Impacts of Outsourcing

On Germany's and Austria's Human Capital

and

the Economic Geography of Central Europe

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List of Abbreviations

CEE	Central and Eastern Europe
COMECON	Council for Mutual Economic Assistance
DIW	German Institute for Economic Research
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GMM	General Method of Moments
HS	Harmonized System
IFS	International Financial Statistics
ILO	International Labor Organization
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification
IT	Information Technology
IV	Instrumental Variables
IZA	Institute for the Study of Labor
NACE	Classification of Economic Activities in the European Community (Nomenclature Générale des Activités Économiques)
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
OeNB	Austrian National Bank
OLS	Ordinary Least Squares
PPS	Purchasing Power Standard

R&D	Research and Development
SME	Small and Medium-sized Enterprises
UN	United Nations
UN COMTRADE	United Nations Commodity Trade Statistics Database
UNCTAD	United Nations Conference on Trade and Development
UK	United Kingdom
US	United States
WTO	World Trade Organization

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Chapter 1

Introduction

The fall of the Communism and the ongoing integration of the global economy are affecting the living conditions within countries in several ways. The magnitude of this shock becomes obvious as 29 percent of the world population lived in Communist countries while only 16 percent in OECD countries.[1] Thus, almost over night, around 1.6 billion people entered the world market by supplying factors and demanding goods and services. Apparently, the dramatic process of worldwide economic integration leads to immense increases and shifts in trade, capital as well as migration flows. The increased possibility of international transactions allows a better allocation of factors and goods. Thus, great opportunities arise for the economic development. Particularly, the worldwide trade and capital flows increased enormously during the last decades. As many economists and the theory of international trade suggest, the worldwide welfare should benefit from the economic integration. However, even if the whole world might gain, the outcome may differ for an individual country, group of persons or even a single person.

During the last decades, the globalization of economic relations became increasingly the focus of the political and economic discussion. The costs and benefits of globalization evoke controversial debates. Which countries might gain from the worldwide economic integration: highly developed countries or less developed countries? The multiple shocks of globalization lead not solely to a reallocation of economic activities between countries. Moreover,

[1] The numbers refer to 1990; own calculations based on data from the Federal Statistical Office of Germany and the OECD.

the globalization process produces winners and losers inside countries as well. Different social classes, people with different educational levels as well as geographical regions within each country are affected by the global political, economic and technical developments in different ways. Therefore, the process of globalization raises various fears of people in highly developed as well as in emerging countries.

There are several channels through which such an external globalization shock affects countries. The main feature of the process of globalization during the recent decades was the rapid increase in international outsourcing and foreign direct investment.[2] International outsourcing refers to the fragmentation of the production process in sequential stages. This slicing-up allows that the activities can cross international borders. The international fragmentation can take place within the boundaries of the firm or in form of arm's-length transactions. While the former implies vertical foreign direct investment, the latter corresponds to imports of intermediate inputs from foreign markets. This thesis will explore the effects of both types of international outsourcing.

Previously, international outsourcing was associated with the relocation of low-skilled workers' jobs from developed countries to emerging countries. Today, however, even high-skilled workers in rich countries are threatened by the competition from low-wage countries. This process highlights a new phenomenon in international outsourcing. In the case of Europe, the former wave of international outsourcing occurred immediately after the fall of the Communism. In the most recent years, high-skilled workers in Western Europe are increasingly affected by the competition from former Communist countries. Two Western European countries are at most affected by the opening-up of Eastern Europe: Austria and Germany. I will concentrate my analysis on these two countries.

Since the beginning of the 1990s, Austria and Germany have experienced multiple shocks of globalization. Besides the ongoing global integration, the deepening integration of the European Union, and the IT revolution, both countries were particularly affected by the fall of the Iron Curtain in 1989 and

[2] See Krugman (1995) and Feenstra (1998).

subsequently the large eastern enlargement of the European Union in 2004. Before, the Iron Curtain intersected Europe for more than 40 years. Europe was divided into two parts; Eastern and Western Europe.[3] Furthermore, Austria's accession to the European Union in 1995 has certain impacts on its economy. Moreover, Germany is specifically affected since the Iron Curtain divided the country internally in East and West Germany. After the reunification, Germany lies now in the center of the European market. On the other hand, Austria is fairly closely located to Eastern Europe in terms of geography but also in terms of culture and economic relations. All theses events are reflected in changes in the volume and pattern of trade, foreign direct investment, and international outsourcing.

In this thesis, I will focus on two subjects which both correspond to internal effects of international outsourcing. First, the thesis addresses the following question: What impacts does international outsourcing have on the relative demand for human capital in Austria and Germany? Usually, outsourcing is assumed to have a skill-biased effect. The existing studies in this field conclude that the international fragmentation favors high-skilled labor. I aim to assess if this is also true for Austria and Germany when considering the recent years. Secondly, I examine the location determinants of outsourcing FDIs in Eastern Europe. In which regions do outsourcing-oriented affiliates of Austrian and German investors locate? Furthermore, I consider the trends in the spatial organization of production in Central Europe which is affected by the locations of foreign subsidiaries.

As starting point, Chapter 2 reviews the theoretical background of factors which influence the relative demand for skilled labor. Moreover, it outlines alternative approaches for explaining the trends in labor market. In a further section, I concentrate on the impacts of international outsourcing as driving force of the labor market outcomes. Additionally, the chapter provides a broad overview of related empirical studies for different countries.

The subsequent Chapter 3 focuses on the impacts of international outsourcing on the German labor market. The contribution of this investigation

[3] In 1990, around 48 percent of Europe's population lived in former Communist countries. (Source: Own calculations based on data from the Federal Statistical Office of Germany.)

to related empirical studies on Germany lies in the following factors. First, facing a striking shift in the pattern of outsourcing sectors in the most recent years, I employ a sample which reaches from the year after the German reunification to recent years of present decade. This extended time period allows to capture the effects of the shift in outsourcing towards high-tech sectors. Secondly, prior empirical examinations of Germany find evidence for the positive impact of outsourcing on the demand for human capital. However, re-estimating those results by employing a proper econometric specification reveals that the found evidence appears extremely weak. Therefore, I estimate the impacts of outsourcing while taking into account alternative explanations, like technological change. Furthermore, I inspect trends of individual sectors in a detailed analysis.

Chapter 4 concerns with the effects of international outsourcing on Austria's human capital. Rarely any other western country has gotten more of a taste of Eastern Europe's opening-up and its consequences than Austria. And as a small and open economy, it gets notably involved in it. This chapter examines the impacts of international fragmentation on the labor market outcomes of high-skilled and low-skilled workers in Austria. The investigation is based on data of the recent period 1995-2003. It allows to capture the effects of Austria's accession to the EU, as well as, the consequences of Eastern Europe's integration with Austria. In addition, I consider the effects of several parameters of the technological change on the demand for skills.

Chapter 5 investigates on the economic geography of the Central European region which was divided by the Iron Curtain. Will there a 'new' Central Europe emerge? Thus, I consider the major trends in industry location in the Central European countries along the former Iron Curtain. They are Austria and Germany in Western Europe and the Czech Republic, Hungary, Poland, and Slovakia in Eastern Europe. In a second part of this chapter, I examine econometrically the determinants of location choice of Austrian and German FDIs in the border regions of Eastern Europe. Particularly, I focus on the location of outsourcing FDIs.

Finally, Chapter 6 provides a summary of the main findings of the thesis.

Chapter 2

Outsourcing and the Demand for High-Skilled Labor: Theory and Empirical Literature

This chapter gives an overview of the theoretical background of the topic on how international outsourcing affects the labor market outcomes of high-skilled and low-skilled workers. After considering some alternative candidates for explaining the labor market trends, I focus on the theoretical model of Feenstra and Hanson (1996a) about international outsourcing. In a second part of the chapter, I review existing empirical studies on the impacts of outsourcing on the labor market in different countries.

2.1 Theoretical Background

2.1.1 Technology and Trade

Since the appearance of a strongly widening wage gap in the United States during the last two decades, there is a theoretical debate on possible factors explaining this trend. Despite the broad consensus that the relative demand shift towards more-skilled labor took place mostly within sectors, there is still disagreement on the question; what factors could be responsible

for these changed labor market outcomes? Since several parameters simultaneously changed in an substantial manner during the last decades, they all come into consideration.

Initially the skill-upgrading of employed labor was attributed to technological change. In an empirical assessment, Bound and Johnson (1992) identify the skilled labor bias of technical change as the major cause for the increased wage divergence in the US during the 1980s. Controlling for shifts in product demand and labor supply of different skill groups, they emphasize on the computer revolution as the principal source of the increase in educational differences within sectors. Berman *et al* (1994) mainly confirm these results from the period 1979-1987 by investigating the shift in relative demand towards skilled labor in 450 US manufacturing industries. Since the shift of labor demand takes place mostly within sectors, they argue that international trade cannot be an important determinant. Additionally, import shares and outsourcing are simply too small to account for a substantial part of the skill-upgrading. Their empirical analysis shows that investment in computers and R&D expenditures together can explain approximately 50 percent of the changed labor market outcomes. In a related paper, Berman *et al* (1998) undertake a similar estimation for ten developed countries and find strong evidence for pervasive skill-biased technological change across countries.

Autor *et al* (1998) also find evidence on positive influence of technical progress and computerization on within-sector skill-upgrading in the US. Their long-run examination indicate that the relative demand for high-skilled workers rose more rapidly during the more recent period (1970-1996) than during the previous decades in the middle of the century (1940-1970). Their empirical analysis shows that skill-upgrading takes place particularly in more computer-intensive sectors. Card and DiNardo (2002) remark critically that skill-biased technical change to which the rise in wage inequality in the US labor market during the 1980s was usually attributed, is not adequate to explain the labor market trends in the 1990s. A fundamental problem for the hypothesis of skill-biased technical change is that wage inequality stabilized

in the 1990s, despite continuing advances in computer technology.

International trade comes into consideration as second candidate for explaining the skill-biased demand shift. However initially, many researchers came to the conclusion that increased competition from low-wage countries cannot explain the shift in the rising relative demand for skills. Feenstra and Hanson (2003) discuss three reasons why trade is thought to have played a minor role in many studies.

First, trade in general and especially with developing countries would be too small to explain significantly the relative demand shift for skills. This view is supported by low shares of trade in GDP, particularly for the US.[1] Arguing that a general shift away from merchandise towards services distorts the numbers, the picture changes taking only into account merchandise trade with merchandise value-added. This merchandise ratio has grown substantially between 1913 and 1990 in virtually all developed countries but not in the US and Japan. Furthermore, the composition of worldwide merchandise trade experienced a shift towards intermediate goods over time.

The second reason why trade is not an important factor in explaining the changes in labor market outcomes relates to sectoral bias in price changes due to international competition. Import competition from low-wage countries should lower prices of low-skill intensive goods relative to more-high-skill intensive goods. However, prices of low-skill intensive goods rose in the 1980s. According to the Stolper-Samuelson theorem,[2] this should result in higher relative wages for low-skilled workers.[3] Observing exactly the opposite let Lawrence and Slaughter (1993) state that price changes could not explain the rising relative wages of high-skilled workers. However, Feenstra and Hanson (2003) argue that taking into account imports of intermediate inputs which may differ in their factor intensities compared to domestic products, the

[1] Krugman (1995) and Feenstra (1998) states that for many developed countries the trade share in GDP in 1970 was not higher than before World War I.

[2] See Stolper and Samuelson (1941)

[3] See Leamer's (1998) analysis of Stolper-Samuelson effects on relative wages in the US. He states that goods prices rather than trade volumes matter. Krugman (2000) contradicts this view and notes that trade volumes are not irrelevant. He considers that the absence of trade volumes in the Stolper-Samuelson theorem which displays a thought experiment of the relation between goods and factor prices, does not mean that volumes are irrelevant to infer the impact of trade on factor prices.

story changes. They mention that domestic prices within individual sectors have grown faster than import prices. These price movements confirm the importance of international outsourcing for explaining the observed wage movements.

Thirdly, international trade should cause an expansion and a contraction of particular sectors, respectively, resulting in a movement of workers between sectors and not within sectors. However, in the US as in many other countries the reallocation of workers occurred mainly within sectors. Some authors conclude that due to the minor role of between sectoral shifts trade cannot be a dominant factor in determining relative wages. Feenstra and Hanson's (1996a) model presented below goes further into the question whether international trade can be related to movements within sectors.

In a related study on the interactions among technology, trade and domestic outsourcing of services, Morrison and Siegel (2001) find that technological change has a stronger impact on changes in labor composition favoring high-skilled workers, than imports and service outsourcing. Using data on 450 US manufacturing industries for the period 1959-1989, they estimate a dynamic cost function to capture direct and indirect effects as well as short and long run impacts. Their results indicate that technological change and particularly computerization simultaneously reduces the demand for low-skilled workers and increases the demand for more highly educated workers. Investment in computers and R&D appear to have the largest potential cost-saving impact and the largest positive impact on college educated workers, while outsourcing services activities domestically has the smallest. Furthermore, trade stimulates computerization, which exacerbates the direct negative impact of trade and technology on the demand for workers without a college degree, and augments the positive effects on the demand for workers with a college degree. Morrison and Siegel (2001), however, do not examine the mechanism by which trade stimulates computerization.

While the standard Heckscher-Ohlin theory of trade explains trade in goods which differ in their factor intensities between differently endowed countries, the new trade theory predicts trade flows between similar coun-

tries. Based on the concept of economies of scale, models of the new trade theory were developed in the late 1970s as a reaction to the empirically observed increasing share of trade between advanced and similar countries. However in the last decades, the new phenomenon of international outsourcing implied a change in the composition and the pattern of trade.[4] A change in the composition occurred with respect to the increasing relative importance of intermediate goods at the expense of final goods which is induced by the increasing international fragmentation of the production process. At the same time in many developed economies, an increasing share of imports from low-wage countries in total imports is observed in recent years. Developed countries are threatened by import competition from Asian as well as Latin American countries, and particularly Western European countries feel a pressure originating from imports from Eastern Europe. This new trend leads to a recovering of the factor-proportions framework.

Feenstra and Hanson (1996a) provide a theoretical model on the impact of international outsourcing on the relative demand for skills. They argue that ignoring the phenomenon of outsourcing misses an increasingly important channel through which international trade affects the labor demand for different skill types within industries. Starting from the empirical fact of a rising wage gap in the US and Mexico, as well, they introduce trade in intermediate goods in a Heckscher-Ohlin framework.[5] The factor-proportions theory models only trade in final goods which differ in their factor intensities. Countries specialize in producing goods in which they have a comparative advantage. Opening of countries to foreign trade implies a sectoral shift towards industries in which the specific country has a cost advantage compared to its trading partners. If the country is relatively well endowed with high-skilled labor, specializing in skill-intensive sectors results in an increased demand for high-skilled workers relative to their low-skilled counterparts, the second factor of production. Therefore, trade in final goods implies a shift in employment *between* sectors. The factor of production that is used inten-

[4] See Hijzen *et al* (2003).

[5] Krugman and Obstfeld (2003) present in their text book the standard Heckscher-Ohlin model. In an extension of this model, Dornbusch *et al* (1980) allow for a continuum of goods instead of only two discrete goods.

sively in the import-competing sector is hurt. It means that the country's abundant factor gains, while the scarce factor loses. This is true in relative as well as absolute terms. Additionally, the Heckscher-Ohlin model predicts the equalization of factor prices between trading partners which means that factor prices move in the US and Mexico in opposite directions. It does not accord with the empirical fact of increasing relative wages in *both* countries. However, the Heckscher-Ohlin theory cannot explain how trade in intermediate goods affects the labor market outcomes. The role of this growing part of international trade in the relative demand for skills is the subject of Feenstra and Hanson's (1996a) model.

2.1.2 International Outsourcing

Feenstra and Hanson (1996a) apply a Heckscher-Ohlin set-up with two countries, North and South. Each country is endowed with three factors of production; low-skilled labor L_i, high-skilled labor H_i, and capital K_i. Their respective factor prices are denoted by w_i, q_i, and r_i, where i indicates North N and South S, respectively. They presume that the North is relatively well endowed with high-skilled labor and capital, while the South is abundant in low-skilled labor. In contrary to the two types of labor which are only mobile between sectors, capital can flow freely between countries if foreign investment is not restricted. However, the skill structure of labor supply is not exogenously fixed in the long-run. The supply will respond to changes in relative factor prices of low-skilled and high-skilled labor. It can be thought of increased incentives for investing in education in the case of an increase in relative wages of high-skilled labor. Furthermore, the relative factor endowments differ sufficiently so that the factor prices are not equalized between North and South. According to the factor-proportions theory, these relative endowments are reflected in South's higher returns to capital, $r_S > r_N$, and higher relative wages of high-skilled workers, $q_S/w_S < q_N/w_N$.

On the production side, Feenstra and Hanson (1996a) assume that a homogeneous final good is produced using a continuum of intermediate goods as inputs, indexed by $z \in [0, 1]$, which can be traded internationally. The

assembling from intermediate inputs into the single manufacturing good Y is assumed costless. However, producing each unit of the intermediate input z requires all three factors of production. While capital enters the production of each input in a constant proportion, the inputs differ with respect to the factor content of high-skilled and low-skilled labor. Moreover, capital $K(z)$ can substitute labor modeled as a Cobb-Douglas production function. As the term in brackets in equation 2.1.2 shows, the two types of labor are combined in a Leontief style, where $a_L(z)$ and $a_H(z)$ indicate the usage of low-skilled and high-skilled labor per each unit of input, respectively. The intermediate inputs are ranked increasingly in their high-skill intensity, represented by the ratio $a_H(z)/a_L(z)$.

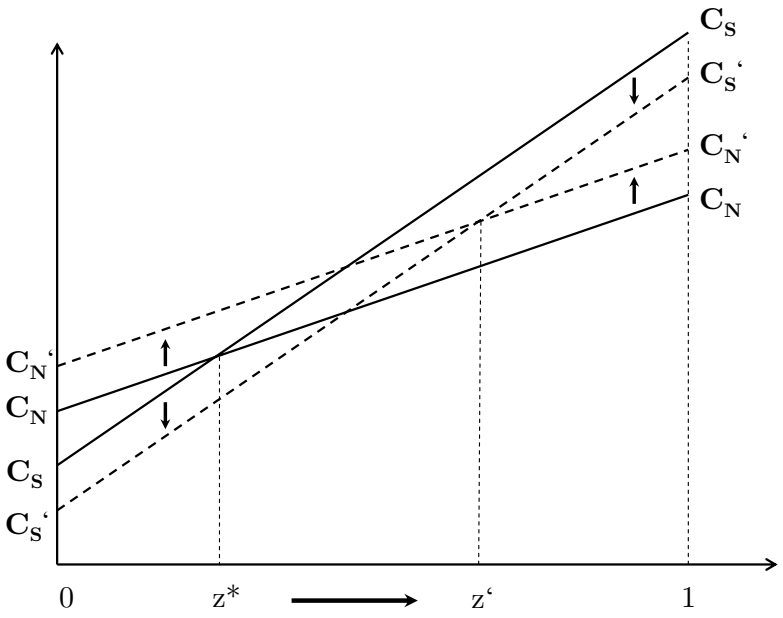
$$x(z) = A_i \left[min \left\{ \frac{L(z)}{a_L(z)}, \frac{H(z)}{a_H(z)} \right\} \right]^{\theta} K(z)^{1-\theta} \tag{2.1}$$

A_i refers to differences in the production technology between both countries. The production function corresponds to the following minimum unit cost function of producing each intermediate input $x(z)$:

$$c(w_i, q_i, r_i; z) = B_i \left[w_i a_L(z) + q_i a_H(z) \right]^{\theta} r_i^{1-\theta}, \tag{2.2}$$

where B is a constant. The unit cost depend on the prices of the three employed factors of production where the content of low-skilled and high-skilled labor is by definition a continuous function of z. Figure 2.1 shows for fixed wages the loci of minimum costs for producing intermediate inputs ranked regarding to ascending z. Line $C_S C_S$ depicts the minimum unit cost for firms in the South, and $C_N C_N$ correspondingly for the North, assuming that all types of inputs are produced in both countries.

The figure indicates the ranges of inputs which are produced in North and South according to the comparative cost advantage, respectively. Each country specializes in the production of a different set of intermediate goods, thus leading to international trade in inputs that originates in differences in factor endowments between countries as in the Heckscher-Ohlin model.



Source: Feenstra and Hanson (1996a), p. 94.

Figure 2.1: Minimum Unit Costs of Inputs

Although the absolute slopes of the minimum cost lines cannot be determined by assumptions of the model, their relative slopes are determined. Because of the low relative wages of low-skilled workers in the South, Southern firms have a comparative advantage in producing inputs using low-skilled labor intensively. The more high-skilled labor is relatively used, the more the comparative cost advantage of the South diminishes. Along the horizontal axis only the mixture of using the two types of labor changes, while capital enters for all input goods z with the same cost share $(1-\theta)$. The intersection of the two minimum cost lines z^* marks the marginal input good where the unit costs are equalized in both countries. The production of inputs $z < z^*$ takes place in the South, while the North produces the more high-skill intensive inputs $z > z^*$. Therefore, both countries specializes in producing inputs in which they have a comparative cost advantage. For the trade pattern, it implies that the South exports low-skill intensive inputs, while the North exports high-skill intensive inputs.

If the initial restrictions on international capital flows are removed, e.g. in the case of an economic integration, Northern firms have an incentive to

invest in the South since the returns to capital are higher in the capital scare country. What impacts does a capital flow from the North to the South have on relative wages of the two skill groups? Assuming further on that the wages for low-skilled and high-skilled workers are constant, the international capital movement leads to higher returns to capital in the North on the one hand and on the other hand to lower returns in the South. The cross border investments imply a convergence in endowment with capital between North and South. As Figure 2.1 shows, it lowers the minimum cost line in the South to $C'_N C'_N$ and raises the unit costs in the North to $C'_S C'_S$. The increasing capital stock in the South relative to the North shifts the dividing input z^* upwards in skill intensity. Thus, the new marginal input good z' uses high-skilled labor more intensively than formerly. Consequently under the presumption of unchanged wages, the South has now a cost advantage in producing inputs in the wider range $[0, z')$ resulting in a broader variation of skill intensity across activities. The gaining of the transitory activities $[z^*, z')$ which are relatively high-skill intensive from the Southern perspective but low-skill intensive from the Northern perspective, results in an increased relative demand for high-skills in the South. Analogously under the new critical value z', the Northern input production concentrates on more skill-intensive activities leading to an upward shift in the relative demand for skills. Finally, *both* countries experience at constant wages an increase in the relative demand for skills originating from an upgrading in the average skill intensity of produced inputs.

Feenstra and Hanson (1996a) propose that unambiguously the relative wages of high-skilled workers will raise in the North as well as in the South and the relative number of workers employed in producing inputs will remain constant or, depending on the labor supply elasticity, increase. Which means the relative demand for high-skilled labor increases in *both* countries, in North and South. Furthermore, Feenstra and Hanson (1996a) show that the Southern workers, both skill groups taken together, obtain a larger proportion of global factor compensations at the expense of workers in the North. Although the low-skilled workers in the North obtain a smaller share of global factor compensations all workers can possibly gain in real terms depending on the

price index and the country size, respectively. Moreover, the changes in relative capital endowments as driving force have not necessarily to be thought as foreign investments of Northern firms. The results hold also for an exogenous capital accumulation in the South relative to the North, $\hat{K}_S > \hat{K}_N$. Alternatively to changes in capital endowments, a technological progress in the South relative to the North, $\hat{A}_S > \hat{A}_N$, also leads to an increasing z^*.

Summarizing, in Feenstra and Hanson's (1996a) model, international outsourcing can be thought of an "endogenous technical change" in the following sense; outsourcing low-skill intensive stages of production in order to seek low costs, is comparable to a cost-reducing innovation that lowers the relative utilization of low-skilled labor. Feenstra and Hanson emphasize the factor bias of outsourcing which induces skill-upgrading domestically and abroad. Thus, outsourcing has similar effects as skill-biased technical change affecting the skill structure of labor demand *within* sectors. The relocation of low-skill intensive parts of the value added chain depresses the relative demand for low-skilled labor within each sector. This within-sector shift in factor intensities contradicts the common view, as the Heckscher-Ohlin model predicts, that international trade can cause only a shift *between* sectors.

Glass and Saggi (2001) approach theoretically the effects of international outsourcing on wages and in particular on innovation. Outsourcing from the North to low-wage countries causes a decline in Northern wages where in this model labor is not distinguished with respect to skills. Based on a product cycle model, they show that risen profits of Northern firms resulting from imported inputs at lower costs, increases the incentives for innovating. Thus by increased innovation, international outsourcing can potentially offset the initial decline in Northern wages. Glass and Saggi (2001) see their model as a complement to Feenstra and Hanson (1996a) by determining the impact of international outsourcing on the rate of innovation.

The different theoretical approaches suggest that it is mainly an empirical question whether international outsourcing is a sufficiently large phenomenon in order to account for the observed changes in labor market outcomes.

2.2 Empirical Literature

The empirical literature on the relationship between international outsourcing and the relative labor demand shifts in favor of skills was initially shaped by the experience in the US of a dramatic widening of the wage gap between low-skilled and high-skilled workers. Consequently, the debate on explaining factors of this development was raising. The debate results mostly in the empirical discussion whether skill-biased technical change on the one hand or on the other hand international trade and outsourcing are responsible for the deteriorating situation of low-skilled workers. Focusing on the latter factor, this section gives an overview of the existing empirical studies on this topic examining different countries and using various measures of outsourcing.[6] Table 2.1 at the end of this chapter gives an overview of the existing studies and summarizes their major results.

Feenstra and Hanson (1996a, 1996b, and 1999) are the first who address the rising wage inequality to international outsourcing. The starting point of their analysis is the empirical finding of a widening wage gap in the United States and simultaneously in Mexico during the 1980s. The authors put these very similar trends in both countries in the context of the trade and investment liberalization facing the NAFTA integration. Their results suggest that outsourcing contributes substantially to the increase in relative wages.

For their first empirical assessment of the role of international outsourcing in the observed shift in labor market outcomes in the US, Feenstra and Hanson (1996a) apply a fairly broad definition of outsourcing. Using import data at the level of 436 sectors they measure international outsourcing as the share of imports in domestic demand. The annual changes in these import shares more than doubled in the 1980s compared to the three preceding decades. Simultaneously, the same happened to the non-production workers' wage bill share. Applying the estimation technique of Berman *et al* (1994) to the sample period 1959-1987, they extend these regressions by their outsourcing definition as additional explanatory variable. Feenstra and

[6] Feenstra and Hanson (2003) and Lübker (2005) provide comprehensive reviews of existing empirical literature about outsourcing and relative demand for skills.

Hanson's (1996a) main finding is that outsourcing accounts for 15 to 33 percent of the increase in the relative demand for non-production workers in US manufacturing. The contribution depends not only on the specification but also on the period under consideration. The highest value, 33 percent, refers to the sub-period of the 1980s.

In a following-up study on the US, Feenstra and Hanson (1996b) use a less general definition of outsourcing. They combine import data with data on purchased inputs at the disaggregated level of 435 four-digit SIC industries for the period 1972-1990. The resulting narrower definition approximates outsourcing by the share of imported intermediate inputs in totally purchased non-energy inputs. Where this share increased rapidly by 0.33 percentage points per year during the 1970s and 1980s, 11.6 percent of material purchases were imported in 1990. Regressing, as in Feenstra and Hanson (1996a), the non-production workers' wage bill share on outsourcing, they find quite different results for the 1970s and 1980s. While in the period 1972-1979 outsourcing has no statistically significant effect on the relative labor demand, the impact of outsourcing is highly significant and positive in the period 1979-1990. In the later period, 31 to more than 50 percent of the increase in the wage bill share can be explained by international outsourcing. Since the results are somewhat stronger than the results obtained by Feenstra and Hanson (1996a), this measure of outsourcing seems to be preferable to the general import share.

According to a more recent work of Feenstra and Hanson (1999), even the definition of outsourcing in Feenstra and Hanson (1996b) appears to be too general. Outsourcing measured in a stricter way might be more relevant since international outsourcing represents the shift of activities abroad which were done formerly in the US within the boundaries of the firm. Thus, Feenstra and Hanson define outsourcing now be restricting it to those inputs that are imported from the same two-digit SIC industry abroad as the good being produced in the US. Using this narrow definition, outsourcing can also be defined as the difference between the broad definition as in Feenstra and Hanson (1996b), and the narrow definition.[7] Moreover, they include as

[7] In Section 3.3.2 of Chapter 3 I will show in more detail the definitions of these

a further structural variable, technical change in their regression measured as expenditures on high-technology capital such as computers. Employing the same basic dataset as Feenstra and Hanson (1996b), the results of the re-estimation indicate that total outsourcing can explain 13-23 percent of the shift towards non-production labor, while technology accounts for 8-32 percent depending on the specification of technological change. Distinguishing total outsourcing in narrow outsourcing and the difference, it follows that narrow outsourcing (11-15 percent) is more important in explaining the skill-upgrading than difference outsourcing (2-8 percent).

Furthermore, Feenstra and Hanson (1999) develop a new methodology to gauge the relative importance of trade against technology for explaining wages. Additionally, in order to resolve the conflict in the literature whether factor-biased or sector-biased technological change affects relative wages, they use a two-stage estimation procedure to endogenize product prices in a first stage. In a second stage using a price regression, changes in factor prises can be attributed to the decomposed contributions of outsourcing and technology. Incorporating the Stolper-Samuelson mechanism, they find that both outsourcing and computers play an important role in explaining the increase in relative wages, where the latter factor, contributing 35 percent, is more than twice as large as the former.

Anderton and Brenton (1999) consider the impact of outsourcing on relative wages and employment of low-skilled workers in the UK. They focus their analysis on the textiles and non-electrical machinery industry during the period 1970-1986.[8] The authors argue that textiles are representing a low-skill intensive sector, while non-electrical machinery is characterized by using intensively high-skilled labor. The main contribution of their paper is the disaggregation of UK's imports according to different groups of source countries in order to examine whether the source of imports matters. Criticizing former empirical studies which proxy outsourcing by overall imports[9] or imported intermediate inputs[10] from all countries, they distinguish between

outsourcing measures.

[8] The two broad industries are disaggregated to 11 sectors at the 4-digit ISIC level.

[9] For example Feenstra and Hanson (1996a).

[10] For example Feenstra and Hanson (1996b, 1999).

imports from industrialized countries and imports from low-wage countries. Thus, Anderton and Brenton (1999) use as proxy for outsourcing the share of imports solely from low-wage countries in each sector's domestic demand. Trade in final as well as intermediate goods with low-wage countries might shift relative demand away from low-skilled towards high-skilled workers in high-wage countries like the UK. In contrast to other empirical studies, they argue that trade in final goods can also cause a relative demand shift within industries, since outsourcing applies not only to intermediate goods but also to finished. Anderton *et al* (2002a) stress some examples where firms outsourced selected stages of production or the whole production process to abroad and import the final goods for marketing and sale in the domestic market.

Their estimation results indicate that imports from low-wage countries have a significantly negative impact on low-skilled workers in the UK measured by the wage bill share of high-skilled workers and alternatively by their employment share. However, they cannot find any significant impact of imports from industrialized countries on low-skilled workers' economic fortunes. Furthermore, their estimates suggest that imports from low-wage countries may account for around 40 percent of the increase in the wage bill share of high-skilled workers in the textiles sector. Additionally, they find some empirical evidence that low-skilled workers in sectors which use this factor intensively, are more affected by outsourcing than their colleagues in more skill-intensive sectors.

In contrast to Anderton and Brenton (1999) who use import penetration measuring outsourcing, a recent study of Hijzen *et al* (2003) analyzing the effects of outsourcing for UK's labor market employs imported intermediate inputs as measure for outsourcing. They take data for 53 manufacturing industries from input-output tables for the period 1982-1997. Furthermore, the employed labor market data allow them to define finer skill groups based on information on qualification and experience, instead of the rough distinction between non-production and production workers. They find for UK's quite flexible labor market a significant increase in the skill premium, while relative employment of high-skilled workers remained unchanged. At the same

time, narrowly defined outsourcing remained constant during the 1980s at 11 percent of value added and increased to 19 percent in 1995 which indicates that outsourcing is predominantly a phenomenon of the 1990s. Furthermore, they observe a sectoral shift in outsourcing over time. While outsourcing was more pronounced in 1984 in low-skill intensive sectors, in 1995 firms of the high-skill sectors pushed up clearly their outsourcing activities in contrast to a slightly falling outsourcing of low-skill sectors.

The regression analysis of Hijzen *et al* (2003) provide empirical evidence of a significantly positive influence of outsourcing on the relative demand for skills. In particular, the narrow measure of outsourcing contributes more than 50 percent to the labor demand shift. While the difference definition of outsourcing is not significant when difference and narrow outsourcing are simultaneously included, narrow outsourcing accounts for about half of the increase in skilled labor cost share. The results do not change when replacing the wage bill share as dependent variable by the employment share. Moreover in all specifications, technical change favors high-skilled workers. Using import penetration alternatively to outsourcing of intermediate inputs, Hijzen *et al* (2003) confirm the results of Anderton and Brenton (1999) that increased import competition from low-wage countries has a stronger impact on relative demand for skills than imports from developed countries.

In a further study, Anderton *et al* (2002a) summarize the results of some of their empirical works. They examine in very similar set-ups the role of outsourcing on the labor market inequality in four industrialized countries whose labor markets differ fundamentally; in the UK, the US, Sweden and Italy. Thus, they separate for each analyzed country between imports from low-wage and high-wage countries at a highly detailed industry level. In their empirical analysis, the authors supplement the standard variable cost function by an import penetration term capturing the firms' incentives to outsource low-skill parts of the production process.

Their empirical results demonstrates the significantly negative impact of imports from low-wage countries on the economic fortunes of low-skilled workers in all examined four countries. Additionally, they find that technical change plays an important role in rising wage and employment inequality dis-

favoring low-skilled labor.*et al* (2002a)[11] For the US, Anderton and Brenton (1998) distinguish 40 manufacturing sectors according to their skill intensity during the period 1970-1993. In the low-skill as well as high-skill intensive sectors the strongest increase in the wage bill and employment inequality occurred in the period 1978-1986. The estimation results indicate that increasing import competition from low-wage countries attributes significantly to the declining relative demand for low skills. However, this is only the case in low-skill intensive sectors. Contrary to low-skill intensive sectors, technical change can explain substantially the rising inequality in more high-skill intensive sectors.

In contrast to the UK and the US, Sweden is a much smaller but more open economy. Additionally, Sweden poses strong regulations concerning the labor market compared to the highly flexible labor markets in the two Anglo-Saxon economies. During the sample period 1970-1993, skill-upgrading took place almost exclusively in Sweden's high-skill sectors. Furthermore, due to strong labor market institutions, virtually only the employment side was affected, while the skill premium remained constant. Anderton *et al* (2002a)[12] find that import penetration measured in volume terms have a significantly positive impact on the employment and wage bill share of high-skilled workers, but only for imports from low-wage countries as in the case of the UK and the US. However, they report a quite interesting result for the import competition by OECD countries. High-skilled workers in Sweden are affected negatively by imports from OECD countries, in the employment share as well as wage bill share. Another notable result is that the impact of imports from low-wage countries on the relative demand for skills seems to be larger for high-skill intensive sectors than for low-skill intensive sectors. Furthermore, technical change affects positively the relative high-skilled workers' demand but the effect is statistically significant only during the recession period of 1990-1993. For the entire sample period, outsourcing to low-wage countries account for about 25 percent of the shift in employment share, while technical change contributes more than 50 percent.

[11] The detailed results for the UK are already shown in Anderton and Brenton (1999).
[12] The results for Sweden are shown in more detail in Anderton *et al* (2002b).

For Italy, Brenton and Pinna (2001) report a decrease in employment share of blue-collar workers by 12 percentage points between 1973 and 1995, while the wage bill share declined by 7 percentage points. This reflects a more pronounced adjustment of employment rather than wages, as in Sweden. Moreover, until the mid-1980s, mainly Italy's powerful trade unions caused a compressing wage gap between high- and low-skilled workers. Because of this fact, Brenton and Pinna (2001) find no influence of economic variables in the developments of labor market outcomes in the 1970s. However in the 1980s and early 1990s, import competition from low-wage countries affects the relative demand in favor of high skills but significantly only in Italy's high-skill intensive sectors. In these sectors, import penetration accounts for about one third of the rise in employment share, while technical change has no significant impact. According to the econometric results for low-skill intensive sectors, technical change puts contrary to high-skill sectors significant pressure on skill upgrading, while outsourcing does not determine the relative labor market outcomes.

A similar study was undertaken by Hsieh and Woo (2005) for Hong Kong's labor market. The opening-up of China's economy to foreign investors in 1979 leads to a tremendous relocation of low-skilled jobs from Hong Kong to China.[13] At the same time, a large movement of workers from manufacturing to outsourcing services and an increased utilization of skilled labor within manufacturing occurred in Hong Kong. Hsieh and Woo report a sharp increase in the share of non-production workers in total manufacturing employment from 17 percent in 1981 to 48 percent fifteen years later on. Feenstra and Hanson (2004) mention Hong Kong's specific role in intermediating trade between China and the rest of the world.[14] It confirms that Hong Kong is specializing in trading and outsourcing services. Hsieh and Woo (2005) use two alternative measures for outsourcing; the share of imports from China in the sum of domestic shipments and imports from China and as a second

[13] Hsieh and Woo (2005) refer to this development as "perhaps the largest case of increased outsourcing in world history".

[14] So in 1998, total trade accounts for 259 percent of Hong Kong's GDP, see Feenstra and Hanson (2004). Also Krugman (1995) mentions Hong Kong's role as supertrader where Hong Kong was in 1990 behind Singapore the second largest supertrader worldwide.

measure, the intermediate inputs imported from China as a fraction of total intermediate inputs. As the OLS regression analysis shows, both measures of outsourcing have similar impacts on non-production workers' wage bill share. An instrumental variable estimation confirms the result of a significantly positive effect of outsourcing to China on the within-industry skill-upgrading. The authors conclude that outsourcing to China can explain 40 to 50 percent of skill upgrading in Hong Kong's manufacturing sector.

In the case of France, Strauss-Kahn (2003) identifies a substantial contribution of outsourcing to the deteriorating situation of low-skilled workers. She calculates an index of vertical specialization measuring international outsourcing at the level of 50 industries by the share of imported inputs in production. Over the period 1977-1993, vertical specialization of France's manufacturing sector rose strongly from 9 to 14 percent. Arguing that the French labor market is highly inflexible, Strauss-Kahn (2003) focuses her analysis on changes in relative employment rather than on relative wages which did not change significantly over the past three decades. According to her findings, outsourcing accounts for 11 to 15 percent of the within-industry decline in low-skilled workers' employment share over the period 1977-1985 and for about 25 percent over the period 1985-1993 which corresponds to an observed acceleration in outsourcing.

The presented results indicate that foreign outsourcing is associated in almost all countries with an increased demand for high-skilled labor. However, all mentioned studies show less evidence on the question what form the outsourcing activities take. Imported intermediate inputs may reflect either arm's-length purchases from foreign suppliers or intra-firm imports from affiliates abroad owned by domestic firms. Slaughter (1995, 2000) examines empirically the role of foreign direct investment abroad in the evolution of US wage inequality. In contrast to a-priori guess, he finds that multinational outsourcing by FDI contributes very little to the widening wage gap in the United States.

Slaughter (1995) analyzes the role of outsourcing by US multinational companies in the within-sector demand shift towards more high-skilled labor. Primarily in order to exhaust international wage differentials, US multina-

tionals transfered in the 1980s low-skilled labor intensive activities from the US to foreign countries within the boundaries of a US-headquartered company. To test whether these multinational companies substitute between less-skilled production labor in the US and abroad, Slaughter (1995) estimates factor-price elasticities for demand for the period 1977-1989. Domestic production labor and production labor in foreign affiliates appear to be weak price substitutes. Additionally referring to stylized facts that indicate a slight decline in absolute and relative affiliates employment during the 1980s, he concludes that intra-firm outsourcing contributes very little to the rising wage inequality in the US.

In a further empirical assessment for the more recent period 1977-1994, Slaughter (2000) highlights evidence for increased transfer of production stages by multinationals to foreign countries. Although affiliates employment abroad declined in absolute terms during the whole sample period, it increased relative to total multinationals employment. Moreover, the absolute number of US-owned affiliates expanded in the period 1982-1994 after contracting earlier. Estimating a standard translog cost function, the US industry data provide no support for the hypothesis that multinationals' engagement abroad[15] contributes significantly to the within-sector skill-upgrading in the US. Slaughter (2000) states that this finding appears to be inconsistent with approaches where affiliate output substitutes for parent low-skill intensive activities.

In a related work on Japan, Head and Ries (2002) examine empirically the role of multinational enterprises in domestic demand for skills. They employ, however in contrast to Slaughter (1995, 2000), firm-level data on offshore production of Japanese companies pooled over the years 1965-1990. During this period, Japanese multinationals moved dramatically production activities offshore. While in the 1970s their foreign affiliates' employment was concentrated in low-wage countries, the distribution shifted towards more high-wage countries in the 1980s.

Head and Ries (2002) mention that the effects of vertical FDIs which are

[15] Slaughter (2000) uses five different measures for multinationals transfer: employment, wage bill, capital stock, value added, and value of intrafirm imports from foreign affiliates. He puts each of these sizes in relation to respective parents' numbers in the US.

associated with fragmenting the production process, on the skill intensity of domestic production depends on two factors: the stages outsourced and the relative factor endowments of the home and host country. They approach offshore activities of Japanese companies by the ratio of firm's overseas to worldwide employment. Estimating a translog cost function with industry-level data to reproduce Slaughter's (1995, 2000) results, shows that multinationals' foreign activities does not have a significant effect on the non-production workers' wage bill share. Whereas Head and Ries find a large positive influence of FDIs if they use their firm-level data which is consistent with vertical specialization. Furthermore, this strongly positive relationship depends on the income per capita of the host country. Moving activities offshore to low-income countries raises significantly the skill-intensity of domestic production, while this skill-upgrading effect diminishes as FDI moves towards higher-income countries. Additionally, Head and Ries (2002) find some evidence for skill-downgrading if stages of production are outsourced to countries with higher income per capita than Japan, as the US. Overall, the offshoring of Japanese multinationals can attribute about 9 percent to the increase in the share of non-production workers' wage bill. Head and Ries (2002) state that this marks a relatively small contribution compared to other studies' results. However, it has to be taken into account that they use a very narrow measure of outsourcing as concentrating only on intra-firm outsourcing. On the other hand, Campa and Goldberg (1997) mention in general a relatively low importance of imported inputs in Japanese manufacturing.[16]

For Germany and Austria, Geishecker (2002, 2005) and Egger and Egger (2003) performed analyzes on the impact of international outsourcing on the skill structures of the respective labor market. In conclusion, the results for both countries confirm the positive influences of international trade and outsourcing on the increased relative skilled labor demand found for most countries. I will present these studies in more detail in my investigation on Germany and Austria in Chapter 4 and 3, respectively.

