at all affected by the change. Hence, altering the minimum wage in Europe will harm firms based in Europe most and is likely to give rise to an equilibrium with heavy weight placed on firms based in America. Importantly, those firms most beneficial for Europe in terms of labour demand are affected most severely.

3.4 The Numerical General Equilibrium

In this section I compute numerically the general equilibrium of the model.[16] As in Markusen and Venables (1998) the benchmark simulation sets trading costs t at 0.15.[17] Countries have identical endowment levels of $L_a = L_e = 150$ and $R_a = R_e = 50$. Thus, labour regulations are the only source of heterogeneity. The fixed costs of multinational enterprises are 1.45 times the fixed costs of national firms when factor prices are equalised, α equals 3/8, β is 2/3.[18] The European wage rate is set initially so that it equals the free

[16] The numerical calculations are conducted using the MCP solver of GAMS.

[17] Only the benchmark simulation is presented in the following. Increasing the level of trading barriers lowers the degree of openness of an economy. The results derived in the full-fledged model setting then more and more resembles those derived in a closed economy setting. See Appendix B.3 for more details on the role of trading barriers. Note also that positive trading barriers are a necessary prerequisite for multinational firms to occur in equilibrium.

[18] The values of α and β are chosen so that the X sector plays a dominant role in determining labour demand in the two economies but the qualitative results are not affected by the choice of the parameters.

market equilibrium ($w_e = 0.6$). In order to study the effect of a one-sided minimum wage in Europe the level of w_e is then successively increased.

The effects of the full-fledged model are contrasted with those derived from a model without multinational firms and those derived in a closed-economy setting. For doing so, three different versions of the model are simulated. First, exporters and multinationals are suppressed, reducing the model essentially to a closed economy setting. Second, firms are allowed to export but multinational firms are still suppressed.[19] Third, both exporting firms and multinational firms are allowed to arise endogenously. Note that the different versions of the model do not specify which type of firm will arise endogenously but only restrict the range of possible firm types. There are also no limitations on the location of the headquarters i.e. the respective firm type might not arise in either country, only in one or in both countries. Furthermore, the term 'closed economy' refers to the X sector only. The numeraire good is freely traded in all three settings.

The numerical simulation serves primarily to establish qualitative results and to assess the relative magnitudes of the effects across the three settings. Quantitative impacts should be interpreted with some caution given the simplifying features of the model. For instance, in reality implicit minimum wages bind only for a fraction of workers. Hence, the quantitative effect of the wage floor on overall unemployment rates is likely to be overstated. Since the same simplifications are present in all three model versions, relative magnitudes should nevertheless have explanatory power.

Table 3.1 provides an overview of the firms actually active in equilibrium over the parameter space $w_e \in [0.60, 0.85]$ and listed separately for the three different model settings. Positive numbers of national and multinational firms headquartered in country $i = a, e$ are indicated by n_i and m_i, respectively.[20] In the closed economy domestic firms do not face foreign competition and will prevail in both countries over the entire parameter space. With intra-industry trade, firms located in America will constantly gain in terms of relative competitiveness, and domestic firms based in Europe will altogether quit the market at a minimum wage of 0.81. Without imposing restrictions on the firm types the initial equilibrium is characterised by coexisting multinational firms. The figure shows that a relatively small increase in European wages is sufficient for all multinational firms based in Europe to displace their headquarters to America. Further increases in w_e benefit national firms based in America which are the only type of firms whose

[19] In the absence of any labour market frictions the model would then essentially reduce to a two-factor version of Brander and Krugman (1983) and Venables (1985).

[20] As in Markusen (2002) a firm type is ignored when there are less than 0.3 firms in equilibrium.

w_e	Closed Economy	Exporters only	Exporters and MNEs
0.60	n_e,n_a	n_e,n_a	m_e,m_a
0.61			
0.62			
0.63			
0.64			
0.65			m_a
0.66			
0.67			
0.68			
0.69			m_a,n_a
0.70			
0.71			
0.72			
0.73			
0.74			m_e,m_a,n_a
0.75			m_e,n_a
0.76			
0.77			
0.78			
0.79			
0.80			
0.81		n_a	
0.82			n_a
0.83			
0.84			
0.85			

Table 3.1: Type(s) of Firms Active in Equilibrium

costs are not affected by European wages. Consequently, for very high levels of w_e multinational firms are no longer profitable and American exporters will be left as the only type of firm active in equilibrium. Interestingly, for $0.74 \leq w_e \leq 0.81$ multinationals relocate from America to Europe – a finding explained later in this section.

Consider now the effect of an increase in w_e on the level of unemployment in Europe as depicted in Figure 3.1. Clearly, unemployment is on the rise for all three simulations. The closed economy setting provides a lower bound to the other specifications. Once firms are allowed to export, the effect of one-sided downward wage rigidity on the unemployment rate is sig-

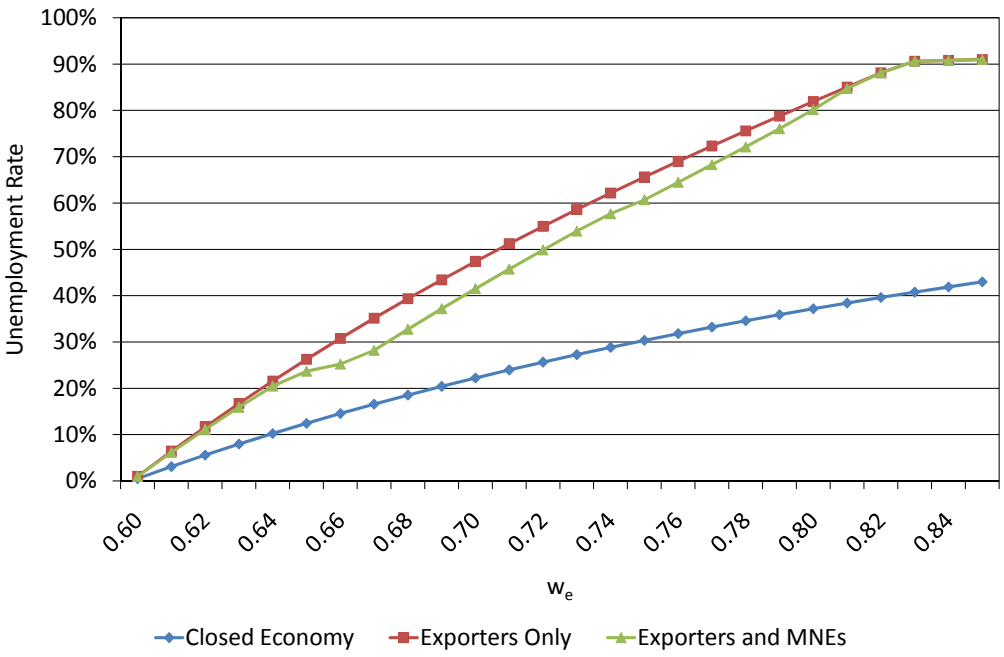


Figure 3.1: Effect of a European Minimum Wage on European Unemployment

nificantly larger. One can also turn the result upside-down. A move from autarky to an open economy will increase European unemployment. The simulation shows that the calculated unemployment rate is more than twice as high over the complete parameter space. Firms based in America produce ever-larger shares of European consumption thereby reducing demand for European labour. In general equilibrium, higher unemployment rates also cause income levels in Europe to fall more rapidly compared to a closed economy setting (see Figure 3.2). Market size and production decline even further.

Interestingly, the existence of multinational enterprises dampens the negative effects of the minimum wage over some range of the parameter space.[21] With MNEs a larger share of production remains in Europe. Multinationals are less affected by changes in w_e than European exporters as parts of their (marginal and fixed) costs depend on American factor prices only. Thus, they

[21]Note that the observed dampening effect of multinational enterprises is only evident in a setting, in which trading barriers are low enough for intra-industry trade to occur. If trading barriers are prohibitively high, the open economy setting with exporting firms will effectively reflect a closed economy. Adding multinational firms to such a scenario will raise the actual unemployment rate because multinational firms will relocate their headquarters to the country with lower factor prices.

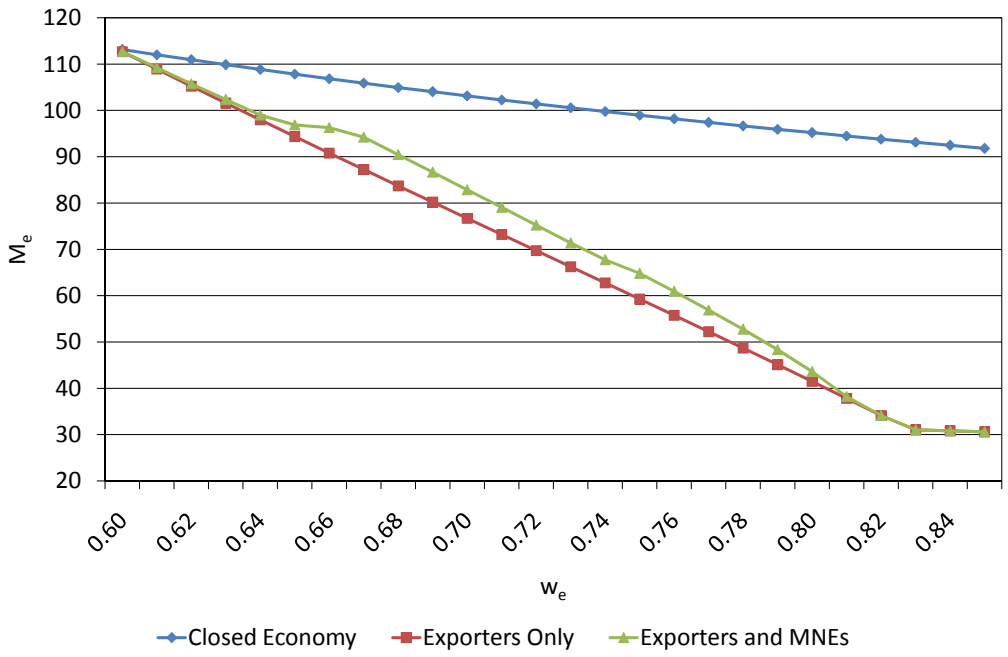


Figure 3.2: Effect of a European Minimum Wage on the European Income Level

are able to compete with American exporters for a wider range of values of the minimum wage. As long as multinationals are present in the market, a fraction of domestic consumption of X is still produced in Europe. This is illustrated in Figure 3.3 that also highlights that the sharp increase in unemployment coincides with the fall in the fraction of X_{eC} produced domestically. With lower unemployment rates purchasing power in Europe initially declines only moderately. Thus, in the presence of MNEs not only a higher fraction of European consumption is met with domestic production. The European market also remains more important in terms of its size relative to the American counterpart.[22] Once all the production takes place in America, further increases in w_e only affect U_e via the impact on Y production. Consequently, the difference between the open and the closed economy setting will diminish for larger values of w_e since in the former setting the domestic production of X is still negatively affected by increases in w_e.

The effect that the introduction of a wage floor in Europe has for the American wage level are illustrated in Figure 3.4. National labour market

[22]Figure B.3 in the Appendix depicts the fraction of *worldwide* X consumption produced in Europe thereby also taking into account differences in the relative market sizes across the different model settings.

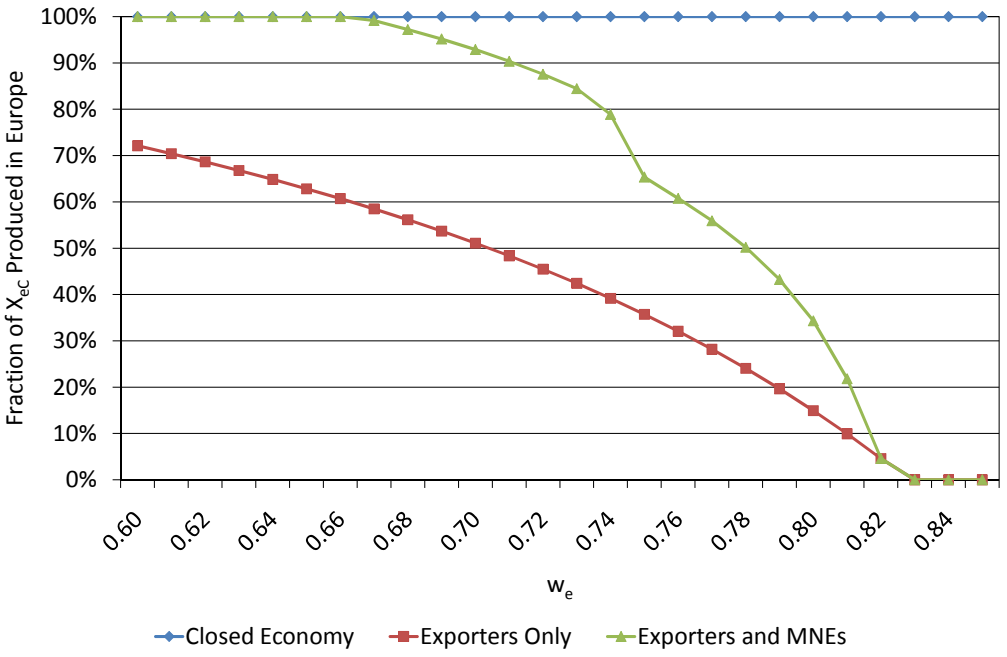


Figure 3.3: Effect of a European Minimum Wage on the Fraction of European X Consumption Produced Domestically

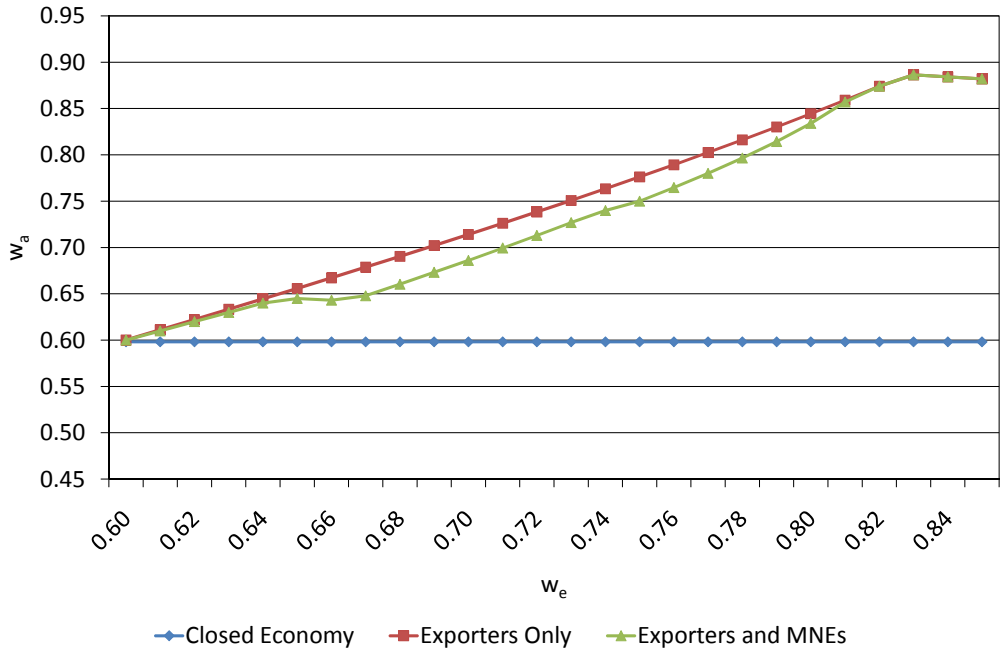


Figure 3.4: Effect of a European Minimum Wage on American Wages

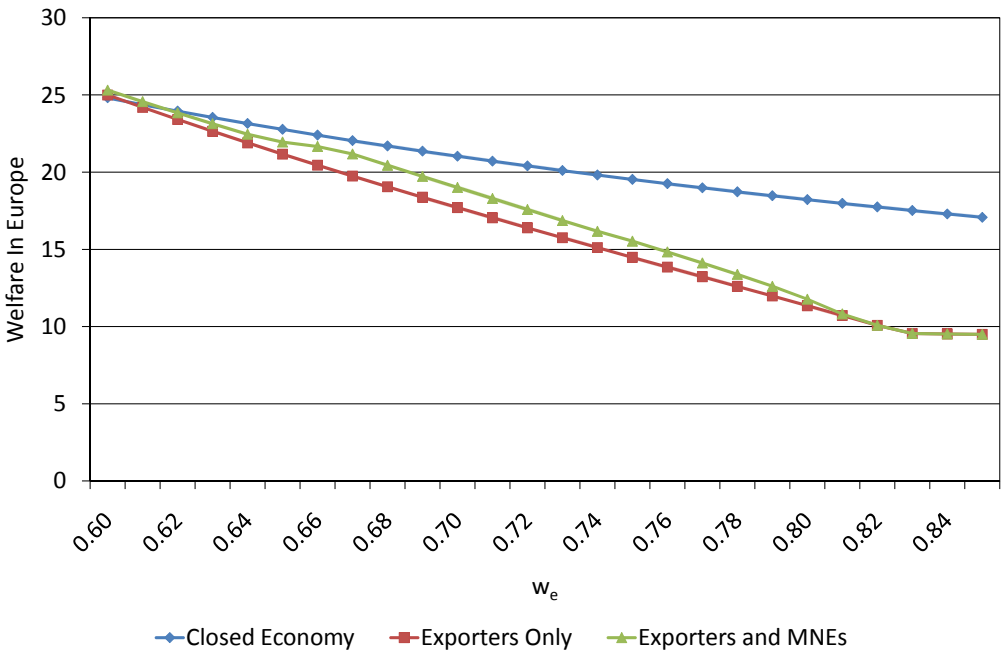


Figure 3.5: Effect of a European Minimum Wage on European Welfare

legislation introduced in Europe has no effect on the American labour market in a closed economy. However, wage rigidity in Europe props up wages in America when product markets are global. American firms gain a relative cost advantage vis-a-vis their competitors and expand production. This raises labour demand and wages in America. As long as multinationals operate in the market, the effect is somewhat less pronounced in the unrestricted setting since a lower fraction of the production for the American market is transferred to America. After reaching a peak, the wage level in America is decreasing in w_e. This is due to the fact that further wage increases in Europe lead to additional unemployment and to income losses in Europe. Demand for good X in Europe falls and so does production and labour demand in America.

There is yet another interesting aspect evident from Figure 3.4. For a certain parameter range the wage level is actually higher in America than in Europe despite the (binding) minimum wage in the latter. How can such an equilibrium be sustainable? The reason is a sort of home market effect. While income levels in America are soaring,[23] unemployment in Europe depresses local income and demand for X production. Therefore, national firms

[23]The effect of wages on income levels in America is depicted in Figure B.4 in the Appendix.

based in America serve a far larger domestic market than their counterparts in Europe. And since national markets are somewhat shielded by trading barriers, American national firms do have a competitive advantage despite their higher marginal production costs.

In the presence of multinational enterprises, wages in America are higher than in Europe for an implicit minimum wage of between 0.75 and 0.81. Note that in this case there is a sudden shift backwards to multinationals based in Europe, since MNEs based in different countries clearly do not have a home market advantage in comparison to each other. Hence, multinationals will always locate their headquarters in the country with lower factor prices.

Finally, a note on the welfare consequences of a national (one-sided) minimum wage. After the preceding analysis it is hardly surprising that introducing downward wage rigidity depresses consumption and hence welfare in Europe. For a given minimum wage moving from a closed to an open economy setting actually lowers welfare. This is an interesting result in itself since it shows that there might be a case for protectionism in the presence of one-sided wage rigidities.[24] The adverse welfare effects are somewhat dampened when multinational firms are allowed to enter.

3.5 National Labour Supplies, Global Consequences

In this section I study the effect of national factor supplies on the two labour markets and, hence, the question of whether and how cross-county differences in the evolution of labour supply affect cross-country wage trends.[25]

In line with Davis (1998a) the fixed European minimum wage insulates America from any effects caused by factor accumulation in Europe. Figure 3.6 shows how American wages and European unemployment vary with European labour endowment. As long as the minimum wage binds, labour supply has no effect on factor prices in Europe and additional labour endowment will add to the European unemployment stock. Hence, the unemployment rate is steeply increasing in L_e. In contrast, the relative cost competitiveness of American firms and American labour demand are not affected by factor

[24]Note that in the present model welfare gains from trade are rather limited even without labour market imperfections. Hence, one cannot necessarily draw the conclusion that in practice the overall welfare gain of globalisation is negative in the presence of (one-sided) wage rigidities. The main point here is that moving from a closed to an open economy may entail significant welfare losses (besides the well-known benefits).

[25]For the simulations the European wage rate is fixed at 0.65.

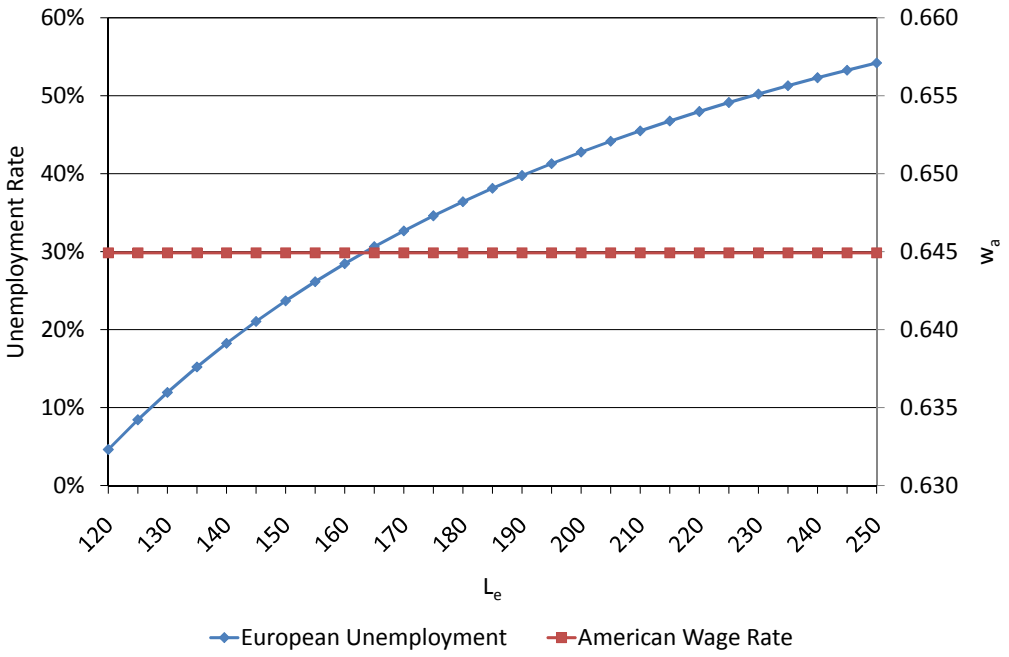


Figure 3.6: Labour Market Consequences of an Increase in European Labour Supply

accumulation in Europe. Therefore, the American wage rate is independent of European factor supplies.