[16] Campa and Goldberg (1997) state in a comparative analysis on external orientation of the manufacturing sector of Canada, the US, the UK and Japan that Japan shows a low general import and imported inputs share.

All studies presented so far in this section dealt with the the impacts of international outsourcing on labor markets of developed countries whose firms move production activities abroad and receives imports of intermediate inputs. Actually, there exists, however, still less evidence on impacts on countries which host outsourced stages of the production process. In which way are their labor markets affected? As seen, the theory predicts also for emerging countries as trading partners of developed countries, an increasing relative demand for high-skilled labor. In the following, I will take a look at three studies concerning host countries of outsourcing activities; one about Mexico and two about Eastern Europe.

An application of their theoretical model outlined in Section 2.1 undertake Feenstra and Hanson (1997) for a "Southern" country, Mexico. Based on the fact that Mexico has experienced a similar rise in wage inequality than the US, they are one of the first researchers analyzing the implications of foreign activities on labor movements in low-wage trading partners of developed countries like the US. In their empirical investigation on Mexico, Feenstra and Hanson (1997) argue that the rising wage inequality during the 1980s is linked to capital inflows from abroad. The capital transfer from the North to the South, here from mainly the US to Mexico, corresponds to a special form of outsourcing, the relocation of activities by multinationals across countries. According to their theoretical model (Feenstra and Hanson (1996a)), investments of Northern firms in the South cause an upward-shift in skill intensity of production in both countries resulting in higher skill premia.

Since Mexico has been relaxing its restrictions of foreign investments in the early 1980s, FDI increased tremendously flowing mainly into regions at the Mexico-US border. The emergence of US-owned assembly plants in these border regions suggests that the effects of foreign activities on labor demand might vary strongly across regions. Overall the share of FDIs in Mexico's total investments increased from 1.4 percent to almost 10 percent between 1983 and 1989. In their empirical analysis, Feenstra and Hanson (1997) use regional data on the number of foreign-owned assembly plants for nine industries over the period 1975 and 1988. They highlight a positive and significant influence of FDI on the relative demand for high-skilled labor. In

border regions where foreign activities are concentrated, FDI can account for 52 percent of the increase in the non-production workers' wage bill share. Separate estimations for relative wages and employment suggest that FDIs affect predominantly relative wages and not relative employment. Remarkably, while outward FDIs have been found by Slaughter (1995, 2000) to have no significant effect on domestic demand for skills in the United States, the opposite appears for inward FDIs in the case of Mexico which is one of the major low-wage trading partner of the US. To gage the effect of NAFTA which enacted in 1994, on Mexico's wage structure, Hanson (2003) examines recent trends in wages during the 1990s. He emphasizes that the regional wage dispersion within Mexico has widened which confirms the experiences for the 1980s. It highlights the exposure of regions to foreign markets as major force for regional wage differentials. Moreover, Hanson finds for Mexico a sustained increases in the returns to skill during the 1990s.

Bruno *et al* (2004) analyze the rapidly increased wage inequality between high-skilled and low-skilled workers in the three largest new EU members; Poland, Hungary and the Czech Republic. Facing the enormous inflow of foreign direct investment, the goal of their paper is to examine whether foreign capital transfer has contributed to the raise in the skill premium in these Central and Eastern European countries. During the transformation from planed to market economies, the countries have experienced a substantial widening in wage inequality. Bruno *et al* (2004) report for the Czech Republic and Poland an increase in skill premium from 1.4 to 1.8 between 1993 and 2000, while the relative wages have risen in Hungary from 1.9 to 2.3. Their sample consists of panel data on six sectors over seven years. In an initial specification where the three countries are pooled together, the impact of FDI on the wage bill share of non-manual workers is not significant. On the skill premium, however, the presence of foreign firms has a strongly positive impact which underlines the importance of multinationals for these transition countries. Pooling only the Czech Republic and Hungary together, the results appears to be robust. In the case of Poland, the results suggest that FDI is responsible neither for the increased relative demand for skills nor for risen relative wages. Concerning the specificity of Poland, Bruno *et al* (2004)

argue that the transition process took place at a slower pace in comparison to the Czech Republic and Hungary.

In opposite to Bruno *et al*'s (2004) results for Poland, Lorentowicz (2006) finds a highly significant impact of foreign firms on the skill-upgrading in Poland's manufacturing. She uses more aggregated data, 23 NACE manufacturing sectors, for the period 1994-2002. The results for this more recent period probably confirm the view of the former study regarding the pace of Poland's transition process. Between 1990 and 2002, wages of high-skilled workers in Poland increased dramatically relative to those of their less-skilled counterparts by annually 4.1 percent on average and reached 203 percent of production workers' wages. Contemporaneously, the stock of foreign capital increased from 4 percent of Poland's GDP in 1994 to 34 percent in 2002. Measuring the presence of foreign firms by the share of foreign-owned in domestic fixed assets, Lorentowicz (2006) finds in a fixed-effects estimation a highly positive impact of FDI on the relative demand for high-skills in Poland. This result is also true for the enormously rising skill premium. Foreign capital can attribute 34 to 52 percent to the increase in non-production workers' wage bill share during the period 1994-2002.[17] As further factors, technological change and the general transition process which liberalized the wage setting mechanism, appear to be responsible for the skill-upgrading in Polish manufacturing.

In summary, most of the mentioned studies find a positive and significant correlation between outsourcing activities and relative demand for skills, although outsourcing is measured in quite different ways. In the last decades, almost all countries experienced an increase in the demand for high-skilled labor relative to low-skilled labor. Contemporaneously, their integration in the world economy rose strongly. Furthermore, the positive impact of outsourcing on skill-upgrading can be found in developed countries whose firms move stages of production abroad, as well as in low-wage countries which mainly host outsourcing activities.

[17] See Lorentowicz *et al* (2006) for further details.

Table 2.1: Overview of Empirical Literature on Outsourcing and Relative Demand for Skills

	country	*period*	***measures*** *outsourcing*	*technical change*	***results***[a] *outsourcing*	*technical change*
Developed Countries						
Anderton and Brenton (1999)	UK	1970-86	low-wage import share	R&D expenditure intensity	+ [40 %]	+ [n.a.]
Anderton and Brenton (1998)	US	1970-93	low-wage import share	R&D expenditure intensity	+ [n.a.] high-skill sectors	+ [n.a.] low-skill sectors
Anderton and Brenton (2000b)	Sweden	1970-93	1. low-wage import share	R&D expenditure intensity	+ [25 %]	+ [50 %]
			2. OECD import share		− [n.a.]	+ [n.a.]
Brenton and Pinna (2001)	Italy	1973-95	low-wage import share	R&D expenditure intensity	+ [33 %] high-skill sectors	(+) [n.a.]
Egger and Egger (2003)	Austria	1990-98	narrow outsourcing		+ [20-29 %]	
Feenstra and Hanson (1996a)	US	1959-87	import share		+ [15-33 %]	
Feenstra and Hanson (1996b)	US	1972-90	wide outsourcing		+ [13-51 %] (1979-90)	
Feenstra and Hanson (1999)	US	1972-90	narrow and difference outsourcing	R&D expenditure intensity (high-tech capital)	+ [13-23 %]	+ [8-32 %]
Geishecker (2002)	Germany	1991-2000	narrow outsourcing	R&D expenditure intensity	+ [19-24 %]	+ [25 %]

Table 2.1 (continued): Overview of Empirical Literature on Outsourcing and Relative Demand for Skills

	country	*period*	***measures*** *outsourcing*	*technical change*	***results***[a] *outsourcing*	*technical change*
Head and Ries (2002)	Japan	1965-90	FDI employment share		+ [9 %]	+
Hijzen *et al* (2003)	UK	1982-97	narrow and difference outsourcing	R&D expenditure intensity	+ [52 %]	+ [n.a.]
Hsieh and Woo (2005)	Hong Kong	1981-96	China import share	worldwide sector-biased technical change	+ [40-50 %]	n.a. [n.a.]
Slaughter (2000)	US	1977-94	FDI employment share		(−) [n.a.]	
Strauss-Kahn (2003)	France	1977-93	wide outsourcing		+ [11-33 %]	
Emerging Countries						
Feenstra and Hanson (1997)	Mexico	1975-88	foreign investment ratio		+ [52 %]	
Bruno *et al* (2004)	Poland, Hungary, Czech Rep.	1993-2000	foreign investment ratio	R&D expenditure intensity	+ [n.a.] CZ, HU	(+) [n.a.]
Lorentowicz (2006))	Poland	1994-2002	foreign investment ratio	R&D expenditure intensity	+ [34-52 %]	+ [n.a.]

[a] + and - indicate the sign of the respective coefficient received from regression analysis. The sign in parentheses means that the coefficient is not statistically significant. The numbers in square parentheses show the contribution of the respective variable to changes in the dependent variable. The dependent variable varies across the studies; high-skilled workers' wage bill share, or relative wages or employment of high-skilled workers.

Notes: ***measures for outsourcing***: *import share*: share of imports from low-wage countries, OECD, and China in domestic demand, respectively; *wide outsourcing*: imported intermediate inputs in percent of output (sales, value added) or total inputs; *narrow outsourcing*: imported intermediate inputs from own sector in percent of output (sales, value added) or total inputs; *difference outsourcing*: difference between *wide* and *narrow* outsourcing; *FDI employment share*: share of firm's overseas in worldwide employment; *foreign investment ratio*: ratio of foreign to domestic investment ***measures for technical change***: *R&D expenditure intensity*: R&D expenditure in percent of output (sales, value added)

Chapter 3

Germany's Role in International Value Added Chain: Impacts on High-Skilled Labor

3.1 Introduction

Germany experienced several political and economic shocks in the past 15 years. The most prominent events were the fall of the Communism and the global economic integration. These external events, which reflect the process of globalization, required extensive adjustments within the country. In addition, the foreign politics had to react to the changing global relations. Internally, the shocks affect in particular the highly inflexible German labor market.

The shocks reach from the fall of the Iron Curtain between Western and Eastern Europe to the deeper integration of the European Union and even to the liberalization of world trade and to the technological progress in IT. In response to the reinforced pressure from international competition that German companies have been under in the past few years, they have undertaken tremendous restructuring measures. Thus, they have strongly restructured with respect to ownership relations, as is even more pronounced with respect

to an international organization of the value added chain from a firm's perspective. German enterprises moved stages in which their own country has no comparative cost advantage, to foreign countries. Consequently, from a country's perspective, Germany is highly integrated in the international value added chain which combines geographically separated stages of production. This restructuring and reorganization process of the German industry has various impacts on the labor market and on the demand for individual skill groups. Furthermore, it gives some insights into the role of Germany in the international value added chain and on which stages of production Germany is specializing.

Previously, international outsourcing was associated with the relocation of low-skilled workers' jobs from developed countries, like Germany, to emerging countries, e.g. Eastern European transition countries. This former wave of international outsourcing occurred immediately after the fall of the Communism. Today, however, even high-skilled workers in rich countries are threatened by the competition from low-wage countries. This process highlights a new phenomenon in international outsourcing, which is characterized by the threat of low- and high-skilled workers and by an increased number of outsourcing firms.[1] Initially, only big multinational companies engaged in outsourcing; today, even many German small and medium-sized enterprises (SME) outsource parts of their production process. The resulting impacts are much larger since SME play an outstanding role in the German economy.

In this chapter, I examine empirically the impact of international outsourcing on the demand for skills in Germany since the beginning of the 1990s. Can international outsourcing explain the changes in the relative demand for high-skilled workers in German manufacturing? Who loses and who gains from outsourcing? This chapter should answer the question of whether the outsourcing activities of German firms hurt the economic prospects of human capital in Germany.

Why is Germany an interesting case in studying the impacts of international outsourcing? As already mentioned, Germany is one of the countries most affected by shocks of globalization. Moreover, Germany is one of the

[1] See Der Spiegel, 44/2004, "Bye-bye 'made in Germany' ".

most open countries worldwide in terms of international trade. In 2003, Germany was the world's biggest exporter accounting for almost 11 percent of worldwide exports. Furthermore, for the past seven years, Germany has been the world's second-largest importing country. The phenomenon that simultaneously to Germany's strong export position a large part of the intermediate inputs are imported, is highly debated in Germany under the term "bazaar economy".[2] At the same time, its labor market is highly regulated by law and dominated by powerful unions. Additionally, Germany steadily specializes fairly intensely in the industrial sector compared to other developed countries.[3]

All of these exogenous, and thus unanticipated, shocks bump on an economic system which has emerged over the past 50 years in a more or less continuously growing economy. In this period, the social net has become increasingly thicker, and Germans have become accustomed to a high level of social security.

The chapter is organized as follows. Section 3.2 takes a look at the main events which have impacted Germany in last 15 years. In Section 3.3, I show the major trends in the relative demand for high-skilled labor and the trends of international outsourcing in German manufacturing. Section 3.4 reviews the existing empirical literature on the influence of outsourcing on the relative demand for skills in Germany and makes critical notes on these studies. The subsequent Section 3.5 briefly outlines the empirical implementation of Feenstra and Hanson's (1996) theoretical model of international outsourcing. Before presenting the empirical results in Section 3.6, I discuss the data sample employed in the analysis. Finally, Section 3.7 provides a conclusion of my findings.

[2] See Sinn (2005).

[3] For example, in the last decades the UK underwent a dramatic change from an industrial economy towards a service-oriented economy. While in 1970, 45 percent of workers were employed in manufacturing, today less than 24 percent are. In Germany, however, still 30 percent of workers are employed in the manufacturing sector. See 'Der Spiegel' (2004).

3.2 Germany's Shocks of Globalization

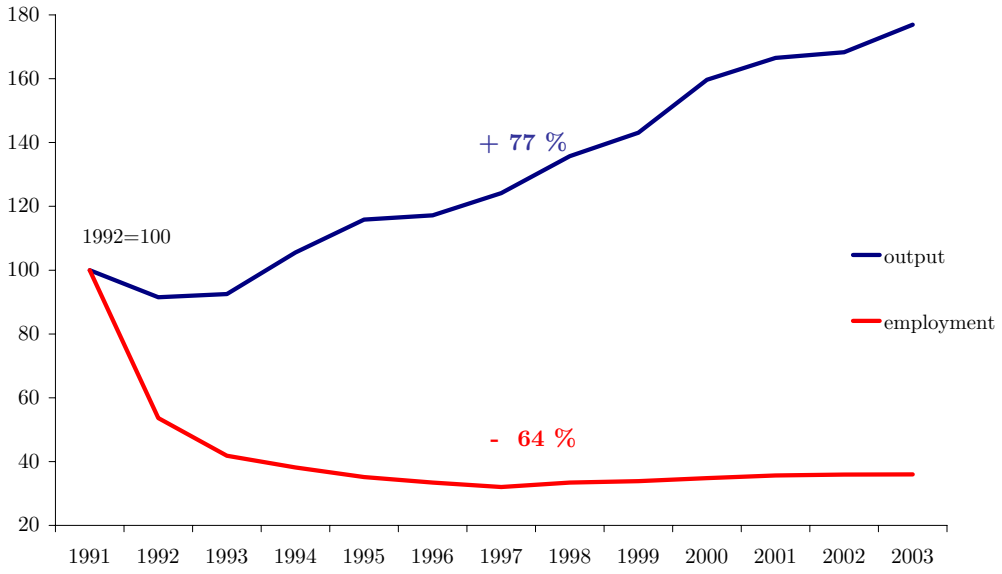
Germany is battling the consequences of at least five shocks that occurred in past 15 years. Besides a general integration of the global economy, Germany is confronted with the consequences of its reunification, the fall of the Communism in Central and Eastern Europe, the deeper integration of the European Union and its eastern enlargement, and the introduction of the euro. In this section, I sketch briefly each of these major events and discuss some indicators and consequences of these shocks.

The year 1989 is a very decisive date in Germany's history. The fall of Communism in the former planned economies affected Germany twice; internally through the reunification and externally through the opening-up of Central and Eastern Europe. And later on, Germany was through the accession of 8 of these countries to the European Union in May 2004.

After 40 years of being a divided country, the fall of the Berlin Wall on November 9, 1989 made it possible for West and East Germany to unify in the following year. In contrast to the widespread initial opinion, the transformation of the former Communist East Germany into a democratic political system with a market economy has required significant breakthroughs and committed long-term efforts. The impacts of the German reunification on the Eastern German economy, especially on the labor market, are tremendous. The restructuring of East Germany's planned enterprises and accompanying raise in Eastern German wages to a comparable level with the west has resulted in extremely high unemployment rates in former East Germany. To absorb these dramatic changes that required painful adjustments, huge transfers form Western to Eastern Germany have been undertaken.

As the lower line in Figure 3.1 shows, the employment in Eastern Germany's mining and manufacturing sector declined tremendously by about 46 percent in the first whole year after the reunification from 1.76 million employees to 0.94 million in 1992. During the following years, the employment continued to fall before employment levels stabilized at a low level in 1995. In contrast to the mentioned decline, the industrial output grew rapidly over the same time period. After declining slightly during the first two years after

reunification, output increased by 77 percent over the period of 1991 to 2003.



Notes: The numbers refer to the mining and manufacturing sector (NACE C and D).
Source: Own calculations based on data from the Federal Statistical Office of Germany.

Figure 3.1: Output and Employment in Eastern Germany

The fall of the Iron Curtain between Western and Eastern Europe did not only result in Germany's reunification but also in an opening-up of all former Communist economies. The subsequent transition from planned economies into market economies had tremendous effects on the political and, in particular, on the economic systems of these countries. However, each of these Central and Eastern European countries is affected in a different way with respect to timing and procedures of transition. A changed trade and FDI pattern indicates the consequences of this transition process for Germany. The changes should be remarkable, since Germany is, besides Austria, the Western European country that is most integrated with Central and Eastern Europe.

In addition to this opening-up, some countries which are most advanced in their transition process, deepened their economic integration with Western Europe. This resulted in their accession to the European Union. After the last round of the enlargement of the European Union in 1995, with the

accession of Austria, Sweden, and Finland, in 2004, the biggest and most drastic enlargement of the European Union took place. The EU enlarged by 10 countries, 8 of which were Central and Eastern European countries. In 2007, with Bulgaria and Romania two further Eastern European transition economies might access to the EU. This enlargement creates a larger free trade area, which should improve the trade intensity and the international competition.

Table 3.1 shows Germany's import and export pattern by regions and countries, respectively. Particularly on the import side, Germany is highly integrated with Central and Eastern Europe (CEE). While the share of imports from CEE declined from 11.2 to 7.7 percent between 1985 and 1990, it has nearly doubled since 1990. As the data show, in particular the imports from the five Central European new EU members experienced a continuous increase from about 3 percent of Germany's imports from all over the world, to almost 10 percent. In terms of value, the imports from these five countries are more than 6.5 times higher in 2004 than in 1990. At the same time, the German economy increased its export activities to the Central European countries from about 3 to nearly 8 percent of total exports.

In the course of the ongoing integration of the European Union, the completion of the Internal Market at the end of 1992 marked a milestone. The Single Act allowed a free movement of goods, services, persons and capital flows between the EU member states. Another milestone in the economic integration of the EU was the launch of Europe's common currency in 1999. The introduction of the euro led to a harmonization of the interest rates among the EU member states, [4] but also to a reduction in transaction costs which facilitates further trade integration. Both events should support the intra-EU trade of the former 15 member states. However in Germany's case, the integration with its co-members in the eighties was already so deep that the integration has remained unchanged or has declined since the 1980s. Germany exported more than 55 percent to other EU-15 countries and received in most recent years roughly 50 percent of its total imports from the EU-15. Considering the enlarged EU-25, intra-EU trade accounts for almost 60

[4] See Sinn(2003), pp. 82-84.

Table 3.1: Germany's Trade Pattern

	1985	1990	1995	2000	2004
	Import Pattern (in percent)				
EU-15	53.53	58.13	56.44	50.89	49.54
CEE	11.23	7.73	8.81	11.95	14.44
EU members	3.03	2.77	5.52	7.70	9.67
Russia	6.11	3.18	2.55	3.51	3.78
USA	6.44	6.49	6.82	8.75	7.07
China	0.56	1.41	2.41	3.45	5.70
Japan	4.21	5.75	5.33	4.99	3.75
ROW	24.03	20.49	20.20	19.97	19.51
	Export Pattern (in percent)				
EU-15	55.16	60.94	58.16	56.47	55.33
CEE	9.84	9.07	8.14	10.18	12.50
EU members	2.83	2.96	5.04	7.23	7.87
Russia	4.88	4.13	2.17	1.96	3.26
USA	9.57	6.90	7.29	10.34	8.87
China	1.17	0.62	1.44	1.58	2.87
Japan	1.40	2.57	2.51	2.21	1.74
ROW	22.86	19.89	22.47	19.22	18.69

Notes: The numbers show the percentage distribution of trade flows. The CEE EU-members correspond to the Czech Republic, Hungary, Poland, Slovak Republic, and to Slovenia. Russia refers to countries of the former Soviet Union, including the Baltic states.
Source: Own calculations based on data from the Federal Statistical Office of Germany.

percent of German imports and for more than 63 percent of German exports.

Finally, trade flows between Germany and China seems to be growing quickly. Specifically on the import side, the changes are exceptionally high. The imports from China to Germany grew from 1.5 to 32.8 billion euros between 1985 and 2004. This growth resulted in Chinese imports comprising 5.7 percent of Germany's total imports in the year 2004.

In summary, Germany is not only a driving force of the rising world trade which is supported by a process of trade liberalization. As Table 3.1 shows, also the geographical pattern of its trading partners changed substantially over time. Particularly the shift in Germany's trade pattern towards emerging countries emphasizes the intense pressure from international competition for German firms. The development adds pressure on the German labor market.

In the last decade virtually all countries were affected by major improvements in information and telecommunication technologies. In particular, the availability of the computer technology and the widespread use of computers in the economy during the 1990s led to a dramatic reorganization in the work process. It has certain impacts on the demand for skills on the one hand and enables, on the other hand, firms to outsource individual stages of the production process. Besides the mentioned opening-up of many countries to international trade, the revolution in IT in the 1990s is a second reason for the rise in international outsourcing.

After showing the multiple shocks of globalization that might substantially affect substantially the German labor market, I focus my analysis in the remaining part of the chapter on one decisive channel of the mentioned shocks: international outsourcing. In this section, I already discussed the trends in international trade as the main phenomenon of globalization. One part of international trade which is growing, is the trade in intermediate goods. The volume of traded inputs measures immediately the new international division of labor emerged by slicing up the value added chain across countries.[5]

[5] See Krugman (1995) for a first description of this new phenomenon in international trade.

3.3 Outsourcing and Germany's Human Capital

3.3.1 Trends in Wages and Employment of Skills

Although the German labor market is known as inflexible and dominated by powerful trade unions, noticeable variation of labor market outcomes over time can be observed. While Germany's labor market institutions prevent large movements in relative wages, the change in relative demand is reflected in relative employment and unemployment, respectively. This is in contrary to the USA and other countries with flexible labor markets, where changes in the demand for skills predominately affect the wages, which adjust to changes in demand. Thus, it resulted in the case of the US, in a widening of the wage gap between high-skilled and low-skilled workers of about 8 percent from 1979 to 1990.[6] On the other hand the German experience is in line with most other Western European countries. For example, in the case of France and Sweden, the skill premia remained relatively stable during the last decades. Arguing that employment share is the more appropriate variable, Strauss-Kahn (2003) and Anderton *et al* (2002b) focus their analyzes of the French and Swedish labor markets, respectively, on the employment side.

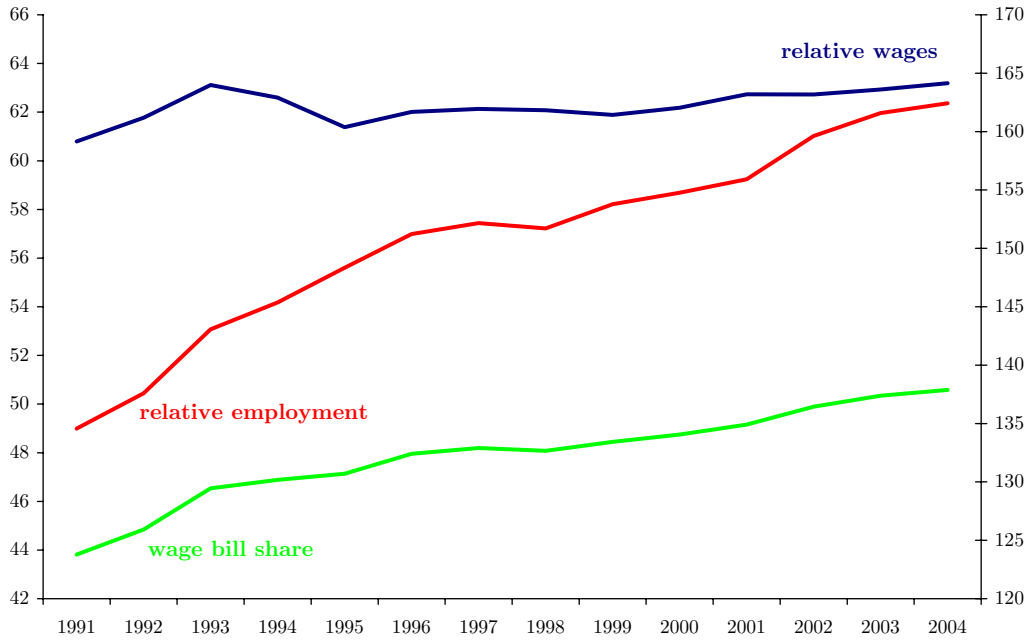
In general economic sense, the relative demand for high-skilled labor consists of two components: price and quantity. In the context of the labor market, these two components are called wages and employment. The multiplication of these two parts gives the demand for labor, as in the realized state, called wage bill. The classification of workers according to their engagement in production and non-production stages of the value added process in a firm is commonly used as a proxy for the skill-level of workers. It is assumed that non-production workers are more-skilled workers than production workers. Micro-data on the educational level of workers support this assumption, as Berman *et al* (1998) show for the US and Head and Ries (2002) for Japan.[7] Along the lines of the existing literature, in this paper,

[6] See Feenstra and Hanson (1999).

[7] However, Leamer (1994) criticizes the classification into production and non-production workers since it might be misleading for some activities with respect to the

high-skilled and low-skilled workers are classified as non-production and production workers, respectively.[8]

Figure 3.2 illustrates the movements in German the labor market that occurred during the last 15 years. It graphs the ratio of high-skilled to low-skilled workers' wages and employment on the one hand and, on the other hand, the high-skilled workers' wage bill share in Germany's manufacturing.



Source: Own calculations based on data taken from the Federal Statistical Office of Germany.

Figure 3.2: Demand for Skills in Germany's Manufacturing

As the data show, the wages of high-skilled workers remained fairly constant relative to those of their low-skilled counterparts. The evolution of the skill premium in Figure 3.2 is scaled on the right-hand side axis. After a small peak in 1993 and a decline until 1995, the wage gap between high-skilled and low-skilled workers starts to increase from about 160 percent in 1995 to 164 percent in 2004. However, over the whole period, the changes

skill-intensity.

[8] According to the German system, non-production workers correspond to "Angestellte" and production workers to "Arbeiter". This distinction seems to be roughly consistent, particularly since my analysis focuses only on the manufacturing sector. Thus, problems disappear which might emerge by comparing service and manufacturing sectors with respect to the mix of production and non-production workers.

are marginally small. Overall, in German manufacturing the non-production workers earn about 60 percent more than the production workers. This size of the skill premium is roughly comparable with other developed countries which are partly characterized by a highly flexible labor market. As already mentioned, in the US the skill premium rose sharply in recent decades and reached a level of about 67 percent in 1994.[9] The skill premium trends vary substantially across German manufacturing sectors. While the skill premium was 107 percent[10] in the clothes sector in 2004, it only reached 38 percent in the food and beverages sector.

Turning to the relative employment, as Figure 3.2 shows, the employment of non-production workers relative to production workers rose by 27 percent from 48.0 percent to 62.4 percent between 1991 and 2004. This trend in relative employment is associated with a steady decline in absolute production workers by 38 percent from almost 6 million to 3.6 million during the period 1991 to 2004. Over the same period, the employment of non-production workers in manufacturing declined only by 21 percent. The developments in Eastern German manufacturing that I mentioned in Section 3.2, contributes a certain amount to the overall decline in employment. I will discuss the special situation of Eastern Germany in more detail below.

The changes in the relative wages and the relative employment reflect a rising aggregate demand for high-skilled workers where the positive employment effect tips the scales. The non-production workers' wage bill share rose steadily by 15 percent over the sample period of fourteen years. However, the computer sector alone reduced its demand for high-skilled labor where a sharp fall in the skill premium outweighs the positive trend on the employment side.

A similar trend, the aggregate demand, displays the non-production workers' wage bill relative to the production workers' wage bill instead of in relation to total wage bill. It increases by 24.4 percentage points from 78 percent to 102 percent during the period 1991 and 2004. The large proportionate movement of relative employment compared to relative wages suggests that

[9] See Slaughter (1999), Figure 1.

[10] Which means that non-production workers earn 107 percent more than production workers in the same sector.

the rise in relative wage bill owes more to increasing disparities in employment than to a widening wage gap. A simple decomposition of the relative demand in a separate wage and employment effect[11] can gauge the contribution of these two trends.

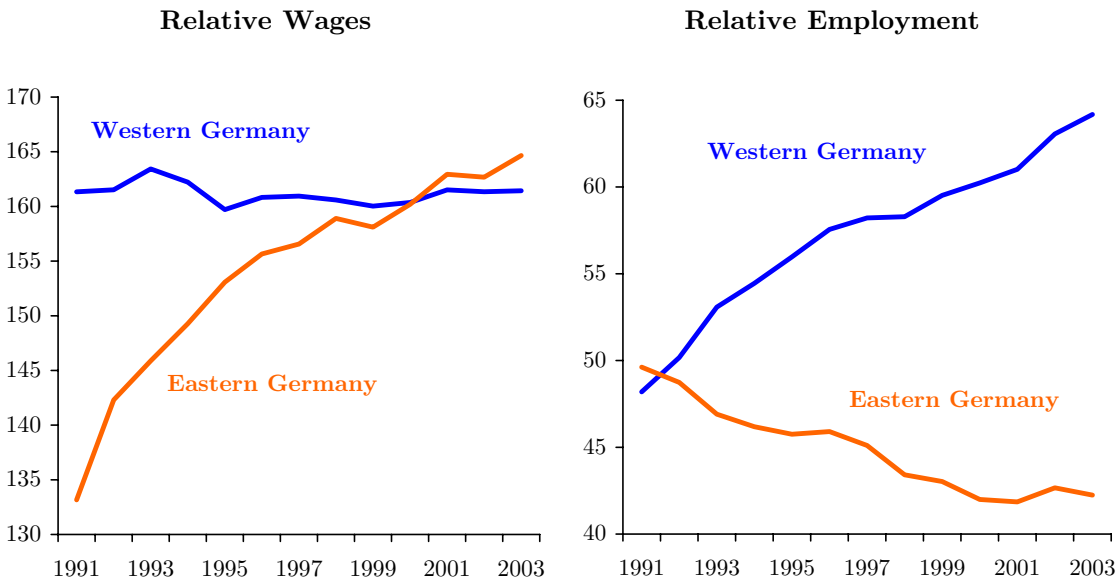
The decomposition suggests that the overall slight increase in the skill premium contributes 2.8 percentage points to the rise in the wage bill of high-skilled workers relative to low-skilled workers, which comes up to 11.4 percent. The increased employment of non-production workers relative to production workers attributes 21.6 percentage points to this change. The variation in the relative employment accounts for 88.6 percent. As already graphically seen, it points to the stickiness of wages in German manufacturing and the reaction of the relative employment. However, the decomposition for the most recent years shows that between 2000 and 2004, 17.5 percent of the rise in the relative demand for skills can be attributed to relative wages, and 82.5 percent contributes to the increased relative employment. Apparently, in recent years the relative wages in Germany became more flexible. The results of this decomposition confirm Geishecker's (2002) findings for a shorter period between 1991 and 2000.[12]

What is the role of the German reunification in the evolution of the overall relative demand for high-skilled labor? The restructuring process in the Eastern German manufacturing sector caused a dramatic decline in the employment of low-skilled as well as high-skilled workers in absolute numbers. While the number of production workers declined by 62 percent between 1991 and 2003, the employment of non-production workers declined even more by 68 percent. In 1997, the production as well as the non-production workers achieved the lowest status since the reunification. Afterwards, in particular the number of production workers increased slightly by 15 percent. It means that the employment of the non-production workers relative to the production workers declined from almost 50 percent in 1991 to 42 percent in 2003.

[11] See Geishecker (2002) for the formula for the decomposition.

[12] He finds that the development of the relative wages of high-skilled workers contributed in the nineties only 9 percent to the increased relative wage bill. But 91 percent can be attributed to the rising relative employment.

As Figure 3.3 shows, the development in Eastern and Western Germany are opposite. In contrast to Eastern Germany, the relative employment of non-production workers experienced a strong increase by 16 percentage points. While at the beginning of the 1990s the relative employment in Eastern and Western Germany is very similar, it diverges dramatically from 1992 onwards.



Source: Own calculations based on data taken from the Federal Statistical Office of Germany.

Figure 3.3: Demand for Skills in Eastern and Western Germany

Moreover, the trends in the skill premium in Eastern Germany differ remarkably from these in Western Germany. The relative wages have remained almost constant in Western Germany while the data show a strong increase in wage dispersion favoring skills in Eastern Germany. In 1991, the high-skilled workers in Eastern Germany's manufacturing earned only 33 percent more than their low-skilled counterparts. However in the most recent years, the skill premium in Eastern Germany is even higher than in the old West German states. After the compression of the relative wages in the era of the Communism, the wage gap between low-skilled and high-skilled workers experienced a tremendous widening in all Eastern European transition countries. For example, in Poland the relative wages for high-skilled workers increased in the last decade from a level which is comparable to that of

Eastern Germany to more than 200 percent in 2003.[13]

The shown skill-upgrading at the aggregate level of the reunited German manufacturing sector could have occurred due to two possible reasons. On the one hand, a shift in employment away from low-skill intensive sectors towards more high-skilled intensive sectors could be responsible for the aggregate movement. And on the other hand, a skill-biased demand shift could also explain the aggregate pattern. While the former reason is associated with a shift *between* sectors, the latter indicates a change which occurs *within* each sector. Following Berman *et al* (1994)[14] the aggregate shift towards more-skilled labor is decomposed into a *between* and a *within* component.[15] Table 3.2 gives an answer to the question which of the two effects dominates.

At the aggregate level, the employment shifted towards non-production workers by 4.45 percentage points during the period 1991-2003. The within sectoral shift by 5.28 percentage points can explain more than 100 percent of the aggregate skill-upgrading in manufacturing. It indicates that the change in the allocation of employment across sectors contributes in the opposite direction than the within sector movement. The negative sign on the "between" term is evidence of a shift towards less-skill intensive sectors that favors the relative employment of production workers. These results are in line with Geishecker's (2002) findings.

Splitting the sample period into two sub-periods reveals a new aspect. The rates are annualized to make changes comparable across time periods of different length. Compared to the previous period, the overall move towards

[13] See Lorentowicz *et al* (2006).

[14] See also Geishecker (2002) and Strauss-Kahn (2003), who carried out similar decomposition exercises.

[15] The decomposition exercise is undertaken according to the following formula presented by Berman *et al* (1994):

$$\Delta E^{HS} = \sum_{i=j}^{n} \left(\overline{E}_i^{HS} * \Delta S_i \right) + \sum_{i=j}^{n} \left(\overline{S}_i * \Delta E_i^{HS} \right)$$

where E_i^{HS} is the proportion of non-production workers in total employment in each individual sector i. S_i denotes the employment share of sector i in aggregate employment. The first term on the right-hand side reports the *between* change, while the second term reports the *within* shift.

non-production workers decelerates from 0.54 to 0.27 percentage points per year over the period 1997-2003. However, the clear dominance of the within-sector movement appears evidently in both sub-periods.

Table 3.2: Decomposition of High-Skill Employment Share

	overall change	within sector	between sectors	within/ overall[a]
	changes in percentage points			
1991-2003	4.45	5.28	-0.79	119
	annual average changes in percent			
1991-1996	0.54	0.64	-0.10	119
1997-2003	0.27	0.30	-0.03	111

[a] Ratio of within-sector change to overall change, in percent.
Source: Own calculations based on data from the Federal Statistical Office of Germany.

The stronger *within* sector shift compared to *between* sectors suggests that the relative skilled labor demand in Germany has arisen mainly in a changed demand structure for skills within each sector. Therefore, as shown in Chapter 2, skill-biased technical change, which affects all sectors, came as candidate for explanation into consideration. As a second candidate with qualitatively similar effects, factor-biased outsourcing appears to be relevant as approached by Feenstra and Hanson (1996a). If firms move stages of the production process offshore to take advantage of factor-cost differential across countries, the skill composition of domestic labor demand should shift within each sector. Below I will examine econometrically the explanatory power of the two factors that affect the within-sector employment structure. After inspecting the trends in international outsourcing in the following section, I will take a closer look at the developments of labor market outcomes and outsourcing at the sectoral level.

3.3.2 Trends in International Outsourcing

The goal of this chapter is to estimate how much international outsourcing attributes to the shown outcomes of the German labor market. There exist different ways to measure the outsourcing activities of firms. The most obvious measure that is often cited in public discussion is the movement of stages of production abroad by multinational firms. Almost every day you can read in German newspapers about such relocations of jobs to foreign countries. Table 3.3 reports the engagement of German firms in foreign affiliates and the geographic pattern of German FDI over time.

Table 3.3: Employment of Foreign Affiliates of German Multinationals

	1991	**1997**	**2003**
FDI employment share[a]	16.39	27.32	34.24
	Geographic Pattern (in percent)[b]		
Developed Countries[e]	71.05	63.56	61.57
Developing Countries[e]	28.95	36.44	38.43
Total	100.00	100.00	100.00
EU-15	42.65	39.28	35.99
CEE	3.16	14.72	18.92
North America[c]	21.39	18.03	18.39
Latin America[d]	15.07	9.03	6.60
Asia	10.01	11.86	14.36
Other	7.72	7.08	5.74
Total	100.00	100.00	100.00

[a] Share of employment of foreign affiliates of German multinationals in total domestic employment of German manufacturing.
[b] Distribution of employment of foreign affiliates of German multinationals across regions.
[c] North America refers to the USA and Canada.
[d] Latin America refers to Latin American countries and the Caribbean.
[e] Developed and developing countries are classified according to UNCTAD where developing countries include the Central and Eastern European transition countries.
Source: Own calculations based on data from UNCTAD, World Investment Directory (2005).

The numbers in Table 3.3 show evidence of the proceeding international organization of the production process carried out by German companies. As the development of the FDI employment share indicates, the importance of employment of foreign affiliates owned by German multinationals gains dramatically over time relative to domestic employment in manufacturing. So the relative employment of foreign affiliates more than doubled between 1991 and 2003. However, the internationalization differs significantly across sectors. In the motor vehicles industry, the proportion between foreign and domestic workers was 38 percent in 1991 and increased to 85 percent in 2003. Also the companies of the tobacco, leather, and chemicals industries are each highly internationalized with a FDI employment share of about 75 percent in 2003. Whereas in the food and beverages and computer industries, the employment of foreign affiliates accounts for less than 8 percent of respective domestic employment.

The second part of Table 3.3 takes a look at changes in the geographical pattern of the foreign affiliates' employment over time. While in 1991 about 71 percent of workers employed abroad by German multinationals were located in developed countries, less than 62 percent are so in 2003. Consequently, the distribution shifted by almost 10 percentage points towards workers in developing countries, which means that in 2003, almost 39 percent of German FDIs employees were located in low-wage countries. It seems noteworthy, however, that the category developing countries include the Central and Eastern European transition countries. Without these countries the share of developing countries fell from 26 to 20 percent of total foreign employment of German multinationals. This fact highlights the tremendously increased importance of Central and Eastern Europe as host region for German FDIs. As the table displays, 19 percent of worldwide employment of German FDIs in 2003 is located in the region of Eastern Europe whereas only 3 percent belonged to this region twelve years ago. For the declining proportion of Latin America is mainly the development in Brazil responsible. Furthermore, the increasing share of Asia is for the most part accountable to China.