The effects of an increase in American labour supply, depicted in Figure 3.7, are more subtle. Initially, there is a parameter range, in which American wages do not respond to domestic labour supply and equal the (fixed) wage in Europe. This result resembles the one of Davis (1998a) who finds that differences in the accumulation of labour cannot explain divergent wage trends. The parameter space corresponds to a regime of multinational firms based in both countries. Increases in the American labour supply put downward pressure on American wages. More and more multinationals move their headquarters from Europe to America increasing labour demand in America and decreasing it in Europe. This allows America to sustain its wage level while European unemployment soars.

Once all multinationals have relocated to America further factor accumulation leads to a decline in American wages. The number of multinationals based in America increases only slightly and no additional labour demand is generated from the relocation of headquarters. In this parameter space unemployment in Europe is hardly affected by American factor accumulation. It even falls somewhat as the (slightly) increasing number of multination-

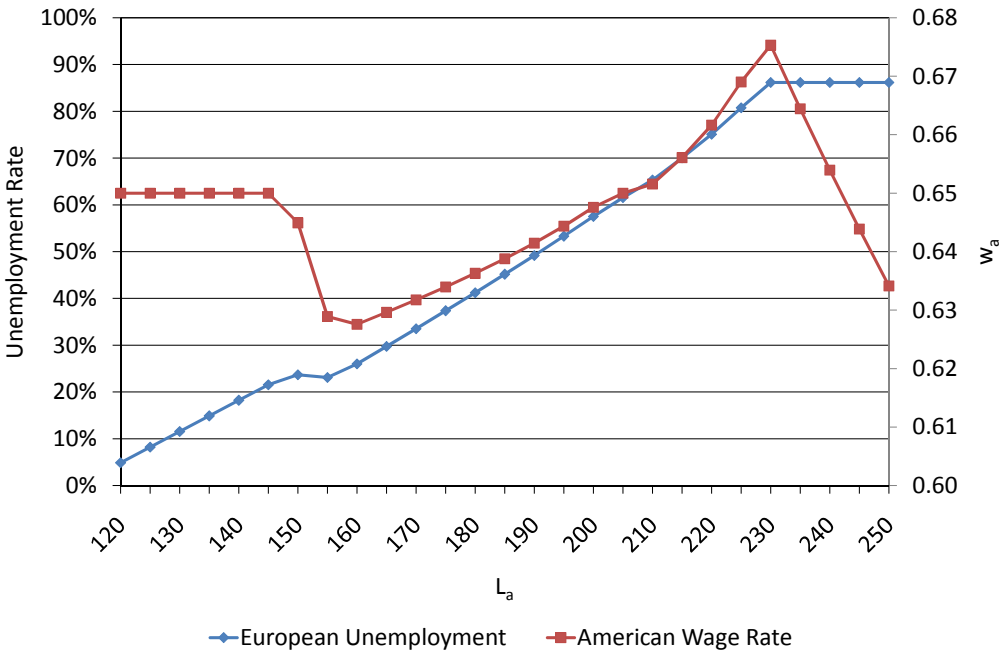


Figure 3.7: Labour Market Consequences of an Increase in American Labour Supply

als based in America is accompanied by a (slight) increase of production in Europe.

Further decreases in the American wage rate increase the competitiveness of national American firms relative to their multinational competitors. As soon as national firms enter the market, production of the X good starts being relocated from Europe to America. This causes a surge in American labour demand and depresses labour demand in Europe. Hence, American wages and unemployment in Europe start to increase hand in hand. These developments also change the relative size of the two markets and favour the establishment of national firms based in America. Further factor accumulation will lead to higher and higher American wages while unemployment keeps on rising in Europe. The development comes to an end at the point at which all the production of the X good takes place in America and only national firms are left in the market. Further increases in American labour supply will then again depress American wages.

3.6 Conclusion

This paper has studied the effects of introducing a one-sided minimum wage in a model of intra-industry trade and multinational firms. Even though factor prices do not equalise across countries, the overarching message of Davis (1998a) is confirmed. National labour market regulations profoundly interact and cannot be analysed in isolation when goods markets are global. It has been shown that the adverse employment effects of an asymmetric minimum wage are much more pronounced in an open economy setting with positive intra-industry trade compared to a framework without exporters. Perhaps surprisingly, multinational firms do not worsen but potentially mitigate the effects somewhat. While there is no one-to-one relation between the European minimum wage and the wage rate in America as in (Davis, 1998a), a (binding) wage floor in one country will prop up wages in the other. American wages can actually rise above the binding minimum wage rate in Europe even though countries are otherwise identical.

The result illustrates why rigid institutions might have contributed significantly to the European unemployment problem even though they were already in place long before the problem actually occurred. Moving towards a global world economy dramatically alters the outcome of labour market rigidity. Consequently, wage flexibility appears to be of specific importance for the labour market performance in open economies. This finding suggests that labour market reforms should indeed be directed towards a higher degree of (wage) flexibility in the face of global competition. Since moving from a closed to an open economy setting depresses welfare in the rigid-wage country, there might also be a case for protectionism in the presence of one-sided wage rigidities.

The interaction of national labour market institutions has also been illustrated with respect to the effects of local factor accumulation on global labour market outcomes. Factor accumulation in Europe has no effect on American wages, which are protected by the binding European minimum wage. Unemployment rates in Europe rise hand and hand with national labour endowment. In contrast, the effects of an increase in the American labour supply are more subtle. In fact, factor accumulation in America can even increase American wages.

The model lends itself to a number of extensions. For instance, the effects of labour market institutions – and (implicit) minimum wages in particular – should differ across workers with different skill levels. A wage floor is certainly more likely to be binding for low-skilled than for high-skilled workers. Hence, allowing for heterogeneous labour may enrich the predictions of the model. The study has also abstracted from key elements that characterise

the recent wave of economic integration. A central and novel feature that has attracted a lot of academic and public attention has been the diffusion of production stages across national boundaries. Furthermore, trade with developing countries such as China or India has soared. Adding these features to the model may generate further important insights into the interaction of national labour market regulations in a globalised world.

Chapter 4

Unionisation Structures and Heterogeneous Firms

Abstract. This paper studies how different unionisation structures affect firm productivity and firm performance in a monopolistic competition model with heterogeneous firms and free entry. While centralised bargaining induces tougher selection among heterogeneous producers and thus increases average productivity, firm-level bargaining allows less productive entrants to remain in the market. Centralised bargaining also results in higher average output and profit levels than either decentralised bargaining or a competitive labour market. From the perspective of consumers, the choice between centralised and decentralised bargaining involves a potential trade-off between product variety and product prices. Extending the model to a two-country setup, I furthermore show that the positive effect of centralised bargaining on average productivity can be overturned when firms face international low-wage competition.

4.1 Introduction

Since the late 1970s, there has been a tendency among OECD countries to grant greater flexibility in the determination of wages. In fact, nine out of twenty-one member countries examined by the OECD (2004b)[1] have allowed wages to adjust more freely to local conditions at the firm level, while not a single member country has moved to more centralised bargaining structures. In many European OECD countries, however, wages continue to be

[1]The OCED does not assess wage setting institutions in central and eastern European OECD countries before the 1990s. Data on the bargaining level are also not provided for Iceland, Luxembourg, Mexico, Turkey and South Korea.

predominantly determined in industry-level collective agreements that specify a uniform wage rate common to all firms in an industry. This paper examines how different bargaining structures affect firm productivity and firm performance in the long run.

What unions do to productivity and firm performance has been the topic of extensive research (cf. Metcalf, 2003; Hirsch, 2004, for recent surveys). Conventional wisdom suggests that by raising pay unions hurt the financial performance of firms – 'unless there is a roughly equivalent union effect on productivity' (Metcalf, 2003, p. 118). The effect of unions on productivity is theoretically ambiguous. Higher wage payments can induce unionised firms to increase the capital intensity of production, thereby increasing the productivity of the remaining workforce. Most of the literature on the relation between unionisation and productivity has focused on the incentives of unionised firms to innovate. Early studies by Grout (1984) and Van der Ploeg (1987) have pointed to a hold-up problem associated with unionisation. Once a firm has incurred the sunk costs of investment, unions can capture part of the innovation rent by demanding higher wages. The incentives of firms to innovate are therefore decreasing in union bargaining power. If firms, however, invest strategically so as to increase their market shares and profits, unionised enterprises may enjoy a strategic advantage over their non-unionised competitors (cf. Tauman and Weiss, 1987; Ulph and Ulph, 1994, 2001). Existing studies have not only focused mainly on firm-level bargaining but have also concentrated on markets that are characterised by a small and fixed number of firms. The market structure in these studies is exogenously given. Unionisation, however, is likely to influence the number and, equally important, the characteristics of firms that survive in the long-run; and financial performance depends crucially on the market environment.

My objective in this paper is to analyse the interactions between bargaining structures, the market environment and firm performance. To that end, I study a monopolistic competition model in the spirit of Melitz and Ottaviano (2008) with heterogeneous firms and free entry. The model incorporates both differences in firm productivity and endogenous mark-ups that respond to the intensity of competition in a market. The intensity of competition is summarised by the number of competing enterprises and their average price level. I distinguish between three different labour market regimes. Wages are either determined in a perfectly competitive labour market, set by firm-specific unions, or fixed by a binding, sector-wide wage agreement. With decentralised bargaining, wages are firm-specific and increase in productivity. With sector-level bargaining, in contrast, wages are uniform, a singular wage rate that is binding for each and every firm.

The model highlights two effects of unionisation that have been largely

overlooked in previous work. First, sector-level bargaining (but not firm-level bargaining) induces tougher selection among heterogeneous producers and changes the productivity distribution among surviving firms. In particular, by increasing wages for all firms, centralised bargaining acts a barrier to entry for low-productivity firms. Second, both bargaining regimes discourage entry and decrease competitive pressures by raising pay. Less intensive competition ceteris paribus results in higher profits of surviving firms and allows less productive enterprises to remain in the market.

Compared to the competitive benchmark, centralised bargaining increases average productivity (due to the selection effect) and boosts average output and profits (due to a combination of the selection and the anti-competitive effect). Firm-level bargaining, in contrast, by allowing less productive firms to survive, decreases average firm productivity and performance. At the level of the individual firm, unionisation creates winners and losers. Decentralised agreements benefit low-productivity firms and harm high-productivity firms, while the opposite is true for centralised wage agreements. Moreover, the paper demonstrates that – from a consumer's perspective – the choice between the two bargaining regimes can involve a trade-off between product prices and product variety. Firm-level bargaining tends to increase product variety but also induces a less favourable price distribution than centralised bargaining does.

My result that wage compression can be beneficial for productivity is related to earlier work by Moene and Wallerstein (1997). Formalising arguments made in the Swedish debate over 'solidaristic' bargaining (Rehn, 1952), Moene and Wallerstein (1997) compare the effects of decentralised and centralised wage bargaining in a vintage capital model of a small open economy in which the price of output is exogenously given. Firms decide when to open new, more productive plants and when to shut down older, less productive ones. Under decentralised bargaining, less productive plants pay lower wages and can therefore remain in the market for a longer time. Centralised bargaining, in contrast, levels interplant wage differentials and drives less productive plants out of the market. Apart from the very different modeling strategy, the principal difference between Moene and Wallerstein (1997) and the present paper is my focus on the intensity of competition as an additional channel through which unionisation can influence productivity and firm performance.[2] The effects of different unionisation structures on firm productivity are also examined by Haucap and Wey (2004) who

[2]The present paper also shows that the choice between centralised and decentralised bargaining involves a trade-off between product prices and product variety. In Moene and Wallerstein (1997), in contrast, output prices are exogenously given.

find that centralised bargaining provides the greatest incentives to innovate. They develop their argument in an unionised oligopoly model with a fixed number of firms and focus on the interaction between bargaining structures and the hold-up problem associated with unionisation. In contrast to their paper, I take a long-run perspective and examine how different unionisation structures affect firm performance in a model with an endogenous market structure.

Extending the model to a two-country setup, I furthermore show that the positive effect centralised bargaining has on average productivity may vanish when firms face international low-wage competition. While both the selection and the anti-competitive effects are still at work in an open economy, collective bargaining, by increasing wages, also induces firms to relocate to the non-unionised country. In such a setting, trade liberalisation can reduce competition and harm productivity in the high-wage country.

The paper is structured as follows: Section 4.2 presents the basic model setting which I then use in Section 4.3 to analyse the effects of unionisation structures on firm productivity and firm performance. Section 4.4 studies the impact of wage bargaining on product variety and product prices. Section 4.5 discusses the implications of collective bargaining in an open economy. Section 4.6 summarises the main findings and concludes.

4.2 The Model Setting

I consider a two-sector economy with a representative consumer that inelastically supplies L units of labour.[3]

4.2.1 Preferences and Demand

Preferences of the representative consumer are given by a quasilinear utility function defined over a continuum of differentiated varieties and a homogeneous numeraire good:

$$U = q_0^c + \alpha \int_{i\in\Omega} q_i^c di - \frac{1}{2}\gamma \int_{i\in\Omega} (q_i^c)^2 di - \frac{1}{2}\eta \left(\int_{i\in\Omega} q_i^c di \right)^2, \qquad (4.1)$$

where q_0^c and q_i^c are the consumption levels of the numeraire good and of variety $i \in \Omega$, respectively. The parameters $\alpha > 0, \eta > 0$ determine demand for the differentiated varieties relative to the numeraire good, while $\gamma > 0$ is an (inverse) measure of the degree of product differentiation between

[3]The model framework is similar to Melitz and Ottaviano (2008) but in addition to their work I study the effects of firm- and sector-level bargaining.

varieties. In the limit, as γ approaches 0, varieties become perfect substitutes and the consumer is only concerned about the total consumption level over all varieties, $Q^c = \int_{i\in\Omega} q_i^c di$. Increases in α and decreases in η both boost demand for the differentiated varieties relative to the numeraire.

The representative consumer maximises (4.1) subject to her budget constraint. Let $\Omega^* \subset \Omega$ be the subset of varieties that are actually consumed ($q_i^c > 0$). The constraint can then be written as

$$I = q_0^c + \int_{i\in\Omega^*} p_i q_i^c di, \tag{4.2}$$

where I represents income, p_i is the price of variety i, and the price of the numeraire good has been normalised to unity. Provided that the representative consumer has positive demand for the numeraire, utility maximisation yields the following inverse demand function for each consumed variety i:

$$p_i = \alpha - \gamma q_i^c - \eta Q^c. \tag{4.3}$$

Let N measure the number of consumed varieties in Ω^*. By inverting (4.3), demand for these varieties can be expressed as follows:

$$q_i = \frac{\alpha}{\eta N + \gamma} - \frac{1}{\gamma} p_i + \frac{\eta N}{\eta N + \gamma} \frac{1}{\gamma} \overline{p}, \ \forall i \in \Omega^*, \tag{4.4}$$

where $\overline{p} = (1/N) \int_{i\in\Omega^*} p_i di$ is the average price of all consumed varieties.

With quasi-linear preferences all income effects are swept up by the numeraire good and q_i is independent of I. Therefore, admittedly, the model has a strong partial equilibrium flavour. However, the price elasticity of demand derived from a quasi-linear utility function has the considerable merit that it is not fixed as in the case of Constant Elasticity of Substitution (CES) preferences but related to the intensity of competition. In fact, the price elasticity $\epsilon_i \equiv |\frac{\partial q_i}{\partial p_i} \frac{p_i}{q_i}| = [(p_{max}/p_i) - 1]^{-1}$ is inversely related to the upper price bound p_{max}, at which demand for a variety i is driven down to zero (i.e. $q_i(p_{max}) = 0$). The price bound is a summary statistic for the 'toughness' of competition and given by

$$p_{max} \equiv \frac{1}{\eta N + \gamma} (\gamma\alpha + \eta N \overline{p}), \tag{4.5}$$

which from (4.3) has to be smaller than α. The upper bound on prices is decreasing in the number of competing enterprises and increasing in the average price level. In line with the empirical evidence (see, for instance, Campbell and Hopenhayn, 2005, and Tybout, 2003), an increase in the intensity of competition, as indicated by a lower price bound, thus increases the price elasticity of demand ϵ_i at any given p_i.

4.2.2 Production, Firm Behaviour and Entry

The numeraire good is sold in a perfectly competitive market and produced under constant returns to scale. One unit of labour is required to produce one unit of the numeraire. As the price of the numeraire is normalised to one, this implies a wage rate of unity in the numeraire good sector.

In the differentiated product sector entry is costly. I take a long-run perspective and assume that there exists a large (unbounded) pool of prospective entrants.[4] In order to enter the market, firms have to incur fixed start-up costs of f_E. Unit costs of production are given by $cw(c)$ with c denoting unit labour requirement and $w(c)$ being the (potentially firm-specific) wage rate. Prior to entry the cost level c of a firm is unknown and each start-up learns its cost level only *after* it has made the initial investment. The cost level is drawn from a common and known distribution $G(c)$ with support on $[0, c_M]$. Following Melitz and Ottaviano (2008), I assume that the productivity draw $1/c$ follows a Pareto distribution with shape parameter $k \geq 1$.[5] Accordingly, the distribution of cost draws $G(c)$ is given by

$$G(c) = \left(\frac{c}{c_M}\right)^k, c \in [0, c_M]. \tag{4.6}$$

The shape parameter k determines the dispersion of cost draws. For $k = 1$ the latter is uniformly distributed on the support. As k increases, the relative frequency of start-ups with high cost levels increases as well.

After a firm has drawn its productivity parameter c it decides whether to remain in the market and to start production. A firm will do so whenever it can cover its marginal costs and earn non-negative (gross) profits. All other entrants leave the market. Surviving firms then maximise their profits $\Pi(c) = [p(c) - cw(c)]q(c)$ taking the number of firms in the market and the average price level as given. Using the demand function in (4.4), the first-order condition of a firm with cost draw c reads

$$q(c) = \frac{1}{\gamma}[p(c) - cw(c)]. \tag{4.7}$$

By solving equation (4.4) for the price level, substituting into (4.7) and also using the definition of p_{max} the profit-maximising price $p(c)$ can be written

[4] A short-run version of the model could be constructed by considering a fixed number of incumbents only (cf. Melitz and Ottaviano, 2008).

[5] Using firm-level data for manufacturing industries in 11 EU countries, Del Gatto et al. (2006) provide evidence that the Pareto is a good approximation to the distribution of firm productivity across sectors and countries. They suggest that on average the shape parameter k is close to two.

as

$$p(c) = \frac{1}{2}\left[p_{max} + cw(c)\right]. \tag{4.8}$$

Hence, the price level does not only increase with unit costs $cw(c)$, it is also (inversely) related to the endogenous degree of competitiveness in the market. The profit-maximising output level $q(c)$, the corresponding profit level $\Pi(c)$ and the markup $\mu(c) = p(c) - cw(c)$ of a firm can also be expressed in terms of $cw(c)$ and p_{max} only:

$$q(c) = \frac{1}{2\gamma}\left[p_{max} - cw(c)\right], \tag{4.9}$$

$$\Pi(c) = \frac{1}{4\gamma}\left[p_{max} - cw(c)\right]^2, \tag{4.10}$$

$$\mu(c) = \frac{1}{2}\left[p_{max} - cw(c)\right]. \tag{4.11}$$

Now let c_{max} reference the cost level of a firm that just earns zero gross profits. This firm's profit-maximising price level is driven down to its marginal cost and the firm is therefore just indifferent about remaining in the market. All firms with $c < c_{max}$ are sufficiently productive to earn positive gross profits and therefore stay in the market and start production. In contrast, firms with cost levels above c_{max} exit.[6] From (4.10) one can directly infer that

$$c_{max} = \frac{p_{max}}{w(c_{max})}. \tag{4.12}$$

The cut-off level is therefore negatively related to the wage rate of the marginal firm but positively associated with the (endogenous) upper price bound p_{max}. Strong competitive pressures thus deter entry of low-productivity firms.

Prior to entry, i.e. before a prospective entrant has undertaken its initial investment, expected gross profits are given by $\int_0^{c_{max}} \Pi(c)dG(c)$. Unrestricted entry ensures that expected gross profits are driven down to the fixed start-up cost f_E and hence total expected profits are driven down to zero. Accordingly, the free-entry equilibrium condition is given by

$$\int_0^{c_{max}} \Pi(c)dG(c) = f_E. \tag{4.13}$$

[6] I will assume in the following that c_{max} is below c_M and hence firms with a cost draw of between c_{max} and c_M have to leave the market.

4.2.3 Labor Market Regimes

Wages in the differentiated good sector can either be determined in a perfectly competitive labour market, fixed by an industry-wide wage agreement, or set by a firm-specific union. These three different scenarios $\rho = P, U, D$ have the following properties:

1. *Competitive Labour Market ($\rho = P$).*[7] Wages in the differentiated good sector just equal the outside option of workers. The latter is determined by the wage rate in the competitive numeraire sector and equals unity. Therefore, in a flexible labour market the corresponding wage rate w^P is given by $\overline{w} = 1$.

2. *Centralised Bargaining ($\rho = U$).* An industry union sets an *uniform* industry-wide wage floor above the competitive wage rate. The wage is given by $w^U = \theta\overline{w} = \theta$ with $\theta > 1$.

3. *Decentralised Bargaining ($\rho = D$).* Union activities are specific to a firm. In particular, there exist N firm-level unions and each union sets a wage rate for its respective firm. In doing so, unions maximise total firm-level rents $[w(c) - \overline{w}]E(c)$, where firm-level employment $E(c)$ is given by $cq(c)$. Solving the maximisation problem then yields a firm-specific wage rate of $w^D(c) = (p_{max} + c)/2c$.[8]

Centralised and decentralised wage bargaining differ in one key characteristic that is crucial for the results to follow. While firm-level bargaining accounts for idiosyncratic firm characteristics, an industry-wide bargaining agreement specifies a uniform wage that is binding for each and every firm. More specifically, under firm-level bargaining the wage rate is increasing in firm productivity (or decreasing in the cost level c). In contrast, the wage rate under centralised wage bargaining is independent from productivity and has to be paid by any firm in the differentiated product sector. In fact, centralised bargaining agreements are frequently criticised for suppressing regional or plant-specific wage differentials. Although the uniform wage rate w^U could in principle be derived endogenously, e.g., from a simple monopoly union model, a binding and exogenously given wage $\theta > 1$ is the simplest and most flexible way to model this characteristic in the present context.[9]

[7] This case has been analysed by Melitz and Ottaviano (2008).

[8] Here I also assume that the bargaining takes place after the entry decision has been made and that firms retain their right-to-manage.

[9] In order to derive a closed form solution for w^U from a monopoly union model, one has to assume that the industry-level union does not take into account its influence on p_{max}. Introducing the free parameter θ will furthermore prove helpful in the following as some of the results depend on the exact level of the binding wage floor.

A possible parameter value of θ is the average wage rate received by workers under decentralised bargaining. Of course, as modelled here, the uniform wage rate $w^U > \overline{w}$ could also result from a (binding) minimum wage imposed by the state.

4.3 Productivity and Firm Performance

In this section I use the model described above to analyse the effect of the different labour market regimes on average firm productivity and firm performance. To build intuition, I start with treating the market structure in the differentiated good sector, as summarised by p_{max}, as exogenously given. By substituting the corresponding wage rate into equation (4.12) the cost cut-off level c^ρ_{max} under each labour market regime $\rho = P, U, D$ can be written as

$$c^P_{max} = p^P_{max}, \quad c^U_{max} = \frac{p^U_{max}}{\theta}, \quad c^D_{max} = p^D_{max}. \tag{4.14}$$

Inspecting equations (4.14) shows that for any exogenously given $p^\rho_{max} = p_{max}$ $(\forall \rho = P, U, D)$ the cost cut-off level is lowest under centralised wage bargaining. Centralised bargaining induces tougher selection by increasing marginal production costs of *all* firms. Entry of low-productivity enterprises is thus deterred. I call this the selection effect of centralised bargaining. With firm-level bargaining, in contrast, wages are firm-specific. Less productive firms have to pay lower wages and the marginal firm just pays the competitive unit wage $w^D(c_{max}) = 1$[10]. Consequently, the selection effect is absent under firm-level bargaining; for any given p_{max} the cost cut-offs c^P_{max} and c^U_{max} are identical. Notice that this result is not specific to the monopoly union model but follows from any model of union behaviour that yields $w(c_{max}) = \overline{w}$.

Consider next the profit level of a firm producing with cost c under labour market regime $\rho = P, U, D$:

$$\begin{aligned} \Pi^P(c) &= \frac{1}{4\gamma}(p^P_{max} - c)^2, \quad \Pi^U(c) = \frac{1}{4\gamma}(p^U_{max} - c\theta)^2, \\ \Pi^D(c) &= \frac{1}{16\gamma}(p^D_{max} - c)^2. \end{aligned} \tag{4.15}$$

Given an exogenous level of competition, profits of a firm with cost draw c are highest in the competitive environment. By increasing wages above the competitive level, both centralised and decentralised wage bargaining ceteris

[10] Evaluating $w^D(c)$ at $c = c_{max}$ yields $p_{max}/2c_{max} + 1/2$. From $c_{max} = p_{max}/w(c_{max})$, it then follows that $w^D(c_{max}) = 1$.

paribus depress profits.[11] Whether a firm is better off under firm- or under sector-level bargaining depends on its cost draw c. Firms with a cost level of above $p_{max}/(2\theta - 1)$ prefer the decentralised over the centralised bargaining mode. High-productivity firms, in contrast, are better off under a uniform wage agreement.

So far I have taken p_{max} as exogenously given. In equilibrium, the cost cut-off level c_{max} and the corresponding upper price bound p_{max} are determined by the free entry condition (4.13). Using equations (4.14) and (4.15), the free entry condition for labour market regime $\rho = P, U, D$ can be rewritten as

$$\int_0^{c^P_{max}} \frac{1}{4\gamma}(c^P_{max} - c)^2 dG(c) = f_E, \; \int_0^{c^U_{max}} \frac{\theta^2}{4\gamma}(c^U_{max} - c)^2 dG(c) = f_E,$$
$$\int_0^{c^D_{max}} \frac{1}{16\gamma}(c^D_{max} - c)^2 dG(c) = f_E. \tag{4.16}$$

The equilibrium cost cut-off levels and upper price bounds are then given by:[12]

$$c^P_{max} = p^P_{max} = \left[2(k+1)(k+2)\gamma(c_M)^k f_E\right]^{1/(k+2)}, \tag{4.17}$$
$$c^U_{max} = \frac{p^U_{max}}{\theta} = \left[\frac{1}{\theta^2}\right]^{1/(k+2)} \left[2(k+1)(k+2)\gamma(c_M)^k f_E\right]^{1/(k+2)}, \tag{4.18}$$
$$c^D_{max} = p^D_{max} = 4^{1/(k+2)} \left[2(k+1)(k+2)\gamma(c_M)^k f_E\right]^{1/(k+2)}. \tag{4.19}$$

Comparing these cut-off levels and price bounds yields

Proposition 1. *The orderings of the cost cut-off levels, c^ρ_{max}, and the upper price bounds, p^ρ_{max}, under the different labour market regimes $\rho = P, U, D$ are as follows:*

i. $c^D_{max} > c^P_{max} > c^U_{max}$,

ii. $p^P_{max} < \min\left[p^U_{max}, p^D_{max}\right]$,

iii. $p^U_{max} > (<)\; p^D_{max}$ *for* $\theta^k > (<)\; 4$.

[11] The marginal firm under decentralised wage bargaining is an exception in this regard because it just has to pay the competitive wage rate.

[12] These cut-off levels are derived under the assumption that $c^\rho_{max} < c_M$. For the different labour market regimes $\rho = P, U, D$ this assumption is fulfilled for $c_M > \sqrt{2(k+1)(k+2)\gamma f_E}$, $c_M > (1/\theta)\sqrt{2(k+1)(k+2)\gamma f_E}$, $c_M > 2\sqrt{2(k+1)(k+2)\gamma f_E}$, respectively.

The equilibrium cost cut-off is thus lowest under centralised bargaining and highest under firm-level bargaining. The overall intensity of competition is highest (the upper price bound is lowest) in the competitive environment. These two findings are directly related to our previous observations that for any given market structure centralised bargaining induces tougher selection and both bargaining regimes reduce profits.

The selection effect of centralised bargaining drives the least efficient firms out of the market and therefore decreases the cost cut-off. At the same time, by decreasing expected profits of potential entrants,[13] centralised bargaining also discourages firm entry and thus reduces the 'toughness' of competition. Since tougher competition also induces tougher selection, the anti-competitive effect works against but does not overturn the selection effect. Firm-level bargaining, in contrast, does not induce tougher selection but ceteris paribus only decreases expected profits of surviving firms. Lower expected profits again discourage entry and reduce the intensity of competition. Firms can then charge higher equilibrium prices and entrants with a relatively high cost level that would not break-even in a perfectly competitive environment (let alone under centralised bargaining) remain in the market. Finally, comparing the 'toughness' of competition under centralised and decentralised wage bargaining shows that the upper price bound is higher under the former if and only if $\theta^k > 4$. Competition is therefore weaker under regime U when the specified wage floor θ is relatively high and/or the distribution of cost draws is skewed towards less productive firms.

Having endogenised the market structure (as summarised by p_{max}), I will now assess how the different labour market regimes affect firm-level performance. The (unweighted) average of some performance measure $z^\rho(c)$ under regime $\rho = P, U, D$ is given by $\overline{z}^\rho = \left[\int_0^{c^\rho_{max}} z^\rho dG(c)\right] / G(c^\rho_{max})$. The firm-level cost average $\overline{c}^\rho$, average output $\overline{q}^\rho$, and the average profit level $\overline{\Pi}^\rho$ can all be written as simple functions of c^ρ_{max} and p^ρ_{max} only:

$$\overline{c}^P = \frac{k}{k+1} c^P_{max},\ \overline{c}^U = \frac{k}{k+1} c^U_{max},\ \overline{c}^D = \frac{k}{k+1} c^D_{max}, \tag{4.20}$$

$$\overline{q}^P = \frac{p^P_{max}}{2\gamma(k+1)},\ \overline{q}^U = \frac{p^U_{max}}{2\gamma(k+1)},\ \overline{q}^D = \frac{p^D_{max}}{4\gamma(k+1)}, \tag{4.21}$$

$$\overline{\Pi}^P = \frac{(p^P_{max})^2}{2\gamma(k+1)(k+2)},\ \overline{\Pi}^U = \frac{(p^U_{max})^2}{2\gamma(k+1)(k+2)},$$

$$\overline{\Pi}^D = \frac{(p^D_{max})^2}{8\gamma(k+1)(k+2)}. \tag{4.22}$$

[13] Centralised bargaining does not only decrease expected profits by increasing pay but also by reducing the ex-ante probability of survival for potential entrants.

Combining these performance measures with equations (4.17) to (4.19) yields

Proposition 2. *The orderings of the firm-level cost averages, $\overline{c}^{\rho}$, the average output levels, $\overline{q}^{\rho}$, and the average profit levels, $\overline{\Pi}^{\rho}$, under the different labour market regimes $\rho = P, U, D$ are as follows:*

i. $\overline{c}^{D} > \overline{c}^{P} > \overline{c}^{U}$,

ii. $\overline{q}^{U} > \overline{q}^{P} > \overline{q}^{D}$,

iii. $\overline{\Pi}^{U} > \overline{\Pi}^{P} > \overline{\Pi}^{D}$.

Compared to both the competitive environment and to firm-level bargaining a uniform wage above the competitive level boosts average firm productivity (lowers the cost average), and leads to an increase in average output and profits. The positive impact on average productivity follows directly from the lower cost cut-off level (cf. Proposition 1i.). Two distinct effects are responsible for the positive effect on average output and profits. First, the productivity-enhancing effect of centralised wage bargaining also increases average output and profits because high-productivity firms generally produce and earn more. Second, at the level of the individual firm, the anti-competitive effect of centralised bargaining enables firms to charge higher mark-ups, expand their production and increase their profits. Despite the higher wage rate associated with unionisation, equilibrium profits of highly productive firms are then higher under sector-level bargaining than they are in a flexible-wage economy. For less productive firms, in contrast, the negative direct effect of higher wages on profits prevails.[14]

In stark contrast to these results, firm-level bargaining reduces average productivity and decreases average output and profits. Firm-level bargaining allows entrants with relatively unfavourable cost draws to remain in the market. Since low-productivity firms tend to be small and less profitable, the negative effect on average productivity also reduces average output and profits. The individual firm can again benefit or lose from firm-level bargaining. While enterprises have to pay higher wages compared to the competitive benchmark (with the marginal firm being the exception), surviving firms benefit from the lower equilibrium level of competition. Since firm-specific wages are increasing in productivity, less productive enterprises benefit from firm-level bargaining while more productive firms are hurt.[15] Decentralised wage

[14]Calculating and comparing equilibrium profits under the different labour market regimes show that gross profits of firms with $c < [\theta^{k/(k+2)} - 1]c^{P}_{max}/(\theta - 1)$ are higher under centralised bargaining than they are in a competitive labour market regime.

[15]The positive (anti-competitive) effect of decentralised bargaining on output and profits dominates for firms with $c > [2 - 4^{1/(k+2)}]c^{P}_{max}$.

agreements thus benefit low-productivity firms and harm high-productivity firms, while the opposite is true for centralised wage agreements.

4.4 Product Prices and Product Variety

After the previous section has studied the effects of different bargaining structures on productivity and firm performance, this section considers the effect on two outcomes that are of central importance to consumers: product prices and product variety.[16]

Consider first the distribution of prices. Using the appropriate wage rate, the profit-maximising price of a variety produced with cost c under labour market regime $\rho = P, U, D$ can be written as:

$$p^P(c) = \frac{1}{2}\left(p^P_{max} + c\right), \quad p^U(c) = \frac{1}{2}\left(p^U_{max} + c\theta\right),$$
$$p^D(c) = \frac{1}{2}\left(3/2p^D_{max} + 1/2c\right). \tag{4.24}$$

The corresponding average price level $\overline{p}^\rho$ is given by $\left[\int_0^{c^\rho_{max}} p^\rho(c)dG(c)\right] / G(c^\rho_{max})$, while the variance of prices $(\delta^\rho_p)^2$ for each labour market regime ρ can be calculated as $\left[\int_0^{c^\rho_{max}} \left(p^\rho(c) - \overline{p}^\rho\right)^2 dG(c)\right] / G(c^\rho_{max})$. Using equations (4.14) and (4.24), I then obtain the following first and second moments of the different price distributions:

[16] In fact, the indirect utility function associated with (4.1) is given by

$$U = I^C + \frac{1}{2}\left(\eta + \frac{\gamma}{N}\right)^{-1}(\alpha - \overline{p})^2 + \frac{1}{2}\frac{N}{\gamma}\theta^2_p, \tag{4.23}$$

where $\theta^2_p = (1/N)\int_{i\in\Omega^*}(p_i - \overline{p})^2\,di$ is the variance of prices. Utility of the representative consumer is thus decreasing in the average price level $\overline{p}$ and increasing in the variance of prices θ^2_p, in product variety N and in income I^C. While the model is well equipped for analysing product prices and variety in the differentiated good sector, it is less appropriate for studying the income effects of unionisation. Not only does the model postulate a constant marginal utility of income, it also abstracts from economy-wide unemployment. Units of labour not demanded by firms in the differentiated good sector are employed in the numeraire sector. Since union bargaining therefore raises pay but does not create unemployment, unionisation increases income by construction. I thus refrain from analysing overall consumer welfare, and only consider product prices and product variety. A complete consumer welfare analysis (with endogenous income) is relegated to Appendix C.1.

$$\overline{p}^P = \frac{2k+1}{2(k+1)} p^P_{max}, \quad \overline{p}^U = \frac{2k+1}{2(k+1)} p^U_{max}, \quad \overline{p}^D = \frac{4k+3}{4(k+1)} p^D_{max}, \tag{4.25}$$

$$(\delta^P_p)^2 = \frac{k(p^P_{max})^2}{4(k+1)^2(k+2)}, \quad (\delta^U_p)^2 = \frac{k(p^U_{max})^2}{4(k+1)^2(k+2)},$$

$$(\delta^D_p)^2 = \frac{k(p^D_{max})^2}{16(k+1)^2(k+2)}. \tag{4.26}$$

Given the equilibrium upper price bounds in equations (4.17) to (4.19), these moments can be ordered as follows:

Proposition 3. *The orderings of the average price levels, $\overline{p}^\rho$, and the variances of prices, $(\delta^\rho_p)^2$, under the different labour market regimes $\rho = P, U, D$ are as follows:*

i. $\overline{p}^P < \min\left(\overline{p}^U, \overline{p}^D\right)$,

ii. $\overline{p}^U < (>)\, \overline{p}^D$ *for* $\theta^k < (>)\, 4\kappa$ *with* $\kappa = [(4k+3)/(4k+2)]^{k+2} > 1$,

iii. $(\delta^U_p)^2 > (\delta^P_p)^2 > (\delta^D_p)^2$.

The average price level is lowest in a flexible-wage economy. There are three reasons why the average price level in a flexible-wage economy differs from the mean of prices under centralised wage bargaining. First, a binding sector-wide wage floor increases unit costs cw. Second, centralised bargaining also decreases competition in equilibrium. Both factors increase ceteris paribus the profit-maximising price of a firm producing with cost c. The selection effect, in contrast, reduces the average price level because it singles out the more productive and thus cheaper firms. Equations (4.25) show that for any given upper price bound $p^P_{max} = p^U_{max} = p_{max}$ average prices under the two regimes P and U are exactly identical. The direct effect on unit costs and the selection effect of centralised wage bargaining hence cancel out. Therefore, the anti-competitive effect of unionisation prevails and $\overline{p}^U$ strictly exceeds $\overline{p}^P$ in equilibrium.

Firm-level bargaining also boosts pay and impedes competition (compared to the competitive benchmark) but does not induce tougher selection. As a result, the average price level is larger under decentralised bargaining than with a perfectly competitive labour market even when we abstract from any anti-competitive effect and take p_{max} as exogenously given. It then also follows that for $\theta^k = 4$ (and hence for $p^U_{max} = p^D_{max}$) $\overline{p}^U$ is strictly lower than $\overline{p}^D$. The average price level thus tends to be smaller under centralised than under decentralised bargaining, because the former regime singles out

more productive firms while the latter does not. Only for large θ, when the intensity of competition under centralised bargaining is very weak, can the ordering of $\overline{p}^U$ and $\overline{p}^D$ be reversed.

Finally, part iii of proposition 3 shows that the variance of prices is largest under centralised wage bargaining and lowest under firm-level bargaining. Compared to the flexible labour market regime, centralised wage bargaining increases the average price level and thus the corresponding variance increases as well. Firm-level bargaining, in contrast, reduces the variance of prices. Since firm-specific wages increase in productivity, firm-level bargaining compresses the distribution of marginal production costs $cw(c)$. Prices charged by individual firms therefore depend little on idiosyncratic cost draws but are primarily determined by the overall market structure that is common to all firms (see equation 4.24). Firms with different cost levels therefore set relatively similar prices and the price variance decreases.

Consider next product variety. Using (4.25), equation (4.5) can be solved for the number of firms in equilibrium and thus for the number of varieties consumed:

$$N^P = \frac{2(k+1)\gamma}{\eta}\frac{\alpha - p^P_{max}}{p^P_{max}}, \quad N^U = \frac{2(k+1)\gamma}{\eta}\frac{\alpha - p^U_{max}}{p^U_{max}},$$
$$N^D = \frac{4(k+1)\gamma}{\eta}\frac{\alpha - p^D_{max}}{p^D_{max}}. \tag{4.27}$$

Equations (4.27) reveal two factors that are of interest for the ordering of product variety under the different labour market regimes. First, variety is positively associated with the 'toughness' of competition. Second, for any given p_{max} the number of consumed varieties is largest with decentralised wage bargaining. This second finding mirrors proposition 3, according to which the average price level is highest under decentralised wage bargaining (for any given p_{max}). A high-price environment allows relatively many firms to survive and thus leads to greater product variety. Accounting for both factors, product variety under the different labour market regimes can be ordered as follows:

Proposition 4. *The ordering of the number of consumed varieties, N^ρ, under the different labour market regimes $\rho = P, U, D$ is as follows:*

i. $N^P > N^U$,

ii. $N^P > (<)\, N^D$ *for* $p^P_{max} > (<)\, \phi\alpha$ *with* $0 < \phi = (2/4^{1/(k+2)} - 1) < 1$,

iii. $N^D > (<) N^U$ *for* $\theta^k > (<) 4\lambda$ *with* $\lambda = \left[\alpha/(2\alpha - 4^{1/(k+2)} p^P_{max})\right]^{k+2} < 1$.[17]

The number of consumed varieties is thus strictly larger in a flexible-wage economy than under centralised wage bargaining, reflecting the anti-competitive effect of the latter. Decentralised wage bargaining, in contrast, can result in either more or less variety than a competitive labour market. Strong demand for the differentiated varieties relative to the numeraire good (high values of α) and a relatively large share of firms with an unfavourable cost draw (high values of k) tend to increase N^D relative to N^P. Finally, the ordering of product variety under decentralised and centralised wage bargaining is ambiguous and depends on the choice of θ. For $\theta^k = 4$ and thus for $p^U_{max} = p^D_{max}$, however, N^D strictly exceeds N^U.

The choice between centralised and decentralised bargaining therefore involves a potential trade-off between product prices and product variety. Holding p_{max} constant, firm-level bargaining is associated with greater product variety but also with relatively higher prices (and a lower price variance).

4.5 Trade Liberalisation

In this section I extend the model setup to a two-country setting and show that the positive effect that centralised bargaining has on average productivity can be overturned when firms face international low-wage competition.[18]

4.5.1 The Open Economy Setting

Consider two countries, Home (H) and Foreign (F), that are identical except for their labour market regimes. The representative consumer in both countries share the same preferences that result in the inverse demand function in (4.3). National goods markets are segmented and firms incur per-unit iceberg trade costs, i.e. exporters have to ship $t > 1$ units of the good in order for one unit to arrive at the export destination.
From equation (4.5) the upper price bound for positive demand in market $i = H, F$, p^i_{max}, is given by

$$p^i_{max} = \frac{1}{\eta N^i + \gamma}(\gamma\alpha + \eta N^i \overline{p}^i), \tag{4.28}$$

[17] $\lambda < 1$ follows from $N^D > 0$ (which implies $\alpha - p^D_{max} = \alpha - 4^{1/(k+2)} p^P_{max} > 0$).

[18] In the Appendix C.2, I briefly show that with symmetric labour market regulations the main results derived in the previous sections continue to hold in the open economy setting.

where N^i is the total number of firms selling in market i and $\overline{p}_i$ denotes their average price level.

Since markets are segmented and marginal production costs are constant, firms separately maximise their profits earned from domestic and export activities. Let $q_L^i(c)$ and $q_X^i(c)$ denote the profit-maximising levels of output sold respectively in the local and in the export market by a firm producing in country i with cost c. The corresponding profit-maximising prices are $p_L^i(c)$ and $p_X^i(c)$. Profits earned from domestic and export sales are then given by

$$\Pi_L^i(c) = \left[p_L^i(c) - cw^i\right] q_L^i(c), \tag{4.29}$$

$$\Pi_X^i(c) = \left[p_X^i(c) - ctw^i\right] q_X^i(c), \tag{4.30}$$

where w^i is the wage rate in country i. The corresponding first-order conditions read

$$q_L^i(c) = \frac{1}{\gamma}\left[p_L^i(c) - cw^i\right], \tag{4.31}$$

$$q_X^i(c) = \frac{1}{\gamma}\left[p_X^i(c) - ctw^i\right]. \tag{4.32}$$

Using the demand system in (4.4), the profit-maximising price and output choices then satisfy

$$p_L^i(c) = \frac{1}{2}\left(p_{max}^i + cw^i\right),\ p_X^i(c) = \frac{1}{2}\left(p_{max}^j + ctw^i\right), \tag{4.33}$$

$$q_L^i(c) = \frac{1}{2\gamma}\left(p_{max}^i - cw^i\right),\ q_X^i(c) = \frac{1}{2\gamma}\left(p_{max}^j - ctw^i\right). \tag{4.34}$$

These choices yield the following maximised profit levels:

$$\Pi_L^i(c) = \frac{1}{4\gamma}\left(p_{max}^i - cw^i\right)^2, \tag{4.35}$$

$$\Pi_X^i(c) = \frac{1}{4\gamma}\left(p_{max}^j - ctw^i\right)^2. \tag{4.36}$$

A firm only chooses to sell in a market if it earns non-negative profits. This leads to (separate) cost cut-off levels for either market. Let c_L^i and c_X^i denote the upper cost bounds of country i's firms for selling in the local and in the export market, respectively. From equations (4.35) and (4.36) these cut-offs must satisfy

$$c_L^i = \frac{p_{max}^i}{w^i}, \tag{4.37}$$

$$c_X^i = \frac{p_{max}^j}{tw^i}. \tag{4.38}$$

Notice that the cut-off levels of local producers in i and exporters from j to i are related through $c_X^j = (w^i c_L^i)/(tw^j)$. Higher trade barriers make it harder for exporters to break even relative to domestic firms. Cross-country differences in the wage level can mitigate or amplify this effect.