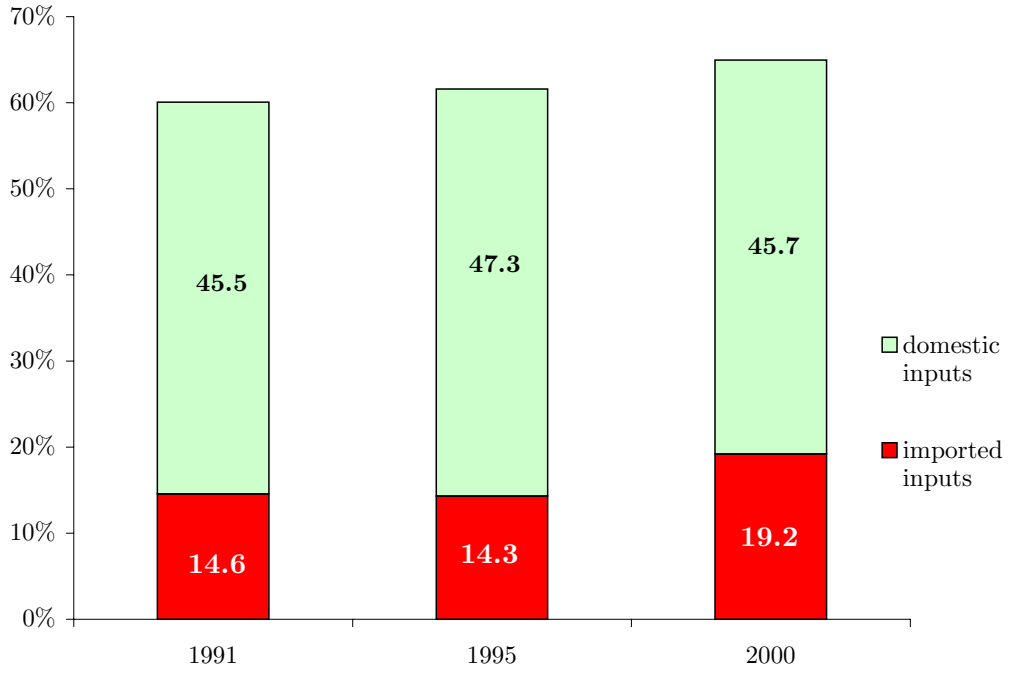
In order to take advantage of the possibility producing abroad at lower

costs, a firm has to decide how to organize its production process internationally. Either it can undertake FDI and relocate the production stage inside the firm to a foreign affiliate, or it can close down the formerly in-house production and replace this stage of production by importing intermediate inputs from suppliers abroad.

Using FDI as a measurement for international outsourcing has two shortcomings, as Slaughter (2000) mentions. First, intrafirm imports from foreign affiliates to the domestic parent firm which can be proxied by the shown FDI employment share, misses arm's-length interactions between foreign and domestic firms. Second, FDIs do not immediately induce intra-firm trade. Market-seeking foreign engagement should not affect the skill-structure of parent's domestic labor demand. Therefore data on the imported intermediate inputs usually taken from input-output table are mostly preferred in the literature.

Figure 3.4 presents the utilization of intermediate inputs in the production process distinguished according to their origin. The intermediate inputs are presented in percent of averaged total manufacturing output. Therefore, the difference between intermediate inputs and output corresponds to the value added. While the value added of firms of the manufacturing sector was on average 40 percent in 1991, it declined to 35 percent in 2000. This trend underlines the increased importance of intermediate goods and highlights the fragmentation of the production process in separate stages.

As Figure 3.4 indicates, intermediate inputs become more relevant over time. Most importantly, the share of imported inputs rose rapidly by 34 percent between 1995 and 2000, while it declined slightly during the early 1990s. Comparing the numbers of 1991 and 2000, suggests that the declining value added can be attributed mainly to increased outsourcing activities. Or in other words, the new outsourcing opportunities did not lead to a decline in the purchase of domestic inputs. Therefore, imported inputs accounted in 2000 for almost 30 percent of purchased total inputs while they were only 23 percent five years ago. It highlights that outsourcing is predominantly a phenomenon of recent years. Therefore, extending the analysis to the early 2000s is considered to be reasonable.



Notes: The bars show the domestic and imported inputs in percent of output averaged over all manufacturing 2-digit NACE sectors.
Source: Own calculations based on data from input-output tables of the Federal Statistical Office of Germany.

Figure 3.4: Domestic and Imported Inputs

Measuring outsourcing as imported inputs aim to capture firms' decisions about undertaking an individual production stage domestically in-house or move it abroad both arm's-length and within the boundaries of the firm by FDI. However, the drawback of this measure is that the output of relocated last stages of the production process, which assemble final goods sold abroad or even re-imported to Germany, is not taken into account.[16] This tends to underestimate the volume of outsourcing activities.

Utilizing data on imported intermediate inputs from input-output tables allows the construction of different measures of outsourcing.[17] All variables which I will present are expressed relative to gross output of the considered

[16] Slaughter (2000) notes that this measure of outsourcing captures only outsourced stages that return to the domestic market for further processing. Therefore, he favors different measures of FDI to estimate outsourcing. Furthermore, Anderton *et al* (2002b) argue that input-output tables, where data on imported inputs are taken from, are reported infrequently and mostly interpolated using import data. Thus, they prefer the direct use of imports that includes both final and intermediate goods.

[17] See Feenstra and Hanson (1999).

sector, Y_i.[18] The wide definition of outsourcing $OUTS^{wide}$ takes the imported intermediate goods of all manufacturing sectors into account. Each industry i purchases imported inputs $ImpInp_{ij}$ from manufacturing industries $n = 1, ..., j$ which corresponds to the column sum over all NACE D industries in the input-output matrix of imports.

$$OUTS_i^{wide} = \frac{\sum_{j=1}^{n} ImpInp_{ij}}{Y_i} \tag{3.1}$$

By restricting the imported intermediate inputs to those which are purchased from foreign firms of the company's own industry, I obtain a second definition of outsourcing, *narrow outsourcing*.

$$OUTS_i^{narrow} = \frac{ImpInp_i}{Y_i} \tag{3.2}$$

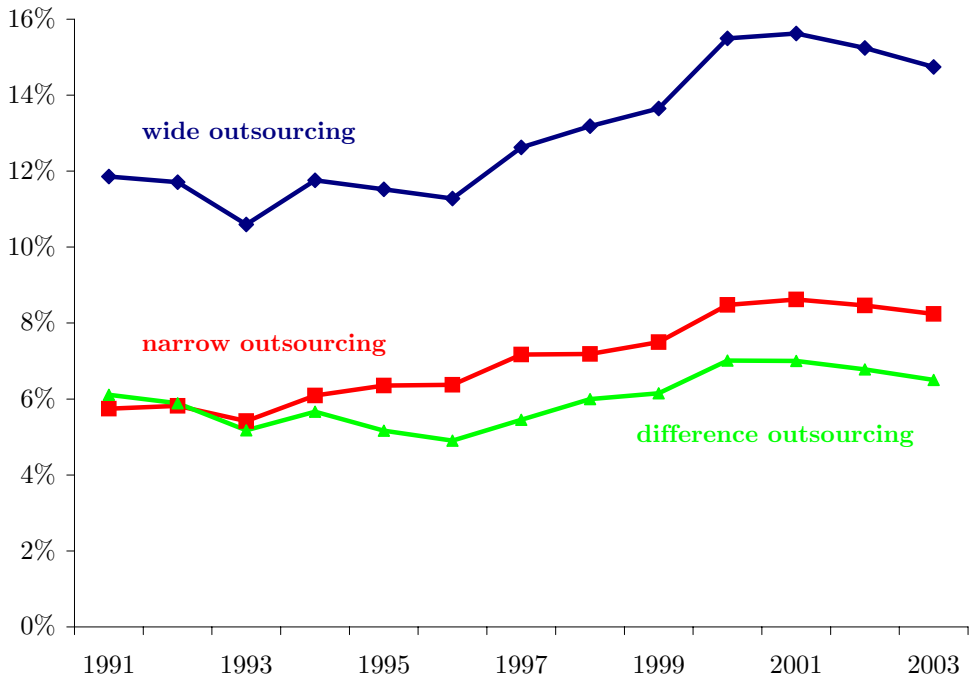
where $ImpInp_i$ denotes the imported inputs that are purchased from the same 2-digit NACE sector as the good being produced. Imported inputs of the own sector are taken from the main diagonal of the input-output matrix of imported goods.

The reason why the literature prefers the narrow definition of outsourcing over the wide definition is that the former measure reflects more appropriately the idea of substituting domestic in-house production with imported intermediates. Only the relocation of stages of production to abroad that could have been done domestically in the *same* sector matters for the impacts on the domestic skill-structure of an individual sector. Sourcing intermediate inputs of all manufacturing industries from foreign countries (*wide outsourcing*) does not directly affect the prospects of workers of the same sector. These imports substitute domestic inputs formerly purchased from other sectors and correspond from the other sectors' perspective to import competition in final goods. Therefore, the narrow measure captures the idea of outsourcing in the sense of import competition in intermediate inputs of

[18] Measuring outsourcing in terms of output captures the general trend of fragmentation reflected in a higher utilization of intermediates which can be purchased from abroad *or* domestically. Whereas outsourcing measured in terms of total intermediate inputs only takes into account the composition between domestic and foreign inputs. Egger and Egger (2003) employ both measures and find in a regression analysis only slight differences. However, they state that outsourcing in terms of output appears to be preferable.

the same industry in the most proper way.

A third measure of international outsourcing makes use of the difference between the wide and the narrow definition. The *difference outsourcing* represents the intermediate inputs imported from all manufacturing sectors except from the same 2-digit NACE sector that uses the inputs.



Notes: wide outsourcing: imported intermediate inputs of the manufacturing sector (NACE D) in percent of gross output.
narrow outsourcing: imported intermediate inputs of the sector's own NACE 2-digit sector in percent of gross output.
difference outsourcing: imported intermediate inputs of the manufacturing sector (NACE D), excluding inputs of the sector's own NACE 2-digit sector, in percent of gross output.
Source: Own calculations based on data from input-output tables of the Federal Statistical Office of Germany.

Figure 3.5: Wide, Narrow, and Difference Outsourcing

Figure 3.5 displays the trends in those three definitions of outsourcing. Averaged over all manufacturing sectors, the *wide outsourcing* increased substantially from 11.9 percent of output in 1991 to 14.7 percent in 2003. The major acceleration occurred between 1996 and 2000. This rise in wide outsourcing is driven for the overwhelming part by the trend of increased outsourcing activities within the same sector. The average *narrow outsourcing* grew considerably from 5.7 percent in 1991 to 8.6 percent at the peak in 2001

while the *difference outsourcing* variable remained stable over time. In the last two years, these outsourcing measures have shown a slightly declining trend. This is in line with the development of FDI.[19]

The trends on average imply that outsourcing activities of German firms are largely a phenomenon of substituting domestic stages of production with foreign inputs of the same sector. It means that firms close down production stages in Germany and replace them with inputs from abroad, either purchased arm's-length or imported from newly established foreign affiliates. The development of *narrow outsourcing* over time confirms the view that this measure best captures the idea of outsourcing. However, the developments differ considerably between sectors. While in sectors such as printing and publishing, manufacturing of rubber and plastics, and tobacco products outsourcing within the same sector is negligible, the computer, transport, and communication equipment industries extensively import inputs of the same 2-digit NACE sector. Roughly 25 percent of their output in Germany in 2003 is assembled from intermediates that are purchased from foreign firms belonging to the same sector. Furthermore, the textiles and clothes sector shows also relatively high rates with about 20 percent. In the next section, I will consider in detail the variation of growth of outsourcing activities across sectors on which my empirical analysis in Section 3.6 is based on.

3.3.3 Trends in Outsourcing and Labor Market at Sectoral Level

Up to now, I considered the trends on average of the manufacturing sector. The aggregate trends are informative but they mask substantial heterogeneity across sectors. In Figure 3.6 the sectors are ranked with respect to their average annual growth rate in outsourcing intensity over the period 1991 through 2003.[20] The figure gives some insights in how the labor market

[19] The share of employment of foreign affiliates in domestic employment declined after the peak in 2001 from 35.6 percent to 34.2 percent in 2003, see Table 3.3.

[20] Ranking the sectors according changes in percentage points of the outsourcing variable reveals a fairly similar picture.

outcomes of each sector are related to the trends in outsourcing and if these links change over time. Therefore, I broke down the sample period into two sub-periods, the early nineties, between 1991 and 1996 and the more recent years 1997-2003.

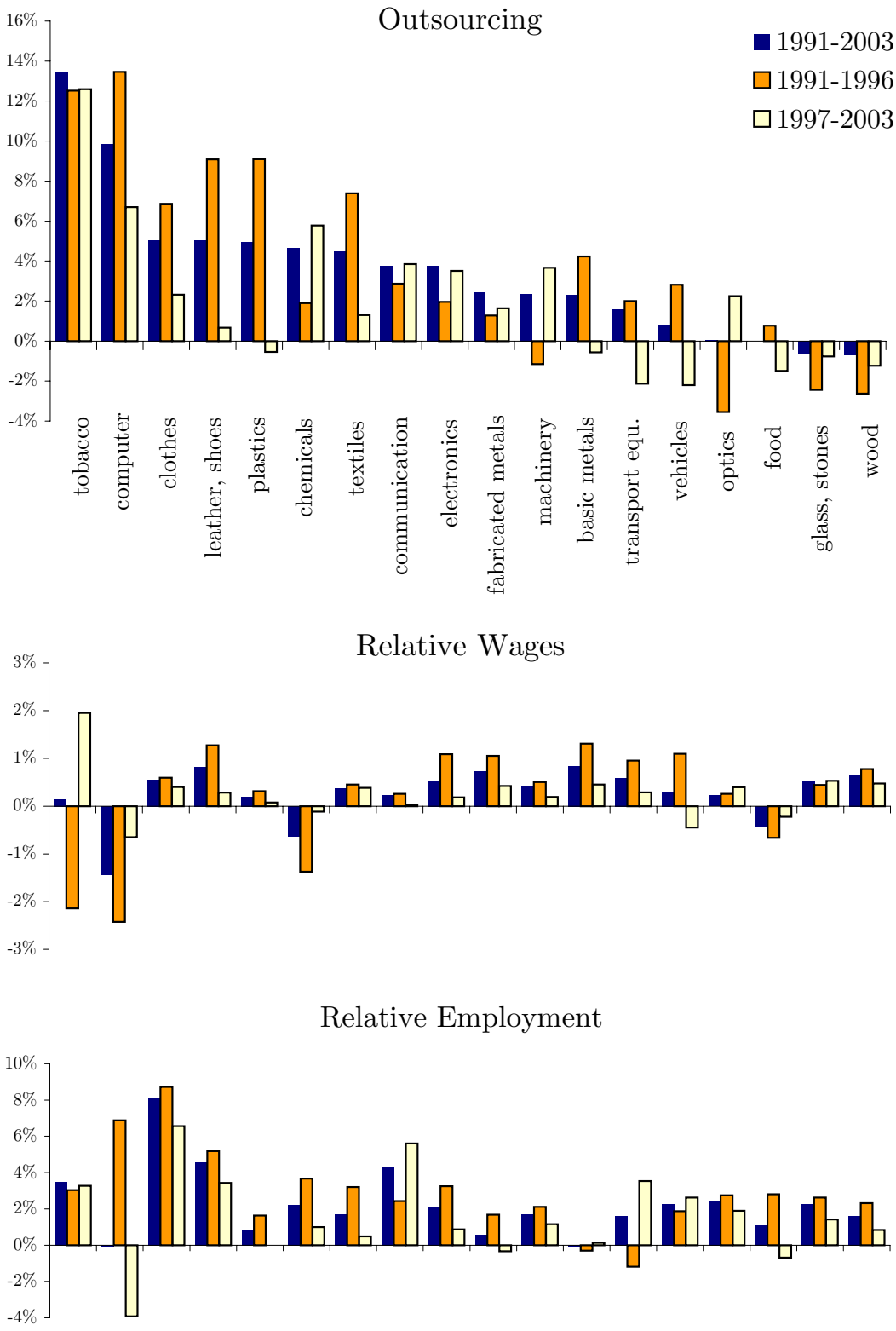
Apparently, almost every sector fragmented its production process internationally during the considered 13 years, shown by the blue bars. The changes in outsourcing activities[21] range from a rise by 13 and 10 percent per year in the tobacco and computer industry, respectively, to an average annual drop by -0.7 percent in the manufacturing of wood, and glass and stones.

The inspection of changes in relative wages shows that they exhibit a substantial variation across sectors although they are fairly stable at the aggregate level. Four sectors[22] even experienced even a decline in the relative wages during the period 1991-2003. This trend was most pronounced in the computer sector, where the wages of non-production workers dropped dramatically from the high level of 239 percent of the production workers' wages by 1.48 percent per year. Over the same period, the relative wages increased by about 0.8 percent each year in both the leather and the basic metals industries which marks the highest growth rate across sectors. Distinguishing the sample period in two sub-periods reveals that in the earlier period between 1991 and 1996, both sectors with the highest increase in outsourcing, tobacco, and computers, experienced a substantial reduction in their relative wages. This suggests a negative impact of outsourcing on the skill premium. However, the picture in the remaining sectors is not that clear. In the later period, the relative wages increased considerably in the two sectors which reduced their outsourcing activities at strongest over the entire period.

Rising relative wages of non-production workers should have led to a shift in employment away from non-production workers. It would be the reaction along the demand curve. However, this standard reaction cannot be observed for most sectors, indicating that the demand curve has shifted outwards. So both the clothes and leather industries show one of the highest growth

[21] Outsourcing is measured according to the narrow measure.

[22] Out of 18 NACE 2-digit manufacturing sectors for which data are continuously available over the period 1991-2003.



Notes: The numbers show average annual growth rates over the respective period. The sectors are ranked in descending order with respect to their growth rates in outsourcing during 1991 and 2003. *Outsourcing* is defined in the narrow way. For further details of variable definition see Table 3.15 in the Appendix.
Source: Own calculations based on data from input-output tables and labor market statistics of the Federal Statistical Office of Germany.

Figure 3.6: Outsourcing, Wages and Employment

rates in relative wages, and at the same time, their relative employment of non-production workers increased most strongly. The relative skilled labor employment tripled in the clothes sector and reached 91 percent in 2004.

Considering the data on relative employment for individual sectors shows for the entire period that only in the sector of manufacturing basic metals the ratio of high-skilled to low-skilled workers declined slightly. Also in both sub-periods, most sectors increased their employment of non-production workers relative to production workers. It seems remarkable, concerning the computer sector, that the strong variation of relative wages over time was accompanied by an enormous movement of the relative employment. So the relative non-production workers' employment increased between 1991 and 1996 from 151 to 227 percent, followed by a sharp decline to 140 percent in 2001 and a rise again in recent years. It reveals the high volatility in the labor demand for skills in the computer sector.[23]

In Table 3.4, I take a closer look at the sectoral pattern of outsourcing and its time structure. In examining trends in the two sub-periods, two broad facts emerge. First, 16 out of 18 sectors increased their outsourcing activities over the entire period of 1991 through 2003 but only 11 sectors show a positive growth rate in the more recent sub-period. Second, a sectoral shift towards more skill-intensive sectors can be observed. As the table indicates, high-skilled labor intensive sectors are the main outsourcers of German manufacturing in the latter sub-period.

One could argue that the incentive to outsource stages of production to low-wage countries is greater in low-skill intensive sectors where low-skilled labor accounts for a substantial portion of total production costs. In general, for the entire period, the ranking of the sectors confirms this view, generally spoken. However, the trend during the total period does not tell the whole story. It misses the sectoral shift over time.

In the early 1990s, firms particularly in the computer, tobacco, plastics, leather, and textiles sectors increased their imported intermediate inputs

[23] Diehl (1999) identifies similar trends of the computer sector in Germany for the period 1970-1993. He states that the employment share of production workers in this sector declined dramatically by 37 percentage points, while the relative wages of production workers increased by the certain amount of more than 20 percentage points.

Table 3.4: Main Outsourcing Sectors

Outsourcing [a]							**Human Capital Intensity** [b]	
1991-2003		1991-1996		1997-2003				
tobacco	13.40	1.	computer	13.46	(2.)	tobacco	12.59	electronics	22.31
computer	9.86	2.	tobacco	12.52	(1.)	computer	6.70	medical, optical instrum.	21.34
clothes	5.05	3.	rubber and plastics	9.10	(12.)	chemicals	5.77	machinery	18.09
leather and shoes	5.03	4.	leather and shoes	9.08	(8.)	radio, TV, communication	3.85	food and beverages	10.23
rubber and plastics	4.95	5.	textiles	7.39	(15.)	machinery	3.66	motor vehicles	9.90
chemicals	4.65	6.	clothes	6.86	(11.)	electronics	3.50	glass and stones	8.92
textiles	4.48	7.	basic metals	4.23	(6.)	clothes	2.32	chemicals	7.28
radio, TV, communication	3.76	8.	radio, TV, communication	2.86	(18.)	medical, optical instrum.	2.25	rubber and plastics	5.36
electronics	3.76	9.	motor vehicles	2.81	(13.)	fabricated metals	1.64	radio, TV, communication	4.50
fabricated metals	2.45	10.	other transport equipment	1.99	(5.)	textiles	1.29	textiles	3.47
machinery	2.36	11.	electronics	1.96	(4.)	leather and shoes	0.67	basic metals	3.08
basic metals	2.31	12.	chemicals	1.90	(3.)	rubber and plastics	-0.54	fabricated metals	2.60
other transport equipment	1.56	13.	fabricated metals	1.27	(7.)	basic metals	-0.57	wood	0.99
motor vehicles	0.83	14.	food and beverages	0.77	(16.)	glass and stones	-0.77	clothes	0.00
medical, optical instrum.	0.07	15.	machinery	-1.15	(17.)	wood	-1.23	tobacco	-
food and beverages	0.00	16.	glass and stones	-2.44	(14.)	food and beverages	-1.49	leather and shoes	-
glass and stones	-0.67	17.	wood	-2.62	(10.)	other transport equipment	-2.13	computer	-
wood	-0.69	18.	medical, optical instrum.	-3.55	(9.)	motor vehicles	-2.20	other transport equipment	-

[a] *Outsourcing* is defined in the narrow way. The numbers show average annual growth rates of outsourcing. The sectors are ranked in descending order for each period. The ranking in parentheses in column "1997-2003" corresponds to the sector's ranking in the period 1991-1996.
[b] *Human Capital Intensity* is defined as the number of employees with college or university degree in percent of total employment.
Source: Own calculations based on data from input-output tables of the Federal Statistical Office of Germany and firm-level data from a survey of 665 German and Austrian multinationals, Chair of International Economics, University of Munich.

from abroad. In the more recent period, the plastics, leather, textiles and basic metals industries reduced their outsourcing activities rapidly.[24] At the same time, the electronics, chemicals, machinery, and the medical and optical instruments sectors which are characterized by low or negative growth rates in the first period, increased their outsourcing activities strongly during the later period. In Table 3.4, this trend can be seen in the numbers in parentheses in the column of the period 1997-2003. These numbers reflect the ranking of the industries in the earlier period. What do these sectors have in common? Out of these sectors come high-tech industries, since their human capital intensity lies clearly above the average. Whereas the sectors which decelerated significantly the growth of imported inputs, are usually characterized as low skill-intensive and traditional sectors. The last column of the table shows the sectors' rankings according to human capital intensity.[25] The sectoral shift suggests that in the early nineties, low-tech sectors mainly outsourced low-skill intensive intermediates to low-wage countries, while in more recent years, human-capital intensive sectors increased substantially the imports of intermediate inputs. The latter might come from more advanced countries which are well endowed with high-skilled labor relative to Germany. As a result, the factor content of imported intermediates might have changed towards more skilled-labor.

Because of the visible strong shift in the pattern of outsourcing sectors, it seems reasonable for the econometric examination to distinguish the period of 1991-2003 in two sub-periods. Furthermore, it appears to be worth analyzing the impact of outsourcing on the skill-structure of individual sectors and groups of sectors classified according to their human capital intensity, respectively. After reviewing existing empirical studies in the next section, I will analyze these phenomena econometrically.

[24] Two of these sectors show negative growth rates and the others clearly lower growth rates in the period 1997-2003 compared to 1991-1996.

[25] Since data on the human capital intensity at the level of individual sectors is not available in official statistics, I use as a proxy data from a unique data set of German and Austrian multinationals.

3.4 Existing Empirical Literature

Recently, the relocation of jobs by German multinational firms from Germany to abroad created a great public sensation. And although the impacts of international outsourcing on the German labor market is highly debated in Germany's publicity, empirical studies about this topic are rare. Geishecker (2002, 2005) and Geishecker and Görg (2004, 2005) are the only studies for Germany that investigate the effects of international outsourcing on the demand for different skill groups during the 1990s. They highlight in their studies that outsourcing leads to skill-upgrading within each sector. Therefore, they conclude, low-skilled workers in Germany are losing from outsourcing. The result confirms the predictions of the theoretical model of Feenstra and Hanson (1996a), and it is in concordance with the large part of the existing empirical literature presented in Section 2.2.

Diehl (1999) undertakes an investigation on the impact of international outsourcing on the skill-structure in German manufacturing during the 1970s and 1980s. He mentions that outsourcing can be understood as substitution of imported inputs for domestic low-skilled workers. In contrast to most other studies, in a cost function framework, he uses relative prices instead of volumes of imported intermediates inputs. Estimating factor demand functions for 28 German manufacturing industries between 1970 and 1993, Diehl (1999) finds only weak evidence on the impact of outsourcing on the domestic skill-structure. In only 16 out of 28 industries has outsourcing had a statistically significant impact on the relative labor demand. While in 11 industries the relative employment of production workers is negatively affected by outsourcing, in the remaining five industries, which are in large part low-skill intensive industries, outsourcing favors production workers. These ambiguous results cannot identify the impact of outsourcing on the demand shift towards non-production workers.

As Geishecker (2002) states, this is the first empirical assessment of the impact of international outsourcing on the demand for low-skilled workers in Germany's manufacturing sector during the 1990s. Recently, a large discussion emerged about the role of the welfare state in the process of globalization.

There exists a broad common sense that the welfare state should compensate the losers from globalization and in particular from international outsourcing, thereby compensation the low-skilled workers for the disadvantages they experience. The mentioned empirical studies of Ingo Geishecker and Holger Görg support the widespread opinion about the deteriorating economic situation of low-skilled workers in Germany. After presenting Geishecker's (2002) major conclusions in the next paragraphs, I will prove the robustness of his empirical results.

Geishecker (2002) analyzes the role of international outsourcing in the relative demand for low-skilled workers in German manufacturing. He reports that in the aggregate manufacturing sector the relative wage bill of low-skilled workers declined by 23 percentage points within the period 1991 to 2000. While the predominant part, 21 percentage points, of this change can be attributed to a decreased relative employment of low-skilled workers, the decline in relative wages contributes only 2 percentage points. It indicates the power of Germany's labor market institutions, especially the high unionization of many manufacturing industries.

In addition, he finds that the observed skill upgrading occurred mostly within individual manufacturing industries. Decomposing the overall shift in the employment share towards high-skilled workers of 3.2 percentage points between 1991 and 2000 shows that the "within" industry relative demand shift accounts for 3.9 percentage points, while the sectoral reallocation towards low-skilled labor intensive industries attributes -0.7 percentage points.

Geishecker's (2002) analysis is based on a sample of 20 manufacturing industries of unified Germany pooled over the years 1991 to 2000. As a measurement for international outsourcing, he uses the imported intermediate goods of the firm's same two-digit sector in percent of the total intermediate goods of the domestic sector. These ratios are derived from data of the input-output table of the German Federal Statistical Office. At the aggregate level of the manufacturing industry, this measurement of international outsourcing increases by around 10 percentage points from 30.6 percent in 1991 to 40.3 percent of the sum of domestic and imported inputs in 2000.

According to the basic econometric specification, Geishecker (2002) regresses the low-skilled workers' wage bill share WBS_{LS} on international outsourcing $OUTS$, the sectoral capital intensity K/L and the lagged relative wages of high-skilled workers w_{HS}/w_{LS}. Additionally, the technical change over time $TECH$ is proxied by the R&D expenditure share in total output. This variable reflects the technical change of the aggregate manufacturing industry and shows no variation across sectors. Furthermore, industry fixed effects are included to control for time-invariant characteristics of each individual industry. Column (1) of Table 3.5 shows the results of Geishecker's (2002) basic regression. However, I replaced the original dependent variable, the *low*-skilled workers' wage bill share by the wage bill share of *high*-skilled workers. Simultaneously, I switched the signs of the estimated coefficients on the explanatory variables to the opposite in order to make Geishecker's results immediately comparable with my outcomes below. The reported standard errors are adjusted for contemporaneous correlation of order one and for heteroscedasticity.

The coefficient on the variable of interest $OUTS$ is positive and statistically significant at the one percent level. It appears that international outsourcing has a positive impact on the demand for high-skilled workers and disfavors low-skilled workers. Moreover, it is notable that also technical change shows the predicted sign and has a skill-biased effect, which confirms the expected low-skilled labor saving character of technology. In a further specification, which is not reported here, Geishecker (2002) distinguishes capital into two components, equipment and plant capital. He states that in this specification only equipment capital impacts low-skilled labor negatively. Thus, he concludes "independent of the specification there is strong evidence for a negative impact of international outsourcing on the relative demand for low-skilled workers."[26]

Nevertheless, are these results robust to the inclusion of additional econometric controls for the panel structure? In a first step, I reestimate Geishecker's specification (1) using a comparable dataset of 19 industries[27] for the same

[26] See Geishecker (2002), p. 13.

[27] Out of 23 NACE D 2-digit industries the following four industries are excluded due

Table 3.5: Robustness of Estimates of Geishecker (2002)

dependent variable:	*wage bill share of high-skilled workers*				
	(1)	(2)	(3)	(4)	(5)
OUTS	0.078***	0.104***	0.000	0.015	0.013
	(0.026)	(0.029)	(0.018)	(0.021)	(0.022)
ln K/Y	-0.020	3.092**	5.723***	4.181**	4.875***
	(0.018)	(1.538)	(1.283)	(1.913)	(1.813)
TECH	3.192*	7.583**			
	(1.946)	(3.633)			
R&D Y					-0.145
					(0.276)
$ln\left(w^{LS}/w^{HS}\right)_{lag}$	-0.200**	-12.838**	-7.202	-7.259	-7.245
	(0.091)	(6.193)	(4.428)	(4.662)	(4.715)
Constant	-0.466*	-45.370	-1257.9***	8.512	10.739
	(0.27)	(33.02)	(106.2)	(23.85)	(23.26)
industry fixed effects	yes	yes	yes	yes	yes
linear time trend	no	no	yes	no	no
time fixed effects	no	no	no	yes	yes
Adj. R^2	0.894	0.979	0.985	0.986	0.985
N	180	171	171	171	162

Notes: Coefficients are estimated by OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are adjusted to contemporaneous correlation of order one and to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes the number of observations.

Variables are defined as follows: *wage bill share* = (wage bill of non-production workers/industry wage bill)*100; *OUTS* = (imported inputs from same sector/domestic and imported intermediates from same sector)*100; *ln Y* = log real output; *ln K/Y* = ln [(capital/output)*100]; *TECH* = (R&D expenditure of manufacturing/output of manufacturing)*100; *R&D Y* = (R&D expenditure of each sector/output of each sector)*100; $ln\left(w^{LS}/w^{HS}\right)_{lag}$ = first lag of ln[(wage of low-skilled workers/wage of high-skilled workers)*100].

Source: Column (1) reports estimates of Geishecker (2002); Columns (2)-(5) report own calculations.

period of time 1991 to 2000. Column (2) in Table 3.5 reports the estimated coefficients, which are qualitatively similar to those of Geishecker (2002), especially the coefficients on the variables of interest outsourcing and technical change. Based on this specification, I replace in column (3) the manufacturing-wide R&D expenditure ratio with a linear time trend to catch various sorts of common changes over time. The result is that the coefficient on the outsourcing variable becomes insignificant and is of negligible size. Moreover, the linear time trend appears significantly positive, which means that outsourcing has no significant additional explanatory power to determine the changes in the labor demand. Although not reported in the table, it should be noted that the results remain unchanged when additionally the technology variable $TECH$ is included. In this case, the coefficient on $TECH$ is not statistically significant yet it is positive.

A proper OLS estimation for panel data requires a two-way fixed effects specification with industry *and* time fixed effects. The year dummies pick up economy wide effects that are specific to individual years but not industries. As the results in column (4) of Table 3.5 show, the inclusion of two-way fixed effects captures all the variation the outsourcing variable contains and makes the coefficient on $OUTS$ insignificant.

The last specification of this table includes a sector-specific R&D expenditure ratio $R\&D/Y$ in the regression which varies over sectors and time. This makes it possible regress the high-skilled workers' wage bill share on technological change and to control at the same time for general effects of individual years. Again, this specification does not change the positive but statistically insignificant impact of international outsourcing on the demand for low-skilled workers.

The estimates suggest that the proposed statistical significance of a negative effect of outsourcing on low-skilled labor is not robust to standard OLS panel estimation techniques. A more recent empirical study supports this statement. Geishecker (2005) does not find significant empirical evidence on the impact of overall outsourcing on the economic fortune of low-skilled

to data constraints: publishing and printing, oil refining and nuclear fuel, furniture and manufacturing n.e.c., and recycling.

workers in German manufacturing. Using a similar set-up, this study analyzes the effects of outsourcing from Germany to Eastern Europe. Combining data on international trade and intermediate inputs, he constructs a narrow and wide measure of outsourcing, distinguishing the imports according to the geographical origin. In order to account for endogeneity of the outsourcing variable, Geishecker (2005) applies the General Method of Moments using first and second lags. Furthermore, he includes a full set of time and industry dummy variables whereas the time dummies should capture technological progress. As a result of the GMM regression analysis, outsourcing to Central and Eastern Europe lowers significantly the relative demand for low-skilled manual workers. However, there is no unambiguous empirical evidence for the effects of outsourcing to other countries than Eastern European and for overall outsourcing. Using OLS fixed effects and GMM estimations, the results on outsourcing are in most specifications statistically insignificant and the direction of influence is not robust.

The highly significant positive impact of outsourcing to Central and Eastern Europe on the relative demand for high-skilled labor that Geishecker (2005) identifies might be plausible, however, the calculation of the geographical distinction of outsourcing requires a critical note.[28] There is no doubt that distinguishing outsourcing according to the geographical origin is very useful for analyzing the effects of outsourcing in more detail. It makes it possible to gain insights on how the source of imported inputs matters for the impact on the labor market. Furthermore, it could identify the role of individual countries in the international value-added chain. However, restrictions of data do not allow to investigations of this role without stringent assumptions. If stages of production are moved offshore due to differences in factor endowments, then it is indeed likely that the shares of intermediate goods in total imports differ across trading partners. One might expect that the mix of intermediate and final goods differ substantially between imports from CEE, and for example, Western European countries. However, when constructing outsourcing measures for individual regions, the crucial assump-

[28] Egger and Egger (2003) construct in a similar way a measure for outsourcing from Austria to Central and Eastern Europe.

tion has to be made that the composition of intermediate and final goods is identical across all regions. Therefore, solely the variation of total imports taken from trade statistics drives the measure of geographical outsourcing. In the face of these problematic features, it seems reasonable to prefer direct measures of import competition.[29]

In a related work, Geishecker and Görg (2005) employ micro-data of the German Socio Economic Panel for the years 1991-2000. The sample covers 1612 individuals and contains detailed information on educational attainment. Geishecker and Görg (2005) measure outsourcing by the value of imported intermediate inputs in a sector's output. This measure corresponds to the wide definition of outsourcing. In the econometric analysis, they estimate wage equations at the level of individuals. Their results indicate that international outsourcing affects wages negatively, but the coefficient appears to not be statistically significant. However, distinguishing the industries into low-skill and high-skill industries reveals that outsourcing has a significant negative impact on wages in low-skill sectors, while the impact is insignificant, yet negative, for high-skill sectors. Furthermore, Geishecker and Görg (2005) show significant empirical evidence that high-skilled workers in high-skill intensive sectors are influenced positively by outsourcing, while low-skilled workers in low-skill intensive sectors experience a negative wage effect from outsourcing. Interestingly, high-skilled workers in low-skill intensive sectors are negatively affected by fragmentation in terms of wages.[30] The authors conclude that the effects of outsourcing on individual wages depend crucially on the characteristics of the industry in which the individual is employed.

This overview of existing empirical studies on Germany shows that the observed overall impacts of outsourcing on the skill-structure are weak. It might be surprising facing the large relocation of production stages offshore

[29] Arguing in this way, Anderton *et al* (2002a) use total import shares distinguished to geographic regions as measure for outsourcing.

[30] In a more detailed study, Geishecker and Görg (2004) distinguish the individuals into three skill categories. They find a strong negative effect of outsourcing on the real wages of low-skilled workers. Their findings led them to conclude that in Germany, low-skilled workers are losers from the internationalization of the production process.

undertaken by German companies in recent years. Significant effects can be detected only for selected skill groups and industries. Furthermore, I have shown that the Geishecker's (2002) findings of an overall negative impact of outsourcing on low-skilled workers are not robust to a proper OLS panel estimation. Therefore, further efforts are required to gain more insights in the reactions of the German labor market on factor-biased outsourcing.

New aspects might be gained by inspecting the effects of outsourcing on relative wages and employment separately instead of the composed relative demand. Furthermore, a closer look at individual sectors which show striking variation in trends, may be useful. Also some work for Germany has to be done on investigating technological change and its channels which have to be approximated in a more accurate way than by time trends and dummies. Moreover, the question of what role governmental R&D policy and other factors of technology diffusion play in skill-upgrading arises. Finally, the shown studies on Germany miss all together the developments in the most recent years. As I have shown, the sectoral pattern of outsourcers shifted substantially in the recent years away from low-skill towards high-skill sectors. It should have certain effects on the consequences of outsourcing. Therefore, it makes it reasonable to extend the period of analysis to the early 2000s, obtaining at the same time a sufficiently long period of time for econometric examination.

3.5 Econometric Specification

3.5.1 Estimation Equation

The model of Feenstra and Hanson (1996a) provides a formalization of the idea that international trade and particularly outsourcing induces a shift in the factor intensities in domestic production. It is common in the literature in this field to estimate industry cost functions for examining the sources of the shift in the skill structure. Following Berman *et al* (1994), the starting point is to consider the variable unit cost function for each industry.

Feenstra and Hanson (2003) state that "any structural variables that shift the production function and therefore affect costs should be included as arguments"[31] in the cost function. Thus, in order to estimate the effect of international outsourcing on the relative skilled labor demand, Feenstra and Hanson (1996a, 1996b) adopt Berman *et al*'s (1994) regression framework by including the outsourcing variable. As outlined in Feenstra and Hanson's model in Chapter 2, the countries are - by assumption - endowed with three factors of production: low-skilled labor, high-skilled labor, and capital. In the production process these three factors are combined, which leads to the following unit cost function for each sector i and for each point in time t:

$$cv_{it} = cv\left(w_{it}^{LS}, w_{it}^{HS}, r_{it}, OUTS_{it}, TECH_{it}\right) \tag{3.3}$$

In addition to the three factors of production whose corresponding factor prices are denoted by w_{it}^{LS}, w_{it}^{HS}, and r_{it}, variables for outsourcing ($OUTS$) and technology ($TECH$) are included. They capture the imported intermediate inputs and the technical change at the sectoral level, respectively. Following the existing literature, the inclusion of outsourcing as well as technological progress in the unit cost function is justified by arguing that merely including the factors of production will not capture other factors which might influence the production costs. In this context, outsourcing can be thought of as a form of technical change since it acts as an "endogenous technical change".[32]

Starting from this variable cost function and assuming capital to be a fixed factor of production, two factors of production are variable in the short-run: low-skilled and high-skilled labor. Following the empirical approach of Berman *et al* (1994) a translog cost function can be derived from the unit cost function. The differentiation of the translog cost function with respect to the prices of the variable factors, w_{it}^{LS} and w_{it}^{HS}, gives the factor demand equation in the form of the factor's share in total variable cost. In my analysis the factor's share in total variable cost corresponds to the high-skilled workers' wage bill in the total wage bill. This wage bill share of the high-skilled

[31] Feenstra and Hanson (2003), p. 21.
[32] See Feenstra and Hanson (1996a).

workers (WBS^{HS}) measures the relative demand for high-skilled labor. By pooling data across industries, I assume that the same cost function applies for all industries. From differentiation of the translog function, it comes out that the relative wages appear on the right-hand side. Berman *et al* (1994) mention that it is not plausible to treat the relative wages as an exogenous explanatory variable. Arguing the variation of wages across industries reflects only differences in the quality of workers, the relative prices of labor can be considered constant across industries. Therefore, to avoid endogeneity problems, relative wages can be omitted from the estimating equation. The cross-industry variation of relative wages is taken into account by using time and industry fixed effects. It gives me the following baseline estimating share equation:

$$\begin{aligned} WBS_{it}^{HS} &= \beta_0 + \beta_1 lnY_{it} + \beta_2 lnK_{it}/Y_{it} + \beta_3 OUTS_{it} + \beta_4 TECH_{it} + \\ &\quad \beta_5 T_t + \beta_6 I_i + u_{it} \end{aligned} \tag{3.4}$$

As already mentioned above, the dependent variable is a composite measure. It incorporates relative wages of non-production workers as well as their relative employment. Although the decomposition of the labor demand in wages and employment is based on weak theoretical foundation, it should provide interesting insights in the mechanism of the labor market. Therefore, below I will replace the wage bill share as dependent variable with the relative wages and alternatively with the relative employment of the high-skilled workers. To control for exogenous variations of the dependent variable which are systematic across industries or years, I include a full set of time (T_t) and industry (I_i) dummies.

3.5.2 Data and Variables

The employed dataset comprises data for NACE 2-digit industries of the German manufacturing sector[33] pooled over the years 1991 to 2003. Out of

[33] The manufacturing sector corresponds to category D (15-37) of the NACE Rev. 1 classification. The European classification system NACE corresponds to the international industry classification ISIC. Thus, NACE Rev. 1 is equivalent to ISIC Rev. 3.

the 23 two-digit industries of NACE D, the following five industries are excluded due to missing data on wages and employment, manufacturing of pulp and paper, printing and publishing, coke and petroleum products, furniture and other manufacturing, and recycling. Finally, it yields a balanced panel dataset consisting of 234 observations. Unfortunately, using a longer time series with data prior to 1991 is not possible due to two reasons. First, the German reunification prevents a longer consistent time series, and secondly, the adoption of the Eurostat NACE industry classification succeeding the specific German system does not allow it. The data I use are taken from different sources, as summarized in Table 3.15 in the Appendix.

Labor market data on wages and employment are available for the broad categories production and non-production workers. The Federal Statistical Office provides the data at the sectoral level of NACE 2-digit. For constructing the outsourcing measures, data on imported intermediate inputs are obtained from German input-output tables for selected years. Since input-output information is not compiled for every year, I estimate the data for missing years using the import data from trade statistics. Therefore, imports are the main driving force of this measure. The Appendix provides a detailed description of the methods for constructing those estimates. For the narrow definition of outsourcing, the imported intermediate inputs at the main diagonal of the input-output table are utilized. They correspond to the inputs from the same sector as the output is being produced. Whereas the column sum of each sector's imported inputs minus the inputs at the main diagonal yields the value of imported inputs on which the measure of difference outsourcing is based on. The technological change over time is approximated by the share of R&D expenditure ratio in value added at the sectoral level. The data on the remaining variables are obtained from the OECD STAN Industrial database. Table 3.15 in the Appendix provides the definitions and sources of all utilized variables.