As in the closed economy setting, each start-up has to make an initial investment. Its cost level is then drawn from a common and known distribution. Unrestricted entry in both countries ensures that expected gross profits, which consist of expected profits from domestic and export activities, are driven down to the fixed entry cost. In order to isolate the effect of different labour market regulations, I assume that new entrants in Home and Foreign draw their cost level from the same cost distribution $G(c) = (c/c_M)^k$ and have to pay the same fixed entry cost f_E. The free entry condition for country i can then be written as

$$\int_0^{c_L^i} \Pi_L^i(c) dG(c) + \int_0^{c_X^i} \Pi_X^i(c) dG(c) = f_E. \tag{4.39}$$

Finally, labour market regulations in Home and Foreign differ. For the sake of brevity, I only consider one specific scenario: firms in Home are subjected to centralised wage bargaining, while the labour market in Foreign is perfectly competitive.[19] The wage rate in Home therefore equals $w^H = \theta$ and is strictly above the unit wage that prevails in Foreign.

4.5.2 Trade Liberalisation and Productivity

I start with rewriting the upper cost bounds for both markets by substituting the respective wage rate into (4.37) and (4.38):

$$c_L^H = \frac{p_{max}^H}{\theta},\ c_X^H = \frac{p_{max}^F}{t\theta}, \tag{4.40}$$

$$c_L^F = p_{max}^F,\ c_X^F = \frac{p_{max}^H}{t}. \tag{4.41}$$

Likewise, profits from domestic and exporting activities of firms located in Home and Foreign, respectively, can be written as

$$\Pi_L^H(c) = \frac{1}{4\gamma}\left(p_{max}^H - c\theta\right)^2,\ \Pi_X^H(c) = \frac{1}{4\gamma}\left(p_{max}^F - ct\theta\right)^2, \tag{4.42}$$

$$\Pi_L^F(c) = \frac{1}{4\gamma}\left(p_{max}^F - c\right)^2,\ \Pi_X^F(c) = \frac{1}{4\gamma}\left(p_{max}^H - ct\right)^2. \tag{4.43}$$

[19] As will become apparent in the next subsection, the main mechanism at work in an open but not in a closed economy setting is a relocation effect. Start-ups prefer to enter in a low- rather than in a high-wage country. Since centralised and decentralised wage bargaining both increase expected wage payments, the relocation effect is present under both bargaining regimes.

Suppose for the moment that p_{max}^H and p_{max}^F are exogenously given and identical. Analogous to the findings for the closed economy setting, centralised bargaining then induces tougher selection; the cost cut-off levels for firms located in Home are ceteris paribus decreasing in θ. For any given level of p_{max} centralised bargaining also depresses firm profits. Inspecting the maximised profit values in (4.42) and (4.43) furthermore shows that for $\theta \geq t$ firms are strictly better off by locating in Foreign rather than in Home (as they can supply both markets at lower costs when based in Foreign). To ensure a positive mass of domestic entrants in Home, I will therefore assume that θ is strictly smaller than t. The free entry condition in (4.39) then holds as an equality.

To solve for the endogenous cost cut-offs levels, use (4.37) and (4.38) to rewrite profits as $\Pi_L^H(c) = \frac{\theta^2}{4\gamma}\left(c_L^H - c\right)^2$, $\Pi_X^H(c) = \frac{\theta^2 t^2}{4\gamma}\left(c_X^H - c\right)^2$ and $\Pi_L^F(c) = \frac{1}{4\gamma}\left(c_L^F - c\right)^2$, $\Pi_X^F(c) = \frac{t^2}{4\gamma}\left(c_X^F - c\right)^2$. Given these expressions, the zero profit conditions can be written as

$$(c_L^H)^{k+2} + t^2(c_X^H)^{k+2} = \frac{\gamma\phi}{\theta^2}, \quad (c_L^F)^{k+2} + t^2(c_X^F)^{k+2} = \gamma\phi, \tag{4.44}$$

where $\phi \equiv (k+1)(k+2)(c_M)^k f_E$. Using $c_X^H = c_L^F/(t\theta)$ and $c_X^F = \theta c_L^H/t$, these conditions can be rewritten as a system of two equations in the two unknowns c_L^H, c_L^F:

$$(c_L^H)^{k+2} + \tau\left(\frac{c_L^F}{\theta}\right)^{k+2} = \frac{\gamma\phi}{\theta^2}, \quad (c_L^F)^{k+2} + \tau(\theta c_L^H)^{k+2} = \gamma\phi, \tag{4.45}$$

with $\tau \equiv t^{-k}$ being an inverse measure of trading costs. Solving this system yields

$$c_L^H = \left[\frac{2\gamma\phi(\theta^k - \tau)}{(1-\tau^2)\theta^{k+2}}\right]^{\frac{1}{k+2}}, \quad c_L^F = \left[\frac{2\gamma\phi(1-\tau\theta^k)}{1-\tau^2}\right]^{\frac{1}{k+2}}. \tag{4.46}$$

The cost cut-offs then pin down the upper price bounds through (4.40) and (4.41).

Before comparing the resulting equilibrium cut-off levels and the corresponding upper price bounds for Home and Foreign, I analyse first how these cost thresholds change as trade barriers are dismantled. Calculating the elasticities of c_L^i with respect to τ for $i = H, F$ gives

$$\frac{\partial c_L^H}{\partial \tau}\frac{\tau}{c_L^H} = \frac{\tau(2\tau\theta^k - \tau^2 - 1)}{(k+2)(1-\tau^2)(\theta^k - \tau)}, \tag{4.47}$$

$$\frac{\partial c_L^F}{\partial \tau}\frac{\tau}{c_L^F} = \frac{\tau(2\tau - (1+\tau^2)\theta^k)}{(k+2)(1-\tau^2)(1-\tau\theta^k)}. \tag{4.48}$$

Analysing these elasticities establishes

Proposition 5. *Trade liberalization (i.e. an increase in τ) will always lower the cost cut-off in Foreign. In contrast, trade liberalisation will increase (decrease) the cut-off in Home for $\theta^k > (1+\tau^2)/2\tau$. Furthermore, the elasticity of c_L^i with respect to τ is strictly larger in Home than its is in Foreign, and it is increasing in θ in the former country while it is decreasing in θ in the latter.*

Proof. The proof is relegated to Appendix C.3. □

With cross-country differences in labour market regimes trade liberalisation has to two distinct effects on the cost cut-offs. First, lower trade barriers increase import competition in both markets. As a result, demand price elasticities increase, the least productive firms are forced to exit and c_L^H and c_L^F decrease. This is the mechanism highlighted by Melitz and Ottaviano (2008). If wages were identical across countries, dismantling trade barriers would always lower the cost cut-offs in both countries. With cross-country wage differentials, however, trade liberalisation has an additional 'relocation' effect. As trade barriers fall, wage differentials become an increasingly important criterion of location. Consequently, the number of entrants and thus the intensity of competition increases in the low-wage country and decreases in the high-wage country. The relocation effect is larger the higher the cross-country wage differential is. When the wage rate in Home is sufficiently high relative to the level of trading barriers, the relocation effect dominates and trade liberalisation strictly increases the cost cut-off in Home. Given (4.40), it then also follows that the intensity of competition in market H decreases (p_{max}^H increases).

Proposition 5 thus shows that in an open economy setting the selection effect of centralised bargaining, described at length for the closed economy setting, is not only thwarted by the anti-competitive effect of higher wages but also by a relocation effect. For hight trade costs the selection effect prevails and the cost cut-off is lower in Home than in Foreign. However, the ordering can be reversed as trade barriers are dismantled. This is demonstrated in

Proposition 6. *The orderings of the cut-off levels, c_L^i, and the upper price bounds, p_{max}^i, for country $i = H, F$ are as follows:*

i. $c_L^H > (<)\ c_L^F$ *for* $\tau > (<)\ (\theta^{k+2} - \theta^k)/(\theta^{2k+2} - 1)$,

ii. $p_{max}^H > p_{max}^F$.

Having explicitly calculated the cost cut-off levels and the corresponding upper price bounds, I can now assess firm-level performance. For doing so, notice first that in some market i the cost of domestic firms $cw^i \in [0, c_L^i]$ and the delivered cost of exporters $tcw^j \in [0, tc_X^j] = [0, c_L^i]$ have identical distributions over the same support, as given by $G(c) = (c/c_L^i)^k$. Average firm performance of local firms in i and exporters from j to i are then also identical, since their output and profit levels depend only on (delivered) costs and on the common upper price bound p_{max}^i. More specifically, I find that

$$\overline{q}_L^H = \overline{q}_X^F = \frac{p_{max}^H}{2\gamma(k+1)}, \quad \overline{q}_L^F = \overline{q}_X^H = \frac{p_{max}^F}{2\gamma(k+1)}, \tag{4.49}$$

$$\overline{\Pi}_L^H = \overline{\Pi}_X^F = \frac{(p_{max}^H)^2}{2\gamma(k+1)(k+2)},$$

$$\overline{\Pi}_L^F = \overline{\Pi}_X^H = \frac{(p_{max}^F)^2}{2\gamma(k+1)(k+2)}. \tag{4.50}$$

Given Proposition 6ii., these average performance measures can be ordered as follows:

Proposition 7. *Output sold in the local market, $\overline{q}_L^i$, and profits earned from domestic sales, $\overline{\Pi}_L^i$, are on average higher for firms located in Home. Thus, the following orderings are established:*

i. $\overline{q}_L^H = \overline{q}_X^F > \overline{q}_L^F = \overline{q}_X^H$,

ii. $\overline{\Pi}_L^H = \overline{\Pi}_X^F > \overline{\Pi}_L^F = \overline{\Pi}_X^H$.

Average profits and sales are thus higher in Home, the country characterised by centralised wage bargaining. This result resembles proposition 2 derived in the closed economy setting. However, in a global world economy not only domestic firms but also foreign enterprises that export from Foreign to Home benefit from the relatively low intensity of competition in Home. Likewise, both local enterprises based in Foreign and exporters from Home to Foreign suffer from the intense competition in Foreign.

Finally, I assess cross-country differences in product variety and in the mean of prices. The average price of a variety sold in country i reflects prices charged by both local firms, $p_L^i(c)$, and by exporting firms from j, $p_X^j(c)$. I previously described that the cost of domestic firms and the delivered cost of exporters share the same distribution. This also leads to matching price distributions. The average price of domestic firms in a country and of exporters to that country are thus identical and given by $\overline{p}^i = \left[\int_0^{c_L^i} p_L^i dG(c)\right] / G(c_L^i)$.

Combining this with equation (4.33) yields:

$$\overline{p}^H = \frac{2k+1}{2k+2} p^H_{max}, \quad \overline{p}^F = \frac{2k+1}{2k+2} p^F_{max}. \tag{4.51}$$

The number of varieties sold in each market can then be calculated by substituting (4.51) into (4.28) and rearranging. Doing so gives

$$N^H = \frac{2(k+1)\gamma}{\eta} \frac{\alpha - p^H_{max}}{p^H_{max}}, \quad N^F = \frac{2(k+1)\gamma}{\eta} \frac{\alpha - p^F_{max}}{p^F_{max}}. \tag{4.52}$$

Given propositions 5 and 6, I can conclude:

Proposition 8. *The number of varieties in Foreign is strictly higher and their average price strictly lower than in Home. Trade liberalisation increases product variety and decreases the average price level in Foreign. In Home, trade liberalisation increases (decreases) variety and decreases (increases) average prices for* $\theta^k < (>) (1+\tau^2)/2\tau$.

The flexible-wage country thus features strictly lower prices and higher product variety than the high-wage country. These orderings thus correspond to the findings for the closed economy. More interestingly, trade liberalisation, by weakening competition, can actually decrease product variety and increase prices in the high-wage country. In contrast, for the low-wage country conventional wisdom holds and economic integration increases product variety and lowers prices.

4.6 Conclusion

This paper has studied how the level at which collective wage contracts are negotiated affects firm productivity and firm performance. While centralised bargaining induces tougher selection among heterogeneous producers and thus increases average productivity, firm-level bargaining allows less productive entrants to stay in the market, as inter-firm productivity differences will find consideration in firm-level wage settlements. Centralised bargaining also results in higher average output and in higher profit levels than either decentralised bargaining or a competitive labour market. Moreover, I have shown that moving from centralised to decentralised bargaining is not necessarily beneficial for consumers. While firm-level bargaining tends to increase product variety, it also entails higher product prices.

The paper has also highlighted that the effects of national labour market regulations may change when goods markets become global. In a two-country

model of trade between a rigid-wage and a flexible-wage economy, centralised bargaining still induces tougher selection. Yet unionisation also induces firms to enter in the low- rather than in the high-wage country. This reduces competition and average productivity in the latter. As trade barriers fall, cross-country wage differentials become an increasingly important criterion for firms in their choice of where to locate. Trade liberalisation can thus reduce competition and lower productivity in the unionised economy.

The predictions of the theoretical model can be useful in guiding future empirical work on the relation between unionisation, productivity, and firm performance. Existing empirical studies mainly seek to identify the effect of a change in unionisation status on an individual firm in a given industry.[20] My work suggests that a more complete analysis requires complementary evidence on the relation between unionisation structures and average firm performance at the industry level that also accounts for the endogeneity of the market structure.

[20]Evidence on the link between unionisation and productivity is inconclusive, while the bulk of studies find unionised workplaces to be less profitable than non-unionised ones (cf. Metcalf, 2003; Hirsch, 2004, for recent surveys of the literature). These findings are not at odds with the theoretical predictions of the present paper. Holding the market structure constant, collective bargaining unambiguously decreases firm-level profits.

Chapter 5

The Impact of Offshoring on Labour Market Dynamics in Germany

Abstract. Using an administrative data set containing daily information on individual workers' employment histories, we investigate how workers' labour market transitions are affected by offshoring. In order to do so, we estimate hazard rate models for match separations, as well as for worker flows from employment to another job, to unemployment, and to non-participation. Offshoring is found to have no significant impact on overall job stability in the manufacturing sector, but it is associated with increased job stability in the service sector. Furthermore, the effect of offshoring varies strongly across skill levels and age groups. This is especially the case in the manufacturing sector, where the hazard of transiting to non-employment rises with offshoring for medium-skilled and older workers.

5.1 Introduction

Fears of economic competition from low-wage countries are widespread among workers, trade unionists and politicians in many industrialised countries. The concern is that economies with relatively high labour costs are adversely affected by labour demand shifting towards economies with lower labour costs, thereby reducing job stability and increasing unemployment. One mechanism which is suspected of leading to such an evolution is offshoring, which occurs when a domestic firm relocates a (production) process

to a foreign supplier.[1]

While a number of theoretical papers has underlined the importance of offshoring for relative labour demand and factor prices (see, for instance, Feenstra and Hanson, 1996b; Arndt, 1997; Deardorff, 2001; Kohler, 2004) no consensus has yet emerged in this regard. Depending on the specific modelling approach, low-skilled workers may lose or benefit from offshoring. More importantly, there are very few theoretical contributions which depart from the assumptions of full employment and perfect factor mobility, or which analyse the short-run dynamics of the globalisation of the production process and the ensuing consequences for the labour market. One noteworthy exception is the article by Mitra and Ranjan (2007), who analyse the impact of offshoring on unemployment within a two-sector model with search frictions in the labour market. In this model, offshoring can generate an increase in wages and a decrease in sectoral unemployment rates if labour is mobile between sectors. This result stands at odds with the public perception where offshoring is mainly associated with employment losses. However, it is in line with the argument stressed by the OECD (2007) that offshoring may induce employment growth by increasing the competitiveness and the productivity of firms.[2] A recent contribution by Egger and Kreickemeier (2008) also studies offshoring in a model with imperfect labour markets. In their setting, offshoring can induce an expansion of the labour-intensive sector and accordingly decrease unemployment rates of low-skilled workers.

In this paper, which is a joint work with Ronald Bachmann, we analyse the effects of offshoring on the dynamics of the German labour market, i.e. on the stability of job matches, as well as on worker flows. The case of Germany is particularly interesting for several reasons. First, Germany is the largest economy in the European Union. Second, it is one of the most open economies in the world, regularly featuring the highest level of exports worldwide. Third, offshoring has grown substantially in Germany over recent years. While offshoring is still more important in manufacturing, during the 1990s growth rates have been considerably higher in the service sector (cf. Horgos, 2007). Finally, there is evidence that West Germany experienced a

[1] The term is meant to include both intra-firm and arm's-length offshoring. In the former case the foreign supplier is affiliated with the domestic firm, while in the latter it is independent. The same phenomenon has also been referred to as international production sharing, fragmentation of production stages, or slicing up the value chain.

[2] Offshoring will directly boost productivity if internationally traded inputs are of higher quality than those available domestically. It may also increase productivity by allowing firms to concentrate on their most efficient activities while relocating relatively inefficient production stages to foreign production sites (cf. Görg et al., 2008). Empirical evidence on the link between offshoring and productivity is presented by, for instance, Amiti and Wei (2006), Egger and Egger (2006), and Görg et al. (2008).

significant increase in economic turbulence, defined as the pace of structural change, during the 1990s (cf. Bachmann and Burda, 2008). The acceleration of offshoring is a natural culprit for this development.

We are not the first to analyse the effects of offshoring on the German labour market.[3] However, while the existing literature is mostly concerned with job stability only, we additionally investigate the effects of offshoring on labour market dynamics by looking at worker flows. In particular, we focus on the three flows resulting from the separation of an employer-employee match: direct job-to-job transitions, the flow from employment to unemployment, and the flow from employment to non-participation, i.e. out of the labour market. The distinction between these three labour market transitions is important because a match separation can have very different reasons and consequences. For example, a separation may be initiated by the worker, who has found a better job. This will in all likelihood result in a direct job-to-job transition. A separation can also be the consequence of a lay-off, in which case the worker has a relatively high probability of becoming unemployed – this entails a transition from employment to unemployment. The worker may even become discouraged to the extent that she leaves the labour market altogether. These different transitions have very different welfare implications, both for the affected worker and for the economy as a whole. In order to assess the consequences of offshoring, the distinction between these three flows is therefore crucial.

Our analysis also takes into account the fact that offshoring increasingly affects sectors outside manufacturing, in particular the service sector. While until recently services were considered to be largely impervious to international competition, rapid developments in information and communication technology (ICT) have provided increasing opportunities for international sourcing in the service sector as well. In this context, ICT allows for the coordination of tasks performed at different locations, facilitates the transmission of instructions and permits the electronic transmission of output. For instance, 'knowledge work', such as data entry and information processing (IT services), and research and consultancy services (ICT-enabled business services) can now be carried out remotely via the Internet and tele- and video-conferencing (cf. OECD, 2004a).

In order to analyse the effects of offshoring in manufacturing and services, we use a very large micro data set covering 2% of the dependent-status German employees. Its large size makes it possible to analyse different skill and age groups in detail. As the data set is derived from administrative records, it has the further advantage of featuring very little measurement

[3]See the next section for a discussion of the literature.

error, as well as being exact to the day. It is thus possible to follow individual labour market transitions, including direct job-to-job flows, in a very exact way.

The plan of the paper is as follows: In the next section, we give a brief review of the relevant literature. The third section of this chapter describes the data set used, while Section 5.4 presents the econometric method. Section 5.5 contains our estimation results. The last section summarises the results and concludes.

5.2 Offshoring and the Labour Market in the Literature

There now exists a sizeable body of empirical studies that investigates the labour market effects of offshoring. In particular, its impact on relative labour demand and the wage skill premium has been widely discussed (see, for instance, Feenstra and Hanson, 1996a, and Feenstra and Hanson, 1999, for the US; Geishecker and Görg, 2008, for Germany; Hijzen et al., 2005, for the UK). However, the literature is much thinner when it comes to the effects on transitional labour market dynamics. At the micro level the issue at hand has only been addressed by Munch (2005), Pfaffermayr et al. (2007), and Geishecker (2008).[4]

Pfaffermayr et al. (2007) examine the importance of offshoring (and trade) for the year-to-year transition probabilities of employment between sectors. Using a random sample of Austrian males, the authors estimate a multinomial logit model with fixed effects. They distinguish between six labour market states: employment in four different sectors, unemployment, and out of the labour force. The individual data is matched with industry-level trade and offshoring indicators that are, however, only available for the manufacturing sector. The study shows that the probability of staying in or changing into the manufacturing sector falls as the level of offshoring rises. This finding is more pronounced in manufacturing industries that have a comparative disadvantage.

Munch (2005) analyses the effects of offshoring on individual job separations. The paper concentrates on the Danish manufacturing sector and combines individual yearly spell data with indicators for offshoring at the

[4]In addition, Kletzer (2000) studies the effect of offshoring on *industry-level* displacement rates. However, studies that analyse outcomes at the industry level may suffer both from an aggregation and an endogeneity bias (see, for instance, Geishecker, 2008, for more details.)

industry level. Provided that offshoring is broadly defined, the estimation of a single risk model documents a (small) positive effect of offshoring on the job separation rate.[5] Distinguishing between job-to-job and job-to-unemployment transition flows, the author also estimates a competing risk model. Offshoring is found to increase both the unemployment risk and the job change hazard rate.[6] The former effect is stronger for low-skilled, the latter for high-skilled workers. Munch (2005) concludes that the quantitative impact of offshoring on out-of-the-job transitions is relatively small.

In a related contribution, Geishecker (2008) analyses the effect of offshoring on work-to-non-employment transitions in the German manufacturing sector. Combining monthly individual-level spell data from the German Socio-Economic Panel (SOEP) with industry-level offshoring measures, the study estimates a discrete time hazard model. Geishecker (2008) finds offshoring, when narrowly defined, to markedly increase the probability of leaving employment. In contrast to Munch (2005), the effect does not differ between skill groups but increases with employment duration.

The paper at hand contributes to the existing literature on the effects of offshoring on labour dynamics in several respects. First, we consider both the manufacturing and the service sector, and compare the effects offshoring has in these two sectors.[7] Second, we distinguish between the competing risks of making job-to-job, job-to-unemployment, and job-to-non-employment transitions. While Munch (2005) has implemented a similar framework in his analysis of Danish data, no comparable study exists for Germany. Third, the large size of the data set allows us to perform our analysis for different age and skill groups. Finally, instead of analysing yearly (Pfaffermayr et al., 2007; Munch, 2005) or monthly (Geishecker, 2008) transitions, our data set contains information on the labour market status of workers on a *daily* basis. This allows us to consider also very short employment spells and permits a more thorough treatment of duration dependence.

[5]However, the offshoring term is rendered statistically insignificant when a narrow concept of offshoring is employed instead. See Section 5.3.2 for a technical definition of narrow and broad offshoring.

[6]Narrow offshoring only has a statistically significant effect on the unemployment hazard of low-skilled workers and the job change hazard of high-skilled workers.

[7]While an increasing number of papers consider the labour market effects of service offshoring (see, for instance, Hijzen et al., 2007, for the UK, and Crinò, 2007, for the U.S.), there exist relatively few studies that examine the impact of offshoring in the service sector. An exception in this regard is the study by Hijzen and Swaim (2007) that analyses the employment effects of offshoring in the service (and the manufacturing) sector. Using industry-level data, they find no negative or even slightly positive effects of offshoring on sector-level employment.

5.3 The Data

5.3.1 The IAB Employment Sample

The data set used is the IAB Employment Sample 1975-2004 (IABS), which is provided by the Institute for Employment Research (IAB) of the German Federal Employment Agency. The data base covers the employment history of 2% of all the persons who, between the 1st January 1975 (for western German employees) or the 1st January 1992 (for eastern German employees) and the 31st December 2004, worked in an employment covered by social security, and is representative for this population. The data source consists of notifications made by employers to the social-security agencies, which include health insurances, statutory pension schemes, and the unemployment insurance agencies.[8] These notifications are made on the behalf of workers, employees and trainees who pay contributions to the social insurance system. This means that, for example, civil servants and the self-employed are not included. Overall, the subsample includes over 1.29 million people, of which 1.1 million are from western Germany. For 1995, the employment statistics, from which the IAB Regional File is drawn, cover nearly 79.4% of the employed persons in western Germany, and 86.2% of all employed persons in eastern Germany. As for the unemployed, only those entitled to unemployment benefits are covered.

For the labour market states of employment and unemployment, the following spell information is available: the starting and ending date of the spell, exact to the day; sex, year of birth, degree of education/training, and the region of the workplace (in cases of an employment spell) or of the unemployment office paying benefits (in cases of an unemployment spell). For employment spells, there is additional information on the occupation and the gross earnings of the worker, an establishment number, the size of the establishment, and the economic sector. Furthermore, the information for employment spells, e.g., with respect to the occupation of an employee, is updated on an annual basis. We use the information on the degree of education/training to define three skill groups: low-skilled workers are individuals with primary or lower secondary education, medium-skilled workers are individuals with secondary education and/or a completed apprenticeship, and high-skilled workers are individuals with tertiary education. The labour market state 'non-participation' is not directly recorded in the data set but can be inferred. A worker is in this state if she does not work full time and does not receive unemployment benefits. This means that non-participation

[8]For a complete description of the data set, see Bender et al. (2000) and Drews (2007).

can coincide with the state 'out of the labour force'. However, it can also mean self-employment, civil-service employment[9], retirement, or marginal employment.[10]

The advantages of the data set are thus as follows: First, it does not suffer from the problems inherent in most panel data sets, e.g., there is no sample attrition, and it follows workers over a long period of time because there is no need for rotation as in the Current Population Survey (CPS). Second, it offers observations at a very high frequency, which means that every actual transition is observed. Again, this is a distinct advantage over survey data like the CPS or the SOEP, which do not record multiple transitions that take place between two interview dates and, in the case of the SOEP, uses retrospective data and does not record all direct job-to-job transitions.

Worker transitions can be inferred from the employment and unemployment histories in the data set. We consider transitions between two labour market states (employment to unemployment or employment to non-participation), as well as transitions from one job to the other (direct job-to-job transitions).[11] It has to be taken into account that there might be measurement error in the data because of the way the data are collected. In particular, workers' notifications of becoming unemployed might not always correspond exactly to the actual change of labour market state. For example, this can arise when a worker gets laid off and does not report to the unemployment office immediately. We correct for this latter potential measurement error in the following way: If the time interval between two records (employment or unemployment) is smaller than 45 days, then this is counted as a direct transition between the two states recorded.[12] If the gap between two notifications is larger than 45 days, then this is counted as an intervening spell of non-participation.

As the labour market records on workers from West Germany start in 1975, i.e. 16 years before the first year of our analysis, their employment durations are accurately observed. For West Germans, the data therefore do not suffer from a problem of left-censoring. East German workers are only included in the data set from 1992 onwards, and there is no information on their labour market history before that date. We regard this as a minor problem, as the labour market history of East Germans before reunification

[9]This applies to 'Beamte', public sector employees under a special, life-time form of civil service employment. Other workers in the public sector are included in the data set.

[10] Bachmann and Schaffner (2008) show that the IAB Employment Sample nevertheless represents aggregate labour market dynamics in Germany well.

[11]The notion of a job in the data set is establishment (not firm) based.

[12]We did the calculation for smaller intervals as well. This does not change the results significantly.

is in all likelihood not very informative for our analysis. First, officially there was hardly any unemployment in East Germany before 1990. Second, the human capital accumulated by East German workers was difficult to transfer to the new economic environment after reunification.

For our analysis, which is described in Section 5.4, we consider workers who were employed full-time in the manufacturing or service sector at least once during the time period 1991-2000. We furthermore exclude workers from the analysis who are younger than 18 years or older than 65 years. These sample restrictions leave us with observations on 175,572 workers in the service sector and 84,051 workers in the manufacturing sector.[13]

5.3.2 Industry-level Data

For the purpose of our study, the most important indicator at the industry level is our measure of offshoring. The latter is considered to be a make-or-buy decision. A firm can either produce a given (intermediate) input in-house or buy it from a (foreign) supplier. Offshoring is then reflected in the foreign content of domestic production and can be measured by the share of imported intermediate inputs in total production. Following the terminology introduced by Feenstra and Hanson (1999), we distinguish between offshoring in a narrow and in a wide sense.

Narrow offshoring is defined as the shift of an industry's *core* activity abroad. Attention is hence restricted to inputs that are imported from the same (two-digit) industry abroad. For instance, intermediate products that the textile sector in Germany imports from some foreign textile sector will count as offshoring. On the contrary, intermediates imported from a foreign food sector by the German textile sector will not be taken into account. Consequently, the offshoring intensity of an industry is measured by the value of intermediate inputs imported from the same industry abroad relative to the total production value of that industry. Largely following the concept proposed by Feenstra and Hanson (1999), and Feenstra and Hanson (1996a), the narrow offshoring indicator is calculated as

$$OFFSH_{it}^{n} = \frac{IMP_{it}}{Y_{it}}, \tag{5.1}$$

where IMP_{it} indicates the value of imported intermediate inputs from industry i abroad and Y_{it} gives the production value of industry i in period t.

[13] For computational reasons, we only use 50% of the workers covered by the IABS in the empirical analysis.

Defining offshoring in a narrow sense accounts only for inputs imported from the same industry abroad. Such an approach has its merits since classifying imports from other industries as offshoring can often be misleading. To borrow an example cited by Feenstra and Hanson (1999), the import of steel by a domestic car manufacturer is typically not classified as offshoring since that company would never have produced steel in the first place. Hence, a measure of offshoring should exclude such imports, which is precisely what the narrow indicator does.

However, by restricting attention to an industry's core activity, the narrow concept of offshoring might miss important offshoring activities, in particular when it comes to service activities. For instance, a car manufacturer might well close its own in-house accounting department and instead purchase the corresponding service from a foreign-based company. Such relocation of activities will not be captured by the narrow measure of offshoring. We therefore also employ a broader concept of offshoring that accounts for the total sum of (non-energy) inputs that an industry i imports from all j industries abroad.[14] Formally, the wide offshoring indicator is calculated as

$$OFFSH_{it}^{w} = \frac{\sum_j IMP_{jt}}{Y_{it}}. \tag{5.2}$$

Notice that an increase in both the narrow and the wide indicator does not necessarily reflect the transfer of *existing* production processes abroad but may also mirror that newly established processes are subcontracted to foreign firms. Hence, an increase in the offshoring intensity does not necessarily imply a displacement of domestic jobs.

Data on imported intermediates and production values are obtained from Input-Output tables of the German Federal Statistical Office (Statistisches Bundesamt, 2002). Information is provided at the NACE two-digit sector level (WZ93), and on an annual basis. Comparable figures are currently only available for the period 1991 to 2000 (and then again for the years 2000 to 2005). The upper panel of Figure 5.1 shows that narrow offshoring has increased significantly in both sectors. However, growth rates were considerably higher in services, where narrow offshoring has increased by at about 180 percent from 1991 to 2000; for manufacturing the increase was 45.9 percent even though from a much higher base.[15] While the service sector has therefore been catching up, narrow offshoring still remains considerably

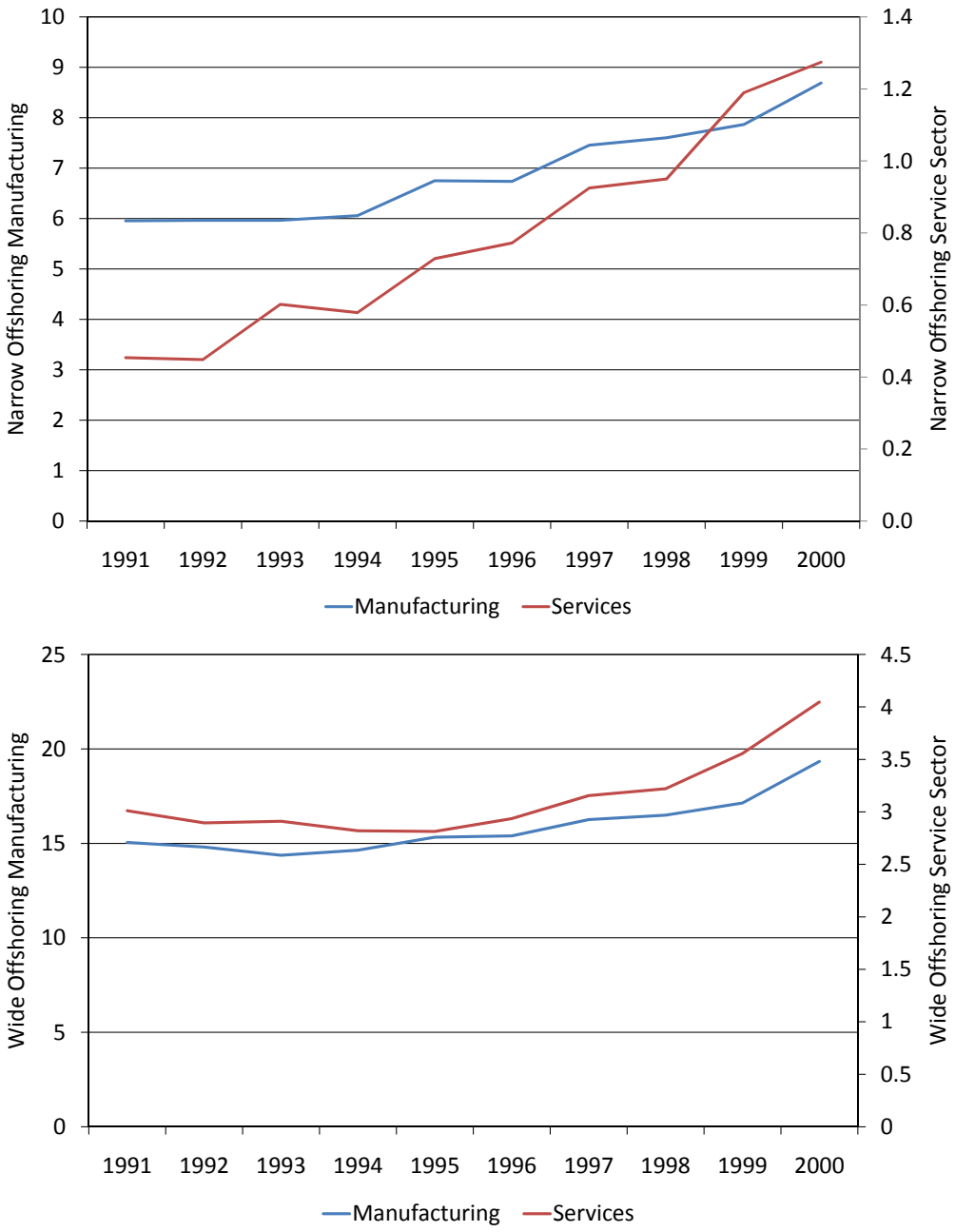
[14]Notice that attention is not restricted to inputs from foreign service or manufacturing sectors. In fact, our wide indicator accounts for all inputs imported from abroad (excluding energy inputs).

[15]Notice that we do not distinguish between material and service offshoring, but between offshoring in the manufacturing sector and offshoring in the service sector.

more important in manufacturing. The lower panel of Figure 5.1 illustrates that growth rates of offshoring are much less pronounced when the latter is measured using a wide rather than a narrow concept. Nevertheless, in both sectors wide offshoring was clearly showing an upwards trend in the second half of the 1990s. The development was somewhat more dynamic in services, but even in manufacturing wide offshoring increased by almost 30 percent between 1991 and 2000. The wide measure also confirms the previous finding that offshoring is still more prevalent in manufacturing.

Differences exist not only between narrow and wide offshoring and between manufacturing and service sectors in general, but also at a more disaggregated level. Table 5.1 documents the development of narrow and wide offshoring at the two-digit sector level. Most industries have experienced tremendous increases in the intensity of narrow offshoring. In some sectors, such as 'wearing apparel' or 'post and telecommunication', growth rates reached 100 percent or more over the ten-year period considered. Other industries, however, such as 'printing and publishing', show no or little upward trend in their offshoring intensity during the 1990s. In addition, some services still remain non-tradable. Accordingly, narrow offshoring does not play any role in, for instance, the hotel and restaurant sector. Wide offshoring, in contrast, is widespread among hotels and restaurants: a mean value of 6.7 puts the industry at the upper range of service sectors. This example also illustrates that the disparities between the two indicators are not limited to a pure level difference. For services in particular, wide and narrow offshoring can provide different angles on the offshoring phenomenon. This is also reflected in the fact that narrow and wide offshoring are far from being perfectly correlated. The correlation coefficient is 0.72 for manufacturing and 0.32 for the service sector.[16]

[16]Correlations were calculated using our final dataset at the micro level.



Source: Input-output tables provided by the Germany Statistical Office and authors' calculations.
Note: The offshoring indices are defined in equations 5.1 and 5.2.

Figure 5.1: The Degree of Narrow and Wide Offshoring in Manufacturing and Services in Germany, 1991 - 2000

		Narrow Offshoring			Wide Offshoring		
	ISIC Rev. 3	Mean	Std. Dev.	Change 1991-2000	Mean	Std. Dev.	Change 1991-2000
Weighted Average Manufacturing	15-37	6.90	0.96	2.74	15.88	1.50	4.30
Foods products, beverages	15	3.78	0.28	0.23	12.59	0.48	-0.26
Tobacco products	16	0.65	0.52	0.71	13.70	2.62	3.96
Textiles	17	7.62	1.75	4.25	20.13	2.99	7.58
Wearing apparel, dressing, fur dying	18	14.75	5.06	13.23	30.15	6.45	16.90
Leather, leather products, footwear	19	18.22	5.36	14.36	24.78	4.99	13.40
Wood, products of wood and cork	20	4.57	0.23	0.06	9.36	0.77	1.65
Paper, paper products	21	14.92	1.96	2.68	21.76	2.31	5.09
Printing, publishing	22	1.70	0.10	0.00	7.18	0.61	0.53
Coke, refined petroleum, nuclear fuel	23	5.77	1.18	-0.70	60.16	6.27	19.62
Chemicals, chemical products	24	10.93	2.24	6.03	18.04	2.96	8.37
Rubber, Plastics Products	25	0.75	0.23	0.46	17.89	1.49	3.18
Other non-metallic mineral products	26	2.25	0.12	0.02	8.17	1.01	2.38
Basic metals	27	14.85	2.16	5.05	23.24	2.84	8.27
Fabricated metals products	28	1.34	0.18	0.40	9.56	0.73	1.96
Machinery and equipment nec	29	5.14	0.39	0.94	12.12	0.93	2.35
Office, accounting, comp. machinery	30	15.86	5.66	13.93	28.85	7.95	20.07
Electrical mach. and apparatus nec	31	4.87	0.90	2.59	9.99	1.54	4.39
Radio, TV, communication equipment	32	16.49	2.25	7.24	22.15	2.36	7.48
Medical precision, optical instruments	33	3.58	0.38	0.40	9.61	1.02	2.41
Motor vehicles, trailers, semi-trailers	34	8.99	1.13	2.42	17.41	1.43	4.59
Other transport equipment	35	27.06	6.99	16.74	32.60	6.56	16.34

		Narrow Offshoring			Wide Offshoring		
	ISIC Rev. 3	Mean	Std. Dev.	Change 1991-2000	Mean	Std. Dev.	Change 1991-2000
Manufacturing nec	36	6.03	1.23	3.39	16.43	1.39	3.44
Recycling	37	0.00	0.00	0.00	6.25	0.57	0.88
Weighted Average Services	50-93	0.79	0.29	0.82	3.14	0.39	1.04
Motor veh. sale, maintenance, repair; retail sale of fuel; retail trade	50 / 52	0.00	0.00	0.00	2.50	0.46	-0.27
Wholesale and commission trade	51	2.66	1.07	3.07	4.04	1.06	3.02
Hotels, restaurants	55	0.00	0.00	0.00	6.72	0.26	-0.16
Transport, storage	60 - 63	0.50	0.18	-0.13	6.53	0.64	1.84
Post, telecommunications	64	3.93	1.04	2.68	4.88	1.42	4.21
Financial intermediations	65 - 67	0.15	0.05	-0.05	4.82	0.58	1.36
Real estate, renting, business activ.	70 - 74	0.69	0.31	0.82	1.49	0.27	0.62
Public administration, defence; compulsory social security	75	0.38	0.16	0.32	3.07	0.43	1.01
Education	80	0.00	0.00	0.00	1.61	0.21	0.45
Health and social work	85	0.00	0.00	0.00	2.92	0.29	0.61
Sewage and refuse disposal, sanitation and similar activ.	90	1.85	0.50	1.26	5.27	0.70	1.66
Activ. of membership organis. nec	91	0.00	0.00	0.00	1.12	0.25	-0.02
Recreational, cultural, sporting activ.	92	4.40	1.75	4.86	5.61	1.66	4.75
Other service activ.	93	0.55	0.38	1.05	1.34	0.31	0.86

Data source: Input-output tables provided by the German Statistical Office.

Note: 'nec' stands for 'not elsewhere classified'.

Table 5.1: Offshoring by Sector

Unfortunately, the industry classification WZ93 is used in the IABS data only from 1999 onwards. For the previous period, workers are assigned to industries according to the older WZ73 classification. Since no recoding scheme exists at present, the reassignment of workers from WZ73 to WZ93 sectors was done manually. We used the finer three-digit WZ73 classification provided in the IABS dataset and assigned each WZ73 sector to one of the sectors distinguished between in the WZ93 classification.[17] The recoding was then tested for the years 1999 and 2000, for which both classification schemes exist in the data. Observations that could not be classified with a certain degree of precision had to be deleted from the dataset.[18] In the two years tested, the misclassification error amounted to approximately 5 percent.

Further industry-level measures used in the empirical analysis are the production value and the capital-output ratio. The former is again taken from the German Federal Statistical Office (Statistisches Bundesamt, 2002) while the latter is computed from data of the OECD STAN and the EU-KLEMS database (cf. Koszerek et al., 2007). Finally, we include regional unemployment rates as provided by the German Federal Employment Office (Bundesagentur für Arbeit, 2007).

The summary statistics of the sample used in the estimations are displayed in Table D.1.

5.4 Econometric Framework and Estimation Strategy

In order to analyse the effect of offshoring on the hazards of job separation and of experiencing different labour market transitions, we estimate hazard rate models. As our dataset contains *daily* information on individual workers' employment histories, we use a specification in continuous time. Since econometric theory offers little guidance on choosing a functional form for the hazard function, we opt for a semi-parametric approach and estimate a piecewise-constant exponential (PCE) model. In contrast to parametric approaches the PCE model allows for more flexibility in the shape of the hazard function and, unlike the Cox proportional hazards model, it provides explicit estimates of the baseline hazard function. The PCE model is an example of a proportional hazard model. Therefore, the conditional hazard rate of

[17] As shown in Table 5.1 some service sectors had to be pooled to avoid ambiguous assignments. A detailed overview of the reassignment can be obtained from the authors upon request.

[18] We deleted any WZ73 observation that could not be assigned to a WZ93 sector with a precision of at least 75 percent.

leaving employment $\lambda(t|X)$ satisfies the separability condition:

$$\lambda(t|X(t)) = \lambda_0(t)exp(\beta' X(t)) \tag{5.3}$$

where X is a vector of individual, potentially time-varying, characteristics, and λ_0 denotes the baseline hazard.[19] The PCE model assumes that the baseline hazard is constant within a specified time interval but does not impose further functional form assumptions. The baseline hazard is then a step function with k segments

$$\lambda_0(t) = \lambda_j,\ a_{j-1} \leq t < a_j,\ j = 1, ..., k. \tag{5.4}$$

We specify five such segments: 0 to 182 days of employment duration, 183 to 365 days, 366 to 1095 days, 1096 to 2920 days, and more than 2920 days.