The key question in the regression analysis is the sign and the significance of the coefficient on $OUTS$. The null hypothesis is $\beta_3 = 0$ which means that there exists no relationship between outsourcing and the skill-structure of labor demand. The alternative hypothesis is $\beta_3 < 0$ or $\beta_3 > 0$. The out-

sourcing variable can be interpreted as the relationship between international outsourcing and a firm's unit input requirement for high-skilled labor.[34] A negative sign indicates that increased outsourcing activities disfavor high-skilled workers relative to low-skilled workers, while a positive sign indicates that outsourcing saves more low-skilled labor relative to high-skilled labor. As mentioned in Chapter 2, the theoretical model of Feenstra and Hanson (1996a) predicts a positive relation.

Commonly, it is assumed that technological progress favors the high-skilled workers.[35] The computerization of the production process is associated with the idea of low-skilled labor saving technology. Hence, the coefficient on technological change should take a positive sign.

The variables of output and capital intensity are included in the regressions as control variables. The level of output controls for effects of economies of scale that may differ across industries. Output is proxied by value added which reflects the transformation of intermediate inputs into finished goods. The coefficient on the output variable should take a negative sign, since in the short-run business-cycles, output tends to hurt the low-skilled workers more than the high-skilled workers.[36] The presumed complementarity of capital and skills should imply a positive sign of the coefficients on the capital intensity.

3.6 Empirical Results

3.6.1 Fixed Effects Estimation

Including industry and time fixed effects, the share of total wage bill going to non-production workers is regressed on outsourcing, technological change and additionally on some control variables. The regressions are run cross-sectionally over 19 NACE 2-digit industries and annually over the period 1991 to 2003. In order to control for omitted variables in the panel dataset which might cause biased estimates, the two-way fixed estimation technique is

[34] See Feenstra and Hanson (1996b).
[35] See Berman *et al* (1994).
[36] See Kraft (1994) for this argument of counter-cyclical reaction.

applied.[37] Fixed-effect estimators allow for unobserved heterogeneity across industries. Industry fixed effects control for variation of omitted variables across industries for which the explanatory variables do not account. While these omitted variables are constant over time but vary across industries, others are constant across industries but vary over time. Therefore, time fixed effects are also included, controlling for unobserved heterogeneity between individual years. Time fixed effects pick up aggregate exogenous factors like economy-wide business cycles or foreign factors which affect all industries equally. Since the employed sample cannot be considered as a random draw of a large population, the fixed effects approach appears to be preferable to a random effects approach.

As statistical tests exhibit,[38] the employed data are plagued with the problem of heteroscedasticity. In order to produce valid statistical inferences, all standard errors reported in the results are robust to heteroscedasticity.[39]

Table 3.6 reports the estimates of the different two-way fixed effects OLS regressions for the wage bill share of high-skilled workers. As its main result, it is striking that the narrow definition of outsourcing has a negative impact on the relative demand for high-skilled labor in all specifications. It suggests that human capital in Germany is losing from moving stages of production offshore. This stands in contrast to the results of the existing empirical literature.

The starting point of the regression analysis is estimating the following basic specification: The non-production workers' wage bill share is regressed on narrow outsourcing omitting technology as further determinant. Furthermore, in column (1) the output of each sector proxied by the value added and the capital to value added ratio are included as controls.

[37] See Stock and Watson (2003) and Wooldridge (2003) for a detailed presentation of panel estimation techniques.

[38] The Breusch-Pagan/Cook-Weisberg and the White/Koenker tests for heteroscedasticity indicate that heteroscedasticity is present. Both tests reject the null hypothesis of homoscedastic disturbances at the one percent level of significance.

[39] Additionally, I estimated the regressions using panel-corrected standard errors using the Stata command *xtpcse, corr(ar1)*. Hence, the disturbances are assumed to be heteroscedastic, contemporaneously correlated across panels, and first-order autocorrelated within panels. The results on the variable of interest, narrow outsourcing, are fairly similar to those reported in the tables of this section.

Table 3.6: Outsourcing and Demand for High-Skilled Labor in Germany

dependent variable:	*wage bill share of high-skilled workers*					
	(1)	(2)	(3)	(4)	(5)	(6)
$OUTS^{narrow}$	-0.209**	-0.187**	-0.259***	-0.244**	-0.260***	-0.207**
	(0.102)	(0.092)	(0.099)	(0.105)	(0.079)	(0.088)
$OUTS^{difference}$		-0.283				
		(0.289)				
ln VA	-7.348**	-6.642**	-7.654**	-5.466	-7.701***	-6.816**
	(3.115)	(3.275)	(2.988)	(3.364)	(2.517)	(2.912)
ln K/VA	0.726	2.214	1.940	4.211	2.466	2.852
	(3.417)	(3.451)	(3.373)	(3.907)	(2.792)	(3.241)
R&D EXP			-0.144**	-0.035	-0.211***	-0.114
			(0.057)	(0.084)	(0.050)	(0.069)
R&D SUB				-0.572**		-0.385*
				(0.263)		(0.213)
$FDI^{out}L$					0.103***	0.095***
					(0.021)	(0.025)
Constant	81.269***	85.239***	83.282***	83.282***	81.807***	80.614***
	(17.314)	(17.837)	(16.579)	(18.655)	(13.825)	(16.104)
Adj. R^2	0.968	0.968	0.969	0.973	0.974	0.977
N	234	234	234	198	234	198

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; $OUTS^{difference}$ = (imported inputs from all sectors (excl. same sector)/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100; *R&D SUB* = (governmental R&D subsidies/value added)*100; $FDI^{out}L$ = (employment in foreign affiliates of German multinationals/sector's domestic employment)*100.

In the first specification, the statistically significant coefficient on narrow outsourcing $OUTS^{narrow}$ indicates that international outsourcing has a negative impact on the demand for non-production workers in Germany. The negative sign of the coefficient on the logged value added $ln\ VA$ suggests that an increase in production is accompanied by a decline in the relative demand for skills. This finding is in line with the argument of Feenstra and Hanson (1996b) that the relative demand for non-production workers is countercyclical. The capital intensity is found to have the predicted sign assuming complementarity between capital and skills. However, the variable is not statistically significant.

Column (2) contains the regression results when including narrow outsourcing $OUTS^{narrow}$ and difference outsourcing $OUTS^{difference}$ simultaneously. Both measures of outsourcing disfavor non-production workers, yet the influence of $OUTS^{difference}$ is not statistically significant.[40] It emphasizes the importance of import competition in intermediate inputs of the same sector as the good being produced. At the same time, the result confirms the theoretical idea that the skill structure of an individual sector's employment is not affected by decisions of replacing domestic inputs purchased from other industries with imported inputs. This outcome occurs in all specifications but is not shown in Table 3.6. Feenstra and Hanson (1999) find a smaller, yet significant, impact of difference outsourcing than narrow outsourcing when including both measures simultaneously.

Columns (3) to (6) present the results when adding control variables for technological change and foreign involvement of German multinationals which may influence the relative demand for high-skilled labor. Specification (3) includes the R&D expenditure ratio $R\&D\ EXP$ as a proxy for technological change in each sector.[41] Including both outsourcing and technical change aims to attribute any residual variation in the wage bill share to

[40] Furthermore, I estimated all specifications replacing narrow and difference outsourcing with wide outsourcing. The results are, however, fairly similar to narrow outsourcing only.

[41] Alternatively, I used the R&D employment ratio as proxy for technological change. The results appear, however, fairly similar to those using the R&D expenditure ratio. Furthermore, I experimented with data on granted patents to capture the output of R&D activities. The estimates of this variable are statistically insignificant and the sign is not robust. A reason might be that the number of granted patents are not an appropriate measure particularly across industries.

structural factors rather than to controls including fixed effects, and a remaining unexplained part. The coefficient on this variable shows a negative sign and is statistically significant at the five percent level.[42] It indicates that technological progress is biased in favor of production workers. The result is in conflict with the commonly-assumed low-skilled labor saving character of technical change. Moreover, controlling for technical change magnifies the negative impact of $OUTS^{narrow}$ on high-skilled labor and raises the statistical significance to the one percent level.

In order to control for the role of state R&D policy in the shift towards more-skilled workers, I additionally include in specification (4) the R&D subsidies of the German Federal government $R\&D\ SUB$. While an average of 6.9 percent of expenditure on R&D undertaken by firms was financed by the federal government in 1993, the share declined to 3.5 percent in 2003. The subsidies vary substantially across industries. Thus, less than 1 percent of the R&D expenditures of the vehicles industry are state-financed, whereas the manufacturing of other transport equipment, which includes aircraft and spacecraft activities, clearly received the absolute and relative largest amount. However, the subsidies to the latter industry declined substantially over time from more than 39 percent of business-financed R&D expenditures in 1993 to 13 percent in 2003. The large variation of R&D subsidies across industries indicates that they are used as an active policy instrument. Since the data on this variable are available only from 1993 onwards, the sample size declines to 198 observations. The significant coefficient on $R\&D\ SUB$ is negative as the $R\&D\ EXP$. However, $R\&D\ EXP$ becomes insignificant which indicates that the subsidy variable captures the explanatory power of the R&D expenditure ratio. Furthermore, the significance of the outsourcing variable slightly falls which underlines the importance of $R\&D\ EXP$ as a factor explaining the labor market outcomes.

Following Slaughter (2000), the specification in column (5) of Table 3.6 includes the FDI employment share $FDI^{out}\ L$ in the regression analysis, while the $R\&D\ SUB$ variable is excluded. Slaughter (2000) uses the em-

[42] The result holds when using the R&D employment ratio instead of the R&D expenditure ratio, which is not reported in the table.

ployment of foreign affiliates of US multinationals as proxy for international outsourcing.[43] I already mentioned the dramatic increase in the FDI employment share in Section 3.3.2. The highly significant and positive coefficient on $FDI^{out}\ L$ suggests that outsourcing, which occurs as intrafirm trade between a domestic parent firm and foreign affiliate, can attribute substantially to explaining the increase in the relative cost share of high-skilled labor. The effect is in the opposite direction to narrow outsourcing. The fact that the narrow outsourcing variable is highly significant in column (5), although $FDI^{out}\ L$ is included, indicates that both variables cannot be used as alternative measures. Moreover, as the opposite signs show, they pick up different factors which appear both highly relevant. The intrafirm trade which is included as part of the narrow measure of outsourcing, has seemingly specific impacts on the skill-structure. The major difference between the two measures is that narrow outsourcing takes into account also arm's-length purchased inputs from abroad.[44] On the other hand, the FDI variable is related to vertical FDI but also horizontal FDI that do not induce intrafirm trade. The last column of the table reports the estimates when all variables are included together. This results confirm the effects seen in the previous specifications.

As mentioned, in all specifications a full set of industry and time dummies is employed that is not reported in the table. However, it is notable that the time dummies are highly statistically significant. The coefficients appear positive and rising in size over time indicating an increase in the relative demand for high-skilled labor within each sector. However, this common trend is not captured by the included explanatory variables. It could be argued that it reflects partly a general trend of changing labor contracts.[45] Explaining this general shift towards non-production workers goes beyond the goal of this chapter to examine the impact of outsourcing on the skill-structure of labor demand.

To get an idea of the importance of outsourcing relative to the other explanatory variables calculating the contribution of each factor appears to be

[43] For further details on Slaughter (2000) see the literature overview in Chapter 2.

[44] See Section 3.3.2 for a more detailed description of these measures.

[45] Diehl (1999) mentions that the German classification according to production and non-production is based on the labor contract.

useful. In Table 3.6, the magnitude of the coefficient on $OUTS^{narrow}$ ranges -0.187 to -0.260. Multiplying the coefficients times the change in narrow outsourcing between 1991 and 2003 (2.59 percentage points) results in range of 0.48 and 0.67. It implies that outsourcing can account for at least 8.7 percent of the observed increase in non-production workers' wage bill share (5.56 percentage points) in the period 1991 and 2003.[46] The contribution increases to 12.1 percent when controlling for technological change. Including additionally the R&D subsidy variable, the highest contribution of outsourcing is obtained with 25.1 percent in column (4).[47] It means that the share of the wage bill of non-production workers would have increased more strongly by one quarter in absence of relocating production stages abroad. How relevant is outsourcing for the evolution of the relative high-skilled labor demand relative to other factors? Technological change can attribute at maximum 4.3 percent, while state-financed R&D expenditure reduces the increase of non-production workers' wage bill share by at most 4.9 percent. On the other hand, the FDI employment share can explain about one third of the increased wage bill share. Concluding, it emphasizes the high importance of foreign activities of German firms for the domestic labor market outcomes of different skill groups. The international involvement of German firms occurs in terms of imports of intermediated inputs and in terms of intrafirm trade induced by foreign investments. Both contribute substantially to the trends in the labor market, however as already stressed, they act in opposite directions.

Up to now, I regressed the non-production workers' wage bill share on various variables to examine determinants of the relative demand for high-skilled workers. Table 3.7 shows the regression results when decomposing the wage bill share into relative wages and relative employment of non-production workers. It allows me to determine through which channel international outsourcing and technological change affect the relative demand for human

[46] The percentage change is averaged over the 18 manufacturing sectors included in the regression analysis.

[47] The calculation of this contribution bases on changes between 1993 and 2003, since data on governmental R&D subsidies are only available from 1993 onwards. The corresponding changes in the wage bill share is 2.75 percentage points and 2.84 percentage points in outsourcing.

capital. As the negative sign on narrow outsourcing in all specifications indicates, the relocation of activities to abroad hurts the economic fortune of non-production workers in terms of employment and compensation, as well.[48] Formally spoken, it implies that outsourcing causes an inward shift of the relative demand curve. At first sight, the result on the relative factor prices seems surprisingly when facing the inflexible wages in Germany. However, as I considered, the trends of relative wages vary substantially across sectors. In columns (1) through (3), where the dependent variables are the relative wages, the control variable $ln\ VA$ appears to have a strongly negative effect. It indicates that a decline in output tends to reduce the wages of non-production workers relative to production workers who are more often unionized. The inclusion of the R&D expenditure share in the second specification increases the statistical significance of the outsourcing variable from the one to the five percent level. Whereas narrow outsourcing becomes insignificant, yet negative, when including simultaneously $R\&D\ EXP$ and $R\&D\ SUB$ in column (3), it is remarkable that the governmental R&D subsidies substantially push up the relative wages of high-skilled workers while negatively influencing the relative employment prospects of high skills.

It turns out in column (4) to (6) of Table 3.7 that import competition in intermediate inputs affects the relative employment of non-production workers strongly negatively. In the last two specifications, the coefficient on the R&D expenditure ratio is positive but not significant. While the inclusion of this variable does not affect the outcome of the outsourcing variable, controlling additionally for state-financed R&D expenditures increases the significance and size of the coefficient on $OUTS^{narrow}$.

Between 1991 and 2003, the skill premium rose on average over the 18 manufacturing sectors by 4.70 percentage points. Multiplying the estimated coefficient on outsourcing in column (2) times the change in the outsourcing variable (-0.663*2.589) yields -1.717. It implies that the relative wages would have increased more pronounced by 36.5 percent in the absence of moving any production stages offshore. On the employment side, outsourcing can

[48] Feenstra and Hanson (1997) who undertake similar estimates of the decomposed relative labor demand in Mexico, find that the predominant effect of FDI occurred on relative wages and not on relative employment.

Table 3.7: Outsourcing and Decomposed Demand for High-Skilled Labor

dependent variable:	*relative wages*			*relative employment*		
	(1)	(2)	(3)	(4)	(5)	(6)
$OUTS^{narrow}$	-0.560*	-0.663**	-0.265	-1.334**	-1.318**	-1.942***
	(0.298)	(0.301)	(0.202)	(0.612)	(0.604)	(0.695)
ln VA	-15.603***	-16.239***	-8.603***	1.326	1.427	3.127
	(4.964)	(4.730)	(3.298)	(12.743)	(12.677)	(17.024)
ln K/VA	-8.099	-5.578	1.290	28.116*	27.718*	28.103
	(9.288)	(8.719)	(4.034)	(16.246)	(16.387)	(20.573)
R&D EXP		-0.300**	-0.417***		0.047	0.545
		(0.141)	(0.150)		(0.328)	(0.491)
R&D SUB			1.519***			-3.474**
			(0.493)			(1.596)
Constant	253.785***	257.966***	216.818***	35.320	34.660	49.056
	(32.071)	(31.055)	(18.526)	(73.759)	(73.432)	(97.409)
Adj. R^2	0.936	0.938	0.966	0.932	0.932	0.936
N	234	234	198	234	234	198

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *relative wages* = (wages of non-production workers/wages of production workers)*100; *relative employment* = (employment of non-production workers/employment of production workers)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100; *R&D SUB* = (governmental R&D subsidies/value added)*100.

account for about 32 percent of the increase in relative employment, as the coefficients in column (4) and (5) indicate. However, the inclusion of the R&D subsidies as a further regressor leads to a rapid increase in the contribution of outsourcing. Narrow outsourcing can negatively account for 85.1 percent of the increase of the relative employment of non-production workers, while the subsidy variable can explain 12.6 percent. A specific case represents specification (3) on the relative wages since the skill premium declined slightly by -0.38 percentage points between 1993 and 2003. Due to data restrictions of the $R\&D\ SUB$ variable, this regression only relates to the years 1993 to 2003. Thus, the R&D subsidies which also fell by -0.23 percentage points, can account for almost 95 percent of the variation in the aggregate relative wages. At the same time, the technology variable has an effect in the opposite direction and contributes more than 100 percent. Overall, the changes in international outsourcing can contribute substantially with around one third to the evolution of both relative wages and relative employment.

3.6.2 Robustness

In this section I discuss the robustness of my empirical results. Inspecting two periods of time reveals certain changes in the effects of international outsourcing over time. Secondly, excluding outlier sectors from the sample tests the robustness of the results for the entire sample. Furthermore, analyzing groups of sectors detects specific mechanism in these sectors. Finally, I take a closer look at the exogeneity of the outsourcing variable.

Time Structure

This section considers whether the results change when distinguishing the entire sample period in two sub-periods. As Section 3.3 descriptively showed, the pattern of outsourcing activities enormously changed over time. In German manufacturing, the broad relocation of stages of production started in the second half of the 1990s. Therefore, I break down the entire sample period into two sub-periods and analyze them separately. I use again OLS

regressions with a full set of industry and time dummies controlling for exogenous changes in the dependent variable which vary systematically across industries or years.

Table 3.8: Outsourcing and Demand for High-Skilled Labor in Two Sub-Periods

dependent variable:	*wage bill share of high-skilled workers*			
	1991-1996		1997-2003	
	(1)	(2)	(3)	(4)
$OUTS^{narrow}$	0.032	0.405**	-0.262**	-0.257**
	(0.143)	(0.195)	(0.110)	(0.117)
ln VA	-3.273	4.864	-0.785	-1.161
	(3.021)	(5.977)	(4.030)	(4.167)
ln K/VA	2.099	9.502	3.662	2.384
	(3.681)	(6.257)	(4.677)	(4.486)
R&D EXP	-0.218***		-0.153**	
	(0.062)		(0.071)	
R&D SUB		-1.300*		-0.532*
		(0.728)		(0.278)
Constant	60.432***	14.939	53.707**	55.774**
	(16.897)	(34.429)	(22.640)	(23.200)
Adj. R^2	0.992	0.995	0.985	0.985
N	108	72	126	126

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100; *R&D SUB* = (governmental R&D subsidies/value added)*100.

The first two columns in Table 3.8 take only data of the early 1990s into account, while columns (3) and (4) examine the relationship in the more recent years. Column (1) reports the estimated coefficients on the variables of the basic specification. It appears that only the technological change proxied by the R&D expenditure ratio significantly affects the relative demand for high-skilled workers. As for the entire period presented in Table 3.6, the effect of $R\&D\ EXP$ is again skill-biased in favor of low-skilled workers. The coefficient on the outsourcing variable $OUTS^{narrow}$ indicates that the substitution of a sector's domestic production of inputs with imports of intermediate inputs shifts the labor demand towards high-skilled workers in the period 1991-1996. While the effect is not statistically significant in specification (1), it becomes significant at the five percent level when replacing the R&D expenditure ratio by the R&D subsidy variable. The positive sign of the coefficient on $OUTS^{narrow}$ is in line with the predictions of the theoretical model of Feenstra and Hanson (1996a), outlined in Chapter 2. Furthermore, it confirms Geishecker's (2002) findings of weak evidence of the skill-biased feature of outsourcing in German manufacturing during the 1990s. The size of the outsourcing coefficient in column (2) indicates that narrow outsourcing can account for 63 percent of the increase in the non-production wage bill share during the period 1993 to 1996.

Turning to the more recent period, however, the outcomes change. During the years 1997 through 2003, outsourcing appears to discriminate against the non-production workers in Germany. In both specifications (3) and (4), the coefficient on the narrow measure of outsourcing turns out to be significantly negative. During the later period, international outsourcing makes a negative contribution of around 14 percent in explaining the trend of skill-upgrading. The coefficient on $R\&D\ SUB$ reveals that state-financed R&D expenditure has in both periods a significantly negative impact on the relative high-skilled labor demand. The controls for output and capital intensity show in both sub-periods no significant effect on the skill-upgrading. Apparently, both controls cannot attribute to the developments at the labor market since they do not change remarkably within the short periods of time.

Table 3.9: Outsourcing and Decomposed Demand for Skills in Two Sub-Periods

	1991-1996		1997-2003	
dependent variable:	*relative wages*	*relative employment*	*relative wages*	*relative employment*
	(1)	(2)	(3)	(4)
$OUTS^{narrow}$	-0.774	2.241**	-0.462**	-1.389*
	(1.066)	(0.974)	(0.225)	(0.745)
ln VA	-24.725	43.871**	-9.106	25.237
	(24.134)	(20.010)	(6.226)	(18.551)
ln K/VA	-20.271	58.369**	0.019	32.194
	(29.430)	(25.628)	(7.857)	(21.850)
R&D EXP	-0.517**	-0.104	-0.097	-0.483
	(0.240)	(0.278)	(0.164)	(0.321)
Constant	6312.978**	-218.342*	218.826***	-61.358
	(145.592)	(123.309)	(34.291)	(105.154)
Adj. R^2	0.903	0.983	0.977	0.961
N	108	108	126	126

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; *N* denotes number of observations.
Variables are defined as follows: *relative wages* = (wages of non-production workers/wages of production workers)*100; *relative employment* = (employment of non-production workers/employment of production workers)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100.

Table 3.9 reports the coefficient estimates when examining the developments of the determinants of relative wages and relative employment in the two sub-periods. Column (1) of the table suggests that only the technological change has a significant influence on the increase of the skill premium during the early 1990s. However, on the employment side, the coefficient on outsourcing is positive and significant at the five percent level. It indicates that international outsourcing can account for about 26 percent of the increased relative employment of non-production workers. The last two columns of the table relate to the effects during the years 1997 to 2003. Outsourcing af-

fects the relative wages as well as the relative employment of non-production workers significantly negatively. The contribution is a 72 percent rise in the relative non-production workers' compensation, however, this is almost three times as large as to the increase in the relative employment. The changes in technological change as well as in the control variables account less for the increase in the dependent variables since the these variables are quite stable in the short-run.

Sectoral Analysis

As shown in Section 3.3.3, the long-run aggregate trends cover up not only discontinuous trends over time but also a substantial shift in the pattern of outsourcing sectors. In this section, I will examine how robust the results are to a sectoral decomposition. Above I already referred to the high volatility of the computer sector. Therefore, as starting point of the sectoral analysis, I examine the role of the NACE 2-digit sector "office, accounting and computing machinery" by excluding this sector from the sample. Table 3.10 reports the estimated coefficients on the variables of the basic specification, including outsourcing and technology. Specification (1) investigates the determinants of the wage bill share of non-production workers. It comes out that the sign on the outsourcing variable turns to the positive when excluding the computer sector from the regressions. It underlines the large explanatory power of the computer sector based on its highly volatile trends. One could argue that the computer sector is an outlier which disturbs the "real" impact of outsourcing. However, to make a statement on the overall relevance of outsourcing at the level of the aggregate manufacturing sector this sector has to be taken into account. Below, I will take a closer look at the role of the computer sector and test whether it is really an outlier sector with specific features.

Table 3.10: Outsourcing and Relative Demand for High-Skilled Labor (Computer Sector Excluded)

dependent variable:	*wage bill share*	*relative wages*	*relative employment*
	(1)	(2)	(3)
$OUTS^{narrow}$	0.230**	-0.375**	1.364***
	(0.103)	(0.166)	(0.333)
ln VA	-5.735***	-13.740***	8.693
	(2.086)	(3.496)	(7.609)
ln K/VA	2.489	3.157	15.168
	(2.522)	(5.038)	(9.589)
R&D EXP	-0.149***	-0.176*	-0.229
	(0.045)	(0.091)	(0.152)
Constant	68.507***	232.653***	-13.327
	(11.518)	(20.217)	(44.573)
Adj. R^2	0.969	0.963	0.955
N	221	221	221

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; *relative wages* = (wages of non-production workers/wages of production workers)*100; *relative employment* = (employment of non-production workers/employment of production workers)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100.

Excluding the computer sector, however, does not change the result that technological change favors the production workers. This impact of technology also seems robust in specifications (2) and (3) where the wage bill share is replaced by relative wages and relative employment as dependent variables, respectively. It is notable that the negative impact of outsourcing on the skill premium in column (2) remains independent of whether the computer sector is taken into account or not. The coefficient is statistically significant at the five percent level. However, the contribution is with 11 percent lower than when employing all sectors. Finally, in specification (3) the narrow measure

of outsourcing appears to have a highly significant and positive effect on the number of employed non-production workers relative to production workers. It can account for 28 percent of the increase in relative employment. The emerged picture infers that the composed positive relative demand effect of outsourcing is caused by the impact on the employment side which offsets the negative influence of outsourcing on the relative wages. The low contribution of outsourcing (9 percent) to the evolution of the wage bill share confirms this fact.

As I considered in Table 3.4 in Section 3.3.3, a notable shift in the pattern of outsourcing sectors emerged over time. I identified that low-skill intensive and traditional sectors tend to reduce, or at least not increase, their outsourcing activities, while human-capital intensive sectors increased rapidly the international fragmentation of the production process during the mid-nineties. Particularly the electronics, chemicals, machinery, and the medical and optical instruments sectors experienced a substantial growth in outsourcing. Furthermore, the computer industry shows in both sub-periods one of the highest growth rates. Compared to the full sample of 18 sectors, the selected high-tech sectors moved substantially more value added offshore during the period 1991-2003. While imported intermediate inputs account for 5.7 percent of the output in the full sample and the high-tech group in 1991, the high-tech industries sourced in 2003 10.2 percent from abroad and the full sample of 18 sectors on average 8.3 percent. In order to check if the computer industry is actually different to other sectors and to examine the trends in more homogeneous group of high-tech industries, I will restrict the analysis to these industries.

Estimating the same specifications as in the case of the full sample, Table 3.11 reports in column (1)-(3) the results when including all five human-capital intensive sectors, and in the remaining columns, reports the results when the computer industry is excluded from this group. As becomes evident from the table, outsourcing has a pronounced effect on the non-production workers' wage bill share independent of the computer industry. Since the coefficient on $OUTS^{narrow}$ remains significantly negative when excluding computers, the impact of the computer sector is apparently not substantially

Table 3.11: Outsourcing and Relative Demand for Skills in High-Skill Sectors

dependent variable:	*wage bill share of high-skilled workers*					
	chemicals, machinery, electronics, optics, computer			chemicals, machinery, electronics, optics		
	(1)	(2)	(3)	(4)	(5)	(6)
$OUTS^{narrow}$	-0.561***	-0.529***	-0.542***	-0.221**	-0.255***	-0.321**
	(0.056)	(0.051)	(0.052)	(0.082)	(0.083)	(0.140)
ln VA	-7.769**	-9.290**	-12.680***	-5.398*	-1.658	-2.726
	(2.996)	(3.526)	(4.236)	(3.072)	(3.707)	(4.476)
ln K/VA	-2.798	-4.842	-3.571	-2.914	0.018	0.053
	(3.518)	(3.797)	(3.911)	(2.710)	(3.169)	(3.305)
R&D EXP		0.052	-0.129*		-0.080	-0.114
		(0.073)	(0.066)		(0.078)	(0.084)
$FDI^{out}L$			0.129***			0.026
			(0.025)			(0.042)
Constant	114.894***	115.067***	138.112***	92.100***	69.244***	75.077***
	(17.916)	(20.667)	(24.492)	(19.408)	(22.758)	(27.079)
Adj. R^2	0.987	0.987	0.992	0.986	0.987	0.986
N	65	65	65	52	52	52

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100; $FDI^{out}L$ = (employment in foreign affiliates of German multinationals/sector's domestic employment)*100.

different than that of other high-tech sectors. It makes clear again that the increased import of intermediate inputs shifts the labor demand away from high-skilled workers towards low-skilled workers. In all three specifications, when the computer industry is included, the coefficient on international outsourcing is statistically significant and fairly stable in size. Thus, outsourcing can contribute around 41 percent to the increase in the wage bill share of 6 percentage points. The negative results on value added indicate that the output elasticity of labor demand is higher for low-skilled than for high-skilled labor. The regression results when including the R&D subsidy variable are not reported because the coefficient on $R\&D\ SUB$ is not significant and does not change the estimates of the other explanatory variables.

Specifications (4) to (6) provide the corresponding estimates when the computer industry is excluded form the analysis. It comes out that in this small sample, only the outsourcing variable can significantly contribute to the development in the dependent variable. The estimates on $OUTS^{narrow}$ are significantly negative and range from -0.221 to -0.321. Depending on the specification, outsourcing can account for 13 to 18 percent of the increase in relative non-production labor demand. The results indicate that high-skilled workers employed in human-capital intensive sectors are hurt substantially by the relocation of production stages offshore.

Until now, I regressed the non-production workers' wage bill share on various variables to examine determinants of the relative demand for high-skilled workers. Table 3.11, however, provides the results for relative wages and relative employment as dependent variables, respectively. The coefficient on outsourcing in column (1) is negative and statistically significant. Excluding the computer industry raises the significance to the one percent level.

What is the economic meaning of the estimates? While the relative wages declined substantially by -4.28 percentage points on average over all five high-tech industries between 1991 and 2003, they increased slightly by 2.46 percentage points when the computer sector was not taken into account. Comparing these trends with the remaining sectors, where the skill premium rose rapidly by more than 10 percent, indicates that the movements in the

high-tech industries are fairly small. On the employment side, the opposite is true. The increase in the relative employment of non-production workers in the human-capital intensive sectors is more than twice as large as the remaining sectors. It follows for the estimates on $OUTS^{narrow}$ in column (1) and (2) that outsourcing can explain far more than 100 percent of the evolution of the skill premium.

Turning to the employment side, comparing the coefficients on outsourcing in (3) and (4) indicates that the computers matter. Both are statistically significant, however, negative with the computer sector and positive without. It is noteworthy in specification (3) that the coefficient on the technology variable is positive and significant. It is consistent with the idea of skill-biased technological change favoring high-skilled labor which is commonly presumed.

Table 3.12: Outsourcing and Decomposed Demand for Skills in High-Skilled Sectors

dependent variable:	*relative wages*		*relative employment*	
	chemicals, machinery, electronics, optics, computer	chemicals, machinery, electronics, optics	chemicals, machinery, electronics, optics, computer	chemicals, machinery, electronics, optics
	(1)	(2)	(3)	(4)
$OUTS^{narrow}$	-1.200**	-1.541***	-2.716***	0.618**
	(0.463)	(0.430)	(0.701)	(0.303)
ln VA	14.109	-42.186**	-74.434	51.214***
	(32.997)	(16.916)	(47.016)	(15.477)
ln K/VA	7.121	-13.671	-23.911	30.248**
	(32.441)	(14.047)	(50.359)	(14.062)
R&D EXP	-0.827*	-0.022	1.810***	-0.319
	(0.417)	(0.234)	(0.592)	(0.252)
Constant	116.077	432.586***	538.502*	-234.652**
	(192.437)	(105.090)	(275.993)	(96.840)
Adj. R^2	0.874	0.967	0.943	0.986
N	65	52	65	52

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *relative wages* = (wages of non-production workers/wages of production workers)*100; *relative employment* = (employment of non-production workers/employment of production workers)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100.

Exogeneity of Outsourcing

In the literature, it is frequently argued that outsourcing cannot be treated as exogenous, since it might be affected by the existing wages in each industry. It would imply a correlation of the outsourcing variable with the error term on the right-hand side. If it is the case, OLS estimations would deliver biased results. Following this line of reasoning, I carry out a Durbin-Wu-Hausman endogeneity test. The null hypothesis of the test states that the regressor is exogenous. The results are shown in Table 3.13.

Table 3.13: Exogeneity Tests for Narrow Outsourcing

	χ^2	P-value	N	Exogeneity
full sample (18 sectors)	0.381	0.537	198	*not rejected*
restricted sample (17 sectors, computer sector excluded)	3.592	0.058	187	*rejected*
1991-1996	1.856	0.173	68	*not rejected*
1997-2003	1.308	0.253	119	*not rejected*

Notes: The test statistics are carried out in Stata using the *ivendog* command.

It appears that the null hypothesis of exogeneity of the outsourcing variable cannot be rejected using the full sample of 18 NACE 2-digit sectors. However, when excluding the computer industry from the sample, the null hypothesis that narrow outsourcing is uncorrelated with the error term can be rejected at the 10 percent level of significance. It implies that the outsourcing variable is endogenous in the case of the restricted sample. Furthermore, I find no evidence of endogeneity of the narrow outsourcing variable when breaking down the restricted sample of 17 sectors in the two sub-periods. As the p-values indicate, I fail to reject the null hypothesis.

Since the test identifies narrow outsourcing as endogenous in the case of the restricted sample of 17 sectors, an instrumental variable (IV) should be applied. However, in the presence of heteroscedasticity, the OLS estimation with IV generates inconsistent standard errors for the coefficient of IV. When facing heteroscedasticity of unknown form, the Generalized Method of Mo-

ments (GMM) should be used to obtain consistent parameter estimates that are, however, not efficient.[49]

Table 3.14 reports the IV-GMM estimation results for the wage bill share as a dependent variable treating outsourcing as endogenous. I choose the second lag of narrow outsourcing as the instrument for this variable. Test statistics for the predictive power of the used instrument are documented in the lower part of the table. As the results of the F-test for the first-stage regressions indicate, the second lag appears a valid instrument. Compared to the two-way fixed effects OLS estimations in column (1) of Table 3.10, the coefficient on narrow outsourcing remains positive yet its magnitude increases. It indicates that the result of the OLS estimation is confirmed by IV-GMM estimates. Furthermore, the size and sign of the coefficient on value added is fairly similar to the OLS results. The remaining variables in Table 3.14 appear to have no relevant influence on the relative demand for non-production workers.

Furthermore, I replace the wage bill share as the dependent variable with relative wages and relative employment, analogously to the OLS estimation presented in Table 3.10. The results for the IV-GMM are not reported here. However, it reveals that the coefficient on the instrumented outsourcing variable is still positive and highly significant in the case of the relative employment as the dependent variable. Regarding the skill premium, outsourcing appears to have a negative impact, as was also measured in the fixed effects OLS estimation. While the size of the coefficient on outsourcing is very similar to the OLS estimation result, the coefficient now becomes insignificant.[50] However, it is noticeable that contrary to relative employment, the Durbin-Wu-Hausman endogeneity test fails to reject to the null hypothesis of exogeneity of narrow outsourcing in the case of regressing relative wages on it.[51]

[49] See Baum *et al* (2003).

[50] The p-value of the coefficient on narrow outsourcing is 0.143 in the IV-GMM estimation of the specification with the further explanatory variables; value added, capital intensity and R&D expenditure ratio.

[51] In the case of relative wages as the dependent variable, the Wu-Hausman F-test yields 0.11 with the corresponding p-value of 0.74.

Table 3.14: Outsourcing and Relative Demand for High-Skilled Labor (IV-GMM)

dependent variable:	*wage bill share of high-skilled workers*		
	(1)	(2)	(3)
$OUTS^{narrow}$	0.775***	0.680***	0.648***
	(0.217)	(0.211)	(0.212)
ln VA	-4.508**	-4.641**	-4.800**
	(1.962)	(1.925)	(1.899)
ln K/VA	0.369	1.114	1.294
	(2.769)	(2.734)	(2.841)
R&D EXP		-0.075	-0.061
		(0.058)	(0.077)
R&D SUB			-0.110
			(0.408)
Constant	75.226***	44.647***	47.261***
	(13.347)	(7.982)	(7.676)
Centered R^2	0.973	0.975	0.976
N	187	187	187
	Test of Predictive Power of Instruments first-stage regressions		
F-test	18.85	22.12	30.87
P-value	0.00	0.00	0.00

Notes: The employed sample consists of 17 NACE 2-digit manufacturing sectors (computers are excluded); coefficients are estimated by IV-GMM; second lag of $OUTS^{narrow}$ is used as instrument for this variable; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; $OUTS^{narrow}$ = (imported inputs from same sector/gross output of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100; *R&D SUB* = (governmental R&D subsidies/value added)*100.

3.7 Conclusion

In the recent decades, Germany experienced a continuous shift away from low-skilled towards high-skilled labor. At the same time, the German economy got increasingly integrated in the international value added chain. This trend can be seen in rapid increases in investment activities of German companies abroad, which relocate a tremendous amount of their value added to foreign countries. It also implies a relocation of jobs to abroad. Additionally, arm's-length international outsourcing accelerated substantially since the mid 1990s. Both phenomena, the skill-upgrading and rising outsourcing activities, occurred contemporaneously. However, it does not necessarily imply a causal relationship between them.

The goal of this chapter has been to examine whether the considered trends in outsourcing can explain the labor market outcomes. Furthermore, I address the question how outsourcing affects Germany's human capital. Does international outsourcing favor high-skilled or low-skilled labor?

As major result, I find that international outsourcing hurts human capital in Germany. The fragmentation of the production process across countries implies a declining relative demand for high-skilled labor in German manufacturing. It contradicts the predominant conclusion of the existing empirical literature on developed as well as emerging countries. From the empirical investigation, three broad facts emerge. First, the decomposition of the relative labor demand in relative employment and relative wages of high-skilled workers reveals that both parameters are negatively affected by outsourcing. The negative impact on the relative wages of non-production appears highly robust to individual sectors. The relocation of production stages offshore can account for 32 percent of the increase in relative employment and for about 36 percent of the rise in skill premium. It implies that in the absence of international outsourcing, relative wages for human capital would have increased more by one third in German manufacturing. Secondly, I have shown that the negative impact of outsourcing occurred particularly in the recent years, while, in the early 1990s, outsourcing increased the demand for high-skilled labor and disfavored low-skilled labor. Reasons for this impact might be the

disruptive influence of the German reunification in the years immediately after 1991 and the observed sectoral shift. This leads to the third discovered fact. I identified an evident shift in the pattern of outsourcing sectors over time away from low-skill intensive towards human-capital intensive sectors. The estimated results indicate that high-skilled workers employed in human-capital intensive sectors are most hurt by outsourcing.

Hence, my analysis contributes an extension of previous studies in this field by utilizing a sample period with more recent years to estimate what appears to be a crucial effect on the changed sectoral pattern during the recent years. Furthermore, I provide a detailed investigation of trends in individual sectors and their impacts on the aggregate results. Moreover, the present work makes the contribution of examining in more detail the effects of technological change on the relative demand for skilled labor in Germany. I have shown that the skill-biased effect of technology favors low-skilled workers. Since it contradicts the common view, some work has to be done to gain better insights in the relationship between technology and demand for skills.

The negative impact of outsourcing on human capital and the shift towards more skill-intensive imports of intermediates as an implication of the sectoral shift suggest that Germany's role in the international division of labor is increasingly specializing in low-skill intensive production stages. Hence, the policy implication has to be to strengthen Germany's endowment with human capital. Relative to its trading partners, which provide more high-skilled labor at lower costs, Germany is less abundant in high-skilled labor.[52]

Although the human capital stock of a country is not exogenous in the long-run,[53] there are little incentives to invest in human capital. The policy advise has to be to strengthen Germany's endowment with human capital.

[52] See Marin (2004) who states that Germany's education level lies below the average of OECD countries. Furthermore, Germany is poorly endowed with highly-educated labor relative to the following Eastern European countries: the Baltic States, Russia, and Hungary. Using data from the ILO, Marin (2004) measures the education level by the share of the labor force with a tertiary education level.

[53] As Feenstra and Hanson (1996a) state in their theoretical model outlined in Chapter 2, the factor endowments are not exogenously fixed in the long-run. They might respond to changes in the relative factor prices.

However, the German labor market institutions prevent a widening of the wage gap. Additionally, outsourcing reduces the skill premium and, therefore, reduces people's own incentives to invest in their education. The government could, however, break this vicious cycle by enforcing the investments in the education system which marks a weakness as the often cited Pisa-study of the OECD revealed.

Appendix

Notes on calculation of imported intermediate inputs

Imported intermediate inputs are calculated from data of input-output tables. They distinguish between domestically produced and imported intermediates. However, the tables are compiled infrequently and are, therefore, not available for each year. For the unified Germany, the input-output tables at the level of NACE 2-digit industries are published for the years 1991, 1995, 1997, 1998, 1999, and 2000. The date of publishing of the input-output table for the year 2000 was 2004. For the missing years between 1991 and 2000, I estimated the import input-output tables by interpolating linearly the input-output coefficients and multiplying them by imported inputs. In a previous step, the imported inputs are yield from multiplying the linearly interpolated share of intermediates in total imports times total imports. The German total imports classified according to NACE are taken from trade statistics provided by the OECD that converted them from HS Rev. 1 to ISIC Rev. 3. In order to receive estimates for the years 2001-2003, I experimented with various methods of extrapolating. There are three parameters that can be adjusted; the distribution between sectors in rows, first, and secondly, in columns of the input-output matrix and thirdly, the share of intermediates in total imports. They all can be hold constant, as in the most "pessimistic" approach, although they show substantial variation in previous years. Alternatively, they all can be extrapolated using only the changes during the last two years. One intermediary version takes the average growth rates of the preceding five years into account. Finally, I chose the intermediary version of extrapolation. Before doing so, I checked the robustness of the regression results using different version of extrapolating. The results appear fairly stable, while the most "optimistic" approach reveals slightly more significant estimates on the outsourcing variable.