Even though we control for a wide array of observable characteristics, the hazard rates of observationally equivalent individuals may still differ from each other. Ignoring such unobserved heterogeneity in duration models produces incorrect results (cf. Lancaster, 1990). To account for unobserved heterogeneity, the proportional hazard model is extended to allow for a multiplicative unobserved heterogeneity term υ, which yields a mixed proportional hazard model.[20] The hazard function then becomes

$$\lambda(t|X(t), \upsilon) = \lambda_0(t)exp(\beta' X(t))\upsilon, \tag{5.5}$$

where υ follows a Gamma distribution, a choice rationalised by Abbring and Van den Berg (2007), and is assumed to be independent of regressors and censoring time. The heterogeneity term is shared across different spells of a given individual, causing observations within groups to be correlated.

The hazard of job separation involves one single risk. In a first step, we can therefore simply estimate the above model for this hazard. In a second step, we distinguish between the different destination states of a worker leaving a job. We thus estimate the competing hazards of transiting from one job to another, from employment to unemployment, and from employment

[19] In proportional hazard models with time-varying covariates, standard tools of duration analysis can only be applied under certain condition (cf. Van den Berg, 2001). In particular, explanatory variables have to be predictable processes, a concept which basically requires weak exogeneity (cf. Ridder and Tunali, 1999). The condition is clearly fulfilled in the present context. Notice in particular that our main variable of interest is measured at the industry level and beyond the control of an individual employee. Furthermore, episode splitting is required in order to estimate continuous-time PCE models with time-covarying covariates. The survival time (episode) for each individual has to be split into subperiods within which each time-varying covariate is constant.

[20] See Van den Berg (2001) for a survey of this model class.

to non-participation. For continuous time models and in the absence of a correlation between the destination-specific unobserved heterogeneity terms, the log-likelihood for a model with three destinations can be partitioned into the sum of three sub-contributions, each of which depends only on parameters of a single destination-specific hazard. The overall likelihood can then be maximised by maximising the three component parts separately (cf., for instance, Kalbfleisch and Prentice, 2002). Accordingly, the competing risk model is estimated as a number of single-risk duration models, one for each of the three destinations. Spells ending in any destination other than the one considered are treated as right censored. Thus, the above model is estimated separately for each of the three competing risks.

As described in Section 5.3.2, we use an offshoring indicator measured at the industry level as an explanatory variable. Because this indicator is common to several individuals, the standard errors are potentially subject to a downward bias (cf. Moulton, 1990). This is due to the fact that such aggregate explanatory variables do not provide independent information for each individual. Following Geishecker (2008), we argue that the data do not allow us to correct for this problem directly, i.e. through clustering, because the number of clusters is small relative to the number of observations. Instead, we include industry and region fixed effects, as well as linear time trends for every industry. This corrects for residual correlation within clusters due to time-invariant, and, in the case of the industry trends, time-variant unobserved heterogeneity.

We also want to make sure that the offshoring indicator does not capture effects which are industry-specific, but unrelated to offshoring. Therefore, in addition to fixed effects and industry-specific time trends that capture technological changes at the industry level (cf. Geishecker and Görg, 2008), we also include the production value and the capital intensity for every industry.[21] Furthermore, monthly dummies are used to take seasonal effects into account. Finally, yearly dummies and regional unemployment rates capture differences in economic conditions over time and across regions.

The hazard rate models described above are estimated separately for the manufacturing and the service sector. For each sector, we first estimate a basic specification with the narrow offshoring indicator as one of the explanatory variables. A second specification includes the interaction of the offshoring indicator with workers' skill levels, and a third specification fea-

[21] Research and development expenditure is sometimes used as an alternative proxy for technological change. The measure has the advantage of allowing for non-linear technological progress at the industry level. Unfortunately, for many service sectors, data are not available over the time period considered. Moreover, even for the manufacturing sector, research and development data are only collected biannually.

tures the interaction of the offshoring indicator with different age classes. The two latter specifications are meant to capture skill- or age-specific effects of offshoring. We then re-estimate the hazard rate models using the wide rather than the narrow offshoring indicator.

5.5 Estimation Results

5.5.1 The baseline specification

For the first specification, and using a narrow concept of offshoring, the results for the hazard of match separation, as well as for the hazards of the three transitions (EE, EU, EN) are in Tables 5.2 and 5.4 for the manufacturing and the service sector, respectively. Generally, the results are in line with the literature on labour market flows (cf. Mortensen and Pissarides, 1999). First, there is negative duration dependence, i.e. the hazard of separating or of making a specific labour market transition falls with match duration. This is generally attributed to the accumulation of human capital and sorting effects (cf. Machin and Manning, 1999). Second, men are considerably less likely to separate from their employer. As an inspection of the individual flows reveals, this is despite the fact that they experience more direct job-to-job transitions than women. This is outweighed by the fact that they are much less likely to become unemployed or non-employed, which is probably to a large extent due to women playing a more important role for child care at home than men. Third, the match separation - age profile displays a U-shape. The jobs of young and old employees are much less stable than jobs of middle-aged employees. Young employees have a high probability of experiencing a direct job-to-job transition, as they engage in job-shopping at the beginning of their working lives (cf. Neal, 1999). Older workers, on the other hand, have a higher probability of leaving the labour market due to retirement, which implies an EN flow. Fourth, foreigners have a higher probability of separating than German nationals, which is entirely due to the fact that they leave the labour market more often. Fifth, employees with low skills and employees with high skills have less stable jobs than employees with medium skills. For the former, this is mainly due to higher inflows into unemployment and flows out of the social security work force. For the latter, lower inflows into unemployment are outweighed by higher job-to-job transitions and higher flows out of the social-security work force. Finally, firm size is generally negatively correlated with the hazard of separating.

	Sep		EE		EU		EN	
DD: 0-6	1.419	[0.015]***	1.011	[0.025]***	1.728	[0.026]***	1.411	[0.023]***
DD: 7-12	1.127	[0.015]***	0.943	[0.025]***	1.738	[0.027]***	0.747	[0.026]***
DD: 13-36	0.576	[0.013]***	0.612	[0.021]***	0.909	[0.026]***	0.312	[0.023]***
DD: 37-96	0.125	[0.012]***	0.252	[0.019]***	0.266	[0.025]***	-0.071	[0.021]***
Male: yes	-0.303	[0.010]***	0.283	[0.018]***	-0.462	[0.021]***	-0.782	[0.019]***
Age 18-24	0.402	[0.014]***	0.181	[0.023]***	0.362	[0.030]***	0.762	[0.025]***
Age 25-29	0.128	[0.013]***	0.071	[0.021]***	0.107	[0.028]***	0.264	[0.024]***
Age 35-39	-0.194	[0.015]***	-0.127	[0.021]***	-0.106	[0.030]***	-0.408	[0.028]***
Age 40-44	-0.294	[0.016]***	-0.198	[0.023]***	-0.123	[0.033]***	-0.660	[0.032]***
Age 45-49	-0.309	[0.017]***	-0.288	[0.025]***	-0.037	[0.034]	-0.636	[0.034]***
Age 50-54	-0.238	[0.016]***	-0.360	[0.025]***	0.177	[0.032]***	-0.456	[0.032]***
Age 55-59	0.531	[0.015]***	-0.597	[0.030]***	1.415	[0.029]***	0.755	[0.027]***
Age 60-65	1.447	[0.019]***	-1.012	[0.062]***	1.806	[0.044]***	2.558	[0.031]***
Foreign: yes	0.115	[0.014]***	-0.091	[0.026]***	0.119	[0.029]***	0.351	[0.024]***
Low skill	0.216	[0.011]***	-0.057	[0.020]***	0.326	[0.022]***	0.357	[0.020]***
High skill	0.103	[0.020]***	0.306	[0.028]***	-0.233	[0.047]***	-0.075	[0.041]*
ES: 5-9	-0.485	[0.021]***	-0.747	[0.033]***	-0.503	[0.039]***	-0.250	[0.040]***
ES: 10-19	-0.533	[0.020]***	-0.800	[0.031]***	-0.594	[0.038]***	-0.283	[0.038]***
ES: 20-49	-0.621	[0.018]***	-0.904	[0.028]***	-0.730	[0.035]***	-0.341	[0.035]***
ES: 50-99	-0.701	[0.018]***	-0.998	[0.029]***	-0.847	[0.035]***	-0.384	[0.035]***
ES: 100-199	-0.754	[0.018]***	-1.087	[0.028]***	-0.911	[0.035]***	-0.404	[0.035]***
ES: 200-499	-0.796	[0.017]***	-1.176	[0.027]***	-0.952	[0.034]***	-0.415	[0.033]***
ES: 500-999	-0.848	[0.019]***	-1.268	[0.030]***	-0.975	[0.037]***	-0.459	[0.036]***
ES: 1000-4999	-0.868	[0.019]***	-1.343	[0.030]***	-1.015	[0.038]***	-0.416	[0.036]***
ES: >5000	-0.989	[0.025]***	-1.789	[0.041]***	-1.340	[0.054]***	-0.203	[0.044]***

	Sep		EE		EU		EN	
K/Y	1.254	[0.211]***	0.917	[0.347]***	1.739	[0.415]***	1.050	[0.367]***
Prod. value	-0.002	[0.001]*	-0.006	[0.002]***	-0.005	[0.002]**	-0.001	[0.002]
$OFFSH^n$	0.002	[0.005]	-0.012	[0.009]	-0.005	[0.010]	0.026	[0.009]***
Unempl	-0.015	[0.007]**	-0.052	[0.010]***	0.056	[0.012]***	-0.006	[0.013]
Failures	80,939		28,762		23,278		28,899	

Further variables: dummies for occupation, economic sector, region, month, year; trend per economic sector.
Base categories: DD: >96 months, Age 30-34, Medium skill, ES: 1-4 employees.
Significance levels: *: 10%, **: 5%, ***: 1%
Data: IABS 1975-2004 and authors' calculations.

Table 5.2: Regression Results for the Manufacturing Sector, Narrow Offshoring

5.5.2 Offshoring in the manufacturing sector

The coefficients on the narrow offshoring indicator yield the result we are most interested in, the impact of offshoring on the different hazard rates. For the manufacturing sector, the results for the hazard of job separation indicate that narrow offshoring has no statistically significant effect on overall job stability. Indeed, no statistically significant effect can be established for any of the three skill categories, as illustrated by the results for Specification II in the first column of Table 5.3. However, as the first column of this table for Specification III makes clear, offshoring in the manufacturing sector is correlated with significantly increased separation rates for older workers. This means that, although overall job stability is not reduced by offshoring, this seems to be the case for older workers.

Table 5.2 also shows that the single risk model masks important effects of narrow offshoring on the destination-specific hazards. In particular, the estimation results for the different transition hazards show that offshoring of core activities increases the hazard of transitions from a job in the manufacturing sector to non-participation. Not distinguishing between different skill groups, the estimates imply that a one percentage point increase in the offshoring intensity increases the hazard of leaving the social security work force by about $exp(0.026) - 1 = 2.6$ percent. Including interaction terms between skill and offshoring (cf. Specification II in Table 5.3) shows that the effect is most pronounced for medium-skilled workers, but also applies to workers with low and high skills (however, for these two groups the effect is only significant at the 10% level). In contrast, no effect is found for job-to-job and job-to-unemployment transitions for either skill group. Our results suggest an explanation for the finding of a negative effect of narrow offshoring on individual employment security by Geishecker (2008), the only comparable study for Germany. In particular, his finding seems to be driven by the transitions from a job to non-participation. Our finding that medium-skilled workers are most, and adversely, affected by offshoring is consistent with a "hollowing-out" of the labour market, which has been found by, e.g., Autor et al. (2003) for the U.S., and Spitz-Oener (2006) for Germany. This concept describes the reallocation of workers from middle-skill occupations towards the tails of the occupational skill distribution.

		Sep		EE		EU		EN	
(I)	$OFFSH^n$	0.002	[0.005]	-0.012	[0.009]	-0.005	[0.010]	0.026	[0.009]***
(II)	$OFFSH^n \times$								
	Low skill	-0.003	[0.005]	-0.015	[0.009]	-0.004	[0.010]	0.017	[0.009]*
	Med. skill	-0.003	[0.005]	-0.013	[0.009]	-0.005	[0.010]	0.031	[0.009]***
	High skill	0.006	[0.006]	-0.007	[0.009]	-0.005	[0.012]	0.018	[0.010]*
(III)	$OFFSH^n \times$								
	Age 18-24	-0.007	[0.006]	-0.023	[0.010]**	-0.014	[0.011]	0.014	[0.009]
	Age 25-29	-0.007	[0.006]	-0.021	[0.009]**	-0.021	[0.011]*	0.018	[0.010]*
	Age 30-34	-0.008	[0.006]	-0.017	[0.009]*	-0.031	[0.011]***	0.012	[0.010]
	Age 35-39	-0.008	[0.006]	-0.013	[0.009]	-0.030	[0.011]***	-0.003	[0.010]
	Age 40-44	-0.007	[0.006]	-0.007	[0.009]	-0.041	[0.011]***	-0.006	[0.011]
	Age 45-49	-0.010	[0.006]*	-0.008	[0.010]	-0.037	[0.011]***	-0.010	[0.011]
	Age 50-54	0.003	[0.006]	-0.005	[0.010]	-0.011	[0.011]	0.018	[0.010]*
	Age 55-59	0.032	[0.005]***	-0.002	[0.010]	0.037	[0.010]***	0.068	[0.009]***
	Age 60-65	0.020	[0.006]***	0.021	[0.013]*	0.035	[0.012]***	0.047	[0.010]***
	Failures	80,939		28,762		23,278		28,899	

Results presented are for three different specifications, including (I) the offshoring indicator, (II) the offshoring indicator interacted with skill group dummies, (III) the offshoring indicator interacted with age dummies. Further explanatory variables included as in Table 5.2. The coefficients for the variables not shown are virtually identical to those in Table 5.2.
Significance levels: *: 10%, **: 5%, ***: 1%
Data: IABS-R01 and authors' calculations.

Table 5.3: Regression Results for the Manufacturing Sector, Age- and Skill-Interactions, Narrow Offshoring

Finally for the manufacturing sector, the effect of narrow offshoring on the destination-specific hazards differs between age groups. As Specification III in Table 5.3 shows, offshoring is significantly and negatively correlated with the hazard of making a transition from employment to unemployment for middle-aged workers, while the same correlation is positive for older workers. This means that the unemployment risk rises with offshoring for older workers, while it falls with offshoring for middle-aged workers. One potential explanation for this result is that the effects of offshoring are multi-faceted: while the productivity of firms is increased, the skill requirements of the production processes that are still performed in-house also change. Younger workers are able to adapt to the latter, and thus to benefit from productivity gains, which overall reduces their risk of becoming unemployed. Older workers are generally less likely to fulfill the new skill requirements, which makes them more vulnerable to unemployment. This is also consistent with the result that the risk of exiting the labour market rises with offshoring for older workers only.

5.5.3 Offshoring in the service sector

For the service sector, the basic regression result for the hazard of match separation is very different from the result obtained for the manufacturing sector (cf. Table 5.4). In particular, narrow offshoring is significantly, and *positively* correlated with job stability in the service sector. An inspection of the results for the different flows shows that this is due to the fact that offshoring is strongly, and negatively, correlated with the hazard of experiencing a direct job-to-job transition.[22] A possible explanation for this, at first sight surprising, finding is that (narrow) offshoring, by increasing the division of labour and thus the specialization of production, is likely to lead to higher levels of competitiveness and productivity of firms. This may translate into higher wages and better job prospects (cf. OECD, 2007). If job-to-job transitions are to a certain degree voluntary, offshoring, by allowing firms to offer more attractive jobs, increases job stability as it induces workers to stay with their employers.[23] Empirical evidence on the wage effects of offshoring could strengthen or undermine the argument. Unfortunately, at present no such

[22]The magnitude of the coefficients is high, suggesting that an increase in the offshoring intensity by one percentage point will decrease the hazard of a job-to-job transition by 23.4 percent. However, it has to be taken into account that such an increase would be massive in the service sector, since the average offshoring intensity amounted to just 1.3 percent in the year 2000.

[23]It should be stressed that by no means all job-to-job transitions reflect voluntary job changes. The protection against (instantaneous) dismissal in Germany allows workers to make direct job-to-job transitions even though they were laid off against their will in the

evidence exists for the German service sector.[24] However, this explanation is not at odds with previous empirical evidence. In a cross-country study for 17 OECD countries Hijzen and Swaim (2007) find no negative or even slightly positive effects of offshoring on labour demand in the service (and the manufacturing) sector.

Alternatively, and in sharp contrast to the previous explanation, the result may hint at declining employment prospects of industries that increase their offshoring intensity. This should arguably also lower workers' inclination to leave their job voluntarily, which lowers direct job-to-job transitions. While the argument cannot be conclusively dismissed, the results for the other two hazards do not support this view. In particular, for the service sector, we do not find any evidence for narrow offshoring to decrease employment security, i.e. to increase the hazard of job-to-unemployment and job-to-non-employment transitions. On the contrary, including interaction terms between offshoring and skill levels shows that employment security of high-skilled workers even increases with the narrow offshoring intensity of an industry: the hazards of making a transition to unemployment and to non-participation both fall for high-skilled workers (cf. Specification II in Table 5.5). This may again point to a rise in firms' labour demand due to offshoring boosting productivity and competitiveness. Neither of these two hazards are affected by offshoring for low-skilled and medium-skilled workers. Therefore, for these worker groups, the increase in job security that goes along with offshoring is entirely due to a decrease of the hazard of making a direct job-to-job transition.

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first place.

[24] A recent paper by Geishecker and Görg (2008) finds a positive (negative) wage effect for high-skilled (low-skilled) workers but concentrates on manufacturing only.

	Sep		EE		EU		EN	
DD: 0-6	1.184	[0.010]***	0.989	[0.015]***	1.975	[0.024]***	0.942	[0.015]***
DD: 7-12	1.135	[0.010]***	1.123	[0.015]***	2.295	[0.024]***	0.562	[0.015]***
DD: 13-36	0.620	[0.009]***	0.752	[0.014]***	1.414	[0.024]***	0.236	[0.014]***
DD: 37-96	0.249	[0.008]***	0.395	[0.013]***	0.658	[0.025]***	0.056	[0.013]***
Male: yes	-0.149	[0.006]***	0.228	[0.009]***	-0.230	[0.014]***	-0.522	[0.010]***
Age 18-24	0.176	[0.008]***	0.263	[0.013]***	0.140	[0.020]***	0.158	[0.014]***
Age 25-29	0.069	[0.007]***	0.142	[0.011]***	-0.004	[0.018]	0.031	[0.012]**
Age 35-39	-0.166	[0.008]***	-0.091	[0.012]***	-0.015	[0.019]	-0.327	[0.014]***
Age 40-44	-0.328	[0.009]***	-0.175	[0.013]***	-0.071	[0.021]***	-0.687	[0.017]***
Age 45-49	-0.397	[0.010]***	-0.255	[0.015]***	-0.027	[0.022]	-0.814	[0.018]***
Age 50-54	-0.399	[0.010]***	-0.341	[0.015]***	0.065	[0.022]***	-0.768	[0.019]***
Age 55-59	-0.056	[0.010]***	-0.525	[0.018]***	0.738	[0.022]***	-0.163	[0.017]***
Age 60-65	0.983	[0.012]***	-0.868	[0.037]***	0.888	[0.036]***	1.840	[0.019]***
Foreign: yes	0.251	[0.010]***	-0.074	[0.018]***	-0.026	[0.027]	0.693	[0.017]***
Low skill	0.287	[0.008]***	0.058	[0.014]***	0.317	[0.017]***	0.523	[0.014]***
High skill	0.009	[0.010]	0.117	[0.014]***	-0.249	[0.025]***	0.004	[0.018]
ES: 5-9	-0.257	[0.009]***	-0.255	[0.015]***	-0.351	[0.019]***	-0.221	[0.016]***
ES: 10-19	-0.280	[0.009]***	-0.249	[0.015]***	-0.450	[0.020]***	-0.233	[0.017]***
ES: 20-49	-0.305	[0.008]***	-0.246	[0.013]***	-0.535	[0.018]***	-0.248	[0.015]***
ES: 50-99	-0.296	[0.009]***	-0.227	[0.014]***	-0.637	[0.020]***	-0.198	[0.016]***
ES: 100-199	-0.331	[0.009]***	-0.260	[0.015]***	-0.734	[0.021]***	-0.224	[0.016]***
ES: 200-499	-0.384	[0.009]***	-0.302	[0.014]***	-0.848	[0.022]***	-0.285	[0.016]***
ES: 500-999	-0.436	[0.011]***	-0.331	[0.017]***	-1.013	[0.028]***	-0.316	[0.019]***
ES: 1000-4999	-0.470	[0.011]***	-0.365	[0.017]***	-1.125	[0.029]***	-0.300	[0.019]***
ES: >5000	-0.455	[0.022]***	-0.360	[0.033]***	-1.216	[0.064]***	-0.283	[0.037]***

	Sep		EE		EU		EN	
K/Y	0.250	[0.059]***	0.717	[0.086]***	-0.017	[0.148]	-0.005	[0.103]
Prod. value	-0.003	[0.001]***	-0.005	[0.001]***	-0.002	[0.002]	-0.001	[0.001]
$OFFSH^n$	-0.113	[0.015]***	-0.266	[0.022]***	-0.002	[0.032]	0.003	[0.026]
Unempl.	-0.019	[0.003]***	-0.049	[0.005]***	0.043	[0.007]***	-0.020	[0.006]***
Failures	226,152		88,295		48,496		89,361	

Further variables: dummies for occupation, economic sector, region, month, year; trend per economic sector.

Base categories: DD: >96 months, Age 30-34, Medium skill, ES: 1-4 employees.

Significance levels: *: 10%, **: 5%, ***: 1%

Data: IABS 1975-2004 and authors' calculations.

Table 5.4: Regression Results for the Service Sector, Narrow Offshoring

		Sep		EE		EU		EN	
(I)	$OFFSH^n$	-0.113	[0.015]***	-0.266	[0.022]***	-0.002	[0.032]	0.003	[0.026]
(II)	$OFFSH^n \times$								
	Low skill	-0.129	[0.016]***	-0.257	[0.025]***	-0.052	[0.035]	0.013	[0.028]
	Med. skill	-0.107	[0.022]***	-0.271	[0.023]***	0.013	[0.032]	0.011	[0.026]
	High skill	-0.141	[0.017]***	-0.238	[0.025]***	-0.117	[0.039]***	-0.129	[0.030]***
(III)	$OFFSH^n \times$								
	Age 18-24	-0.061	[0.016]***	-0.328	[0.024]***	0.054	[0.034]	0.146	[0.027]***
	Age 25-29	-0.130	[0.015]***	-0.286	[0.023]***	-0.014	[0.034]	-0.026	[0.027]
	Age 30-34	-0.153	[0.016]***	-0.274	[0.023]***	-0.028	[0.034]	-0.094	[0.027]***
	Age 35-39	-0.116	[0.016]***	-0.224	[0.023]***	-0.030	[0.034]	-0.095	[0.028]***
	Age 40-44	-0.109	[0.016]***	-0.252	[0.024]***	-0.015	[0.035]	-0.050	[0.029]*
	Age 45-49	-0.114	[0.016]***	-0.242	[0.024]***	-0.045	[0.036]	-0.065	[0.030]**
	Age 50-54	-0.101	[0.016]***	-0.247	[0.025]***	-0.009	[0.035]	0.003	[0.030]
	Age 55-59	-0.084	[0.017]***	-0.261	[0.027]***	0.020	[0.035]	0.104	[0.028]***
	Age 60-65	-0.138	[0.018]***	-0.226	[0.037]***	0.101	[0.041]**	0.011	[0.029]
	Failures	226,152		88,295		48,496		89,361	

Results presented are for three different specifications, including (I) the offshoring indicator, (II) the offshoring indicator interacted with skill group dummies, (III) the offshoring indicator interacted with age dummies. Further explanatory variables included as in Table 5.4. The coefficients for the variables not shown are virtually identical to those in Table 5.4.
Significance levels: *: 10%, **: 5%, ***: 1%
Data: IABS-R01 and authors' calculations.

Table 5.5: Regression Results for the Service Sector, Age- and Skill-Interactions, Narrow Offshoring

Finally, the effect of narrow offshoring in the service sector differs much less between age groups than in the manufacturing sector. Specification II in Table 5.5 shows that for all age groups, offshoring is negatively correlated with the hazards of separating and of transiting directly from one job to another. The only transition hazard where offshoring seems to have an age-specific effect is the transition from employment to non-participation. While this hazard rises with narrow offshoring for very young workers (aged 18-24) and relatively old workers (55-59), it falls with offshoring for middle-aged workers. The latter effect can again be attributed to the productivity-enhancing effect of offshoring. The effect on older workers in the service sector is similar to the one in manufacturing and therefore probably also due to the fact that older workers have difficulties adapting to changed skill requirements. The effect on younger workers could be due to the fact that these workers try to keep up with changing skill requirements by returning to full-time education. Unfortunately, our data set does not allow us to investigate these hypotheses further.

A potential explanation for why the effects of offshoring on labour market dynamics differ so markedly between sectors may be found in differences in the economic situation of the two sectors. In manufacturing, firms may have predominately relocated *existing* production processes to foreign production sites in an attempt to remain internationally competitive. Clearly then, existing jobs will be displaced by offshoring even though the negative effect is partly compensated by the positive pro-competitive and productivity-enhancing effect. In contrast, over the time period considered, the service sector was constantly expanding. Hence, the rise in offshoring in the service sector may be driven by domestic firms subcontracting newly created production processes to foreign firms. Therefore, domestic workers may reap the benefits of offshoring while their jobs are not directly put at risk.

		Sep		EE		EU		EN	
Manufacturing	$OFFSH^n$	0.002	[0.005]	-0.012	[0.009]	-0.005	[0.010]	0.026	[0.009]***
	$OFFSH^w$	-0.004	[0.005]	-0.011	[0.008]	-0.018	[0.010]*	0.019	[0.008]**
Services	$OFFSH^n$	-0.113	[0.015]***	-0.266	[0.022]***	-0.002	[0.032]	0.003	[0.026]
	$OFFSH^w$	-0.024	[0.011]**	0.020	[0.016]	-0.068	[0.023]***	-0.036	[0.018]**

Results presented are for four different regressions, two for the manufacturing and two for the service sector, including indicators for narrow and wide offshoring, respectively. Further explanatory variables included as in Table 5.2. The coefficients for the variables not shown are virtually identical to those in Tables 5.2 and 5.4.
Significance levels: *: 10%, **: 5%, ***: 1%

Data: IABS-R01 and authors' calculations.

Table 5.6: Regression Results for Narrow and Wide Offshoring in Manufacturing and Services

5.5.4 Narrow vs. wide offshoring

We performed the same analysis for the manufacturing and the service sector using the wide offshoring indicator. As Table 5.6 shows, the results for the manufacturing sector are very similar when using the wide rather than the narrow offshoring concepts. The coefficient on the wide indicator is not significant for separations and for direct job-to-job transitions, and it is only significant (and negative) at the 10% level for the transition from employment to unemployment. In contrast to that, the hazard of exiting the labour market is significantly increased both in the case of the narrow indicator (at the 1% level) and the wide indicator (at the 5% level). Interestingly, the fact that this effect is strongest for medium-skilled workers holds for both indicators.[25] Given the strong correlation between the two indicators in the manufacturing sector, the similarity of the results might not seem surprising. However, previous studies did not find significant effects of wide offshoring (cf. Geishecker, 2008).

In the service sector, on the other hand, the overlap of the two indicators is much less pronounced than in the manufacturing sector. This is also reflected in the results. In general, when using the wide indicator we continue to find a positive correlation between offshoring and job stability in the service sector. However, the effect is quantitatively much smaller than for narrow offshoring. Moreover, inspecting the results for the different flows unearths some important differences. In particular, when measured using a wide concept, offshoring is no longer statistically significantly correlated with the overall hazard of direct job-to-job flows in the service sector. In contrast, wide offshoring in the service sector is negatively associated with the hazard of making a transition from employment to unemployment as well as from employment to non-participation.

While for services the results for wide and narrow offshoring are therefore clearly very different, they could be due to the same underlying mechanism. As argued above, an increase in offshoring is likely to increase productivity. This implies that firms are able to offer higher wages to their employees, which potentially reduces voluntary job-to-job transitions. This seems to be the case for narrow offshoring. On the other hand, the increase in productivity can also decrease involuntary transitions to unemployment and non-participation, as observed for wide offshoring. The contrasting findings could be due to wide offshoring being less correlated with any direct (negative) employment effect of offshoring.[26] The productivity-increasing effect of

[25]The results for age and skill groups are not reported for the wide offshoring indicator but are available from the authors upon request.

[26]For instance, employment in a software firm will not be directly affected when the

offshoring then induces employment growth and increases job security. As a consequence, workers are more willing to change their jobs and increase mobility which in turn counterbalances any negative effect of higher wages on job-to-job flows. Furthermore, composition effects are likely to play a role for the differing results. As pointed out in Section 5.3, due to the non-tradeable nature of some service products, narrow offshoring is zero throughout the sample period in some service sectors. Wide offshoring, in contrast, is always positive and varies over time. Hence, when using the wide rather than the narrow concept of offshoring, identification does not hinge on a subset of sectors only. This can give rise to composition effects and hence explain the observed differences with workers in different sectors reacting differently to changes in offshoring.

5.6 Conclusion

In this paper, we have investigated the impact of offshoring on job stability as well as on worker flows from employment to another job, to unemployment, and out of the labour force. Our analysis has focused on the German manufacturing and service sectors during the time period 1991-2000. Using a very large administrative micro data set covering 2% of German employees, we have estimated hazard rate models for the hazards of separating, and of experiencing the three transitions mentioned above. Industry-level measures of offshoring were derived from input-output tables and included as explanatory variables in the regressions.

Our results can be summarised as follows: First, neither narrow nor wide offshoring has an impact on overall job stability in the manufacturing sector. However, the flow from employment in manufacturing to non-participation displays a negative correlation with offshoring. The only comparable study for Germany (Geishecker, 2008) has found a negative effect of narrow offshoring on individual employment security but did not distinguish between worker flows. Therefore, in light of our results, Geishecker's result seems to be driven by the transitions from a job to non-participation. Second, providing the first evidence for offshoring in the service sector, we have found both offshoring measures to be associated with an increase in overall job stability. Narrow offshoring reduces the hazard of job-to-job transitions for all workers while wide offshoring is negatively associated with the hazard of making a transition from service employment to unemployment as well as from service

latter starts purchasing accounting services from a foreign rather than from a domestic firm. Purchasing programming capacities from abroad is, in contrast, more likely to be associated with a direct job loss in the firm.

employment to non-participation. Third, while the effects of offshoring are neutral or even beneficial overall, they are strongly heterogeneous. Looking at differences between skill groups, in the manufacturing sector the hazard of leaving the labour market is most strongly increased for medium-skilled workers. In the service sector, on the other hand, high-skilled workers seem to benefit most from narrow offshoring as their hazard of transiting from employment to any of the three labour market states falls. Finally, in contrast to previous studies we have also analysed age groups in detail. The estimates suggest that the effects of offshoring are strongly age-specific in the manufacturing sector. Here, while overall job stability remains unaffected, for older workers it is significantly reduced by offshoring. This is due to the fact that their hazard of becoming unemployed and of leaving the labour market is significantly raised.

Our paper thus contributes to the growing evidence that offshoring has no negative effects on aggregate labour market performance. However, we have shown that certain worker groups seem to be adversely affected. Furthermore, we have demonstrated that there exist important differences in the effects of offshoring between the manufacturing and the service sector, and that it is crucial to distinguish between different labour market transitions. The underlying reasons for these differences, however, remain a matter of further investigation. In general, there are two competing forces at work: On the one hand, offshoring can directly reduce labour demand by domestic firms, which reduces job stability, at least in the short run; on the other hand, firms that engage in offshoring may increase their competitiveness and their profitability. This has the potential of increasing employment, and leading to greater job stability and lower labour market turnover. While we have provided some first explanations for why these effects may differ between sectors, worker groups, and labour market transitions, gaining a more thorough understanding of the reasons underlying our empirical findings is clearly warranted.

Appendix A

Economic Integration, Process and Product Innovation, and Relative Skill Demand

A.1 Proof of Proposition 1

Proof. What remains to be shown for the proposition to hold is that increasing the investment in product R&D will induce output changes, which further increase the incentives for product innovation. In the symmetric equilibrium, marginal benefits of investing in product innovation are increasing in $q_{1F}q_{1H}$. Taking the first derivative with respect to e gives

$$\frac{\partial(q_{1F}q_{1H})}{\partial e} = q_{1F}\frac{\partial q_{1H}}{\partial e} + q_{1H}\frac{\partial q_{1F}}{\partial e}, \tag{A.1}$$

which has to be negative for the proposition to hold (remember that e is an *inverse* measure of product differentiation). Substituting equations (2.12) and (2.13) into (A.1) and rearranging gives the following condition for $\frac{\partial(q_{1F}q_{1H})}{\partial e} < 0$:

$$\frac{(q_{1F}+q_{1H})(a-\alpha(k)w)}{(2+e)^2} + \frac{4q_{1H}et}{(4-e^2)^2} \geq \frac{q_{1F}(4+e^2)t}{(4-e^2)^2}. \tag{A.2}$$

Since $q_{1H} \geq q_{1F}$ for $t \geq 0$, the condition above will still hold if one replaces q_{1H} by q_{1F} on the left hand side. Simple calculation then reveals that the condition reduces to

$$2(a-\alpha(k)w) \geq t, \tag{A.3}$$

which has to hold for positive levels of intra-industry trade. □

A.2 Proof of Proposition 3

Proof. Differentiating equation (2.18) with respect to t (and ignoring the common denominator) shows that the first effect identified in proposition 2 will outweigh the third if the following condition holds:

$$\frac{w^2}{r^2}(q_{1H}+q_{1F})\left(\frac{\partial q_{1H}}{\partial t}+\frac{\partial q_{1F}}{\partial t}\right)(q_{1H}+q_{1F})(\overline{c}-k_1)+$$
$$\frac{4}{r^2}\left(q_{1H}q_{1F}^2\frac{\partial q_{1H}}{\partial t}+q_{1H}^2q_{1F}\frac{\partial q_{1F}}{\partial t}\right)(q_{1H}+q_{1F})(\overline{c}-k_1)-$$
$$\left(\frac{w^2(q_{1H}+q_{1F})^2}{2r^2}+\frac{2q_{1H}^2q_{1F}^2}{r^2}\right)\left(\frac{\partial q_{1H}}{\partial t}+\frac{\partial q_{1F}}{\partial t}\right)(\overline{c}-k_1)\leq 0. \tag{A.4}$$

Multiply out and rearrange to obtain

$$(\phi+4q_{1H}q_{1F}^3)\frac{\partial q_{1H}}{\partial t}+(\phi+4q_{1H}^3q_{1F})\frac{\partial q_{1F}}{\partial t}\leq 0, \tag{A.5}$$

with $\phi = 1/2w^2q_{1H}^2 + w^2q_{1H}q_{1F} + 1/2w^2q_{1F}^2 + 2q_{1H}^2q_{1F}^2 > 0$. For positive levels of exports the condition has to be fulfilled since $-\frac{\partial q_{1F}}{\partial t} > \frac{\partial q_{1H}}{\partial t}$ and $q_{1H} \geq q_{1F} > 0$. This proves the second part of proposition 3. The first part follows directly from the fact that the remaining second effect will also depress the demand for unskilled workers, i.e. work into the same direction as the first one does. □

Appendix B

Foreign Competition, Multinational Firms, and the Effects of One-Sided Wage Rigidity

B.1 Proof of Proposition 1

Proof. I start with differentiating equations (3.26), (3.30) and (3.31) with respect to w_e to find

$$\begin{aligned}
\frac{\partial \varepsilon^c}{\partial w_e} &= \frac{r_e R_e (L_e - U_e)}{(w_e(L_e - U_e) + r_e R_e)^2} > 0, \\
\frac{\partial \varepsilon^{oe}}{\partial w_e} &= c w_a (c+t) \left(\frac{-n(n-1)}{(n w_a (c+t) - c(n-1) w_e)^2} - \frac{2}{(w_a(c+t) + c w_e)^2} \right) \\
&\quad + \frac{r R_e (L_e - U_e)}{(w_e(L_e - U_e) + r_e R_e)^2} < \frac{\partial \varepsilon^c}{\partial w_e}, \\
\frac{\partial \varepsilon^{oa}}{\partial w_a} &= c w_a (c+t) \left(\frac{-(n-1)n}{(cn w_a - (n-1)(c+t) w_e)^2} - \frac{2}{(c w_a + (c+t) w_e)^2} \right) \\
&\quad < 0.
\end{aligned}$$

Next, one can calculate the wage rate at which ε^{oe} exactly equals ε^c. This is true for $w_e = \frac{n w_a (c+t)}{c(3n-2)}$. Moreover, ε^{oe} coincides with the lower bound of ε^c (i.e. with minus one) for $w_e = \frac{c n w_a}{(c+t)(3n-2)}$. Combining these findings with the results concerning the derivatives of the elasticities with respect to w_e, the

open economy elasticities are always lower than ε^c for

$$w_e \geq \frac{nw_a(c+t)}{c(3n-2)}, \tag{B.1}$$

$$w_e \geq \frac{cnw_a}{(c+t)(3n-2)}. \tag{B.2}$$

Consider first condition (B.1) referring to the wage elasticity of production for market e. From equation (3.28) one can infer that for nonnegative levels of exports into the European market, w_e has to be equal to or larger than $\frac{(n-1)w_a(c+t)}{cn}$. Plugging this lower bound into equation (B.1) leaves us with $\frac{n-1}{n} \geq \frac{n}{3n-2}$, which is always fulfilled for the assumption $n \geq 2$. Similarly, for the American market one can derive a lower bound for w_e from equation (3.27) assuming $X_{aa}^n > 0$.[1] Substituting into condition (B.2) yields again $\frac{n-1}{n} \geq \frac{n}{3n-2}$. □

B.2 Proof of Proposition 2

Proof. Taking the first derivative of exports from America to Europe with respect to w_e yields

$$\begin{aligned}\frac{\partial X_{ae}^n}{\partial w_e} =& \frac{\beta(2n-1)(nw_a(c+t)(L_e-U_e)(c(3n-1)w_e-(n-1)w_a(c+t)))}{(n(c+t)w_a+cnw_e)^3} \\ &+ \frac{\beta(2n-1)(cnR_e((3n-2)w_a(c+t)-cnw_e)r_e)}{(n(c+t)w_a+cnw_e)^3}.\end{aligned} \tag{B.3}$$

This expression is nonnegative if $w_e \geq \frac{(n-1)(c+t)w_a}{(3n-1)c}$ and $w_e \leq \frac{(3n-2)w_a(c+t)}{cn}$. By plugging in the lower and upper bound for w_e as derived from equation (3.27) and (3.28), one obtains $\frac{1}{n} \geq \frac{1}{3n-1}$ and $\frac{n}{n-1} \leq \frac{3n-2}{n}$. The assumption $n \geq 2$ guarantees that these conditions are satisfied.
The derivative of production of a firm based in America for its domestic market with respect to European wages is given by

$$\frac{\partial X_{aa}^n}{\partial w_e} = \frac{\beta(w_aL_a+r_aR_a)(2n-1)(c+t)(cw_a(3n-2)-nw_e(c+t))}{n^2((c+t)w_e+cw_a)^3}. \tag{B.4}$$

The expression will be nonnegative for $w_e \leq \frac{cw_a(3n-2)}{n(c+t)}$ which can again be verified by plugging in the upper bound of w_e. □

[1] The assumption follows directly from assuming nonnegative intra-industry trade. A national firm will always produce for the domestic market provided that it is an exporter.

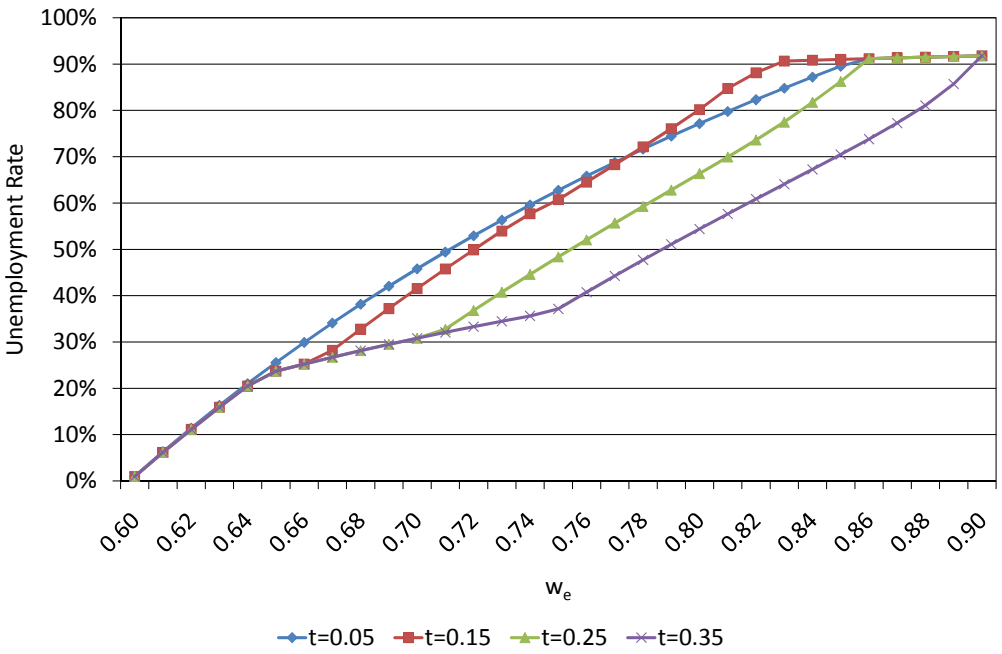

Figure B.1: Effect of a European Minimum Wage on Unemployment for Different Trading Costs

B.3 The Role of Trading Barriers

In the main text I have illustrated in section 3.4 how the effects of a one-sided minimum wage in an open economy with multinationals differ from those in a closed economy and an open economy without multinational firms. It has been shown that the effects of national labour market institutions are much more pronounced in a world in which product markets are linked globally. Trading barriers are of great importance to the result as they determine the degree of openness of an economy and the type of firms active in equilibrium. With very high trading barriers horizontal multinational enterprises are more likely to arise while exporting is relatively costly. In this section, the unrestricted full-fledged model is simulated for different levels of trading barriers $t = \{0.05, 0.15, 0.25, 0.35\}$ to assess their influence on the model's main results.

Figure B.1 provides an overview of the effect of a one-sided minimum wage in Europe on the unemployment rate. Consider first the cases of $t = \{0.15, 0.25, 0.35\}$. The three curves coincide for a range of parameter values at the lower and the upper bound of w_e. For low and high levels of the minimum wage the active types of firms are the same irrespective of the level

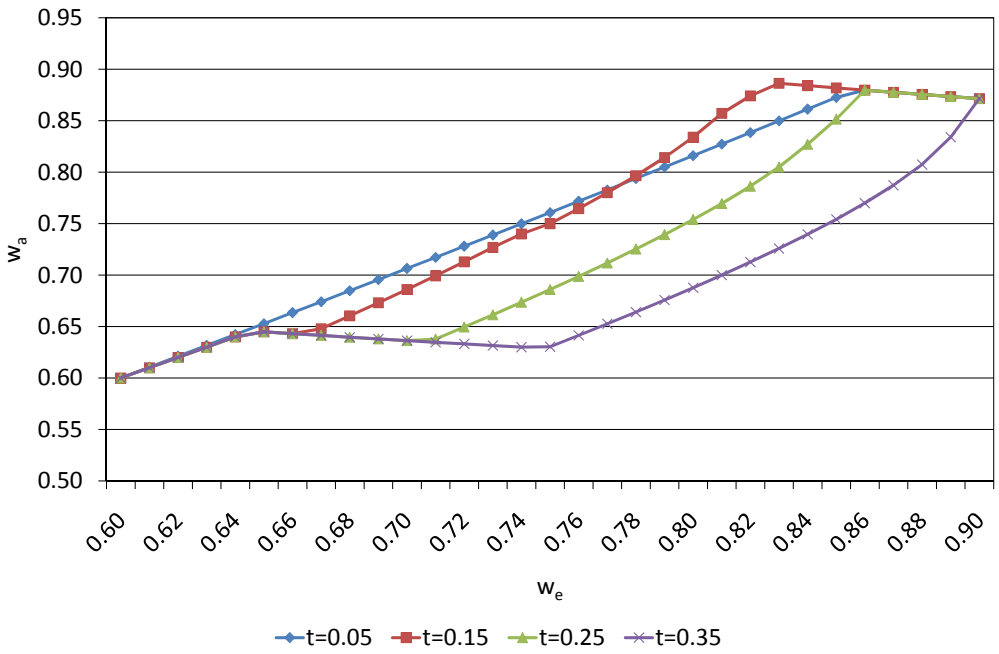

Figure B.2: Effect of a European Minimum Wage on American Wages for Different Trading Costs

of trading barriers. Introducing only a moderate minimum wage will prevent multinational enterprises from leaving the market while at very high levels only national firms based in America can prevail (see Table B.1).