Table 3.15: Definition and Source of Variables

Variable	**Description**	**Source**
wage bill share of high-skilled workers	wage bill of non-production workers in percent of total wage bill	Federal Statistical Office of Germany
relative wages	wages of non-production workers in percent of wages of production workers	Federal Statistical Office of Germany
relative employment	employment of non-production workers in percent of employment of production workers	Federal Statistical Office of Germany
$OUTS^{narrow}$	imported inputs from the same NACE 2-digit sector in percent of gross output	Federal Statistical Office of Germany (input-output tables), OECD STAN database
$OUTS^{difference}$	imported inputs from all sectors (excluding the same NACE 2-digit sector) in percent of gross output	Federal Statistical Office of Germany (input-output tables), OECD STAN database
VA	value added, deflated by sector-specific producer price indices, in million EUR	OECD STAN Industrial database, Federal Statistical Office of Germany
K/VA	gross capital stock in per cent of value added	OECD STAN Industrial database
R&D EXP	business enterprise R&D expenditure in percent of value added	OECD ANBERD database
R&D SUB	R&D subsidies of Federal Government in percent of value added	Federal Ministry of Education and Research, OECD STAN Industrial database
FDI^{out} *L*	employment in foreign affiliates of German multinationals in per cent of sector's domestic employment	UNCTAD, OECD STAN Industrial database

Chapter 4

Globalization and Austria: Outsourcing and the Demand for High-Skilled Labor

4.1 Introduction

Since the beginning of the 1990s, Austria has experienced multiple shocks of globalization. The fall of the Iron Curtain in 1989; Austria's accession to the European Union in 1995; and in the year 2004, the large eastern enlargement of the European Union, including four countries that share a border with Austria, are some of the most prominent events. Rarely any other western country has gotten more of a taste of globalization and its consequences than Austria. And as a small and open economy, it gets notably involved in it. Which indicators might reflect these revolutionary developments?

Phenomena of the globalization process might be changes in the amount and the pattern of international trade flows as well as factor movements. One of these phenomena is the frequently cited international slicing-up of the value added chain,[1] which leads to an increase in trade of intermediate input goods. The international outsourcing of production stages causes a biased demand for different factors, for example different types of labor or skills. Thus, outsourcing activities of firms affect their relative demand for

[1] See Krugman (1995).

different types of labor on the labor market.

In the case of Austria, significant changes in international trade as well as foreign direct investment reflect those international developments. Furthermore, Austria is faced by an ongoing and rapidly accelerating technical change and tremendous increase in international outsourcing, which reflects partly the changes in trade pattern. These dramatic changes document the importance of globalization for Austria. I will examine these developments in more detail in the next section.

Through which channels do the mentioned *external* events affect Austria? One such a channel is international outsourcing, which should affect the demand for labor in a biased way according to skills. In this paper, I will take a closer look at the *internal*[2] consequences, particularly, for Austria's labor market and the relative demand for human capital. In a theoretical model, Feenstra and Hanson (1996a) formalize the idea of a trade-induced within-industries shift in factor intensities of the production process. Plausibly, such distributional effects inside a country caused by external events should find stronger expression in the case of a small open economy. The reason is that such an economy is usually strongly exposed to international interactions.

Austria is a relatively small and open economy,[3] and it is the Western European country that is geographically the most proximate to Eastern Europe. Austria borders on four Eastern European countries[4] and shares roughly 48 percent of its border with the new Eastern EU-Members. As is well known, Eastern Europe differs dramatically in its factor prices, particularly wages, compared to Austria.

In comparison to the often-cited trade and outsourcing integration between the United States and Mexico, the integration between Austria and Eastern Europe seems to be much more intensive. In particular, if you take into account Austria's immediate geographical proximity to countries with a large difference in wages. Furthermore, Austria's labor market is, in contrary

[2] Which means inside a country.

[3] For example, compared to Germany, Austria is ten-times smaller (measured by inhabitants), and at the same time, with 56 percent in 2003, Austria's import ratio is significantly larger than the Germany's (32 percent). These numbers are based on own calculations with data taken from WTO Trade Profiles.

[4] They are the Czech Republic, Slovakia, Hungary, and Slovenia.

to the US, highly inflexible. Thus, Austria, a country with one of the highest unionization rates in Europe is characterized by rigid wages. The external shocks, particularly the integration with the Eastern European countries, might result in different effects than a widening wage gap between skills as in the US.

Austria is often called as the springboard to the East. Because of cultural and historic reasons, Austria is well connected with Eastern Europe and specializes in offering "outsourcing service". A comparable role plays Hong Kong for China since China opened its economy to foreign investors two decades ago. In the manufacturing sector, Hong Kong's firms relocated many low-skilled jobs to China. At the same time, Hong Kong was specializing in activities of outsourcing services.[5] Section 4.2.2 will take a closer look at this issue in the case of Austria.

At the same time, Austria acts as "toehold" to Eastern Europe for many multinational firms. The importance of foreign firms for Austria's investments abroad appears striking. In particular, the area of Vienna acts as regional headquarter for Eastern Europe since it receives a lot of foreign direct investment from global companies which are destined for Austria's neighbor countries in the East. In 2000, almost 39 percent of Austria's FDI stocks abroad are influenced by foreign multinational firms.[6] However, only around one quarter of the number of Austrian investors are controlled by firms from abroad. It indicates that the investment volume of this type of investor lies clearly above an average Austrian investor. Furthermore, 45 percent of FDI which Austria received in 2000, were invested in firms which undertake foreign investments by their own. Moreover, data on investors in Central and Eastern Europe show that 26 percent of Austrian investments in this region are undertaken by firms which are by the majority directly controlled by foreign firms.[7]

[5] See Hsieh and Woo (2005) for a detailed analysis on the impact of outsourcing to China on Hong Kong's labor market.

[6] The numbers refer to data from the Austrian National Bank, see Dell'mour (2004).

[7] The numbers refer to investments which are undertaken by Austrian firms owned itself by foreign companies. The calculations base on data from a unique survey of Austrian investors in CEE. The survey was undertaken by the Chair of International Economics, University of Munich. See Section 5.6 of Chapter 5 for detailed description of the data sample.

Because of the mentioned facts, Austria should be strongly affected by the given shocks of globalization. What effects that do *external* events like globalization or the EU eastern enlargement have on *internal* factor markets, should be discussed in this chapter. Who are the losers, and who are the winners of globalization in an open country like Austria? In order to measure the impact of outsourcing on labor market outcomes, an ideal experiment would require a small country which experiences a large exogenous shock of outsourcing. Austria approaches these requirements fairly well. Eastern Europe's opening can be seen as exogenous to Austria. Moreover, the trends in the Austrian labor market is substantial. It appears that the demand for high-skilled workers increased in the last decade. Decomposing this increased demand brings to light that the employment of non-production workers increased strongly, whereas at the same time their wages declined.

In the literature, three central explanations for this shift in the demand for skills are favored. At first, technical change is assumed to increase the demand for skilled labor, while secondly, international trade is a possible candidate for explaining this demand shift. Thus, import competition in final goods from low-wage countries might shift resources towards more skill-intensive industries and to more skill-intensive product types within the same industry. Another phenomenon of globalization is the outsourcing of production to countries with differences in relative factor endowment. This leads to shifts in the demand for skills within an industry as well as within a firm.

The chapter is organized as follows. After these introductory remarks, I take a closer look at Austria's major events and trends in the last decade. Section 4.2 shows the developments in international outsourcing and the demand for skills. The section provides descriptive statistics for the entire manufacturing sector and individual sectors. The subsequent section 4.3 gives a brief overview of related existing literature for Austria. In Section 4.4, I the empirical implementation of the theoretical model of Feenstra and Hanson (1996a) and describe the employed data. Section 4.5 reports the empirical results of a panel estimation for fifteen sectors. Two specifications of international outsourcing are considered. In the first specification, outsourcing is defined as imported intermediate input goods while the second specification

differentiates Austria's imports according to their regional origin. The final section concludes and discusses the empirical findings.

4.2 Facts of Austria

4.2.1 Austria in the Nineties

The fall of Communism states a globalization shock for Austria. This brought Austria overnight back from a somewhat isolated location at the border of Europe to its center. The speed of this revolution led the process to appear as a kind of natural experiment. However, many other shocks have stricken Austria simultaneously.

As mentioned before, the integration with the former Communist countries of Eastern Europe is the most prominent external event that affects Austria strongly. This integration seems to be one among many other integration processes between a high-income country and a low-income country, as for example the NAFTA integration between the US and Canada on the one hand and Mexico on the other.

Although the wages of the Eastern European countries have caught up very quickly, Austria's wages are still much higher in 2003. In nominal terms, the labor costs in the new Eastern European member states are just 18 percent of the labor costs in Austria.[8] The wage gap between Austria and the South-Eastern European countries of Bulgaria and Romania is even more pronounced. They achieve just 5 percent of Austria's labor cost level. Also in PPS terms, the wage gap is quite huge. In PPS, the labor costs in the newly accessed countries are about one third of the Austrian level. Also, if you keep in mind that the gap in labor productivity is still extensive, there remains a substantial wage gap. The newly accessed EU countries achieve roughly 60 percent of the Austrian productivity level, where the two candidate countries, Bulgaria and Romania are less than one third productive as Austria.[9] It appears noticeable that Austria's labor costs exceed the average EU-15 level

[8] These statements are based on monthly labor costs data taken from Eurostat.

[9] These numbers are taken from the Structural Indicators of the Statistical Yearbook of Austria, Statistics Austria 2005.

by 13 percent. Therefore, Austria is also compared to other highly developed European countries a high-wage country.

Recognizing this huge wage gap between Austria and its neighboring transition countries, it seems plausible that a pattern of division of labor might emerge with Eastern Europe specializing in the production of low-skilled labor intensive goods and Austria in goods that use high-skilled labor and capital intensively. According to the predictions of the Heckscher-Ohlin theory, the lower wages in Central and Eastern Europe might indicate that these countries are abundantly endowed with labor and especially with low-skilled labor. Furthermore, it corresponds to the assumption in Feenstra and Hanson's (1996a) model. Surely, this applies to the integration of the US and Mexico or to the former southern enlargements of the European Union as well.[10]

But for Austria, this assumption appears to be inappropriate. Compared to Austria, the Eastern European transition countries are rich in skills; they are abundantly endowed with human capital.[11] As the ILO-data of education show 15 percent of Austria's economically active population have a tertiary education degree in the year 2000.[12] This share lies in the lower third of the Western European countries whose high-skilled share is on average 24 percent. The Eastern European countries exhibit a high-skilled share of around 21 percent, also higher than Austria's 15 percent. The figures indicate that Austria is even more scarcely endowed with high-skilled labor than one would expect. From the perspective of Austria, the integration with Eastern Europe is an integration with a low-wage, high-skilled region.

In this section, the following four facts concerning Austria should be stressed: technical progress, foreign direct investment, general trade flows, and trade in intermediates. At first, the following paragraph presents the dramatic changes in Austria's outgoing foreign direct investment. As another

[10] Several studies (e.g. Baldwin (1994)) have considered the enlargement of the EU to Greece, Spain and Portugal as an example for the eastern enlargement in 2004.

[11] See Marin (2004).

[12] Tertiary education is defined as level 5A-9 according to ISCED-97. Source of data: own calculations based on ILO labor statistics, several years.

remarkable fact, the general trade pattern of Austria is sketched. Finally, as central indicator of globalization in this chapter, international outsourcing and trade in intermediate goods are considered in the more detail.

Table 4.1: R&D intensity

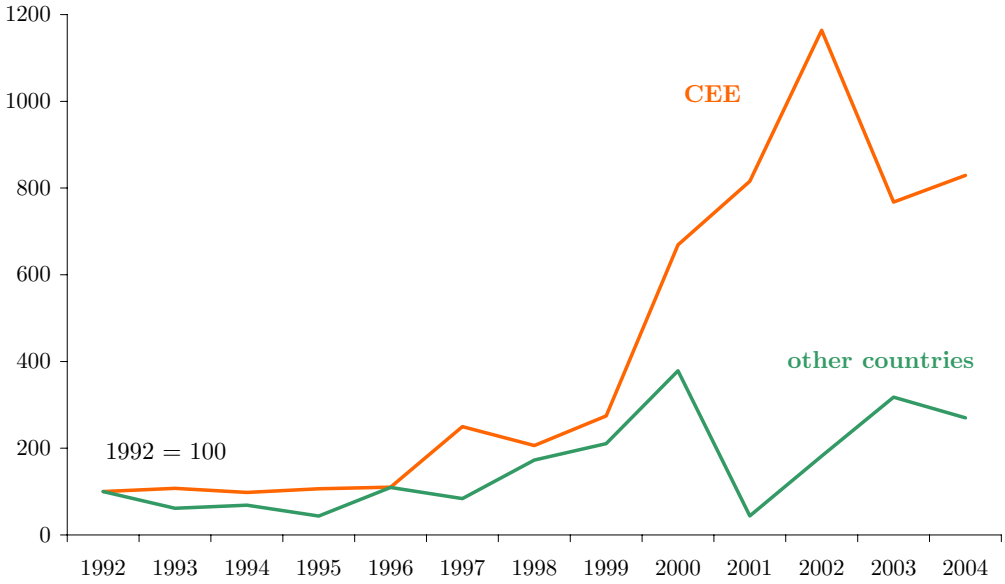
	R&D expenditure as a percentage of GDP		
	1991	1997	2002
Austria	1.47	1.71	2.19
Germany	2.53	2.29	2.52
France	2.37	2.22	2.20
Finland	2.04	2.71	3.46
EU-15	**1.90**	**1.80**	**1.93**
US	2.72	2.58	2.67
Japan	2.93	2.83	3.12
OECD	**2.22**	**2.09**	**2.26**

Source: OECD Science, Technology and Industry Outlook 2003 and 2004, and Eurostat.

In the last decade, Austria was affected by technical progress excessively compared to other countries. Table 4.1 provides a comparison of technical change across developed countries. As a proxy for technical change, I use the R&D expenditure share in GDP. While the expenditure ratio of the aggregates of EU-15 and OECD countries remained more or less constant during the last decade, the table shows remarkable variation across countries. Starting from a strikingly low level, in Austria, the expenditure ratio for R&D was growing on average by 3.7 percent each year. The growth rate even accelerates in most recent years. Therefore, Austria's investment in R&D lies today significantly above the EU-15 average. Also in Finland and other Scandinavian[13] countries, the R&D intensity experienced a tremendous increase and overshoots today clearly the average of the European Union.

[13] This is not shown in Table 4.1.

However, the R&D expenditure ratio was stable in most other developed countries.



Source: Own calculations based on data of Austrian National Bank, OeNB.

Figure 4.1: Austria's Foreign Direct Investment Flows

As Figure 4.1 shows, Austria's foreign direct investment exploded in the last decade. In the first few years of the 21^{st} century, Austrian firms are investing over eight times more in the Eastern European transition countries than they have done in 1992. This reflects partly a worldwide rise of investing abroad, as the trend of Austria's investment in the remaining countries indicates. However, CEE has become much more attractive as host region for Austrian investment activities. As already suggested, Austria's FDI pattern has changed dramatically since the beginning of the nineties. Table 4.2 shows the distribution of the investment flows according to their main destinations.

A huge movement in the distribution has taken place. The distribution shifted enormously away from the EU-15 countries and other countries towards Central and Eastern Europe. Thus, the main host countries of Austrian FDIs are now the new EU members in Eastern Europe. In the recent years, about 55 percent of Austrian FDI has gone to Central and Eastern Europe, whereas in 1992 just 28 percent went to this region.[14] Nearly one

[14] In 2003, CEE accounted for 88 percent of Austria's outgoing FDIs, while only for 4 percent in the case of Germany (see Marin *et al* (2003)).

third of FDIs went to Austria's four former Communist neighbor countries. The strong presence of Austrian investors in CEE also reflects the fact that Austria is among the largest investors in many Eastern European countries.

Table 4.2: Austria's Foreign Direct Investment Pattern

	1992-1998	1999-2004
CEE	37.06	55.36
Hungary	14.08	10.12
Czech Republic	8.54	9.90
Poland	4.78	8.45
Croatia	2.45	5.42
Slovak Republic	3.20	5.05
Slovenia	2.64	4.05
Romania	1.17	7.06
Russia	0.62	1.98
Bulgaria	0.28	1.01
EU-15	41.74	32.54
Germany	12.62	14.18
UK	9.59	3.44
other	21.20	12.10
total	100.00	100.00

Notes: The numbers show the percentage distribution of Austria's outgoing foreign direct investment flows. Countries are ranked according to their average (1992-2004) importance as host country.
Source: Own calculations based on data from the Austrian National Bank, OeNB.

How are FDIs related to international outsourcing? Generally, if investment abroad is motivated by differences between the source and host country, intra-firm trade might be induced. The large wage differentials between Austria and CEE suggest that FDIs to CEE are mainly motivated by lower production costs and induce substantial intra-firm trade. Therefore, FDI flows to Eastern Europe would approximate fairly well international out-

sourcing. Thus, the changed investment behavior of Austrian firms might have substantial effects on the domestic labor market. However, for the most part, Austria's economy consists of small specialized firms rather than vertically integrated companies. This implies that Austrian firms buy intermediate goods mainly from other firms instead of producing them by their own. Following this reasoning, international outsourcing might not be observable as intra-firm trade but rather as arm's-length purchases of foreign inputs. Furthermore, Protsenko (2004) states that most Austrian FDIs in CEE are horizontally motivated. It suggests that FDIs might not approximate adequately international outsourcing. Even in the case of the US, Slaughter (1995) finds that intra-firm outsourcing contributes very little to the increased wage inequality.

Besides the mobility of factors, as capital in the form of direct investments, economic integration is characterized by an increased exchange of goods and services. According to the Heckscher-Ohlin theory, the trade pattern can give some insights into the relative factor endowment of the trading partners. A trade pattern is defined by two dimensions; the trading partners and the traded goods according to their sector.

Table 4.3: Austria's Imports

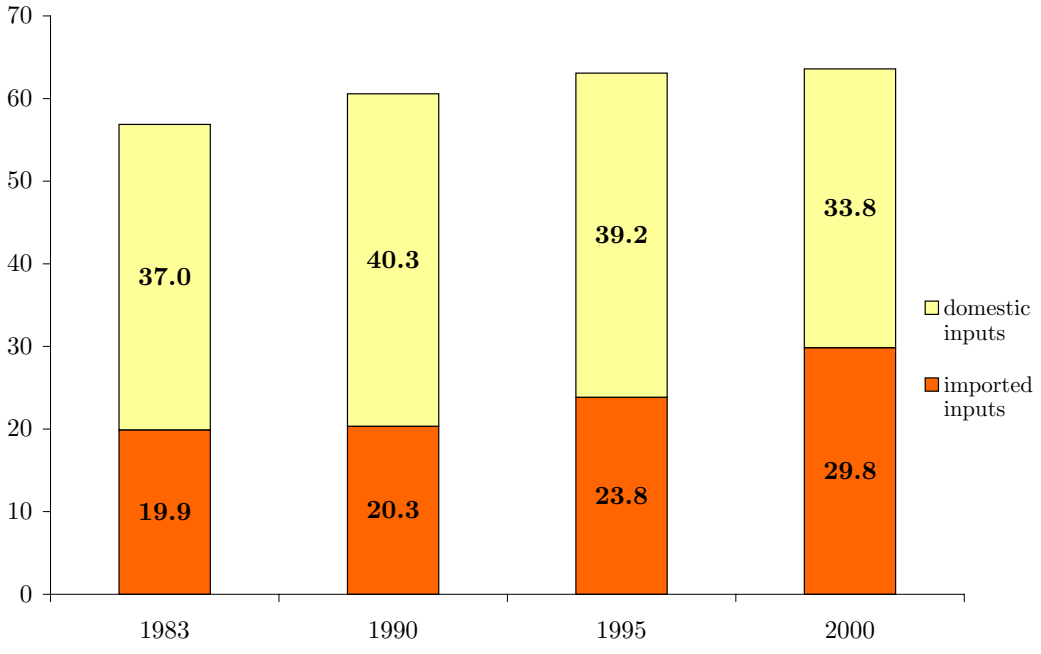
	Import Pattern				Import Volumes
	1990	1995	2000	2004	change of imports 1990-2004
		in % of total imports			
EU-15	71.20	72.18	66.15	65.98	+ 105 %
CEE	3.85	8.95	12.52	14.87	+ 753 %
other	24.95	18.87	21.32	19.15	+ 70 %
total	100.00	100.00	100.00	100.00	+ 121 %

Source: Own calculations based on data from Statistics Austria.

Table 4.3 shows the distribution of Austria's imports with respect to the countries of origin. As you can see at a glance, the import pattern of Austria changed in the last fifteen years in favor of trade with the Eastern European

transition countries. However, the process of trade integration seems not finished yet. The rapid liberalization of trade regulations between the EU and the transition countries led to the expectation of a speedy emergence of a new trade pattern, but as the numbers show that this process is still on the way. So the imports from CEE increased by 42 percent solely during the last five years whereas the imports from other countries to Austria rose just by seven percent.

The third indicator of Austria's globalization is outsourcing measured by the imports of intermediate goods. These data are taken from the input-output table, which depicts the input-output relations between all sectors of the economy. With respect to international outsourcing, the fact of interest is that the inputs can be differentiated between domestic and imported intermediate goods. Figure 4.2 gives an overview of the development since the beginning of the eighties. The intermediate inputs are shown in relation to the value of production.



Notes: The numbers show the intermediate inputs in percent of output for the mining and manufacturing sector (NACE C and D).
Source: Own calculations based on data from the input-output tables, Statistics Austria.

Figure 4.2: Austria's Outsourcing - Domestic and Imported Inputs

The total inputs in percentage of output increased in the years 1983 to 1995 from 57 percent to 63 percent, which indicates an economy-wide reduction of the value added generated by particular firms. However, in the last five years, the value added share has remained constant, whereas the imported inputs have exhibited strongly-accelerated growth. In the 1990s, the measure for international outsourcing shows a growth in imported inputs from 20 to almost 30 percent of output, while remaining constant in the previous decade. The increase even accelerates in the late nineties. While less than 38 percent of all inputs were sourced from abroad in 1995, just five years later, about 47 percent of inputs were imported. This might be due to Austria's accession to the EU and the progressive integration of Eastern Europe.

What do these numbers suggest? Can you conclude from the observed numbers that Austria is exposed strongly to international outsourcing and globalization, respectively? As was already shown, in 2000, 47 percent of the inputs of Austria's manufacturing sector were sourced from foreign countries, whereas in Germany, just 29 percent of the inputs were imported.[15] Since the degree of value added in Austria is lower,[16] the difference in the share of intermediate goods in output is slightly less pronounced, 20.0 percent in Germany and 30.2 percent in Austria.

As mentioned before, Austria's higher import ratio indicates that Austria is more exposed to import competition. However, the numbers in this paragraph show that Austria also faces a higher import competition in intermediate goods. This strong exposure to foreign markets might have extensive impacts on the Austrian labor market. The question addressed in this chapter is the impact of outsourcing or generally international trade on different kinds of skills. By definition, this question focuses on trade between differently endowed countries in goods with different factor intensities. This is valid for imported intermediate as well as imported final goods.

[15] These numbers are derived from the input-output tables of Austria and Germany for the mining and manufacturing sector (NACE C and D).

[16] 63.8 percent in Austria versus 67.7 percent in Germany.

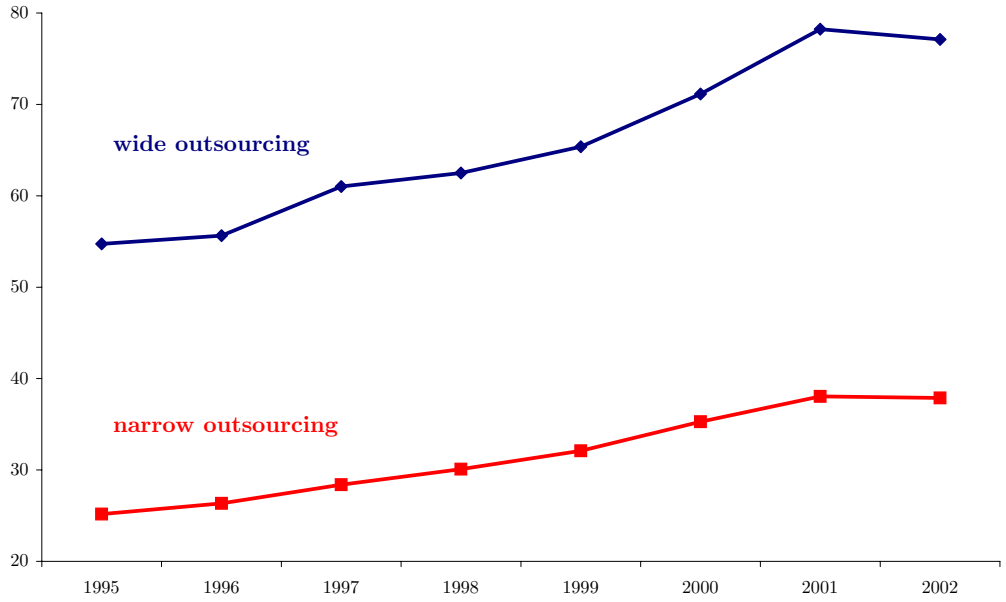
4.2.2 Outsourcing and Labor Market

Outsourcing refers to the slicing-up of the value added chain. The fragmentation of the production process can appear either between firms in the form of a supplier-recipient relation (*inter*-firm) or within a firm as production linkages and induced trade flows between geographically-separated parent and affiliate firms (*intra*-firm). The term intra-firm outsourcing can be interchangeably used with vertical FDIs. Figure H. 1 in the Appendix depicts this terminology graphically. In the case of interfirm outsourcing, a firm substitutes in-house production of intermediate goods by at arm's length purchased inputs. In this case, inputs can be drawn from domestic or foreign markets. Whereas in the case of intra-firm outsourcing, a parent firm sources its inputs from affiliate firms that can be located in the same country or abroad. The last case is well-known as vertical FDIs. In this paper I will focus on an intersection of inter-firm and intra-firm outsourcing, the so-called international outsourcing. In the case of international outsourcing domestic value added is substituted by imported intermediates, which are used as inputs by Austrian firms.

From a firm's perspective, the decision process appears in the following way. First, firms are concerned with decisions if they produce intermediates in-house or buy these at markets. It is the decision on the degree of vertical integration and the frontier of a firm. However this decision tells nothing directly about international outsourcing. Second, a firm has to decide on the location of its plants and the source countries of inputs. This concerns the decision of domestic versus foreign sourcing of inputs and refers to international outsourcing.

This chapter gives an answer to the question about the consequences of an increased competition due to imported intermediate goods for the Austrian labor market. What is an appropriate measure of the competition in imported inputs? The existing literature shows up two definitions which use data of input-output tables: wide and narrow definitions of outsourcing. The wide definition refers to the intermediate goods that a particular sector imports from all sectors around the world. In contrast, the narrow definition of

outsourcing is related to the imported inputs from the firm's own sector. The reason for favoring the later definition[17] is that the workers of a particular sector might be solely affected by decisions of firms at the sectoral level over "make or buy" inputs. Firms of a particular sector are not able to produce inputs which they buy from other sectors. Therefore, the factor intensities and the demand for high-skilled labor should not be affected by the decision if inputs from other sectors are sourced domestically or from abroad. In this chapter, I will use the narrow as well as the wide definition of international outsourcing.



Notes: *wide outsourcing*: imported intermediate goods from mining and manufacturing sector in percent of value added; *narrow outsourcing*: imported intermediate goods from own NACE 2-digits sector in percent of value added.
Source: Own calculations based on data taken from the input-output table, Statistics Austria.

Figure 4.3: Wide and Narrow Outsourcing

Figure 4.3 shows the development of international outsourcing measured in two different ways; wide and narrow definition. They are measured as the imported intermediate goods[18] from all mining and manufacturing sectors (*wide*) and from solely the same sector (*narrow*) in percent of sector's value added. As the lines indicate, both measures rise significantly during the years 1995 to 2002. The narrowly defined outsourcing was growing steadily

[17] See Geishecker (2002).
[18] Imported intermediate goods are defined according to the input-output table.

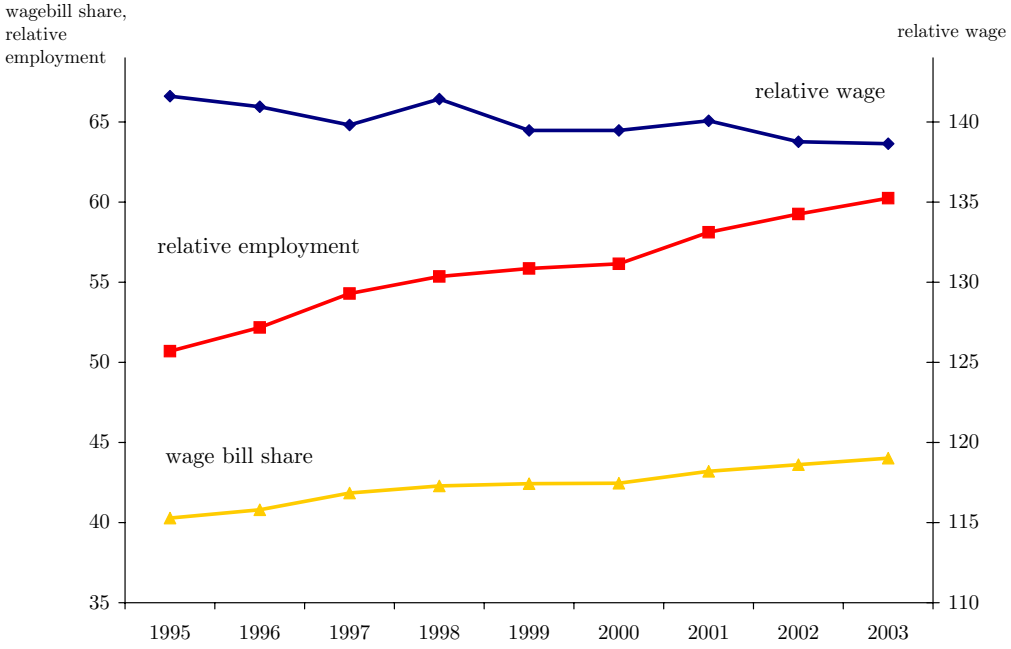
from 25.2 to 37.9 percent, while outsourcing according to the wide definition increased by 22 percentage points to 77.1 percent of value added in 2002. It corresponds to an increase of 50 percent in the case of the narrow definition and 41 percent in the case of the wide definition. Although narrow outsourcing was growing faster than wide outsourcing in terms of percentage change, today only 51 percent of the imported intermediate goods are sourced from abroad within the same sector. Whereas in 1994, 54 percent of the imported inputs came from the same sector and the remaining 46 percent from other mining and manufacturing sectors. It means that the so-called difference outsourcing[19] of intermediates from other sectors than the some one has become more important. This is contrary to the situation in Germany as outlined in Chapter 3.

In order to examine the impact of international outsourcing in more detail, let me first take a look at the main developments in the Austrian labor market in the last decade. In general, how can the demand for high-skilled labor be empirically implemented? In economics, demand is generally characterized by prices and quantities. With respect to the labor market, multiplying these two components of demand, wages times employment, results in the wage bill. The wage bill share of high-skilled labor is therefore the wage bill of high-skilled workers divided by the overall wage bill of high-skilled and low-skilled workers. Besides the wage bill share, Figure 4.4 also depicts the two elements of the decomposed relative labor demand for high-skilled workers: the relative wages of the high-skilled workers and their relative employment. From a empirical point of view, a decomposition of the wage bill might bring some useful insights in the reaction of labor markets to globalization.

The figure shows that the demand for high-skilled labor was rising significantly. The share of non-production workers' wage bill in total wage bill increased by nearly four percentage points in the sample period 1995-2003 to 44 percent. For comparison, Feenstra and Hanson (1996) find for the US an increase in the wage bill share of high-skilled workers from 34 percent to 42 percent in the relatively long period between 1972 and 1990. The annual

[19] See Feenstra and Hanson (1999).

changes are strikingly similar to the development in Austria in the considered period. However, Berman *et al* (1994) state a more moderate increase of just six percentage points for an even longer period from 1959 to 1989. Particularly pronounced is the trend of rising demand for high-skills in Austria in the leather and shoes sector as well as in the electronic sector (computers, electronic parts, optical instruments, etc.). In the leather and shoes sector, the wage bill share jumped up by approximately 10 percentage points.



Notes: The figure shows numbers for the mining and manufacturing sector (NACE C and D).
Source: Own calculations based on data from the Association of Austrian Social Insurance.

Figure 4.4: Demand for High-Skilled Labor

As can be seen in the figure, this rise is driven by the increased relative employment of high-skilled workers, while the relative wages act in the opposite direction. The number of non-production workers relative to production workers increased strongly from 50.7 percent in 1995 to 60.2 percent in 2003. It is remarkable that in contrast to many other countries in Austria an increase in the wage gap cannot be observed. In the year 1995, high-skilled workers earned on average around 42 percent more than low-skilled workers. This gap declined by two percentage points until the year 2003.

In summary, due to strong labor market institutions in Austria, a growing

relative employment rather than relative wages reflect an increase in relative demand for high-skilled workers. Moreover, this is in line with experiences of Sweden. Remarkably, Sweden is comparable to Austria in size and openness of its economy, as well as, in its high labor market rigidities. As Anderton *et al* (2002b) report, relative employment increased steadily from 38 to 55 percent between 1970 and 1993, while the skill premium remained constant during the 1970s and 1980s and even fell during Sweden's recession in the early 1990s.

A decomposition of the relative demand for high-skilled labor allows to gain interesting insights in the contribution of the changes in relative wages and employment. In the entire Austrian mining and manufacturing sector, the wage bill of non-production workers relative to production workers increased by 11.2 percentage points in the period 1995 to 2003. Decomposing this overall shift in demand[20] shows that the increase in relative employment contributes + 12.6 percentage points. However, the decline in relative wages negatively accounts for about - 1.4 percentage points of the overall change. It underlines the well-known fact of highly rigid absolute as well as relative wages in Austria, as in many other Western European countries. Furthermore, it indicates the power of unions in the wage setting process in Austrian industry where traditionally the unionization rate is high primarily in the group of production workers.

As mentioned, Austria acts as a springboard to Eastern Europe. It implies that Austria's economy is specializing in offering services which are related to international outsourcing. Such services support Austrian as well as multinational companies in their outsourcing activities mainly directed to Eastern Europe. In the case of Hong Kong, Hsieh and Woo (2005) find a large sectoral shift in employment away from the manufacturing sector towards outsourcing services.[21]

[20] The decomposition is carried out according to the formula provided by Berman *et al* (1994).

[21] Between 1981 and 1991, Hong Kong's employment share of outsourcing services increased by 17 percentage points while the share of the manufacturing sector fell by 20 percentage points. See Hsieh and Woo (2005). They attribute these trends to China's opening to foreign trade and investment.

Table 4.4: Employment by Sector

	1990	1995	2000	2003
	distribution in percent			
agriculture	1.7	1.7	1.8	1.6
industry	51.6	44.4	41.1	38.9
outsourcing services[a]	17.6	21.2	25.8	27.4
other services[b]	29.2	32.7	31.4	32.1

[a] Outsourcing services is defined as storage and transportation services, communication services, banking, insurance, real estate, renting, legal, accounting, and consulting.
[b] Other services is defined as wholesale and retail trade, repairing, hotels, and restaurants.
Source: Own calculations based on data from the Association of Austrian Social Insurance.

During the 1990s, the Austrian economy experienced also a large sectoral shift in its economic activities. While in 1990 almost 52 percent of total working force of the private sector was employed in the industry sector, in 2003 the employment share of the industry sector was less than 39 percent. At the same time, the employment share of services associated with international outsourcing[22] increased by almost 10 percentage points and reached in 2003 27.4 percent of total private employment. At a more disaggregated level, the sector of accounting, legal and business consulting[23] shows with 76 percent between 1995 and 2004 the highest employment growth rate among all sectors. This sector offers various services which are highly related to outsourcing activities. At the same time, the employment share of "other services" of the private sector increased only modestly.[24] The mentioned sectoral employment shift towards outsourcing services points up the importance of outsourcing for Austria. In order to analyze the role of the sectoral employment shift in the increased relative demand for skills, a decomposition of the aggregated skill-upgrading appears useful. Generally, an aggregate

[22] Outsourcing services are defined as storage and transportation services, communication services, banking, insurance, real estate, renting, legal, accounting, and consulting (NACE I-K).
[23] It corresponds to the NACE 2-digits level sector 74.
[24] Also the employment of the state sector (public administration, defense, education and health) was growing only slightly from 21.5 to 23.0 percent of Austria's total employment (1990-2003).

change in a relative number can be caused by a shift within sectors or a reallocation of activities between heterogeneous sectors. As the first column of Table 4.5 shows, the share of non-production workers in total employment increased by 3.8 percentage points in Austria's private sector in the period 1995-2002. However, the shift in the high-skilled employment share is clearly smaller in the service sector than in the mining and manufacturing sector. While the relative employment share increased by 3.6 percentage points in mining and manufacturing, it rose by only 1.4 percentage points in services in the considered eight years. A very similar picture emerges considering the high-skilled workers' wage bill share.

International outsourcing might affect the economy-wide relative demand for human capital in two ways; first, by reallocating workers from manufacturing to more skill-intensive outsourcing services, and secondly, by skill-biased demand within individual manufacturing sectors in the sense of Feenstra and Hanson's (1996a) model. The decomposition of the change in aggregate employment share[25] indicates that the reallocation of workers from mining and manufacturing to services, including outsourcing services, accounts for 0.53 percentage points, as column 2 of Table 4.5 shows. It corresponds to 14 percent of the overall increase. The fact that the reallocation is positive, indicates that services are more skill-intensive than manufacturing.[26]

[25] The decomposition is calculated according to the following formula provided by Hsieh and Woo (2005):

$$\Delta P = \Delta E^{serv} \left(P^{serv} - P^{manu}\right) + \Delta P^{manu} * E^{manu} + \Delta P^{serv} * E^{serv}$$

with P denoting the share of non-production workers in total employment and E denoting the employment share of the service ($serv$) and the mining and manufacturing ($manu$) sector in total private sector, respectively. Column 2 of Table 4.5 reports estimates of the first term of the right-hand side of the formula. This term captures the sectoral shift effect. The second and third term measure the aggregate demand shift towards non-production workers in the manufacturing and service sector, respectively.

[26] However, due to the rough distinction between non-production and production workers as proxy for high-skilled and low-skilled workers, this statement has to be taken with caution.

Table 4.5: Decomposition of Aggregate Shift in Demand for Skills

	overall change	reallocation to services	within manufacturing	changes in manufacturing		
				overall	between	within
employment share	3.80	0.53	1.06	3.57	-0.01	3.58
wage bill share	4.03	0.53	0.98	3.34	-0.11	3.34

Notes: The numbers show changes in percentage points between 1995 and 2002. The manufacturing sector includes the mining sector. Overall change refers to change in the private sector. *employment share*: (non-production workers/(non-production workers + production workers))*100; *wage bill share*: (wage bill of non-production workers/total wage bill)*100
Source: Own calculations based on data from the Association of Austrian Social Insurance.

In a further step focusing on the manufacturing sector, I examine the contribution of shifts within and between individual sectors to the declining relative demand for low-skilled workers. It gives insights in the role of international outsourcing for the relative demand shift. Assuming that individual sectors are affected unequally by outsourcing, shifts within individual manufacturing sectors should contribute to the overall decline in relative demand for low-skilled workers. The decomposition[27] indicates the importance of skill-biased processes like outsourcing, which take place within sectors. Column 3 in Table 4.5 reports the results on the second right-hand side term of the between-within decomposition formula weighted by the employment share of manufacturing. The result is that the skill-upgrading within manufacturing can explain 1.06 percentage points of the rising relative demand. It corresponds to 28 percent. Hsieh and Woo (2005) get similar results from their decomposition exercise for Hong Kong. They find that the sectoral reallocation accounts for roughly 16 percent of the economy-wide relative demand shift for skills between 1981 and 1996, while the skill-biased demand shift within individual manufacturing sectors accounts for roughly 30 percent.

[27] The formula for the decomposition of between and within shifts (for further details see Hsieh and Woo (2005) and Berman *et al* (1994)) is:

$$\Delta P^{manu} = \sum_i \left(\Delta E_i^{manu} * \overline{P}_i^{manu} \right) + \sum_i \left(\Delta P_i^{manu} * \overline{E}_i^{manu} \right)$$

with i denoting the individual sector in mining and manufacturing. The right panel of Table 4.5 presents the estimates on the three terms of the decomposition exercise.

Focusing on the impacts of trade, the observed increase in relative demand for high-skilled labor can be attributed to import competition in final goods or, alternatively, intermediate inputs, better known as international outsourcing. The first force suggests that increased imports of low-skill intensive goods lowers the demand for low-skilled labor in Austria. This mechanism causes a shift in employment between sectors towards more skill-intensive sectors. However in the case of the second force, the import of intermediate goods leads to a relative demand shift for skills within specific sectors. While the first force refers to the classical Heckscher-Ohlin theory with trade in final goods which differ with respect to their factor intensities, the second force is captured by the theoretical model of Feenstra and Hanson (1996a). As outlined in Section 2.1.2 of Chapter 2, they show that outsourcing of low-skill intensive stages of the production process results in a within-industry skill-upgrading. However, the decomposing does not allow to discriminate definitely between these two impacts of trade since forces such as skill-biased technological progress are alternative candidates for explaining the considered demand shifts in the Austrian labor market.

The last three columns of Table 4.5 present the results of the within-between decomposition for the mining and manufacturing sector over the period from 1995-2002. Breaking down the period in two sub-periods indicates that the annual average overall change in the years 1995 to 1998 is with 0.66 percentage points more pronounced than in the years 1999 to 2002 with an annual change of 0.46 percentage points. The decomposition analysis suggests that in manufacturing no reallocation has taken place towards more skill-intensive sectors. The overall increase in relative demand for skills can be completely attributed to skill upgrading within individual sectors. At first view, the results might not be surprising keeping in mind the relative shortness of the analyzed period of time. However, as Table 4.4 has shown, also in short term the sectoral pattern can change remarkably. The findings strongly suggest that international outsourcing modeled in the Feenstra and Hanson (1996a) way is an appropriate candidate for explaining the demand shift. Decomposing the wage bill share provides fairly similar results.[28]

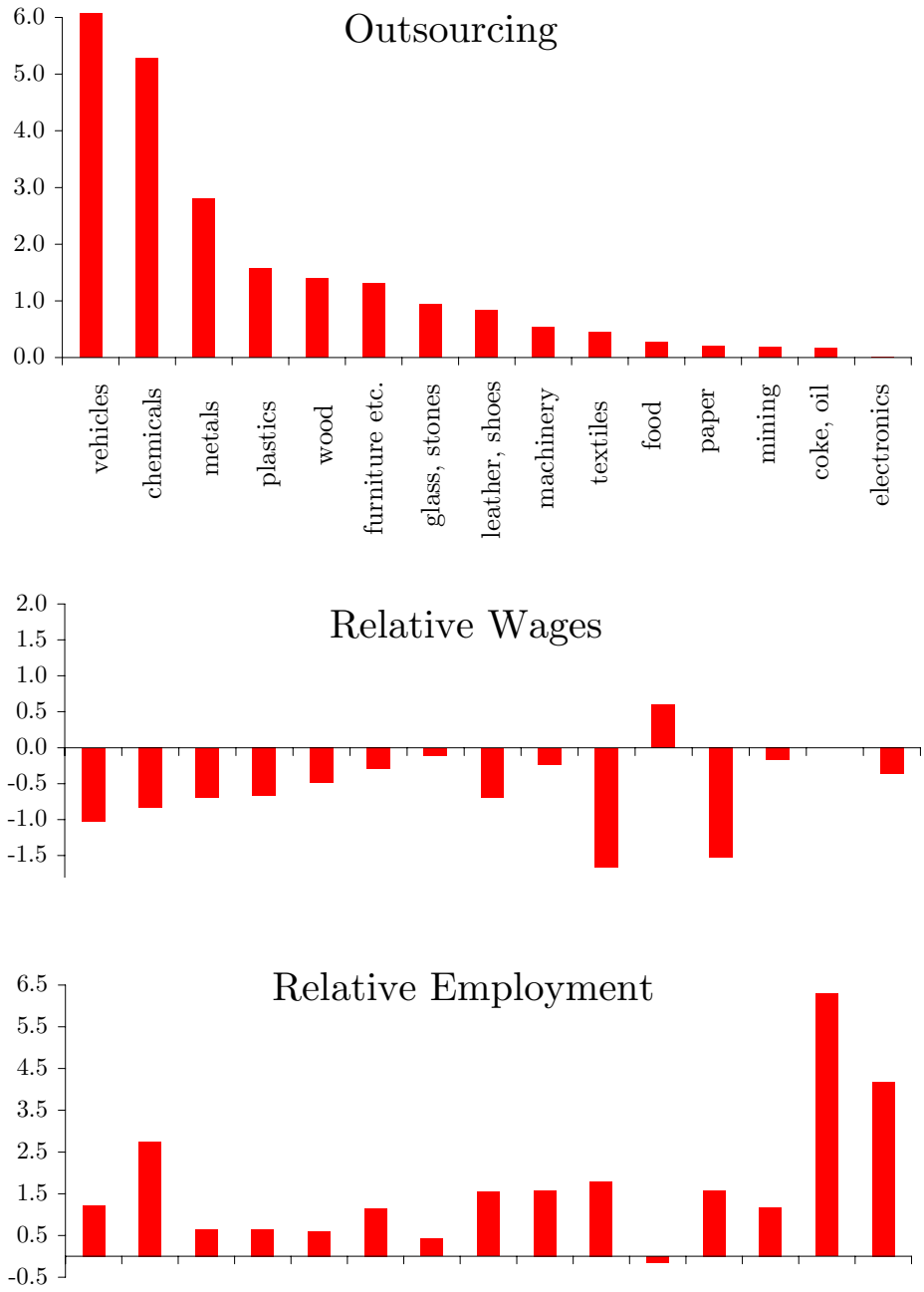
[28] The results are shown in the second row of Table 4.5.

So far, this section has examined primarily aggregate trends in international outsourcing and the demand for skills in mining and manufacturing. However, as Figure 4.5 suggests, there is substantial variation at the level of individual sectors. Furthermore, the econometric analysis in Section 4.5 is carried out at the sectoral level. The figure ranks the fifteen sectors under consideration according to the changes in their outsourcing activities. In the examined sample period 1995-2002, all sectors were enforcing their outsourcing activities. The vehicle and chemical sector are the two sectors with the largest increase in imports of intermediate inputs. Both sectors concurrently saw the relative wages of high-skilled workers in their sectors decrease above the national average of the manufacturing sector, while the relative employment rose at a fairly strong rate.[29] The vehicles sector is not only the sector which experienced the highest increase in imported intermediates between 1995 and 2002. It also shows the highest level of outsourcing intensity. In 2002, imported intermediate goods account for 38.9 percent of the output of the vehicles sector, while the average value for aggregated mining and manufacturing is 14.8 percent.

In the Austrian mining and manufacturing sector, the skill premium declined in virtually all sectors. It confirms the aggregate picture presented in Figure 4.4. Most pronounced is this trend in the textiles and paper industry. The skill premium in the two sectors declined by 1.66 and 1.53 percentage points per year, respectively. In 1995, non-production workers in the textiles sector earned 62 percent more than their production counterparts. It is the sector with the highest wage gap whereas in the paper sector the wage for non-production workers exceeds that of production workers only by 17 percent in 2002.

Furthermore, Figure 4.5 presents the sectoral variation of changes in relative employment of non-production workers. Apparently, the employment of non-production relative to production workers increased in almost every sector. Two sectors show clearly the largest changes; the coke and petroleum

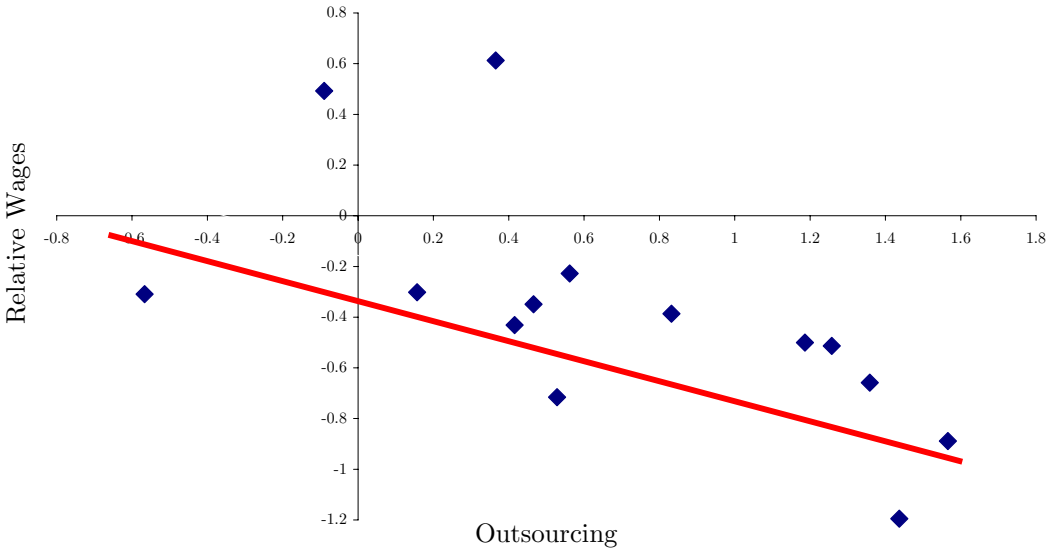
[29] The relative wages declined annually by 1.02 and 0.83 percentage points in the vehicle and the chemical industry, respectively, while the relative employment rose by 1.22 and 2.75 percentage points.



Notes: The numbers show average annual changes in percentage points for the years 1995-2002. The sectors are ranked in descending order with respect to outsourcing. *outsourcing* is defined in the narrow way. For further details of variable definition see Table G.1 in the Appendix.
Source: Own calculations based on data from Statistics Austria and the Association of Austrian Social Insurance.

Figure 4.5: Outsourcing, Wages and Employment

sector and the electronics sector. At the same time, these two sectors experienced more or less no changes in their outsourcing activities and skill premium. Overall, the figure suggests that enhanced outsourcing activities correspond to a reduced skill premium. However, the relationship between changes in outsourcing activities and relative employment appears not obvious.



Notes: The figure shows annual changes for 15 mining and manufacturing sectors between 1995 and 2003 in percentage points. For the definition of the variables (*relative wages* and *outsourcing* in wide definition), see Table G.1 in the Appendix.
Source: Own calculations based on data from Statistics Austria and the Association of Austrian Social Insurance.

Figure 4.6: Outsourcing and Relative Wages

The scatterplot in Figure 4.6 depicts the relationship between outsourcing and skill premia. It is evident from the figure that there is some variation across industries in the relation between changes in these two variables. Most sectors, however, have reinforced strongly their outsourcing in the years 1995 to 2003, while at the same time, high-skilled workers experienced a decrease in their relative wages in the majority of the sectors. Graphically, this correlation can be seen from the fact that most sectors are located in the fourth quadrant. The figure suggests a strong negative impact of outsourcing on the skill premium. Section 4.5 provides an econometric analysis of the relationship by regressing the relative demand for high-skilled labor as well as relative wages and relative employment on international outsourcing.

Table 4.6: Outsourcing and Relative Demand for Skills in Selected Countries

	Austria 1995-2002	Germany 1991-2003	USA 1979-1990
	annual average growth rates		
outsourcing	6.01[e]	3.86[f]	3.82[g]
FDI intensity[a]	9.06	6.33	-
high-skilled workers' wage bill share[b]	1.14	1.16	1.67
relative wages[c]	-0.29	0.23	0.72
relative employment[d]	2.25	1.98	-

[a] (employment of FDIs abroad/domestic employment)*100, in mining and manufacturing for Austria, in manufacturing for Germany.
[b] (wage bill of non-production workers/total wage bill)*100 in mining and manufacturing for Austria, in manufacturing for Germany and USA.
[c] (wage of non-production workers/wage of production workers)*100 in mining and manufacturing for Austria, in manufacturing for Germany and USA.
[d] (number of non-production workers/number of production workers)*100 in mining and manufacturing for Austria, in manufacturing for Germany and USA.
[e] narrow definition of outsourcing = (imported inputs from same sector/value added)*100, mining and manufacturing.
[f] narrow definition of outsourcing = (imported inputs from same sector/gross output)*100, manufacturing.
[g] (imported inputs from the same sector/total non-energy material purchases)*100, manufacturing.
Source: Austria and Germany: own calculations; USA: data from Feenstra and Hanson (1996b).

To evaluate internationally the trends in Austria, Table 4.6 provides a comparison of trends in outsourcing in selected countries and the development in the relative demand for skills. The examined periods are not the same for the European and American part of this table. However, these periods of time have something in common. The eighties in North America were marked by the integration of the US and Canada with Mexico facing the North American Free Trade Agreement (NAFTA). On the other hand, since the fall of the Iron Curtain, Europe is battling with the economic integration between western and eastern part crowned with the eastern enlargement of the European Union. Firms in the US as well as in Austria and Germany started in the respective period to rely more on imported intermediate goods in their production.

In the examined periods all three countries experienced enormous increases of foreign activities. With an annual growth rate of outsourcing of 6 percent, Austria shows clearly the strongest increase in import competition

from intermediate inputs since its accession to the European Union. The annual increase in international outsourcing in Germany and the US are of the same order of magnitude. However, compared to Austria, the increases in outsourcing activities of German and US firms appear to be small. The importance of Austrian and German firms' foreign activities gained sharply in terms of domestic employment, by annually 9 and 6 percent, respectively.

While the development of the wage bill of high-skilled workers relative to the wage bill of total workers are almost identical in Austria and Germany, it rose more pronounced in the US in the 1980s. Particularly the skill premium increased substantially in the US economy. In Germany, the wage gap widened slightly between 1991 and 2003, while Austria's skill premium even declined modestly. The annual increase in the relative employment of high-skilled labor is similar between Austria and Germany.

A large widening wage gap is the motivation of analysis for many investigations, especially the large wage gap in the US but also in Eastern Europe.[30]. However in the case of Austria, the wage gap is closing while the relative number of high-skilled workers is rising. Therefore, the question I address in this chapter differs somewhat from other studies. Given the great exposure of the small Western European country Austria to global competition, what consequences does this have for its labor market?

4.3 Existing Empirical Literature

Egger and Egger (2003) provide a theoretical model on outsourcing in the case of a small open economy, like Austria. In their empirical investigation of Austrian manufacturing, they find evidence for outsourcing to Eastern Europe as being a driving force for a substantial shift towards high-skilled labor.

Under the assumption of a unionized labor market particularly for low-skilled workers, Egger and Egger (2003) analyze in a three countries framework an trade integration of two small open countries which differ in their

[30] For example in Poland, the skill premium increased from 44 to 106 percent in the last decade (1994-2003). Also Hungary and the Czech Republic experienced a sharp widening of the wage gap between high-skilled and low-skilled workers, see Lorentowicz *et al* (2006).

factor endowments. They propose that trade cost reduction stimulates outsourcing activities and leads, therefore, to a higher relative employment of high-skilled workers in the skill abundant country with an unionized labor market. Allowing for fragmenting the production process of the final good across countries induces trade in intermediate goods. Their model predicts an increase in relative employment and wages of high-skilled workers in the country which moves stages of production offshore, associated with Austria.

In the empirical examination for Austria, Egger and Egger (2003) identify a strong increase of relative high-skilled workers' employment during the years 1990-1998. In the same period, outsourcing from Austria to Eastern Europe was rising dramatically. They construct a narrow measure of outsourcing to Eastern Europe combining data from input-output tables and trade statistics. Labor market data are taken from statistics of the Austrian Chamber of Commerce which allow to distinguish skill groups according to workers' utilization in the production process. Furthermore, trade cost are proxied by tariff rates and non-tariff barriers. Arguing that in an unionized economy mainly the employment side is affected from outsourcing, they focus their analysis on relative employment. Using panel data for twenty 2-digit NACE sectors over 9 years, Egger and Egger (2003) identify in a first step low-wage cost as major determinant of outsourcing to the East. Secondly, they find in various instrumental-variables specifications that outsourcing to the Eastern formerly planned economies significantly shifts the relative labor demand towards high-skilled workers. Thus, outsourcing to Eastern Europe can account for 20 up to 29 percent of the increase in relative employment of high-skilled workers in Austria.

In a more recent work, Egger and Egger (2005) use econometric techniques that allow to take into account inter-sectoral spillover effects. They state that usually direct impacts of outsourcing on the labor demand are analyzed ignoring spillover effects of outsourcing. This might lead to an underestimation of the role of international outsourcing. In an empirical investigation on Austrian outsourcing to Eastern Europe, Egger and Egger (2005) show that indirect spillover effects can account for about two-thirds of the employment effect of outsourcing.

4.4 Estimating Equation and Data

Analogously to the investigation on German manufacturing in Section 3, I make use of a cost share equation in oder to estimate the impacts of outsourcing on the Austrian relative demand for human capital. The basic wage bill share equation is supplemented by structural variables and takes the following form:

$$\begin{aligned} WBS_{it}^{HS} &= \beta_0 + \beta_1 lnY_{it} + \beta_2 lnK_{it}/Y_{it} + \beta_3 OUTS_{it} + \beta_4 TECH_{it} + \\ &\quad \beta_5 T_t + \beta_6 I_i + u_{it} \end{aligned} \tag{4.1}$$

where WBS_{it}^{HS} denotes the share of non-production workers' wage bill in total wage bill in industry i and year t. Y_{it} is the sector's output and K_{it}/Y_{it} is the capital intensity for each sector i. Moreover, $OUTS_{it}$ denotes international outsourcing, the variable of interest. Additionally, technological change ($TECH_{it}$) is included in the equation. Furthermore, a full set of time (T_t) and industry (I_i) dummies are included in the estimating equation.

The employed data sample comprises annual data of 15 industrial sectors that are pooled over the years 1995-2002. The sectors are classified according to the European NACE system at the 2-letter level.[31] Unfortunately, systematic changes in the sector classification prevent the usage of longer time series before 1995. Therefore, the sample period starts in 1995 which marks the year of Austria's accession to the EU.

The labor demand data are taken from the Association of Austrian Social Insurance. The skill levels are proxied by the commonly used broad definition of production ("Arbeiter") and non-production workers ("Angestellte") for low-skilled and high-skilled workers. The statistics report the wages and the employment separately for production and non-production workers.

Furthermore, I define the variable international outsourcing $OUTS$ as the share of imported inputs in value added. In the case of the wide definition ($OUTS^{wide}$), the imported intermediate goods refer to the imported inputs from all manufacturing sectors (NACE C and D). In opposite to this, the

[31] The considered sectors belong to NACE C and D.

narrow definition of outsourcing ($OUTS^{narrow}$) takes into account solely the imported inputs of the same NACE 2-letter sector, as the good being produced. Alternatively, some other studies are using the imported intermediate inputs as a share of the sum of domestic and imported inputs.[32] The advantage of measuring outsourcing in relation to value added rather than inputs is that it controls for changes in the degree of value added. Consequently, the measure I use takes into account general changes in the use of intermediate goods. Since I want to analyze the importance of outsourcing for the labor market, it might not be appropriate to look just at the relative importance of imported inputs compared to total inputs.

As control variables, I use data on output Y, value added VA, and gross fixed capital formation K from the OCED STAN database. Since no industry-level measure of capital stocks is available,[33] I use gross fixed capital formation data to construct a measure for the capital stocks. For this calculation, I employ the perpetual inventory method.

Technological change is proxied by the variable $R\&D\ L$ meaning R&D personnel as a proportion of sector's employment. In addition to the R&D employment ratio, the regressions are carried out with data on R&D expenditures relative to value added. However, the results for the estimated coefficients are fairly similar to that for R&D employment.

See the Data Appendix for a further description of the data and their sources.

4.5 Empirical Analysis

This section analyzes the consequences of increased competition due to international trade for the Austrian labor market. In particular, I want to address the question of how import competition affects the relative demand for high-skilled labor in Austria. Import competition arise in form of imports of final goods or intermediate goods. The latter refers to outsourcing of intermedi-

[32] See for example Feenstra and Hanson (1996b) and Geishecker (2002).

[33] Data of capital stocks are available only at the aggregated level of ISIC 1-letter sectors for the years 1988 to 2000.

ates that are imported by Austrian firms as inputs for their production in Austria. Section 4.5.1 presents the estimation results for this measure, while Section 4.5.2 focuses on import penetration.

For the empirical analysis, a panel estimation technique with two-way fixed effects is employed. The different specifications are estimated with fixed effects, since any variation between units not accounted for by the independent variables creates unobserved heterogeneity in the model. Given that industries differ from each other in time-invariant characteristics not included in the empirical model, estimating OLS without industry fixed effects would relegate the omitted heterogeneity to the error term and the coefficients would be biased. Furthermore, the estimation also incorporates time fixed effects. By including time dummies, I assume that there are aggregate trends which all industries in the same way and vary only over time. Time fixed effects control for such common trends.

4.5.1 International Outsourcing

The estimation results on the basic equation 4.4 are presented in Table 4.7. The table reports OLS results for different specifications with industry and year dummies using the narrow definition of outsourcing. The main finding on foreign outsourcing is that the international fragmentation of production stages has a negative impact on the relative demand for human capital in Austria.

In column (1) of Table 4.7, the wage bill share of the high-skilled workers is regressed on $OUTS^{narrow}$ and the two control variables, Y and the capital output ratio K/Y. The results suggest that outsourcing has a significant negative effect on the demand for high-skilled labor. Thus, rather than saving on low-skilled labor as is commonly assumed, outsourcing saves on high-skilled labor relative to low-skilled labor. Furthermore, the sector's output and capital output ratio have a positive impact on the non-production workers' share of the wage bill.[34] This suggest that the output elasticity is higher for high-skilled labor than for low-skilled labor.

[34] I have also run all the regressions with investments (gross fixed capital formation) instead of capital stocks, but the results are very similar.

Table 4.7: Outsourcing and Demand for High-Skilled Labor in Austria

dependent variable:	*wage bill share of high-skilled workers*			
	(1)	(2)	(3)	(4)
$OUTS^{narrow}$	- 0.018*	- 0.030**	- 0.034***	- 0.036***
	(0.011)	(0.012)	(0.010)	(0.010)
ln Y	3.999*	4.256**	3.721*	2.704
	(2.100)	(1.962)	(1.964)	(2.031)
ln K/Y	3.440*	4.740**	4.098*	2.826
	(2.059)	(2.064)	(2.067)	(2.098)
R&D L		0.414**	0.362*	0.365**
		(0.198)	(0.183)	(0.179)
R&D SUB			0.829***	0.974***
			(0.303)	(0.311)
FDI L				-0.039**
				(0.019)
Constant	- 3.647	- 11.677	- 4.552	10.394
	(25.443)	(24.341)	(24.353)	(25.474)
Adj. R^2	0.997	0.997	0.997	0.997
N	120	120	120	120

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficients on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; $OUTS^{narrow}$ = (imported inputs from same sector/value added)*100; *ln Y* = ln real output; *ln K/Y* = ln [(capital/output)*100]; *R&D L* = (R&D employment/employment)*100; *R&D SUB* = (R&D subsidies/value added)*100; *FDI L* = (employment in foreign affiliates in Austria/employment)*100.

Additionally, specification (2) includes the R&D employment ratio ($R\&D\ L$) as a proxy for technical change,[35] which is positively signed and statistically significant at the five percent level. This indicates that labor saving technical change shifts the demand toward non-production workers. It is interesting to note that the inclusion of $R\&D\ L$ in column (2) magnifies the negative impact of $OUTS^{narrow}$ on high-skilled labor and raises the significance to the five percent level.

In the case of Austria, multiple factors influence the technological progress. The inclusion of two additional variables $R\&D\ SUB$ and $FDI\ L$ in the regression allows me to determine what effects the kind of financing and the source of R&D expenditures do have. I include these two variables to control for further factors which may have put pressure on the relative demand for high-skilled labor in Austria.

$R\&D\ SUB$ measures public subsidies to the private sector in percent of value added. The reason for including this variable in the regression is that the government in Austria pursued an active technology policy. I might push up the relative demand for high-skilled labor in Austria. $R\&D\ SUB$ is supposed to control for this policy induced effect on relative demand for high-skilled workers.[36] Compared to other OECD countries, governmental R&D policy plays an important role in Austria. In 2001, 38.2 percent of R&D expenditures are financed by the government, whereas only 29.1 percent of R&D expenditures are state-financed on OECD average (see Table 4.8). Since these state-financed R&D expenditures are used as a policy instrument, they might be unequally distributed among sectors. As a proxy for R&D subsidies I use in my analysis the R&D subsidies of the state-owned research foundation for enterprises ("Österreichische Forschungsförderungsgesellschaft"). The subsidies vary from 2.3 percent of the sector's R&D expenditures in the coke and oil sector to 21.6 percent in the wood sector.

[35] The regressions are also carried out with data on R&D expenditures relative to value added. The results for the estimated coefficients (not reported here) are very similar to those for R&D employment.

[36] For the R&D policy induced effect on relative wages for skilled workers in Austria see Marin (1995). She shows that the same policy has contributed to the slowing of the speed by which the pattern of trade moved up the technological ladder in Austria.

Table 4.8: Who Contributes to R&D

	Financing R&D in 2001 (in percent)				
	Austria	USA	France	Japan	Finland
State Aid	38.2	27.8	36.9	18.5	25.5
Domestic Firms	41.8	67.3	54.2	73.0	70.8
Foreign Firms	19.7	-	7.2	0.4	2.5

Notes: Due to other (not specified) contributors the numbers have not to sum up to 100 for each country.
Source: Statistische Nachrichten 6/2004, Statistics Austria.

The positive and highly significant coefficient on $R\&D\ SUB$ indicates that an increase of state-aided R&D expenditures in percent of value added by 1 percentage point is pushing up the relative wage bill of high-skilled workers by 0.83 percentage points. The technology policy effect on the relative wage bill of skilled workers is of much larger magnitude than the effect of technical change and outsourcing. Furthermore, the simultaneous inclusion of $R\&D\ L$ and $R\&D\ SUB$ increases the statistical significance of $OUTS^{narrow}$ to the one percent level.

In the last specification of Table 4.7, I include $FDI\ L$ measuring the percentage of employment of foreign affiliates in Austria by sector. The reason why I include this variable is that foreign firms play an important role in the R&D and trade activity taking place in Austria. In 2001, 20 percent of total R&D expenditures are financed by foreign firms (see Table 4.8). The share is even higher considering only business R&D expenditures.[37] This share is the largest one among OECD countries.[38] The R&D expenditures financed from abroad are overwhelmingly R&D activities which conduct affiliated companies of foreign firms in Austria. One reason for the attractiveness of Austria as location of R&D activities might be governmental incentives in form of tax privileges.[39] The technology transfer from abroad should favor

[37] 30.2 percent of R&D expenditures of the business sector in 2001 are financed by abroad.
[38] In the EU-15 countries 7.7 percent of the R&D activity is undertaken by foreign multinationals. See Statistische Nachrichten 6/2004, Statistics Austria.
[39] See Statistische Nachrichten 6/2004, Statistics Austria.

the high-skilled workers in Austria.

Furthermore, foreign affiliates in Austria generate a large share of Austrian imports. Table 4.9 shows, that roughly one third of all imports are done by foreign multinationals in Austria. The presence of foreign firms in Austria varies strongly according to the sector. The share of employment of foreign affiliates in percent of sector's employment ranges from 3.8 percent in the furniture sector to 70 percent in the coke and oil sector.[40]

Table 4.9: Role of Foreign Firms for Austria's Trade and Labor Market

	1995	1998	2002
share of FDIs employment in total employment	16.26	17.00	16.65
share of FDIs-imports in total imports	-	21.75	32.08

Source: Own calculations based on data from the Austrian National Bank, OeNB, the OECD STAN database, and Eurostat Comext database.

As the estimation results in Table 4.7 show, foreign multinationals tend to increase the relative demand for low-skilled labor in Austria. It suggests that they invest mainly in sectors which use low-skilled labor intensively. This is consistent with the fact that Austria is a human capital poor country relative to its main trading partners.[41] The estimated coefficient on $FDI\ L$ is negative and significant at the five percent level.

It is remarkable that the inclusion of R&D variables increases significantly the magnitude of the coefficient estimates on $OUTS^{narrow}$. The economic impact of outsourcing implied by the estimates is substantial over the considered period. The annual change in the non-production wage bill share was 0.48. Multiplying the coefficient on outsourcing in specification (4) times the annual change in outsourcing (1.81) and dividing this by the change in wage bill share [(-0.036*1.81)/0.48] results in a contribution of -0.136. It implies that the wage bill share would have increased more strongly by 13.6 percent if the outsourcing would have not changed in the last decade. It is notewor-

[40] The numbers show averages for 1995 to 2002.

[41] For a comparison of Austria's skill endowment with other OECD and Eastern European countries see Marin (2004).

thy that the technological change ($R\&D\ L$) can account for only 3.4 to 3.9 percent of the rise of the wage bill share.

How robust are these results? A decomposition of the wage bill share in prices and quantities, known as relative wages and relative employment may deliver interesting insights. In Table 4.5.1, the dependent variable *wage bill share* is replaced by *relative wages*[42] and *relative employment* of high-skilled labor, respectively. I then run similar regressions as in Table 4.7.[43] Arguing that labor markets are not flexible, several studies concerning continental Western European countries[44] concentrate their analysis exclusively on the employment side.

The coefficient on the outsourcing variable is negative and statistically significant at the one percent level in all three *relative wage* regressions and somewhat less significant but also negative in the *relative employment* regression. It indicates that international outsourcing has a substantially negative impact on Austria's human capital in terms of wages and employment. Moreover, both R&D measures have a strong and significant impact on the relative employment. The $R\&D\ L$ ratio and the $R\&D\ SUB$ influence the relative employment of high-skilled workers positively, whereas the $FDI\ L$ ratio has a strong negative impact, which is not reported in the table. These variables, however, have only a minor effect on relative wages.

It results that international outsourcing can explain 38 percent of the decrease in the wage gap between the 70-percentile of the non-production workers and the 30-percentile wage of the production workers. Furthermore, relative employment would have grown by 24 percent more in the absence of outsourcing activities that occurred in the considered period of 8 years. As shown in Table 4.5.1 outsourcing has a negative impact on relative wages, as well as on relative employment. However, while the wage gap is decreasing,

[42] See the Data Appendix for a note on calculation *relative wages*. Due to missing values on the 70-percentile wages of the mining (NACE C), coke and petroleum (NACE DF), and vehicles (NACE DM) sector the sample reduces to 13 sectors.

[43] The reason why I use now value added instead of output (as in Table 4.7) as control variable, is simply because of value added performs slightly better.

[44] See, for example, Egger and Egger (2003) in the case of Austria, Brenton and Pinna (2001) in the case of Italy, and Anderton and Brenton (2000b) in the case of Sweden.

outsourcing contributes significantly to this development, and it acts against the rise in relative employment.

Using the wide definition of outsourcing, the results in Table H.2 in the Appendix confirm the above mentioned estimation results on the narrowly defined outsourcing. *Wide* outsourcing is defined as the share of imported inputs from *all* mining and manufacturing sectors in percent of the sector's value added. As the coefficient estimates on $OUTS^{wide}$ indicate, outsourcing has a statistically significant and negative impact on the relative high-skilled labor demand also when using the wide definition. Furthermore, wide outsourcing affects the relative wages significantly negatively and has no significant effect on the relative employment.

Table 4.10: Outsourcing and Decomposed Demand for High-Skilled Labor in Austria

dependent variable:	*relative wages*			*relative employment*		
	(1)	(2)	(3)	(4)	(5)	(6)
$OUTS^{narrow}$	- 0.155***	- 0.148***	- 0.179***	- 0.109*	- 0.149**	- 0.142***
	(0.056)	(0.055)	(0.061)	(0.063)	(0.067)	(0.051)
ln VA	- 20.131**	- 27.179***	- 22.592***	67.617***	52.529***	66.058***
	(8.557)	(9.386)	(8.270)	(14.162)	(9.758)	(15.608)
ln K/VA	- 17.521*	- 22.064**	- 19.831**	57.372***	51.123***	54.806***
	(9.145)	(9.115)	(8.724)	(10.280)	(7.831)	(11.164)
R&D L		2.637*			3.074***	
		(1.516)			(1.073)	
R&D SUB			2.349			4.923**
			(1.664)			(2.025)
Constant	449.505***	520.155***	480.238***	- 721.512***	- 582.880***	- 697.668***
	(104.218)	(109.201)	(100.009)	(152.852)	(106.720)	(168.349)
Adj. R^2	0.975	0.976	0.975	0.994	0.995	0.994
N	96	96	96	120	120	120

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficients on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *relative wages* = (70-percentile wage of non-production workers/30-percentile wage of production workers)*100; *relative employment* = (number of non-production workers/number of production workers)*100; $OUTS^{narrow}$ = (imported inputs from same sector/value added)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital/value added)*100]; *R&D L* = (R&D employment/employment)*100; *R&D SUB* = (R&D subsidies/value added)*100.

A further robustness check concerns the assumed exogeneity of international outsourcing. So far, I have neglected the potential correlation of the outsourcing variable with the error term of the dependent variable. If the outsourcing variable is afflicted with endogeneity, the OLS estimates are inconsistent.[45] Therefore, in oder to evaluate if the outsourcing variable ($OUTS^{narrow}$) is actually endogenous in my sample I carry out the Durbin-Wu-Hausman endogeneity test. Table 4.11 reports the test statistics.

Table 4.11: Exogeneity Tests for Narrow Outsourcing

	χ^2	P-value	Exogeneity
wage bill share regression	0.0764	0.782	*not rejected*
relative wages regression	0.0546	0.815	*not rejected*
relative employment regression	0.2498	0.618	*not rejected*

Notes: The test statistics are carried out in Stata using the *ivendog* command; numbers refer to 105 observations; test statistics show results for the first lag of OUT^{narrow}.

The table suggests that the outsourcing variable appears to be exogenous. This is true for all three dependent variables, the *wage bill share*, *relative wages*, and *relative employment*. The high p-values indicate that I cannot reject the null hypothesis of exogeneity. Therefore, the estimates are consistent when using OLS. Nevertheless, I undertake instrumental variable regressions to see if the results differ from OLS. Applying the General Method of Moments (GMM) I use the own first lag as an instrument for $OUTS^{narrow}$. Thus, I can estimate the parameters in a consistent way. However, the results using GMM are generally not efficient.

Table 4.12 shows the results of the IV-GMM estimation. In all three specifications, the coefficient of the variable of interest, $OUTS^{narrow}$, is negative. However, narrow outsourcing appears only to have a significant impact on the relative wages of non-production workers. It confirms the results received from OLS estimations. However, facing the exogeneity of the outsourcing variable, OLS estimations appear to be preferable over GMM since the OLS estimates are more efficient.

[45] See also Section 3.6.2 of Chapter 3 where I considered the problem of endogeneity in the case of Germany.

Table 4.12: Outsourcing and Relative Demand for High-Skilled Labor (IV-GMM)

dependent variable:	*wage bill share*	*relative wages*	*relative employment*
	(1)	(2)	(3)
$OUTS^{narrow}$	-0.027	-0.063**	-0.105
	(0.028)	(0.025)	(0.113)
ln Y	4.482**	-7.007**	46.870***
	(1.752)	(3.273)	(9.097)
ln K/Y	4.756**	-3.044	53.002***
	(1.933)	(3.567)	(13.681)
R&D L	0.352	0.235	-0.157
	(0.225)	(0.300)	(1.205)
Constant	-18.195	184.506***	-544.624***
	(21.122)	(39.409)	(127.812)
Centered R^2	0.997	0.995	0.995
N	105	105	105
Test of Predictive Power of Instrument		*F-test*	16.75
		P-value	0.000

Notes: Coefficients are estimated by IV-GMM; first lag of $OUTS^{narrow}$ is used as instrument for this variable; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations.

Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; *relative wages* = (70-percentile wage of non-production workers/30-percentile wage of production workers)*100; *relative employment* = (number of non-production workers/number of production workers)*100; $OUTS^{narrow}$ = (imported inputs from same sector/value added)*100; *ln Y* = ln real output; *ln K/Y* = ln [(capital stock/output)*100]; *R&D L* = (R&D employment/employment)*100.

4.5.2 Import Penetration

In this section I examine the consequences of Austria's changed import pattern on the relative demand for high-skilled labor in domestic sectors. Particularly, I focus my analysis on the increased importance of imports from Eastern Europe. As already mentioned, due to data restrictions, this question cannot be answered by the outsourcing data used in the previous section which were received from input-output tables. Therefore, in this section I will analyze the effects of imports disaggregated by their geographical source. The import data for this analysis are taken from the Eurostat trade data base Comext and are recoded from the trade classification system SITC to the industry classification system ISIC.[46] The resulting sector-specific import ratios represent a measure for import penetration. They indicate how strong particular sectors are exposed to competition arising from imported goods. It notable that the import shares are capturing trends in both outsourcing of intermediate inputs and direct import substitution of final goods. Anderton *et al* (2002a)[47] argue that restricting outsourcing to the imports solely of intermediate inputs does not take into account outsourcing of final goods. They mention that outsourcing of the final stage of the production process or the entire production process by German firms might have similar effects like outsourcing in intermediates.

I seek to assess to what extent imports from certain regions, particularly from Central and Eastern Europe, contribute to the within-sector variation in the demand for high-skilled labor in Austria.

This analysis is based on the same theoretical considerations and estimating equation as the previous section. In the specifications of Table 4.13, the wage bill share of high-skilled workers is regressed on the sector-specific import ratios. In column (1) to (3) the imports from all countries excluding Central and Eastern Europe are taken into account, while in columns (4) to (6) solely imports from the Eastern European transition countries are con-

[46] According to the correspondence table from Eurostat, I transformed the original trade data from the trade classification SITC at 5-digit level to the industry classification at ISIC 4-digit level. See the Data Appendix for a more detailed description of the trade data and their transformation.

[47] See Chapter 2 for a more detailed description of Anderton *et al* (2002a).

sidered. The data are pooled across fifteen sectors and eight years, from 1995 to 2002, resulting in 120 observations.

The results in the table suggest that only the imports from Central and Eastern European countries (measured by the import ratio IM_{CEE}/Y) have statistically significant effects. The coefficient indicate that imports from Central and Eastern Europe have a positive influence on relative demand for high-skilled labor, whereas imports from other countries have no skilled-biased effect on the labor demand. As Anderton and Brenton (1999) state for the UK, the source of imports matters with respect to the relative demand for skills. Moreover, it is noteworthy that the imports from the other countries IM_{ROW}/Y are dominated by intra-EU-15 imports and particularly by imports from Germany.[48] Similarly to the regressions with outsourcing data from the input-output table, the R&D intensity and the R&D subsidies provided by the government have positive impacts on the relative demand for high-skilled workers.

[48] Roughly 50 percent of all imports to Austria come from Germany.

Table 4.13: Import Penetration and Demand for High-Skilled Labor

dependent variable:	*wage bill share of high-skilled workers*					
	(1)	(2)	(3)	(4)	(5)	(6)
IM_{ROW}/Y	0.001	0.001	- 0.001			
	(0.006)	(0.006)	(0.006)			
IM_{CEE}/Y				0.053***	0.056***	0.050***
				(0.017)	(0.017)	(0.015)
ln Y	3.917**	3.284*	3.452*	3.942**	3.182*	3.558*
	(1.969)	(1.907)	(1.936)	(1.779)	(1.668)	(1.801)
ln K/Y	3.561*	3.090*	3.236*	4.185**	3.648**	3.893**
	(1.810)	(1.771)	(1.835)	(1.710)	(1.614)	(1.753)
R&D L		0.161*			0.192*	
		(0.096)			(0.100)	
R&D SUB			0.780**			0.693**
			(0.378)			(0.317)
Constant	- 4.063	2.737	1.085	- 9.708	- 1.569	- 5.296
	(23.372)	(22.673)	(23.080)	(20.924)	(19.528)	(21.238)
R^2	0.997	0.997	0.997	0.997	0.997	0.997
N	120	120	120	120	120	120

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficients on industry and time fixed effects are not reported; N denotes number of observations.
Variables are defined as follows: *wage bill share of high-skilled workers* = (wage bill of non-production workers/total wage bill)*100; IM_{ROW}/Y = worldwide Austrian imports (excluding from CEE)/output)*100; IM_{ROW}/Y = Austrian imports from CEE/output)*100; *ln Y* = ln real output; *ln K/Y* = ln [(capital/output)*100]; *R&D L* = (R&D employment/employment)*100; *R&D SUB* = (R&D subsidies/value added)*100.

4.6 Concluding Remarks

In this chapter, I have examined the importance of outsourcing for the labor market outcomes in Austria. In contrary to other studies on the topic, I find that international outsourcing has hurt the economic fortunes of human capital in Austria. Moreover, outsourcing has a negative impact on the skill premium as well as the relative employment of high-skilled workers.

At the first glance, the obtained results seems to contradict the predictions of the theoretical model of Feenstra and Hanson (1996a). However, it might depend on that the model's assumption on the factor abundance of the outsourcer country is not reasonable in the case of Austria. The model assumes that the North which undertakes outsourcing to the South, is relatively well endowed with capital *and* high-skilled labor. However, Austria appears to be a poor human capital country compared to its trading partners and host countries of FDIs.[49]

Table 4.14 provides a summary of my findings for Austria and Germany. Furthermore, the table compares the results with the empirical findings of Feenstra and Hanson (1996b) for the US. Several points appear noteworthy from the table.

First, the contribution of outsourcing to the development of the wage bill share appears to be substantially smaller in both European countries than in the US. Furthermore, as the negative signs in the case of Austria and Germany indicate, international outsourcing works against a stronger increase of the relative skilled labor demand. Secondly, the contribution of outsourcing to the evolution of the skill premium appears strikingly similar in Austria and Germany. In both countries outsourcing can account for roughly 35 percent of the change in the relative wage for high-skilled workers. It means that in the absence of outsourcing the relative wages for human capital would have declined by 35 percent less in Austria, while the relative wages in Germany would have increased by one third more. Finally, the table shows that outsourcing reduces substantially the relative employment of high-skilled workers in both countries. However, the contribution to the

[49] See Marin (2004).

increase in relative employment is with on average 58 percent clearly higher in Germany.

Furthermore, it is remarkable that governmental R&D policy has different effects on skill-upgrading in Germany and Austria. While R&D subsidies have a positive impact on the relative demand for high-skilled labor in Austria, they only affect the skill premium positively in Germany. However, in Germany, the governmental R&D policy disfavors the relative employment of high-skilled workers.

Table 4.14: Contribution of Outsourcing to Labor Market Outcomes

	Austria[a] 1995-2002	Germany[b] 1991-2003	USA[c] 1979-1990
		contribution in percent	
wage bill share[d]	-6.8 - -13.6	-8.7 - -25.1	30.9 - 51.3
relative wages [e]	33.0 - 38.1	-30.8 - -36.5	-
relative employment [f]	-18.4 - -25.2	-31.8 - -85.1	-

[a] narrow definition of outsourcing = (imported inputs from same sector/value added)*100, mining and manufacturing.
[b] narrow definition of outsourcing = (imported inputs from same sector/gross output)*100, manufacturing.
[c] (imported inputs from the same sector/total non-energy material purchases)*100, manufacturing.
[d] (wage bill of non-production workers/total wage bill)*100.
[e] (wage of non-production workers/wage of production workers)*100;.
[f] (number of non-production workers/number of production workers)*100;.
Source: Austria and Germany: own calculations; USA: calculations taken from Feenstra and Hanson (1996b).