The effect of the level of trading barriers is evident from the intermediate parameter range. With relative low barriers exporters will enter the market already at relatively small values of w_e. Labour demand for the production of the X good is transferred abroad and the unemployment rate rises abruptly above the one calculated in simulations with higher trading barriers. A comparably moderate minimum wage is sufficient to generate high unemployment. With higher levels of trading costs the entry barriers for exporting national firms are higher. Therefore, the 'turning point', at which the fraction of X consumption produced abroad increases sharply, lies at higher values of w_e. The range of parameters w_e consistent with multinational production is extended while exporting firms arise only at higher values of w_e. Hence, higher trading barriers reduce the adverse effects on unemployment in Europe for intermediate values of w_e.

Figure B.2 provides the mirror image for the American labour market. Again, the curves coincide for low and high levels of w_e. American wages are increasing initially as multinational enterprises are relocating their headquar-

<table>
<tr><th>w_e</th><th>$t = 0.05$</th><th>$t = 0.15$</th><th>$t = 0.25$</th><th>$t = 0.35$</th></tr>
<tr><td>0.60
0.61
0.62
0.63
0.64</td><td rowspan="19">n_e,n_a</td><td rowspan="5">m_e,m_a</td><td rowspan="5">m_e,m_a</td><td rowspan="5">m_e,m_a</td></tr>
<tr><td>0.65
0.66
0.67
0.68</td><td rowspan="4">m_a</td><td rowspan="8">m_a</td><td rowspan="11">m_a</td></tr>
<tr><td>0.69
0.70
0.71
0.72</td><td rowspan="4">m_a,n_a</td></tr>
<tr><td>0.73</td><td rowspan="10">m_a,n_a</td></tr>
<tr><td>0.74</td><td>m_e,m_a,n_a</td></tr>
<tr><td>0.75
0.76
0.77
0.78
0.79
0.80
0.81</td><td rowspan="7">m_e,n_a</td></tr>
<tr><td>0.82
0.83</td><td rowspan="9">m_a,n_a</td></tr>
<tr><td>0.84</td><td rowspan="8">n_a</td></tr>
<tr><td>0.85</td><td>m_e, n_a</td></tr>
<tr><td>0.86
0.87
0.88
0.89
0.90</td><td rowspan="5">n_a</td></tr>
</table>

Table B.1: Type(s) of Firms Active in Equilibrium for Different Trading Costs

ters to America. A marked increase in w_a can be observed once American exporters start to produce a higher fraction for the European market. The lower the level of trading barriers is the lower is the level of w_e that is sufficient for the appearance of American-based exporting firms. Consequently, the positive effect of implicit European minimum wages on wages in America

is higher with lower trading barriers for some intermediate parameter range of w_e.

The two figures also show that there is an interesting twist for $t = 0.05$. Note first that for trading barriers of such small magnitude multinational enterprises will never arise since exporting is almost costless. Moving from $t = 0.15$ to $t = 0.05$ can then actually *decrease* unemployment in Europe in the case of a very high wage floor. Intuitively, the very high unemployment rate in Europe depresses income and market size. Worldwide consumption of X is then strongly dominated by American demand. Very low trading barriers enables exporters from Europe to access the American market and European labour benefits since a fraction of American demand is met with European production.

B.4 Additional Figures

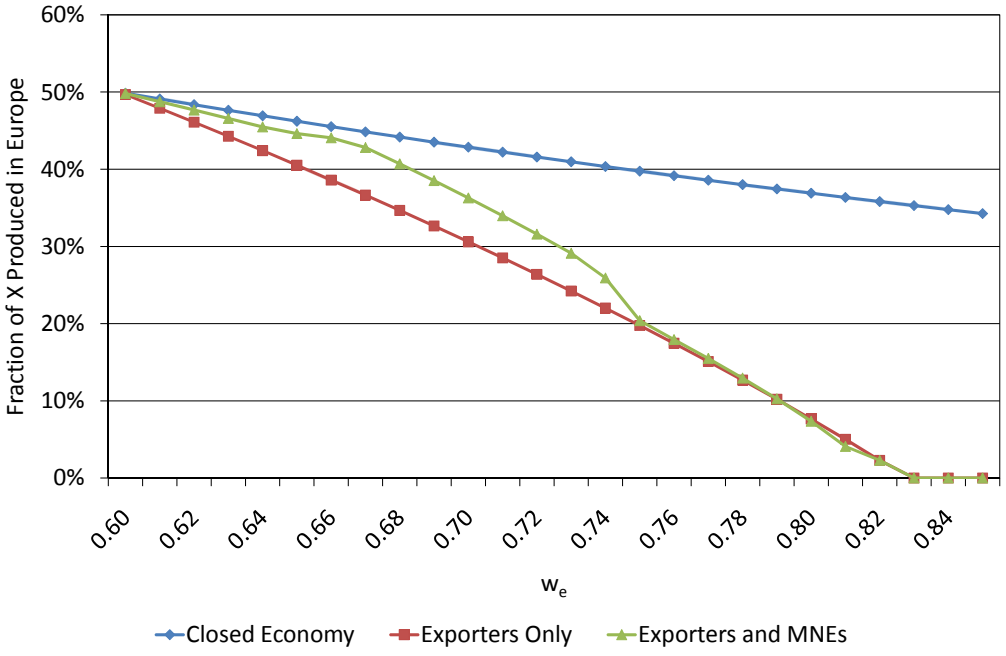

Figure B.3: Effect of a European Minimum Wage on the Fraction of Worldwide X Consumption Produced in Europe

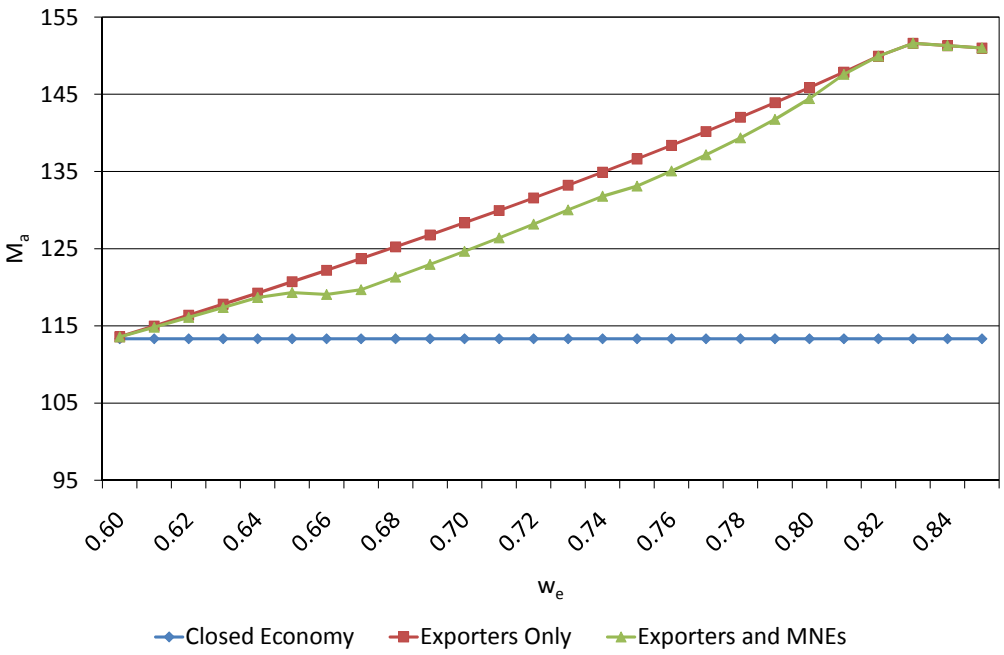

Figure B.4: Effect of a European Minimum Wage on the American Income Level

Appendix C

Unionisation Structures and Heterogeneous Firms

C.1 Consumer Welfare in the Closed Economy Setting

In this subsection, I consider consumer welfare. The indirect utility function associated with (4.1) is given by

$$U = I^C + \frac{1}{2}\left(\eta + \frac{\gamma}{N}\right)^{-1}(\alpha - \overline{p})^2 + \frac{1}{2}\frac{N}{\gamma}\theta_p^2, \tag{C.1}$$

where $\theta_p^2 = (1/N)\int_{i\in\Omega^*}(p_i - \overline{p})^2\,di$ is the variance of prices. The utility of the representative consumer depends on the price distribution, on product variety and on total income. The first two determinants have been discussed extensively in Section 4.4 and I now consider income.

Overall profits net of entry costs, i.e. gross profits of all surviving firms minus the start up costs of all entrants, are zero. Wages are therefore the only source of income in the model. The wage bill of the differentiated product sector can be calculated by multiplying the average wage bill of a single firm, $\overline{W}^\rho = \left[\int_0^{c^\rho_{max}} c^\rho q^\rho(c) w^\rho(c) dG(c)\right]/G(c^\rho_{max})$, by the total number of firms, N^ρ. Units of labour not demanded by firms in the differentiated good sector are employed in the numeraire sector and earn the competitive wage rate of one. Labour income in the numeraire good sector thus equals total labour supply minus the units of labour employed in the differentiated good sector. The latter can be found by multiplying the average labour demand of a single firm, $\overline{E}^\rho = \left[\int_0^{c^\rho_{max}} c^\rho q^\rho(c) dG(c)\right]/G(c^\rho_{max})$, by the total number of firms. Summarising the above, total income I^ρ under labour market regime

$\rho = P, U, D$ is given by $\overline{WB}^{\rho} N^{\rho} + (L - \overline{E}^{\rho} N^{\rho})$. Rearranging gives

$$I^{\rho} = L + \left(\frac{\overline{W}^{\rho}}{\overline{E}^{\rho}} - 1 \right) \overline{E}^{\rho} N^{\rho}. \tag{C.2}$$

Equation (C.2) demonstrates that total income can be apportioned into labour supply L, which equals the total wage bill in case all workers were employed in the numeraire good sector, plus the rent earned by labour in the differentiated good sector. The rent increases with the average wage differential between the two sectors ($\overline{W}^{\rho}/\overline{E}^{\rho} - 1$) and with employment in the differentiated product sector ($\overline{E}^{\rho} N^{\rho}$). With a perfectly competitive labour market the inter-sectoral wage differential is zero and income just equals L. With centralised bargaining the wage differential is $\theta - 1$ and firm-level bargaining elicits an average differential of $(k+1)/k - 1$. Multiplying the respective wage differential by the corresponding employment level and substituting into (C.2) yields:

$$I^{P} = L, \; I^{U} = L + \frac{k(\theta - 1)}{\theta} \frac{(\alpha - p^{U}_{max}) p^{U}_{max}}{\eta(k+2)}, \; I^{D} = L + \frac{(\alpha - p^{D}_{max}) p^{D}_{max}}{\eta(k+2)}. \tag{C.3}$$

Given the full employment assumption and the fact that bargaining raises pay, labour income under both bargaining regimes exceeds income in the flexible wage economy. The ordering of I^{U} and I^{D} is, however, ambiguous and depends on the rent earned by labour under the the two bargaining modes. Very low and very high values of θ cause the rent earned under centralised bargaining to approach zero (and I^{U} to fall below I^{D}). Small values of θ level the inter-sectoral wage differential, while very large values marginalise employment in the differentiated good sector. For intermediate levels of θ, however, labour income under centralised wage bargaining can exceed income under firm-level bargaining. Consider exemplarily the case of $\theta^{k} = 4$ (and hence $p^{U}_{max} = p^{D}_{max}$).[1] Income under centralised bargaining is then larger (smaller) than income under firm-level bargaining for $k > 2$ ($k < 2$). While the wage differential is strictly larger under regime U at $\theta^{k} = 4$,[2] more firms are active under regime D (cf. proposition 4ii.). Finally, average labour demand per firm, $\overline{E}$, is larger (smaller) under centralised bargaining for $k > 2$ ($k < 2$).[3]

[1] More generally, I^{U} is larger (smaller) than I^{D} for $k(\theta - 1)\left(\alpha - p^{U}_{max}\right) > (<) \left(4\theta^{2}\right)^{1/(k+2)} \left(\alpha - p^{D}_{max}\right)$.

[2] $4^{1/k}$ is strictly larger than $(k+1)/k$ for $k \geq 1$.

[3] Calculating average labour demand explicitly gives $\overline{E}^{U} = \left(k(p^{U}_{max})^{2}\right)/(2\nu\theta)$ and $\overline{E}^{D} = \left(k(p^{D}_{max})^{2}\right)/(4\nu)$ with $\nu = \gamma(k+1)(k+2)$. For $\theta^{k} = 4$ $\overline{E}^{U}$ is larger than $\overline{E}^{D}$ provided that $4^{1/k} < 2$.

With endogenous income, utility under labour market regime ρ, U^ρ, can be written as:

$$U^P = L + \frac{1}{2\eta}(\alpha - p^P_{max})\left(\alpha - \frac{k+1}{k+2}p^P_{max}\right), \tag{C.4}$$

$$U^U = L + \frac{1}{2\eta}(\alpha - p^U_{max})\left(\alpha - \frac{2k-\theta(k-1)}{\theta(k+2)}p^U_{max}\right), \tag{C.5}$$

$$U^D = L + \frac{1}{2\eta}(\alpha - p^D_{max})\left(\alpha - \frac{2k-1}{2k+4}p^D_{max}\right). \tag{C.6}$$

For small values of θ centralised bargaining can actually result in higher consumer welfare than a competitive labour market. To see this possibility, notice that U^P and U^U converge as θ approaches the competitive wage rate of one. It then remains to be shown that at $\theta = 1$ utility under centralised bargaining can be increasing in θ. Differentiating U^U with respect to θ gives

$$\frac{\partial U^U}{\partial \theta} = -\Upsilon\left[2p^U_{max}(2 + k(\theta - 1) - \theta) + \alpha(3\theta - 4)\right], \tag{C.7}$$

where Υ is strictly positive. The sign of (C.7) is indeed indeterminate for $1 \leq \theta < 4/3$ (but strictly negative thereafter). It then follows that centralised bargaining can in principle improve utility of the representative consumer by increasing income and the variance of prices.

C.2 The Open Economy Setting with Symmetric Labour Market Regimes

In this subsection, I consider the two-country setting with *symmetric* labour market regulations. Since the two trading partners Home and Foreign are then identical, I drop the country superscript $i = H, F$. Instead, the superscript $\rho = P, U$ is used to distinguish between country pairs sharing a perfectly competitive labour market and a centralised wage bargaining regime, respectively. Given the symmetry of the model, I shall only present equations for Home. Analogous equations exist for Foreign as well.

Using (4.37) and (4.38), for each country pair $\rho = P, U$ firm-level profits (4.31) and (4.32) can be rewritten as

$$\Pi^P_L(c) = \frac{1}{4\gamma}\left(c^P_L - c\right)^2, \; \Pi^P_X(c) = \frac{t^2}{4\gamma}\left(c^P_X - c\right)^2, \tag{C.8}$$

$$\Pi^U_L(c) = \frac{\theta^2}{4\gamma}\left(c^U_L - c\right)^2, \; \Pi^U_X(c) = \frac{t^2\theta^2}{4\gamma}\left(c^U_X - c\right)^2. \tag{C.9}$$

The corresponding free entry conditions are then given by:

$$(c_L^P)^{k+2} + t^2(c_X^P)^{k+2} = 2\gamma\phi, \quad (c_L^U)^{k+2} + t^2(c_X^U)^{k+2} = \frac{2\gamma\phi}{\theta^2}, \tag{C.10}$$

with $\phi \equiv (k+1)(k+2)(c_M)^k f_E$. Using $c_X^\rho = c_L^\rho/t$, these equations can then be solved for the cost thresholds c_L^ρ and the corresponding upper price bounds:

$$c_L^P = p_{max}^P = \left(\frac{2\gamma\phi}{1+\rho}\right)^{1/(k+2)}, \tag{C.11}$$

$$c_L^U = \frac{p_{max}^U}{\theta} = \left(\frac{1}{\theta^2}\right)^{1/(k+2)} \left(\frac{2\gamma\phi}{1+\rho}\right)^{1/(k+2)}. \tag{C.12}$$

Inspecting these expressions shows that - analogous to the closed economy setting - the cut-off level c_L^P strictly exceeds c_L^U and the corresponding price bound p_{max}^P falls short of p_{max}^U. With symmetric labour markets the orderings of both the cost cut-offs and the upper price bounds established in the closed economy model carry over to the open economy setting. Furthermore, without cross-country differences in the wage rate, trade liberalisation just increases import competition and thus always induces tougher selection among heterogeneous producers – independent of the specific labour market regime.

C.3 Proof of Proposition 5

Proof. For a positive mass of entrants in Home, θ has to be smaller than t. This also implies that $\theta^k - \tau$ and $1 - \tau\theta^k$ (with $\tau = 1/t^k$) are both positive in sign. The elasticity of c_L^H with respect to τ is then positive (negative) for $\theta^k > (<) (1+\tau^2)/2\tau$. The corresponding elasticity of Foreign is negative for $\theta^k > 2\tau/(\tau+1)$. This latter condition is always fulfilled for the relevant parameter values $t > \theta > 1$, $0 < \tau < 1$. Furthermore, differentiating the two elasticities with respect to τ gives

$$\partial\left(\frac{\partial c_L^H}{\partial\tau}\frac{\tau}{c_L^H}\right)/\partial\tau = \tau/\left[(k+2)(1-\tau^2)(\theta^k-\tau)^2\right] > 0,$$

$$\partial\left(\frac{\partial c_L^F}{\partial\tau}\frac{\tau}{c_L^F}\right)/\partial\tau = \tau(\tau^2-1)/\left[(k+2)(1-\tau^2)(1-\tau\theta^k)^2\right] < 0,$$

where the respective signs directly follow from $\tau < 1$. □

Appendix D

The Impact of Offshoring on Labour Market Dynamics in Germany

D.1 Descriptive Statistics

		Manufacturing		Service Sector	
		Mean	Std. Dev.	Mean	Std. Dev.
Employment duration 0 - 6 months	DD: 0-6	0.080	[0.271]	0.130	[0.337]
Employment duration 7-12 months	DD: 7-12	0.061	[0.239]	0.099	[0.298]
Employment duration 13-36 months	DD: 13-36	0.169	[0.375]	0.237	[0.425]
Employment duration 37-96 months	DD: 37-96	0.260	[0.439]	0.273	[0.446]
Gender	Male: yes	0.765	[0.424]	0.503	[0.500]
Age 18 to 24	Age 18-24	0.078	[0.268]	0.092	[0.289]
Age 25 to 29	Age 25-29	0.131	[0.337]	0.146	[0.353]
Age 30 to 34	Age 30-34	0.154	[0.360]	0.156	[0.363]
Age 35 to 39	Age 35-39	0.144	[0.351]	0.141	[0.348]
Age 40 to 44	Age 40-44	0.131	[0.337]	0.128	[0.334]
Age 45 to 49	Age 45-49	0.117	[0.322]	0.113	[0.317]
Age 50 to 54	Age 50-54	0.122	[0.328]	0.109	[0.312]
Age 55 to 59	Age 55-59	0.096	[0.295]	0.089	[0.284]
Age 60 to 65	Age 60-65	0.026	[0.150]	0.027	[0.161]
Foreign nationality	Foreign: yes	0.088	[0.284]	0.041	[0.199]
Low-skilled worker	Low skill	0.203	[0.403]	0.096	[0.294]
Medium-skilled worker	Medium skill	0.723	[0.448]	0.790	[0.407]
High-skilled worker	High skill	0.074	[0.262]	0.114	[0.318]
Establishment size 1 - 4 employees	ES: 1-4	0.031	[0.173]	0.121	[0.326]
Est. size 5 - 9 employees	ES: 5-9	0.038	[0.191]	0.086	[0.280]
Est. size 10 - 19 employees	ES: 10-19	0.052	[0.221]	0.091	[0.288]
Est. size 20 - 49 employees	ES: 20-49	0.093	[0.290]	0.147	[0.354]
Est. size 50 - 99 employees	ES: 50-99	0.094	[0.292]	0.117	[0.321]
Est. size 100 - 199 employees	ES: 100-199	0.120	[0.325]	0.113	[0.316]
Est. size 200 - 499 employees	ES: 200-499	0.177	[0.382]	0.133	[0.339]
Est. size 500 - 999 employees	ES: 500-999	0.123	[0.329]	0.079	[0.269]

		Manufacturing		Service Sector	
		Mean	Std. Dev.	Mean	Std. Dev.
Est. size 1000 - 4999 employees	ES: 1000-4999	0.156	[0.363]	0.093	[0.291]
Est. size $\geq$ 5000 employees	ES: $\geq$ 5000	0.113	[0.317]	0.016	[0.124]
Capital-output ratio	K/Y	0.449	[0.105]	1.981	[1.686]
Production value [in 1000]	Prod. value	82.669	[46.818]	187.395	[152.308]
Offshoring, narrow	$OFFSH^n$	6.594	[5.433]	0.609	[1.059]
Offshoring, wide	$OFFSH^w$	15.144	[6.733]	3.307	[1.619]
Regional unemployment	Unempl	9.420	[3.508]	10.652	[4.115]

Table D.1: Summary Statistics

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Selbständigkeitserklärung

Hiermit erkläre ich, dass ich außer von den in der Danksagung genannten Personen keine weitere Hilfe von anderen Personen bei der Abfassung der Dissertation erhalten habe. Wie ich an mehreren Stellen dieser Arbeit deutlich gemacht habe, ist Kapitel 5 eine gemeinsame Forschungsarbeit mit Dr. Ronald Bachmann. Darüber hinaus habe ich außer der angeführten Literatur und den in der Dissertation angegebenen Hilfsmitteln keine weiteren Hilfsmittel verwendet. Ich bezeuge durch meine Unterschrift, dass meine Angaben über die bei der Abfassung meiner Dissertation benutzten Hilfsmittel, über die mir zuteil gewordene Hilfe sowie über frühere Begutachtungen meiner Dissertation in jeder Hinsicht der Wahrheit entsprechen.

Berlin, den 16. Juni 2009