This chapter contributes to the existing literature in two ways. First, it uses very recent data which allows to evaluate appropriately the effects of the economic integration between Austria and Eastern Europe. It comes out that human capital in Austria loses in the recent years. Furthermore, I have identified that outsourcing has a negative impact on the wages and employment of high-killed workers relative to their low-skilled counterparts. Secondly, a detailed analysis of the channels of technology allows to distinguish between different effects. Thus, I found empirical evidence that R&D subsidies and technological progress favor human capital. Particularly, R&D

policy pursued by the Austrian government has a strong positive effect on the relative demand for high-skilled workers.

Concerning the role of Austria in the international value-added chain, I found evidence that Austria is specializing in providing outsourcing-related services. It emphasizes Austria's role as toehold for investments in Eastern Europe. Moreover, Austria's role for Eastern Europe appears to be similar to Hong Kong's role as bridge to China. I focus my investigation on the Austrian manufacturing sector. However, there must be future research on the impacts of Austria's concentration in providing outsourcing services for investors in Eastern Europe. Particularly, what effects does this have on the demand for human capital in the service sector.

Appendix

4.7 Data

Notes on calculation of variables

wages: Since Austria's wages are recorded according to at most to the social security contribution ceiling, an accurate measure of mean wages is not possible. The capping of high earnings which are highly correlated with non-production workers, introduces a downward bias in relative wage rates. However, the statistics of the Association of Austrian Social Insurance report different percentile wages for production and non-production workers.
For calculating the *wage bill share* and *relative wages*, I experimented with various approaches including ratios of mean, median, and different percentile wages. Furthermore, I used those alternative calculations as dependent variable for the regression analysis in order to check for robustness. Finally, I decided to use the mean wages for calculating the wage bill of production and non-production workers. Therefore, all reported *wage bill share* regression show results on the *wage bill share* of mean wages. For regressions with *relative wages* as dependent variable, I calculated the ratio of the 70-percentile wage of the non-production workers to the 30-percentile wage of the production workers.

imported intermediate goods: As in most countries, input-output tables for Austria are compiled not annually. The most recent available input-output tables are from 1995 and 2000. Therefore, I estimate the input-output tables for the missing years by interpolating the input-output coefficients and multiplying them by imported inputs. The extrapolation of data for the years 2001 and 2002 is undertaken analogously to the extrapolation of German input-output tables. In the case of Austria, however, I used averages over the years 1995 and 2000. See Appendix of Chapter 3 for further details.

These imported inputs are obtained from the interpolated share of intermediate goods in total imports and the value of total imports. In absence of trade data classified according to NACE, I calculated the total imports by transforming import data at the HS Rev.1 6-digit level to ISIC Rev. 3 categories at 4-digit level. The import data in HS classification are taken from the Eurostat Comext database. For the transformation, I used a detailed conversation table provided by the UN. Since the data on labor market determine the level of sectoral aggregation, I aggregated the imported inputs to the chosen NACE 2-letter level of analysis. Therefore, Austria's imports at the sectoral level formulate the estimated input-output tables for the missing years.

capital stock: Gross fixed capital stocks are calculated according to the perpetual inventory method using data on gross fixed capital formation (GFCF), which are deflated by a general price index for investment goods.[50] The initial capital stock for the year 1994, K_{1994}, is estimated by using the values of capital formation in the preceding years, 1990 to 1993.

$$K_{1994} = (GFCF_{1990} + GFCF_{1991} + GFCF_{1992} + GFCF_{1993} + GFCF_{1994}) * 2$$

The gross fixed capital stocks for the sample period are calculated according to the following simple formula, assuming a constant depreciation rate of 10 percent.

$$K_t = 0.9 * K_{t-1} + GFCF_t$$

To check the validity of this estimation, we compare the aggregate estimate for NACE D with the net capital stocks provided by Statistics Austria. The size of these stocks differ somewhat, but the development is very similar.

[50] For this calculation see Egger (2000).

Table G.1: Definition and Source of Variables

Variable	**Description**	**Source**
wage bill share	share of non-production workers' wage bill in total wage bill, in percent	Association of Austrian Social Insurance
relative wages	70-percentile non-production wage relative to 30-percentile production wage, in percent	Association of Austrian Social Insurance
relative employment	non-production workers relative to production workers, in percent	Association of Austrian Social Insurance
$OUTS^{narrow}$	share of imported inputs from the same NACE 2-letter sector in value added, in percent	Statistics Austria (input-output table), OECD STAN database
$OUTS^{wide}$	share of imported inputs from the mining and manufacturing sector in value added, in percent	Statistics Austria (input-output table), OECD STAN database
IM_{ROW}/Y	share of Austria's imports from all over the world (except from CEE) in output, in percent	Comext database, Eurostat
IM_{CEE}/Y	share of Austria's imports from CEE in output in percent	Comext database, Eurostat
Y	output (production), deflated by sector-specific producer price indices, in million EUR	OECD STAN database
VA	value added, deflated by sector-specific producer price indices, in million EUR	OECD STAN database
K/Y	gross fixed capital stock relative to output, in percent	OECD STAN database
K/VA	gross fixed capital stock relative to value added, in percent	OECD STAN database
R&D L	R&D employment relative to total employment, in percent	Eurostat, OECD STAN database
R&D SUB	R&D subsidies relative to value added, in percent	Austrian Research Promotion Organization, OECD STAN database
FDI L	employment in foreign affiliates in Austria relative to total sector's employment, in percent	OeNB, OECD STAN database

4.8 Figures and Tables

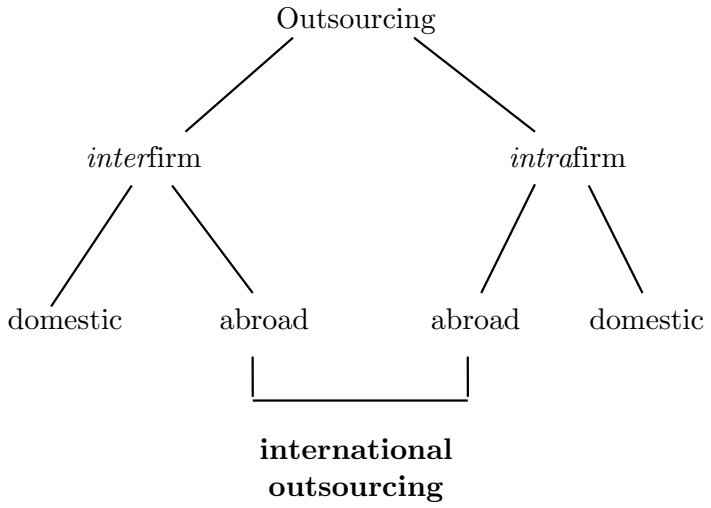


Figure H. 1: Types of Outsourcing

Table H.2: Outsourcing (wide definition) and relative demand for high-skilled labor

dependent variable:	*wage bill share*				*relative wages*			*relative employment*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$OUTS^{wide}$	- 0.009*	- 0.010**	- 0.015***	- 0.020***	- 0.069**	- 0.060*	- 0.109***	0.020	- 0.001	0.006
	(0.005)	(0.005)	(0.005)	(0.006)	(0.033)	(0.031)	(0.035)	(0.052)	(0.042)	(0.053)
ln VA	4.385**	3.649**	3.315**	2.873	- 19.137**	- 26.406***	- 21.897**	61.324***	49.672***	60.298***
	(1.742)	(1.728)	(1.668)	(1.816)	(9.539)	(8.537)	(15.794)	(10.111)	(17.036)	
ln K/VA	4.164**	3.851**	3.815**	3.348*	- 14.777	- 18.112	- 14.846	59.052***	54.103***	58.992***
	(1.777)	(1.739)	(1.699)	(1.881)	(10.945)	(10.904)	(10.624)	(13.953)	(10.662)	(14.371)
R&D L		0.193**	0.205**	0.058		2.956*			3.059***	
		(0.091)	(0.094)	(0.108)		(1.697)			(1.111)	
R&D SUB			0.981**	1.241***			3.355*			3.491
			(0.351)	(0.398)			(1.938)			(2.477)
FDI L				- 0.051**						
				(0.024)						
Constant	-11.679	-5.215	- 2.047	5.332	432.0***	501.1***	458.1***	- 690.6***	- 580.2***	- 682.1***
	20.782	20.443	19.553	21.967	115.657	117.386	109.451	182.240	121.208	194.101
Adj. R^2	0.996	0.996	0.996	0.997	0.966	0.968	0.968	0.992	0.993	0.992
N	120	120	120	120	96	96	96	120	120	120

Notes: Coefficients are estimated by two-way fixed effects OLS regressions; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; estimated coefficient on industry and time fixed effects are not reported; N denotes number of observations. Variables are defined as follows: *wage bill share* = (wage bill of non-production workers/total wage bill)*100; *relative wages* = (70-percentile wage of non-production workers/30-percentile of production workers)*100; *relative employment* = (number of non-production workers/number of production workers)*100; $OUTS^{wide}$ = (imported inputs from mining and manufacturing sector/value added of the sector)*100; *ln VA* = ln real value added; *ln K/VA* = ln [(capital stock/value added)*100]; *R&D EXP* = (R&D expenditure/value added)*100; *R&D SUB* = (governmental R&D subsidies/value added)*100; *FDI L* = (employment in foreign affiliates in Austria/employment)*100.

Chapter 5

Economic Geography of Central Europe and Location Choice of FDIs

5.1 Introduction

The fall of the Iron Curtain which intersected Europe in its heart for more than 40 years, is supposed to entail profound impacts on the location of economic activity in the unified Europe. A new economic geography might emerge in Europe. The economic integration between countries affects the spatial organization of production. It applies to the relocation of industry across countries but even inside countries. The movement towards a more integrated market influences the internal economic geography of countries.

The fall of the Communism acts like an external shock and can, therefore, be seen as a natural experiment. What effects does the opening-up of Eastern Europe have on existing spatial pattern of economic activity in Europe which emerged in the last half century? The integration of Eastern Europe into the international economy implies a re-organization of the production process in Europe. The economic geography might be affected inside, especially, those countries along the removed border between the East and the West. The former border regions became overnight central regions with an excellent market access. Will a new economic center emerge in the middle of

Europe? Furthermore, will the former border regions in immediate proximity to the Iron Curtain be the most benefiting regions when Eastern and Western Europe integrate? It concerns the Western European border regions in Austria and Germany as well as the regions of the former Communist countries which border the EU-15.

Since the beginning of the nineties, several steps of economic integration have been undertaken concerning Central Europe. Rapidly, tariffs and other trade barriers have been reduced between the EU and EFTA, and the transition countries of Eastern Europe. A further step of integration marks the accession of Austria to the European Union in 1995. The process culminates for the moment in the accession of eight Eastern European transition countries. Hence, a new single market evolved in the heart of Europe.

The former centrally planned economies pursued an import-substitution policy and restricted their international trade relations, in particular with Western European countries.[1] The result was a monocentric inward-looking agglomeration of economic activity in the capital region. This spatial distribution of industry location might change now in favor of a more dispersed pattern. Those regions will gain which border the export markets in Western Europe. Simultaneously, the Western European regions which are neighbors of the new EU members, might also benefit from an improved market access.

The goal of this chapter is to investigate how the economic integration of Eastern and Western Europe influences the internal economic geography of the affected countries. At first, I will examine the recent trends in location of industrial activities. Thereby, I focus my analysis on the two Western European countries, Austria and Germany, and the four neighboring Eastern European countries; the Czech Republic, Hungary, Poland, and Slovakia. Changes in the economic geography might be caused by relocating of existing production sites within a country or by entering of new firms. While the former factor involves the free movement of activities across regions that was formerly restricted by the political system, the latter factor is mainly related to the entrance of foreign firms by settling affiliates.

In a second part of the chapter, I will focus on location decisions of new

[1] Economic relations between Communist states were organized by the Comecon.

market entrants. Facing the enormous capital inflows, investing multinational companies might play an crucial role in the fortune of individual regions in Eastern Europe. The location decisions might be not random. What does the choice of location of foreign establishments determine? Do outsourcing FDIs tend to locate in regions bordering Western Europe? Outsourcing FDIs are characterized by moving individual stages of production offshore. I examine these questions by analyzing the location decisions of Austrian and German companies. They tend to establish their Eastern European affiliates, particularly, in regions which border on the European Union and in capital regions.

The chapter is organized as follows. After highlighting briefly the geography of Europe given the Iron Curtain in Section 5.2, I review the related theoretical and empirical literature in Section 5.3. The subsequent section 5.4 is concerned with the recent trends in the economic geography of industry in the two Western European countries, Austria and Germany, and the bordering Eastern European countries. Section 5.5 lays out the geographical location of Austrian and German affiliates in Eastern Europe. Section 5.6 presents the results of an econometric analysis on determinants of FDIs location in Central Europe. Finally, Section 5.7 gives a conclusion.

5.2 Central Europe and the Iron Curtain

After the World War II, the Iron Curtain intersected Europe in its heart for more than 40 years. Thus, during the Cold War, Europe was divided politically and economically into East and West. While the Western European countries organized their economic activities in a market-oriented system, the states on the East to the Iron Curtain planned their economies centrally by governmental administration. Furthermore, the Iron Curtain did allow neither movements of persons nor goods and services, as well as capital between the two parts of Europe. Before Europe was split in half, the cultural and economic relations between Western and Eastern Europe were intensive.

Not surprisingly, Eastern and Western Europe has a common historical

background. Particularly, before the World War I, the westernmost former Warsaw Pact countries were strongly tied to Western Europe. During the Austrian-Hungarian Monarchy, this multi-national region was culturally and economically highly integrated. The Empire's territory enclosed Austria, Bosnia and Herzegovina, Croatia, the Czech Republic, Hungary, Slovakia and Slovenia. Furthermore, parts of the neighboring countries belonged to the Empire in Central Europe. In total, the territory includes 49 million people.[2] However, the economic development was marked by wide discrepancies within the Empire, although the new technologies spread rapidly throughout the territory. In the northern part of the Central European area, the German Empire was located. Its territory comprised large parts of Poland and the Russian region Kaliningrad in the East.

Figure 5.1: Europe and the Iron Curtain

[2] See Wikipedia for an outline of the history of Austria-Hungary.

The map highlights the situation of Europe during the Cold War. It shows up the course of the Iron Curtain. Today, Austria, Germany, and Italy share a border with the former Communist countries in the center of Europe.[3] I this chapter, I focus my analysis on Austria and Germany which were most affected by the opening-up of Eastern Europe. Germany is specifically affected since the Iron Curtain divided the country internally in East and West Germany. After the reunification, Germany lies in the center of the European market. On the other hand, Austria is fairly closely located to Eastern Europe in terms of geography but also in terms of culture and economic relations.

Beyond the former Iron Curtain, I consider the so-called Visegrád group. The Visegrád group corresponds to the former Warsaw Pact countries; the Czech Republic, Hungary, Poland, and Slovakia which are all lying in Central Europe.[4] Central Europe denotes the region lying in the middle of Europe between the vaguely defined areas of Eastern and Western Europe.

After the end of the Cold War in 1990, the Eastern European countries opened rapidly their economies to the world market. However, during the division of Europe, the economic development of the East and the West was strongly diverging. It results in an enormous welfare gap in the center of Europe. After the fall of the Iron Curtain, the border between Western and Eastern Europe marks the frontier between two highly differently developed regions. The GDP per capita of the new EU members reached 42.2 percent of the average EU-15 level in 1995. This gap was closing to 47.4 percent in 2002. Comparing the directly bordering countries, Austria and Germany, with the Czech Republic, Hungary, Poland, and Slovakia reveals a larger gap of 39.0 percent in 1995 that closed rapidly to 46.8 percent in 2002.[5] The economic gap in Central Europe is still striking along the former Iron Curtain, although Eastern Europe is catching up recently.

[3] Furthermore, Finland borders Russia in Northern Europe and Greece is a neighbor country of the former Communist Bulgaria in the South-East.

[4] The Visegrád group originated in a summit held in the Hungarian city Visegrád. The governments of the four Central European countries agree to establish co-operation in economic and political matters.

[5] The numbers correspond to GDP per inhabitant in purchasing power parities. For the calculation data from Eurostat online database are used.

During the last decades or even centuries, a certain pattern of agglomeration of economic activity emerged in Western Europe. Economic activity agglomerates along a banana-shaped axis running from London to Milan, containing Belgium, Luxembourg, Eastern France, Western and Southern Germany, and Northern Italy. It is called the 'Blue Banana'.[6] This core region proves to be the pole of growth and innovation of Western Europe. Facing the unified Europe, the following question has arisen; is the existing agglomeration persistent?

The Iron Curtain split Central Europe, a former integrated region, in two parts for almost half a century. Thus, this period can be seen as a natural experiment. As the theory of new economic geography suggests, such shocks can produce persistent changes in spatial structure.[7] Krugman and Venables (1995) provide a model of agglomeration outcomes when two countries integrate. At a certain level of trade costs, multiple equilibria are sustainable. It means that economic activity could be dispersed over both countries or agglomerated in one country. However, the country in which the agglomeration takes place, depends on the initial market size. Thus, history matters for the agglomeration of production.

What implications does it have on the current situation of Europe? Even if the shock of the fall of the Iron Curtain is immense, the agglomeration along the 'Blue Banana' may be a sustainable equilibrium. However, if the opening-up of Eastern Europe causes a weakening of 'old' linkages, a new economic geography could emerge in the center of Europe. Hospers (2003) states that a 'Yellow Banana' could be expected reaching from Paris to Warsaw. It would connect Western and Eastern Europe and give rise to a new Central Europe. However, statements beyond such speculations are a matter of time and empirics.

Before considering the trends in spatial distribution of economic activity, the next section outlines a theoretical model and related empirical literature. The model of new economic geography explains the location of economic activity inside a country facing an international economic integration.

[6] According to Heidenreich's (1998) outline of Europe's history of cities and regions, the 'Blue Banana' dates back to Medieval or even Roman times. See also Hospers (2003).

[7] See Krugman (1998) for an outline of the idea of 'new economic geography'.

5.3 Economic Geography - Theoretical Background and Related Literature

In new economic geography models, spatial agglomerations usually involve the existence of linkages. In the absence of interactions among economic units, like persons or firms, no agglomeration would emerge in a world of positive transport costs. Inside a country, economic activity might concentrate in individual regions. A region that offers a large market for intermediate and final goods, appears more attractive for locating production. In a world of positive transport costs, the geographical proximity to the purchasing power matters. This demand effect corresponds to the concept of backward linkage. On the other hand, industry agglomeration in a region implies a large supply of intermediate inputs. In order to avoid transport costs firms are attracted to this region. The effect of lower costs of production refers to the concept of forward linkage.[8] The interaction of increasing returns to scale and transport costs creates a self-reinforcing process of industrial agglomeration.

The empirical considerations in the next section are based on the new geography model of Krugman and Livas (1996).[9] They provide a formal explanation of the existence of large cities observed in Third World countries. Such national industry agglomerations arise as a consequence of backward and forward linkages in an economy in which firms serve a small domestic market. Hence, they conclude that giant cities result from import-substitution policies of those countries. Opening-up the economy to international trade leads to the reorganization of the internal economic geography. The production will disperse spatially since the orientation to foreign markets weakens national linkages. This let Krugman and Livas (1996) conclude that international trade affects the internal economic geography of countries.

Hanson (1998) analyzes empirically the effects of the NAFTA integration on the location of economic activities in Canada, Mexico, and the United States. He finds that Mexico experienced a dramatic expansion of manu-

[8] See Krugman and Venables (1995) and Fujita *et al* (1999) for presenting the concept of backward and forward linkage.

[9] See also Fujita *et al* (1999), Chapter 18, for presenting Krugman and Livas' (1996) model.

facturing employment in its northern regions which border the US. At the same time the agglomeration of the employment in the previous economic center Mexico City contracts. Moreover, Hanson (1998) states that the wage premium for skills increased in the border regions facing the NAFTA integration. Contrary to the changes in Mexico, only the US cities on the Mexican border show a significant growth in employment. However, the distribution of economic activities in the remaining US and Canadian regions remain unaffected.

Brülhart *et al* (2006) explore the internal economic geographies of five Central European EU countries, the Czech Republic, Hungary, Poland, Slovenia, and Slovakia. They formulate a "Comecon hypothesis" according to which the spatial distribution is strongly concentrated in the capital region. However, foreign market of regions has played no systematic role in the centrally planned economies of Eastern Europe. Brülhart *et al* (2006) find empirical evidence for their hypothesis. They state that wages are higher in capital regions and service employment is strongly concentrated in those regions. Furthermore, compared to EU-15 countries, the concentration in the capital regions are significantly stronger.

Furthermore, Lorentowicz (2006) finds for Poland strong evidence that market-seeking FDIs locate in the capital region. In her investigation, she distinguishes between vertical and horizontal FDIs and analyzes the determinants of location in the case of Polish regions. She identifies that export-oriented investors choose low-wage regions which are at the same time relatively well endowed with high-skilled labor. Furthermore, the empirical results show that vertical FDIs tend to locate in western border regions of Poland. Additionally, Lorentowicz (2006) provides a comprehensive overview of existing empirical literature on location choice of multinational firms.

5.4 Agglomeration in Central Europe?

In order to explore the economic geography of the unified Central Europe, I present recent trends in industry location in the following. Thereby I distinguish three types of regions inside each country to the West and East

of the former Iron Curtain; border, capital, and other regions. In the case of Austria and Germany, border regions correspond to regions neighboring the Visegrád countries. On the other hand, border regions in the new EU members refer to regions bordering Austria and Germany.[10]

The internal spatial distributions shown below refer to employment of the industry sector. The reason of why the location of service activities are not taken into account, is related to the fundamental difference between services and industry in locating. Usually, services establish in regions where their customers are located since a large number of service activities are not tradeable. Furthermore, some services like engineering, investment banking and other high-skill activities, benefit at most from economies of agglomeration. Such positive agglomeration effects occur particularly in the capital area which corresponds to the economic center in relatively small Eastern European economies. Furthermore, border regions provide a rather inadequate access to the local market but a good access to export markets. Thus, the attractiveness of border regions is of only minor relevance for service activities. In opposite to services, firms of the industrial sector appear to be more mobile. They might respond to improved access to foreign markets by relocating production sites close to the border. In accordance with this argumentation, I concentrate my analysis on the location of industry employment. The next section considers the trends in Austria and Germany.

5.4.1 Austria's and Germany's Border Regions

Austria shares borders with the following former Communist countries; the Czech Republic, Slovakia, Hungary, and Slovenia. Table 5.1 displays the distribution of Austrian industry employment across regions over the period 1991-2001. Since five out of nine Austrian NUTS 2 regions[11] border next to Eastern European countries, I use data at the more disaggregate level of NUTS 3 in order to classify the districts into border, capital, and other regions.

[10] See the Appendix (A. Definition for distribution (Section 5.4)) for a detailed description of how regions are defined.

[11] The NUTS 2 regions correspond to Austrian "Bundesländer".

Table 5.1: Distribution of Industry Employment in Austria

	distribution in percent of national industry employment			
	1991	1995	1998	2001
border regions	16.9	16.8	17.0	17.7
capital region	24.0	22.5	20.9	18.7
other regions	59.2	60.7	62.1	63.7

Notes: Regions are defined according to NUTS 3. See Appendix for further details.
Source: Own calculations based on data from Statistics Austria.

The table suggests that Austria experienced a decentralization of its production. It is striking that the employment shifted dramatically away from Vienna towards border regions and western regions. The share of industry employment in regions which border the new EU members has risen slightly from 16.9 to 17.7 during the period of ten years under consideration. Moreover, the movement to western regions which border on Germany and Italy, was more pronounced. It occurred mainly after 1995, the year of Austria's accession to the European Union. Therefore for Austria, it seems to be the case that the effect of the own accession dominates forces of agglomerating at the border to Eastern Europe.

Table 5.2: Distribution of Industry Employment in Germany

	distribution in percent of national industry employment			
	1991	1995	1998	2001
border regions	9.1	8.4	8.4	7.9
capital region	3.3	3.0	2.7	2.4
other regions	87.5	88.5	88.9	89.7

Notes: Regions are defined according to NUTS 3. See Appendix for further details.
Source: Own calculations based on data from the Federal Statistical Office of Germany.

Table 5.2 shows the geographic distribution of industry employment in Germany for the years 1991-2001.[12] As in the case of Austria, the employment shifted away from the capital region. Furthermore, also the relative

[12] Using data on German districts at the NUTS 3 level, I declare districts which border directly and indirectly to Poland and the Czech Republic as border regions. Germany is broken down in 439 administrative districts.

industry employment has diminished in border regions. Facing the tremendous re-structuring in Eastern Germany, the changes in spatial distribution appear only marginal.

However, a closer look at the case of Eastern Germany reveals a substantial shift towards regions which border Western Germany. In 2001, 17.8 percent of the Eastern German industry employment[13] takes place in districts at 'inner German border', while it was only 14.1 in 1991. The employment in Eastern German regions bordering Poland and the Czech Republic increased slightly from 31.8 to 32.7 percent of total employment of the 'New Länder' but declined in percent of national employment from 7.1 to 5.7 during the period 1991 and 2001. In the Western German border regions to the Czech Republic, the agglomeration remains unchanged.[14] While 12.9 percent of the Bavarian industry employment was located in border regions in 1991, ten years later it was with 12.8 percent almost the same.

It appears that the economic geography of both Western European countries is less affected by opening-up of Eastern Europe. The European Commission states that Western European border regions might even lose in the short-run. However, they expect that those regions gain in the long-run due to their central location.[15]

Why does the economic integration of Eastern and Western Europe have no impacts on the agglomeration structure in Austria and Germany? First, Eastern Europe plays only a minor, if increasing role as trading partner for Austria and Germany. In 2002, 17.6 percent of Austria's exports went to Eastern Europe, while more than 60 percent were shipped to the EU-15 region. However, in the year 1989 when the Iron Curtain fell, only 9 percent of exports flowed to Eastern Europe. Germany is even less integrated with Eastern Europe than Austria. However, the exports to this region grew from 6.9 percent in 1989 to 11.7 percent in 2003. At the same time, the exports to other EU-15 countries are more than four-times as large.[16] It seems to be

[13] Excluding Berlin.

[14] In Western Germany, only Bavaria borders directly on Eastern Europe.

[15] See European Commission (2001) for an outline of the impacts of the Eastern EU-enlargement on the Western European border regions.

[16] The data are taken from the Statistical Yearbooks of Austria and Germany.

obvious that the small size of Eastern Europe relative to the large market of the pre-2004 European Union plays a crucial role. The trade orientation implies that Austrian and German economic activity might be concentrated rather in regions which border other EU-15 members. This is in line with the mentioned 'Blue Banana'.

A second factor for the slight effects on the industry location in Austria and Germany might be the spatial pattern which established over decades. The emerged economic geography appears to be stable since the agglomeration forces are sufficiently strong. The incentives for firms to relocate their production sites to regions along the border with Eastern Europe are of less importance. On the other hand, if they decide to move they will move the production stages immediately offshore to Eastern Europe.

5.4.2 New Agglomerations in Eastern Europe

During the era of Communism, the economy in Eastern Europe was centrally planned. It also applied to the location of production. The transformation to the market economic system accompanies with firms' free choice of location. Thus, the companies can now relocate their production according to new opportunities of individual regions. Considering the relocation of existing sites, Brülhart *et al* (2006) state that the shift towards regions with good market access depends on the mobility of firms. However, a second factor that might determine the geographic location of economic activity comes up; the entrance of new firms. The Eastern European transition countries received a tremendous amount of FDI inflow during the last 15 years. If foreign multinationals enter the market by greenfield investments, the impact on the economic geography appears to be obvious. However, the acquisition of existing companies might also influence the location of employment inside a country. Presumingly, the new foreign owner might restructure the acquired production site and adjust the capacity. Therefore, the opening up to foreign investors might cause the emergence of new agglomerations.

Analogously to presenting changes in the spatial pattern of Austria and Germany, this section takes a look at the location of industry employment

in Eastern Europe. In doing so, I focus my analysis on the four Eastern European transition countries which share a border with Western European EU-15 members, Germany and Austria.[17] They are Poland which borders on Germany, and the Czech Republic which borders on Germany and Austria. Additionally in the East, Slovakia and Hungary are neighbors of Austria.

Table 5.3 shows up the regional distribution of industry employment in Poland for the period 1985 to 2001.[18] From the table it becomes evident that since 1989 the Polish industry employment reallocates towards the capital, Warsaw. Surprisingly, the relative employment in western regions bordering Germany declined from 15.3 percent in 1985 to 13.6 percent in 2001. During the same period, employment taking place in the capital region increased from 11.8 to 14.5 percent. Moreover, it is noteworthy that the spatial distribution remained unchanged during the eighties when Poland's economy was centrally planned. This is in accordance with the idea of dynamic relocations after the fall of the Communism.

Table 5.3: Distribution of Industry Employment in Poland

	distribution in percent of national industry employment				
	1985	1989	1993	1997	2001
border regions	15.3	15.0	14.6	14.0	13.6
capital region	11.8	11.8	12.4	13.5	14.5
other regions	72.9	73.3	73.0	72.5	71.9

Notes: Regions are defined according to NUTS 2. See Appendix for further details.
Source: Own calculations based on data from the Central Statistical Office of Poland.

How has the geographic distribution changed in other transition countries? Table 5.4 shows the trends in the Czech Republic. During the past ten years, the regional pattern of industry employment has altered considerably. In 1991, the regions which border Austria and Germany, accounted for

[17] Slovenia is not taken into account in the investigation due to its relative small country size. The NUTS classification of regions does not allow to distinguish sufficiently many regions.

[18] It draws on data of NUTS 2 regions which I classify as border, capital and other regions. See the Appendix (A. Definition for distribution (Section 5.4)) for a detailed description of how regions are defined for the four Visegrád countries.

34 percent of the Czech industry employment. Ten years later, Czech border regions host with over 39 percent substantially more of the national industry employment. Also the *other regions* gained slightly, while the industry employment in the capital area dropped dramatically.

Table 5.4: Distribution of Industry Employment in the Czech Republic

	distribution in percent of national industry employment			
	1991	1995	1999	2001
border regions	34.0	38.4	39.5	39.4
capital region	12.3	6.0	5.7	5.3
other regions	53.7	55.6	54.8	55.4

Notes: Regions are defined according to NUTS 2. See Appendix for further details.
Source: Own calculations based on data from the Czech Statistical Office.

For Slovakia, the investigation on the impact of international integration on internal location is somewhat complicated due to the geographical location of the capital city, Bratislava. Slovakia's capital region is simultaneously a border region. Table 5.5 provides the spatial trends in industry employment between 1990 and 2002. Apparently, the industry agglomeration shifted to the west during the last thirteen years. Together, the border and capital region gained almost five percentage points of relative employment.

Table 5.5: Distribution of Industry Employment in Slovakia

	distribution in percent of national industry employment			
	1990	1994	1998	2002
border region	9.2	8.9	10.0	10.3
capital region	37.3	37.9	39.1	41.0
other regions	53.5	53.2	50.9	48.8

Notes: Regions are defined according to NUTS 2. See Appendix for further details.
Source: Own calculations based on data from the Statistical Office of the Slovak Republic.

Finally, Table 5.6 shows the geographic distribution of the Hungarian industry employment over the period 1985 to 2001. Apparently, the employment shifted broadly away from the capital area towards regions which border

on Austria. Between 1989 and 2001, the share of employment located in the border regions increased rapidly by five percentage points to 15.6 percent in 2001. Again, the stable distribution before 1989 illustrates the impact of the international opening-up on the internal location of production.

Table 5.6: Distribution of Industry Employment in Hungary

	distribution in percent of national industry employment				
	1985	1989	1993	1997	2001
border regions	10.1	10.5	12.8	14.9	15.6
capital region	29.1	28.0	25.4	21.6	22.5
other regions	60.8	61.4	61.8	63.6	62.0

Notes: Regions are defined according to NUTS 2. See Appendix for further details.
Source: Own calculations based on data from the Hungarian Central Statistical Office.

In summary, the opening-up of Eastern Europe affected the spatial distribution of economic activity in the transition countries remarkably. In all Visegrád countries except Poland, the location of industry shifted towards regions bordering the EU-15. It indicates that a new agglomeration in Central Europe might emerge. According to the predictions of Krugman and Livas' (1996) model, the agglomeration shifted away from the capital region. However, there is one exception, Poland, where the opposite occurred. While moving away from border and other regions, production agglomerates increasingly in the capital there. The most important difference between Poland and the other countries of the Visegrád group, is its size.[19] Relative to the foreign market, the domestic market is more important than in the clearly smaller economies. This fact corresponds to the small trade ratio of Poland. In 2003, the share of combined imports and exports in GDP was 51 percent in Poland and distinctly more than 100 percent in the other Visegrád countries.[20]

At the same time, the spatial structure of production in the EU-15 regions which border the East shows no clear evidence of shifting towards the new

[19] Poland alone has 38.2 million inhabitants and is, thus, almost 50 percent larger than the other three Visegrád countries together.
[20] The numbers (for 2003) refer to own calculations using data from IMF, IFS database.

members of the European Union. The result is in line with findings of other studies. As outlined above, Hanson (1998) states for the NAFTA integration only less effects on the economic geography of the USA and Canada, while in Mexico the distribution shifts substantially away from the capital towards regions bordering on the US.

In the remaining of the chapter, I concentrate my analysis on foreign subsidiaries in the Visgrád countries owned by Austrian and German multinational firms. The employed data are taken from a unique firm survey among Austrian and German investors. Section 5.6 provides a description of the data.

5.5 The Role of FDI - Economic Geography of Austrian and German FDI in Eastern Europe

Eastern Europe experienced a tremendous inflow of FDI since the fall of the Iron Curtain. Especially, the new EU members host a large part of this capital transfer. However, the geographical pattern of the origin of FDI differs across the host countries. What role do the two neighboring Western European countries Austria and Germany play?

Table 5.7 displays the relative importance of each six largest investor countries for the Czech Republic, Hungary, Poland, and Slovakia. The table indicates that both Austria and Germany play an important role in all those four countries. Together, Austrian and German investors can account for 24 percent in Poland to 45 percent in Slovakia of incoming FDIs from all over the world. Relative to its size, Austria's multinationals are strongly present in three out of four countries considered. However in Poland, Austrian investments play an only minor role. This might be the case because Poland does not border on Austria and, furthermore, Austria's historic ties are much stronger with the other Visegrád countries. It is notable that Netherlands'

importance as investor is comparable to that of Austria while having similar country size.

Table 5.7: FDI Inward Stocks by Country

distribution in percent								
Czech Republic		Hungary		Poland		Slovakia	
Netherlands	29.0	**Germany**	22.2	Netherlands	22.5	**Germany**	26.2
Germany	28.3	**Austria**	18.7	**Germany**	20.2	**Austria**	19.0
Austria	10.3	Netherlands	15.7	USA	11.6	Netherlands	15.9
USA	6.5	USA	10.3	France	10.8	Czech Rep.	7.8
France	5.2	France	5.8	Italy	5.3	USA	6.8
Belgium	3.7	Belgium	4.2	**Austria**	3.7	Hungary	2.5

Notes: The numbers show FDI stocks averaged over 1996 (Hungary: 1992, Czech Republic: 1997) and 2000. Belgium corresponds to Belgium and Luxembourg.
Source: Own calculations based on data from UNCTAD World Investment Directory, Central and Eastern Europe 2003.

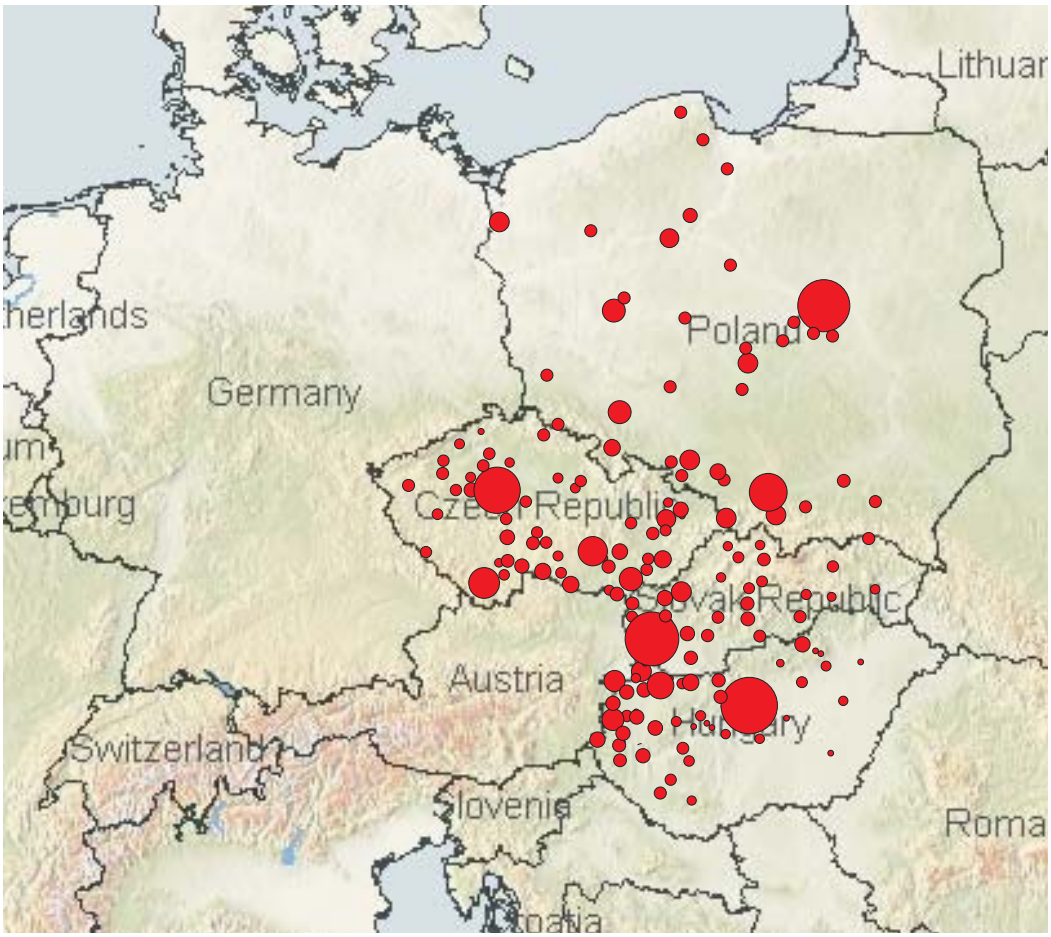
5.5.1 Geography of FDI Locations

The question that I examine in the empirical analysis is whether FDIs are randomly distributed across the surface of the host country. How does the geographic pattern of the location of foreign affiliates look like? Are there agglomerations observable? And where are such agglomerations located?

The view of the distribution of foreign-owned firms compared to the general spatial distribution of firms gives a first idea of the location of foreign affiliates across regions inside the four Visegrád states. In Hungarian border regions, 23 percent of all firms are owned by foreign multinational companies. This share is almost twice as large as the share in other non-capital regions. However, also in the capital region, relatively many foreign subsidiaries are located. In Budapest, one fifth of all incorporated firms are foreign-owned.[21] Comparable patterns can be found in all Visegrád countries. In Poland, the differences are less pronounced across regions. However, the Polish regions

[21] The numbers refer to the year 2000. They are calculated by using data from the Statistical Yearbook of Hungary.

bordering on Germany, show with 34 percent a higher import penetration than the other Polish regions, including Warsaw.[22]



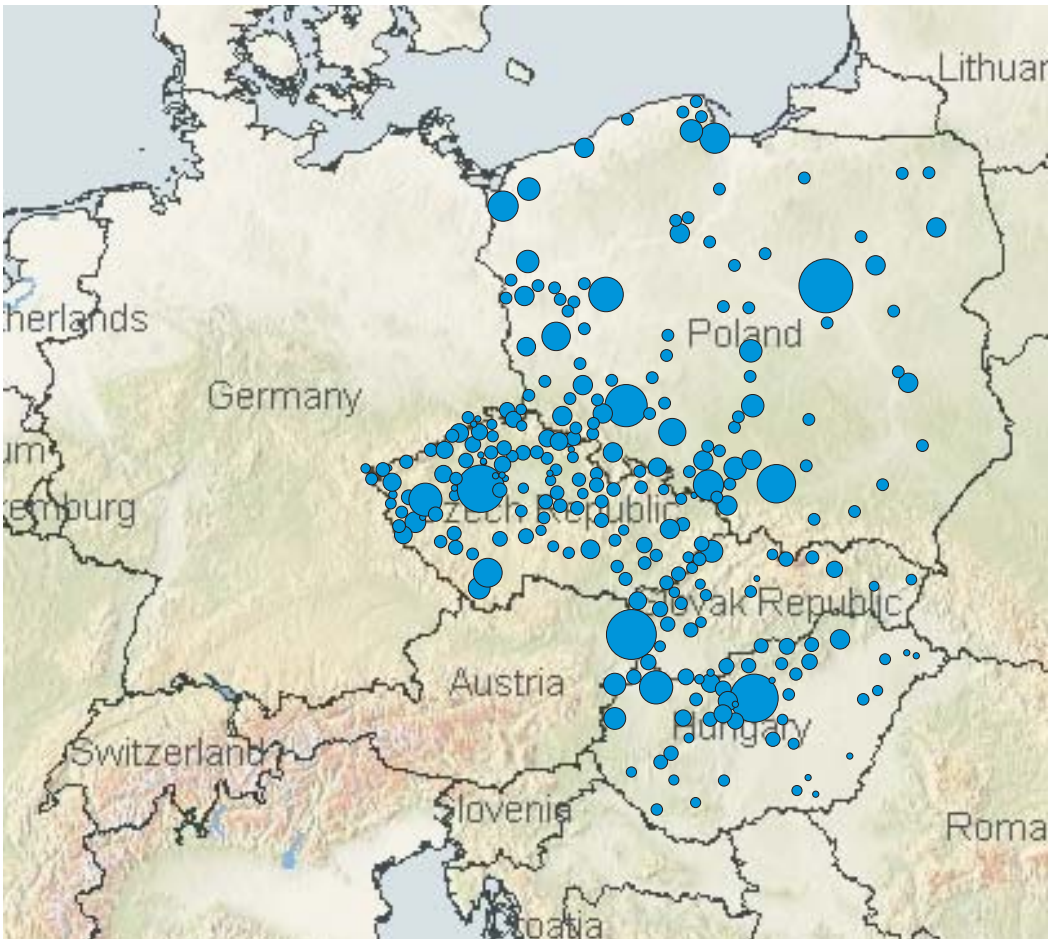
Notes: The spots indicate the location of Austrian affiliates in Visegrád countries. The size of the spots corresponds to the number of affiliates agglomerated at one place.
Source: Own calculations based on data from firm survey of 2200 investment projects in Eastern Europe by 660 firms, Chair of International Economics, University of Munich.

Figure 5.2: Location of Austrian Affiliates

Figure 5.2 maps the locations of foreign affiliates owned by Austrian firms in the four Visegrád countries. The red spots present graphically the location of 616 Austrian subsidiaries of the service and industry sector. At the first view, it appears that the location choice is not random, neither across countries nor inside countries. The largest spots in each country mark the agglomerations in the respective capital area. Can there any other patterns be detected? A closer look reveals that the foreign activities of Austrian

[22] The share of foreign firms in total firms refers to 2001, calculated on data from the Statistical Yearbook of the Republic of Poland.

companies accumulate in border regions. However, it seems to be crucial whether the region borders on Germany or Austria. Only the direct border to Austria appears to have a positive impact. The density of subsidiaries located in regions of the Czech Republic, Slovakia, and Hungary which share a border with Austria is striking. Particularly, the investments in Hungary show very low spatial dispersion. The establishments are concentrated in Budapest and close to the western border. These statements are in general also valid for German investments, as Figure 5.3 indicates.



Notes: The spots indicate the location of German affiliates in Visegrád countries. The size of the spots corresponds to the number of affiliates agglomerated at one place.
Source: Own calculations based on data from firm survey of 2200 investment projects in Eastern Europe by 660 firms, Chair of International Economics, University of Munich.

Figure 5.3: Location of German Affiliates

The map of Figure 5.3 depicts the location of 775 German subsidiaries in the four Visegrád countries. Compared to the location of Austrian affiliates, the pattern appears more dispersed. Moreover, German multinationals tend

to establish their affiliates mainly in the Czech Republic and regions in Poland and Slovakia which border on the Czech Republic. The spatial pattern of German FDIs in Poland might foremost influenced by the history. Before the end of the World War II, Germans were settled in the Poland's south-western region, Silesia.

Strikingly, there are no German affiliates located in the Czech regions bordering Austria. Furthermore, the spatial pattern for Hungary indicates what role does the nationality of the owner play. While Austrian FDIs concentrate highly in the region bordering Austria, German subsidiaries agglomerate in Budapest and in the northern area of Hungary.[23]

The maps have shown that FDIs tend to locate on the one hand in capitals and on the other hand in regions bordering Germany and Austria, respectively. However, the inspection has revealed that the country of investors' origin influences substantially the location choice. Hence, only the direct border matters and not the fact if the region borders the EU-15 market.

5.5.2 Intra-Firm Linkages

If the new economic geography theory proves to be true, backward and forward linkages should play a dominant role in the location decision. Usually, the linkages refer to interactions among local firms or markets. In the following analysis, I define backward and forward linkages as relations between parent and foreign affiliate firm. While forward linkages correspond to inputs shipped from the parent firm to the foreign affiliate for re-processing, backward linkages are related to the affiliate's output delivered to the parent firm for re-processing or marketing.[24]

The intra-firm linkages are related to the motivation for investing abroad. The theoretical literature distinguishes two broad types of foreign direct investment; horizontally and vertically motivated FDI. While the former refers

[23] Those regions where Austrian and German subsidiaries agglomerate attract also much FDI from other countries. Thus, Boudier-Bensebaa (2005) states for total FDIs to Hungary that they agglomerate in western and northern regions.

[24] Protsenko (2004) and Hauser (2006) define vertical backward and forward FDIs in a similar way. Protsenko (2004) explores the question whether horizontal and vertical FDIs have different impacts on the Czech economy, see Protsenko (2004) Chapter 5.

to international engagement in order to serve foreign local markets, the latter aims to take advantage of international differentials in production costs.[25] Vertical FDI corresponds to fragmentation of the production process when locating separate production stages in different countries. This type of FDI implies intra-firm trade.

The starting point of my analysis is the influence of those different types of foreign engagement on the location decision. In the case of vertical FDIs, intra-firm trade between the parent firm and the foreign affiliate can take place in form of forward or backward linkages. Both linkages are afflicted with transport costs. When parent and affiliate are linked forwardly and backwardly at the same time, they are burden twice by transport costs. Thus, minimizing transport costs is crucial for vertical FDIs. Border regions offer the best opportunity to reduce the distance between parent firm and foreign subsidiary.

Table 5.8: Trade and Outsourcing Orientation of Austrian and German FDIs

		intra-firm	
	export share	backward linkage	forward linkage
border regions	44.9	42.2	35.2
capital region	15.0	11.5	40.3
other regions	35.9	30.9	33.5

Notes: The numbers show average values over Austrian and German affiliates in the Czech Republic, Hungary, Poland, and Slovakia; referring to the industry sector.
Variables are defined as follows: *export share* = (affiliate's output exported/affiliate's output)*100; *backward linkage* = (affiliate's output shipped to parent firm for reprocessing or marketing/affiliate's output)*100; *forward linkage* = (affiliate's inputs delivered from parent firm/affiliate's total inputs)*100.
Source: Own calculations based on data from firm survey of 2200 investment projects in Eastern Europe by 660 firms, Chair of International Economics, University of Munich.

Table 5.8 displays the export and outsourcing orientation of Austrian and German FDIs in the Visegrád countries. The numbers suggest that there are substantial differences between the type of regions. It is striking

[25] The theory of horizontal FDI model the interaction between trade costs and firm-level economies of scale, see Markusen (1984) and Brainard (1993). On the other hand, Helpman and Krugman (1985) provide a formalization of the idea of vertical FDI. See Protsenko (2004) for an enlightening discussion of both phenomena.

that foreign affiliates in border regions export with 45 percent of their output more than affiliates in other non-capital regions. Compared to subsidiaries located in the capital, they export actually triple of their output.[26] A similar picture emerges when considering the backward linkage. It indicates that a large share of exports is shipped to the parent company in Austria and Germany. Inspecting forward linkages, it appears that the differences are less pronounced, while affiliates in the capital receive the most inputs from their parents abroad.

Overall, the picture suggests that FDIs in border region are substantially more vertical orientated. This becomes true, especially, when comparing FDIs in border and capital regions. The regression analysis in the next section will show whether the difference across regions are statistically significant. Furthermore, it will reveal if the export and outsourcing-orientation of FDIs can explain the location choice.

5.6 Determinants of FDI Locations - An Econometric Analysis

In this section, I examine empirically the characteristics of firms which determine the location of a foreign direct investment. When the investment takes place in a border or capital region, what are the respective characteristics of the parent firm? And on the other hand, which types of investments take place in these region? I will employ an estimation technique with a binary dependent variable corresponding to the chosen region. Before presenting the estimation results, I describe briefly the data under consideration.

The following investigation concentrates on the location decision from a parent company's point of view concerning foreign affiliates. It is assumed that the Austrian and German investors decide in a first stage which kind of activities they intend to operate abroad. As comprehensively described by theoretical models, firms undertake direct investments in foreign countries on

[26] It is true although only industry investments are taken into account and FDIs in the service sector are excluded.

the one hand in order to gain access to new local markets and on the other hand to exploit differences in production costs by outsourcing.

In a second step, the firms make a decision where to locate a new foreign affiliate. In which country and at the same time in which region? For some investments the decision about the region might dominate the decision about the country. For example, the location decision of many service fields like business consultancy, investment banking, or headquarters of subsidiaries might be definitely the capital of each country. Companies of such sectors are looking only for sites in capitals independently on the individual country. On the other hand, firms which intend to ship inputs and output within the firm might locate close to the border to avoid transportation costs.

It is a well-known fact that the Eastern European countries received tremendous FDI inflows after the fall of the Iron Curtain. The empirical literature on determinants of capital inflows focuses mainly on the distribution of FDIs across the transition countries. However, there is less empirical evidence, particularly at the level of firms, on the geographical distribution of FDIs within countries. Are they located systematically in individual regions inside a country? What factors do determine such a pattern of unequally distributed locations?

Data

The data sample consists of unique firm-level information on investment projects in Eastern European transition economies. The data relate on 2200 investment projects which were undertaken by 660 Austrian and German multinational firms during the period 1989 to 2001. The survey among German and Austrian investors has been conducted by the Chair of International Economics at the University of Munich. Since the survey is almost a full population sample, the data set is highly representative for German and Austrian investments in this region.[27] The cross-sectional data set com-

[27] As Marin (2004) states, in terms of investment value the 1200 German investment projects of the sample represent 80 percent of total German FDI in Eastern Europe. The 1000 investment projects undertaken by Austrian firms represent actually 100 percent of engagement of Austria's economy in Central and Eastern Europe. See Marin (2004) and Marin *et al* (2003) for a detailed description of the data.

prises information on the Western European investors and on the affiliates in Eastern Europe. Furthermore, the sample provides information on the interaction between parent and affiliate firm.

Empirical Results

In order to identify the determinants of the location decision of firms I estimate the probability of that an investor locates its affiliate in a region which borders on the parent's country. The starting point of my analysis is the influence of two different types of foreign engagement, vertical and horizontal FDIs, on the location decision. Particularly, vertical FDIs which generate intra-firm trade, are afflicted by transport costs. The intra-firm trade between the parent firm and the foreign affiliate can take place in form of forward and backward linkages. I estimate the following equation using a probit regression:[28]

$$\begin{aligned} Border_i &= \beta_0 + \beta_1 BackwardLinkage_i + \beta_2 ForwardLinkage_i + \\ &\quad \beta_3 WE_p + \beta_4 EE_a + \beta_5 Year + u_i \end{aligned} \tag{5.1}$$

where i is the cross section unit, the individual affiliate firm. $Border$ denotes the dependent binary variable. It takes the parameter value one when the affiliate is located in a border region and zero when the location is somewhere else in the four countries under consideration. Besides the two intra-firm variables, $Backward$ and $Forward\ Linkage$, the dummy variable WE_a is included which indicates if the investor comes from Austria or Germany $p = A, D$. Furthermore, the discrete variable EE_a corresponds to the Eastern European host country ($a = CZ, HU, PL, SK$). Both country variables are included to control for characteristics of the investor's country and the host country of the affiliates. Additionally, the linear time trend $Year$ takes into account the year of building up the foreign affiliate. It ranges from 1989 to 2001. The employed sample comprises data on about 1300 subsidiaries[29] in the Czech Republic, Hungary, Poland, and Slovakia owned by Austrian and

[28] I estimated all following specifications also with OLS regressions. The probit and OLS results appear, however, fairly similar.

[29] Due to missing values, the exact number of observations depends on the variables included in the respective specification.

German companies. The investments take place in the industry and service sector.

Table 5.9: intra-firm Linkages and Location of FDIs in Border Regions

dependent variable:	*border region dummy (=1 if border region, =0 otherwise)*		
	(1)	(2)	(3)
Backward Linkage	0.007***	0.007***	0.006***
	(0.001)	(0.001)	(0.001)
Forward Linkage		-0.002*	-0.001
		(0.001)	(0.001)
Industry Dummy			0.552***
			(0.098)
Constant	-56.789**	-70.523**	-71.318**
	(26.279)	(27.451)	(28.124)
Pseudo R^2	0.075	0.075	0.102
N	1336	1230	1230

Notes: Coefficients are estimated by probit regressions; dummies for investor country (Austria or Germany) and host countries (Czech Republic, Hungary, Poland, Slovakia) are included but not reported; additionally, a linear time trend for date of investment is included but not reported; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; N denotes number of observations; sample consists of service and industry subsidiaries.
Variables are defined as follows: *backward linkage* = (affiliate's output shipped to parent firm for re-processing or marketing/affiliate's output)*100; *forward linkage* = (affiliate's inputs delivered from parent firm/affiliate's total inputs)*100; *industry dummy* = dummy variable corresponding to affiliate's sector (=1 if industry, =0 if services).

Table 5.9 reports the results of backward and forward linkages as explanatory factors of the location decision. In specification (1) the border dummy is regressed solely on the backward linkage variable. The highly statistically significant coefficient indicates that affiliates with strong backward linkages to the parent firm clearly tend to be located close to the border between Western and Eastern Europe. Furthermore, it is noteworthy that the coefficient on the included linear time trend is statistically significant in all specifications. The positive sign suggests that the foreign investors increased their engagement in border region relative to other places over time.

Column (2) shows the results when including both backward and forward linkages. While the coefficient on the backward linkage remains unchanged, the coefficient on the forward linkage is negatively and significant at the ten percent level. It indicates that subsidiaries in the border region receive less inputs from the Western European parent firm than affiliates located in other regions. However, the magnitude of the coefficient on the forward linkage measured in percent of inputs is smaller than that of the backward linkage which is defined as percentage share of output.

What role do sectoral characteristics play? The impact of intra-firm trade on locating might differ substantially between the industry and service sector. The intra-firm exports and imports in the service sector is characterized by immaterial transfers which cause only negligible physical transportation costs. However, shipping industry goods between the domestic and foreign production site generates substantial transportation costs. Therefore, specification (3) in Table 5.9 controls for those differences by including an industry dummy. It does not affect the result on the backward linkage, while the coefficient on the forward linkage gets insignificant. It implies that subsidiaries in border regions are significantly more strongly tied to their owner in Austrian and Germany than subsidiaries located in other regions also when controlling for the broad sector. However, this linkage occurs only on the export side of affiliate output and not on the input side of intra-firm trade. Thus, backward linkages appear to be more important. The reason might be that the value of goods shipped back to parent firm is higher than the inputs which the affiliate receives from the parent firm. It is the case because the foreign production site in Eastern Europe adds value on the delivered inputs. Therefore, transport costs and consequently the importance of locating close to the parent's country is of higher relevance for the re-processed intra-firm trade, namely the backward linkage. The positive and highly significant coefficient on the binary variable *Industry Dummy* suggests that mainly investment projects of the industry sector are concentrated in the border regions. It emphasizes the low importance of the distance between the parent and the affiliate firm in the case of the service sector. A look at the descriptive statistics confirms this view.

Table 5.10: Location of FDIs - Industry and Services

	border regions	capital regions	other regions	N
Industry	28.8	27.3	43.9	729
Services	12.2	73.4	14.4	662

Notes: *Industry* sector corresponds to the production of goods classified according to SITC and *Services* correspond to non-SITC activities; *N* denotes number of affiliates. *Source:* Own calculations based on data from firm survey of 2200 investment projects in Eastern Europe by 660 firms, Chair of International Economics, University of Munich.

Table 5.10 displays the distribution of the investment projects over border, capital, and other regions when distinguishing between affiliates of the industry and services sector. It appears at the first glance that the geographical patterns differ substantially between the two broad sectors. In the industry sector 29 percent of the subsidiaries owned by Austrian and German companies are located in border regions and slightly less in the region of the respective capital; Prague in the Czech Republic, Budapest in Hungary, Warsaw in Poland, and Bratislava in Slovakia. While affiliates belonging to the industry sector are roughly equally distributed across border and capital regions, services are apparently highly agglomerated in capital regions. Almost three quarters of Austrian and German subsidiaries in the four new EU members are located in the political and economic center of the respective country. However, only 12 percent of the foreign affiliates in the service sector are located in border regions. Considering each host country separately shows that in Hungary the service FDIs of Austrian and German investors are at most concentrated in the capital. Thus, 88 percent of foreign direct investment in the service sector flow to Budapest. On the other hand, the Polish capital Warsaw receives only 61 percent of service FDIs. In the case of the industry sector, 42 percent of the investments of Austrian and German firms in the Czech Republic go to regions which border on EU-15 members. However, comparisons across countries have to be taken with caution since they depend highly on the definition of border and capital regions. Since the pattern appears to be dramatically heterogeneous between the industry and services sector, the determinants of locating might also differ. Further-

more, because of the marginal role of service branches in border regions, I will concentrate the further empirical investigation on the industry sector.

Table 5.11 provides the results of a more detailed analysis of the influences of trade related features of the subsidiaries on the location decision. As in all following estimations, the sample is restricted to subsidiaries of the industry sector. Outsourcing activities can be measured in different ways. However, most of these measures appear to be correlated at the level of subsidiaries. For example, the export share of a subsidiary and the intra-firm shipments to the parent firm are by definition correlated. Therefore, I include the explanatory variables in Table 5.11 mutually. Column (1)-(4) examine the probability of investing in a border region versus any other region of the Visegrád countries as in the preceding regressions. However, as already seen when considering the service sector, the capital region is characterized by special features which might also be the case in the industry sector. Therefore, in column (5)-(8) only subsidiaries located in non-capital regions are taken into account. The dependent variable corresponds to the probability of locating the production site in a border region versus another region except the capital region.

The coefficient on *Backward Linkage* in column (1) corresponds to the result reported in Table 5.9. Thus, the result does not depend on the service or industry sector. As the coefficient on the explanatory variable in the second specification shows, the inputs shipped from the parent to the affiliate firm plays no role in the location decision. However, in specification (3), the export orientation of the subsidiary has a strongly positive influence on the location decision in favor of border regions. The coefficient is statistically significant at the one percent level and of the same magnitude as that of the backward linkage in column (1). Furthermore, the export share can be disaggregated according to destination. Column (4) reports the estimation results for exports to the respective parent country, Austria or Germany, and the EU-15 region excluding the parent country. It appears that the investors prefer border regions as location for subsidiaries which export a substantial part of their output to both the parent country and other countries of the EU-15. The result implies that not only intra-firm linkages are an important determinant of locating but also the opportunity of exporting is crucial.

Table 5.11: intra-firm Linkages and Exports of Austrian and German Foreign Affiliates

dependent variable:	*border region dummy (=1 if border region, =0 otherwise)*							
	border vs. all other regions				*border vs. other non-capital regions*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Backward Linkage	0.007***				0.004**			
	(0.001)				(0.001)			
Forward Linkage		0.001				0.003*		
		(0.002)				(0.002)		
EXP Share			0.007***				0.004**	
			(0.001)				(0.002)	
EXP_{pcoun} *Share*				0.007***				0.004**
				(0.002)				(0.002)
EXP_{EU-15} *Share*				0.007***				0.004
				(0.003)				(0.003)
Constant	-33.178	-60.549	-55.846	-44.559	21.567	-13.464	-3.576	1.722
	(35.605)	(37.071)	(36.498)	(36.474)	(39.949)	(41.313)	(40.861)	(40.917)
Pseudo R^2	0.090	0.057	0.091	0.082	0.072	0.070	0.067	0.067
N	706	661	670	673	512	485	482	484

Notes: Coefficients are estimated by probit regressions; dummies for investor country (Austria or Germany) and host countries (Czech Republic, Hungary, Poland, Slovakia) are included but not reported; additionally, a linear time trend for date of investment is included but not reported; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; N denotes number of observations; sample consists of industry subsidiaries.
Variables are defined as follows: *backward linkage* = (affiliate's output shipped to parent firm for re-processing or marketing/affiliate's output)*100; *forward linkage* = (affiliate's inputs delivered from parent firm/affiliate's total inputs)*100; *EXP share* = (affiliate's output exported/affiliate's output)*100; EXP_{pcoun} *share* = (affiliate's output exported to the respective parent country, Austria and Germany/affiliate's output)*100; EXP_{EU-15} *share* = (affiliate's output exported to EU-15 countries (excluding Austria and Germany, respectively)/affiliate's output)*100.

The last four specifications of Table 5.11 highlight the robustness of these findings when comparing border regions with non-capital regions which might be more homogeneous than the capital region. In this restricted sample, the results on the export orientation seems to be mainly driven by intra-firm exports, as the insignificant difference between border and other non-capital region shows concerning the exports to other EU-15 countries. Moreover, the coefficient on *Forward Linkage* in column (6) indicates that the delivering of the inputs from the parent to the affiliate firm favors a location in the border region compared to other regions except the capital.

The findings of the table suggest that the access to foreign markets, particularly the EU-15, plays an important role in locating foreign owned production sites in regions neighboring "old" Europe. Since the border regions in the transition countries are at the same time regions in the center of Europe they offer an excellent place to export the output to other European countries. Thus, they exhibit an favorable combination of the feature of a good market access to countries with high purchasing power and the feature of low production cost.

In the next table, I take a look at further characteristics of the subsidiaries which are decisive for establishing production sites in border regions. Besides intra-firm relations in form of trade, the employed technology and skills might differ across foreign subsidiaries in individual regions. In column (1) and (2), two different measures of technology address this question. The dummy variable *Technology* captures how easy the utilized technology can be copied. It takes the value one when the technology is only hard or not possible to copy and zero otherwise. *HC Intensity* proxies the human capital intensity of the affiliate's production process by the share of employees with college or university degree in total employment. The coefficients on both variables are highly statistically significant and negative. It implies that technologically more advanced production stages tend to settle down not in border regions.

Table 5.12: Characteristics and Motives of Austrian and German Affiliates in Border Regions

dependent variable:	*border region dummy (=1 if border region, =0 otherwise)*					
	(1)	(2)	(3)	(4)	(5)	(6)
Technology	-0.452***		-0.384***	-0.393***		
	(0.109)		(0.113)	(0.113)		
HC Intensity		-0.047***				
		(0.016)				
Local Foreign Suppliers			0.126**	0.129**		
			(0.054)	(0.054)		
Relocation				0.248**		
				(0.120)		
Decision Power$_{p-a}$					-0.185*	
					(0.109)	
Labor Costs						0.129***
						(0.036)
Market Access						-0.115***
						(0.041)
Transport Costs						0.095***
						(0.036)
Constant	-37.228	31.922	-17.611	-26.263	27.180	-58.469
	(36.297)	(84.314)	(37.390)	(37.819)	(52.011)	(36.582)
Adj. R^2	0.078	0.101	0.081	0.086	0.058	0.102
N	664	134	639	639	296	701

Notes: Coefficients are estimated by probit regressions; dummies for investor country (Austria or Germany) and host countries (Czech Republic, Hungary, Poland, Slovakia) are included but not reported; additionally, a linear time trend for date of investment is included but not reported; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; N denotes number of observations; sample consists of industry subsidiaries. Variables are defined as follows: *technology* = dummy variable corresponding to affiliate's technology (=1 if hardly or non copyable technology, =0 if easily copyable technology); *HC intensity* = (affiliate's employees with college or university degree/affiliate's total employment)*100; *local foreign suppliers* = importance of local presence of foreign suppliers, ranked by investor between 5 (decisive) and 1 (not at all important); *relocation* = dummy variable, =1 if investment is relocation of existing capacity, =0 if investment is capacity expansion or new product line; *decision power*$_{p-a}$ = distribution of decision power between parent and affiliate firm, ranked by investor between 1 (decision taken by parent firm) and 5 (decision taken by affiliate firm); *labor costs* = importance of labor costs as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important); *market access* = importance of local market access as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important); *transport costs* = importance of transport costs as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important).

In specification (3), *Local Foreign Suppliers* is included additionally to *Technology*. The variable reflects the importance of agglomeration of foreign firm in a specific region. The coefficient estimate suggests that the presence of other foreign firms which provide inputs for the own affiliate, is decisive for investors which choose the border region as location. It implies that establishing foreign affiliates in the border region creates a self-reinforcement process of industry agglomeration. The process might result in the emergence of a new Central Europe.

The positive coefficient on *Relocation* in column (4) indicates that those investments locate in border regions which move existing production abroad. It is in line with the idea that mainly outsourcing FDIs take place in Central European border regions. At the same time, it confirms the result on technology that subsidiaries in border regions do not fabricate very innovative products.

How are parent and affiliate firms linked besides intra-firm trade? *Decision* $Power_{p-a}$ captures the degree of centralization of decision making. Decisions can be made by the parent firm or the foreign affiliate can decide autonomously. The variable takes the value one if all decisions are centralized at the parent firm and five if the affiliate makes all decisions. On average the variable takes the value 2.95 which means that the decision power is equally distributed between parent and affiliate firm. It reveals that the subsidiaries of Austrian firms are slightly more centralized than German foreign subsidiaries.[30] The coefficient estimate on *Decision* $Power_{p-a}$ suggests that subsidiaries in border regions are more hierarchical organized than subsidiaries in other regions. The Austrian and German parent firm holds more decision power compared to affiliates in non-border regions. Again it emphasizes the outsourcing character of FDIs located in regions in Eastern Europe bordering on Austria and Germany. Since the purpose of this kind of investment is priorly to take advantage of low production cost, it can be done without workers' initiative.[31]

[30] See Marin and Verdier (2005). They find that Austrian firms are in general more hierarchical organized than German firms.

[31] See Marin and Verdier (2003a, 2003b) who approach the relationship between hierarchical organization and workers' initiative.

In the last specification of Table 5.12, I consider what role the motivation for investing in Eastern Europe does play in the location decision. The three parameters, *Labor Costs*, *Market Access*, and *Transport Costs*, reflect qualitative evaluations of the investors' motives. While labor costs driven FDIs take place in border regions, market seeking investments do not. The positive sign on *Transport Costs* suggests that subsidiaries which are transport costs intensive, locate in border regions. The border location allows to minimizes costs of transportation when importing intermediates or exporting manufactured goods. All three motive variables highlight the vertical character of investments established in border regions.

Up to now, I considered Austria and Germany as one region and controlled for differences by including a country dummy. In order to evaluate differences in the location decision between the two Western European countries, I will break down the sample in Austrian and German investors. For the sample of the Austrian parent firms, I take into account only investments in the directly bordering Eastern European countries, the Czech Republic, Hungary, Slovakia. As border regions are defined the regions of those three countries which share a border with Austria. Analogously, the sample of German investors comprises only subsidiaries in the Czech Republic and Poland. I undertake the same probit regressions for affiliates owned by Austrian multinationals and German multinationals. The results on the former are reported in the left panel (column (1)-(6)) of Table 5.13, while the last six columns refer to German affiliates in Eastern Europe.

The coefficients in the first two columns for the Austrian and the German sample look very similar and confirm the results of Table 5.9. Indicating, both the backward linkage and the export orientation towards the parent country have a significantly positive impact on the location decision in favor of border regions. However, the effects are more significant in the case of German investors. The export orientation towards other EU-15 countries is positive for both countries yet insignificant for Austria and only slightly significant for Germany what is not shown in the table.

Table 5.13: Austrian and German Affiliates in Eastern European Border Regions

dependent variable:	*border region dummy (=1 if border region, =0 otherwise)*											
	Austrian Affiliates						*German Affiliates*					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Backward Linkage	0.006**		0.006**				0.007***		0.007***			
	(0.003)		(0.003)				(0.002)		(0.002)			
Forward Linkage	0.000						0.002					
	(0.004)						(0.002)					
EXP_{pcoun} *Share*		0.012**						0.009***				
		(0.005)						(0.002)				
Technology			-0.188						-0.409**			
			(0.212)						(0.163)			
Decision Power$_{p-a}$				-0.401***						0.117		
				(0.154)						(0.180)		
Relocation					0.118						0.425***	
					(0.239)						(0.152)	
Expansion						-0.259						-0.427**
						(0.316)						(0.197)
Constant	106.461*	139.287**	124.280**	204.949***	120.758**	129.368**	-116.775**	-101.585*	-75.174	-51.379	-119.826**	-110.783**
	(63.793)	(62.529)	(61.193)	(77.705)	(60.416)	(61.055)	(58.706)	(57.382)	(58.729)	(103.425)	(55.112)	(54.747)
Pseudo R^2	0.044	0.057	0.054	0.101	0.031	0.032	0.057	0.053	0.063	0.006	0.028	0.020
N	326	331	318	129	356	356	160	169	165	87	169	169

Notes: Coefficients are estimated by probit regressions; dummies for investor country (Austria or Germany) and host countries (Czech Republic, Hungary, Poland, Slovakia) are included but not reported; additionally, a linear time trend for date of investment is included but not reported; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; N denotes number of observations; sample consists of industry subsidiaries.
Variables are defined as follows: *backward linkage* = (affiliate's output shipped to parent firm for re-processing or marketing/affiliate's output)*100; *forward linkage* = (affiliate's inputs delivered from parent firm/affiliate's total inputs)*100; EXP_{pcoun} *share* = (affiliate's output exported to the respective parent country, Austria and Germany/affiliate's output)*100; *technology* = dummy variable corresponding to affiliate's technology (=1 if hardly or non copyable technology, =0 if easily copyable technology); *decision power*$_{p-a}$ = distribution of decision power between parent and affiliate firm, ranked by investor between 1 (decision taken by parent firm) and 5 (decision taken by affiliate firm); *relocation* = dummy variable, =1 if investment is relocation of existing capacity, =0 if investment is capacity expansion or new product line; *expansion* = dummy variable, =1 if capacity expansion or new product line, =0 if relocation of existing capacity, *relocation* and *expansion* are not mutually exclusive.

Concerning the technology variable in column (3) and (9), respectively, it reveals that only the German subsidiaries operate in the border regions with significantly more conventional technology. Moreover, the result in column (4) indicates that the Austrian parent firms hold significantly more decision power in the case of foreign affiliates located in border regions. Among other factors, it reflects the geographical proximity of many Austrian firms to Eastern European border regions. It allows the centralization of decisions combined with an intensive monitoring. In opposite to the Austrian case, the coefficient in column (10) is positive yet not significant in the case of German investors. One explanation could be the geographical distance between the German economic centers and the border regions. Thus, the relative closeness of border regions compared to others seems to be negligible.

The estimates on the coefficients on *Relocation* and *Expansion* confirm the fact that FDIs in border regions are mainly relocations of existing production sites of the investor. The negative sign on the variable of expanding the capacity mirrors the results on the relocation variable. Although the direction of the effects is the same in both countries, only the estimates for Germany are statistically significant.

Finally, Austrian and German FDIs differ also with respect to the time structure. While the significant and positive linear time trend in the case of German subsidiaries indicates that German investors tend to increase their engagement in border regions over time, it is the other way around concerning Austrian investors.

Summing up, the country where the investor is from matters for the location decision. As the results in Table 5.13 show, the behavior where to locate the subsidiary differs strikingly between Austrian and German investors with respect to the degree of innovation of the relocated production and the centralization of decisions.

So far, I looked at the determinants of establishing subsidiaries in border regions. However, what factors do induce investors to locate production sites in the capital of a country? I mentioned that service activities are highly agglomerated in the capital region. However, why are firms of the industry sector investing there? In order to answer this question, I replace the border dummy variable as dependent variable with a dummy variable indicating if the subsidiary is located in the capital region versus somewhere else. Table 5.14 reports the results on the probit regressions. The estimates mirror the results on the border region regressions. Moreover, all coefficients appear highly significant. The results indicate that foreign production sites located in capitals export substantially less of their output to the parent firm and, in general, to foreign countries. Surprisingly, the intra-firm linkage concerning shipping inputs from the parent firm to the affiliate firm is positively related to the location in the capital. Furthermore, the table shows that the coefficients on all three investment motives take the opposite sign as in the case of the border regression. Thus, low labor costs and transport costs play a minor role for investments in the capital. However, the access to the local market appears to be a crucial motive. As the last column of the table indicates, it is more probable that subsidiaries which hold substantial decision power, are located in the capital.

Table 5.14: Austrian and German Affiliates in Capital Regions

dependent variable:	*capital region dummy (=1 if capital region, =0 otherwise)*				
	(1)	(2)	(3)	(4)	(5)
Backward Linkage	-0.013***	-0.007***	-0.006**		-0.012***
	(0.002)	(0.002)	(0.002)		(0.003)
Forward Linkage	0.007***	0.007***	0.007***		0.009***
	(0.002)	(0.002)	(0.002)		(0.002)
EXP Share		-0.009***	-0.007***		
		(0.002)	(0.002)		
Labor Costs			-0.152***	-0.228***	
			(0.045)	(0.038)	
Market Access				0.188***	
				(0.051)	
Transport Costs				-0.170***	
				(0.037)	
Decision Power$_{p-a}$					0.525***
					(0.129)
Constant	144.744***	146.408***	139.386***	122.555***	9.012
	(42.371)	(43.029)	(43.291)	(39.882)	(62.936)
Pseudo R^2	0.144	0.171	0.187	0.171	0.169
N	660	636	636	701	280

Notes: Coefficients are estimated by probit regressions; dummies for investor country (Austria or Germany) and host countries (Czech Republic, Hungary, Poland, Slovakia) are included but not reported; additionally, a linear time trend for date of investment is included but not reported; *** (**) [*] indicates significance at the 1 (5) [10] percent level; standard errors in parentheses are robust to heteroscedasticity; N denotes number of observations; sample consists of industry subsidiaries.
Variables are defined as follows: *backward linkage* = (affiliate's output shipped to parent firm for re-processing or marketing/affiliate's output)*100; *forward linkage* = (affiliate's inputs delivered from parent firm/affiliate's total inputs)*100; *EXP share* = (affiliate's output exported/affiliate's output)*100; *labor costs* = importance of labor costs as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important); *market access* = importance of local market access as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important); *transport costs* = importance of transport costs as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important); *decision power*$_{p-a}$ = distribution of decision power between parent and affiliate firm, ranked by investor between 1 (decision taken by parent firm) and 5 (decision taken by affiliate firm).

5.7 Conclusion

After the fall of the Iron Curtain, Europe's 'heart' seems to re-industrialize. Thus, Eastern Europe's opening-up leads to a new spatial organization of production in Europe. Particularly, the liberalization of trade and foreign investment has severe impacts on the economic geography of Eastern Europe. Such shifts take place not only between countries but merely inside countries. How does the new spatial pattern of Central Europe look like? Furthermore, Western European FDI in this region plays an important role. What determines their location choice? The shock of the fall of the Iron Curtain creates the situation of a natural experiment for exploring location determinants. I addressed both questions in this chapter.

First, I identified that the industry location in Eastern Europe shifted substantially towards Western Europe. Particularly in Eastern Europe, a relocation of production took place towards regions which border on the EU-15 and offer, therefore, an excellent market access. In all Visegrád countries, except Poland, the industry employment moved towards regions bordering the EU-15 away from the respective capital region. Hanson (1998) observed similar trends in Mexico when facing the NAFTA integration with the US and Canada. In contrast to these dynamics in Eastern Europe, the spatial organization of production in Austria and Germany remained unchanged. The West contributes to this shift when investing immensely in the Eastern European border regions.

Secondly, analyzing firm-level data on Austrian and German investors, I found strong empirical evidence that vertical FDIs prefer to locate in regions that border on the EU-15. Mainly outsourcing and export oriented FDIs choose to locate their production sites in the border regions of the Czech Republic, Hungary, Poland, and Slovakia. Those types of foreign affiliates are afflicted with high transport cost and, thus, the location close to the country of destination appears to be crucial. Furthermore, the results showed that foreign subsidiaries located in border regions are more strongly labor cost driven than those in other regions. Moreover, investments in border regions tend to be a relocation of existing capacities in Western Europe.

Affiliates in border regions are also more centrally organized which means that those affiliates have less decision power. Additionally, I found that the more technology-intensive and the more market-seeking investment projects are, the lower is the probability that they locate in border regions. All these results are mirrored when exploring determinants for locating in capital regions. In summary, the choice of location appears not to be random.

The major contribution of this chapter is the analysis of the location choice using firm-level data. I focused on the role of linkages between the parent firm and the foreign affiliate. Directions for future research are examining changes in choosing locations in Eastern Europe over time. The rapid economic development of the Visegrád states accompanies lower differences in production costs between Western and Eastern Europe. Therefore, vertical FDIs may relocate. Will they move to eastern regions bordering potential EU candidates? In such a scenario, horizontal FDIs might increasingly locate in Central Europe.

Appendix

Notes on Definition of Regions

A. Definition for distribution (Section 5.4)

The industry employment in the countries considered is categorized as employment in border, capital, and other regions according to NUTS classification of Eurostat. The regions are defined in the following way:

Austria:
border regions: *AT 111*, *AT 112*, *AT 113*, *AT 124*, *AT 125*, *AT 211*, *AT 213*, *AT 224*, *AT 226*, *AT 313*
capital region: *AT 126*, *AT 127*, *AT 130*

Notes: Employment corresponds to manufacturing employment (NACE D); data of 1991 are converted from the national classification of districts to NUTS 3; data beyond 1991 at the level of NUTS 3.
Source: Own calculations based on data taken from Statistical Yearbook (various issues), Statistics Austria.

Germany:
border regions: *DE 224*, *DE 225*, *DE 228*, *DE 229*, *DE 22B*, *DE 231*, *DE 233*, *DE 234*, *DE 235*, *DE 237*, *DE 239*, *DE 23A*, *DE 244*, *DE 249*, *DE 24D*, *DE 402*, *DE 403*, *DE 405*, *DE 406*, *DE 409*, *DE 40A*, *DE 40B*, *DE 40C*, *DE 40G*, *DE 40I*, *DE 80B*, *DE 80F*, *DE 80I*, *DE D11*, *DE D12*, *DE D13*, *DE D14*, *DE D15*, *DE D16*, *DE D17*, *DE D18*, *DE D19*, *DE D1A*, *DE D1B*, *DE D21*, *DE D22*, *DE D23*, *DE D24*, *DE D25*, *DE D26*, *DE D28*, *DE D29*, *DE D2A*, *DE D2B*, *DE D33*
capital region: *DE 301*, *DE 302*

Notes: Employment corresponds to industry (including construction) employment (NACE C-F); data at the level of NUTS 3.
Source: Own calculations based on data taken from Federal Statistical Office of Germany

Czech Republic:
border regions: *CZ 03*, *CZ 04*, *CZ 06*
capital region: *CZ 01*

Notes: Employment corresponds to industry employment (NACE C-E); data at the level of NUTS 2.
Source: Own calculations based on data taken from Statistical Yearbook of the Czech Republic (various issues), Czech Statistical Office.

Hungary:
border region: *HU 03*
capital region: *HU 01*

Notes: Employment corresponds to industry employment (NACE C-E); data at the level of NUTS 2.
Source: Own calculations based on data taken from Statistical Yearbook of Hungary (various issues), Hungarian Central Statistical Office.

Poland:
border regions: *PL 01*, *PL 04*, *PL 0G*
capital region: *PL 07*

Notes: Employment corresponds to industry employment (NACE C-E); data until 1997 are converted from the national classification of districts to NUTS 2; data of 2001 at the level of NUTS 3.
Source: Own calculations based on data taken from Statistical Yearbook of the Republic of Poland (various issues), Central Statistical Office of Poland.

Slovakia:
border region: *SK 02*
capital region: *SK 01*

Notes: Employment corresponds to industry employment (NACE C-E); data at the level of NUTS 2.
Source: Own calculations based on data taken from Statistical Yearbook of the Slovak Republic (various issues), Statistical Office of the Slovak Republic.

B. Definition for regression (Section 5.6)

The locations of Austrian and German subsidiaries in the Czech Republic, Hungary, Poland, and Slovakia are categorized as border, capital, and other regions according to NUTS 2 classification of Eurostat. The corresponding dummy variables employed in the regression analysis are *border region dummy* and *capital region dummy*. The regions are defined in the following way:

border regions which border on Austria and Germany:

in the Czech Republic: *CZ 03*, *CZ 04*, *CZ 06*

in Hungary: *HU 03*

in Poland: *PL 01*, *PL 04*, *PL 0G*

in Slovakia: *SK 02*

border regions which border on Austria:

in the Czech Republic: *CZ 03*, *CZ 06*

in Hungary: *HU 03*

in Slovakia: *SK 02*

border regions which border on Germany:

in the Czech Republic: *CZ 03*, *CZ 04*

in Poland: *PL 01*, *PL 04*, *PL 0G*

capital regions:

in the Czech Republic: *CZ 01* (Prague)

in Hungary: *HU 01* (Budapest)

in Poland: *PL 07* (Warsaw)

in Slovakia: *SK 01* (Bratislava)

Table G.1: Definition of Variables

Variable	**Description**
border region dummy	=1 if the affiliate is located in border region, =0 otherwise
capital region dummy	=1 if the affiliate is located in capital region, =0 otherwise
backward linkage	share of affiliate's output shipped to parent firm for re-processing or marketing in percent of affiliate's output
forward linkage	share of affiliate's inputs delivered from parent firm in percent of affiliate's total inputs
industry dummy	=1 if the affiliate is engaged in industry sector, =0 if the affiliate is engaged in service sector
EXP share	share of affiliate's output exported to foreign countries in percent of affiliate's output
EXP_{pcoun} *share*	share of affiliate's output exported to respective parent country, Austria and Germany, in per cent of affiliate's output
EXP_{EU-15} *share*	share of affiliate's output exported to EU-15 countries (excluding Austria and Germany, respectively) in percent of affiliate's output
technology	dummy variable corresponding to affiliate's technology (=1 if hardly or non copyable technology, =0 if easily copyable technology)
HC intensity	share of employees with college or university degree in percent of affiliate's total employment
local foreign suppliers	importance of local presence of foreign suppliers for investment decision, ranked by investor between 5 (decisive) and 1 (not at all important)
relocation	dummy variable corresponding to relocation investment (=1 if relocation of existing capacity, =0 if capacity expansion or new product line)
expansion	dummy variable corresponding to capacity expansion (=1 if capacity expansion or new product line, =0 if relocation of existing capacity)

Table G.1 (continued): Definition of Variables

Variable	**Description**
decision power$_{p-a}$	distribution of decision power between parent and affiliate firm, combined measure of 14 decisions concerning financial, strategic and operational matters, ranked by investor between 1 (decision taken by parent firm) and 5 (decision taken by affiliate firm)
labor costs	importance of labor costs as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important)
market access	importance of local market access as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important)
transport costs	importance of transport costs as investment motive, ranked by investor between 5 (decisive) and 1 (not at all important)

Source: All variables are own calculations based on data from firm survey of 2200 investment projects in Eastern Europe by 665 Austrian and German multinational firms, Chair of International Economics, University of Munich.

Chapter 6

Concluding Remarks

Since the fall of the Communism, the world economy has revolutionized. The economic integration of large parts of the world in the global economic system has several impacts. Besides the effects on the relations *between* countries, the process of globalization has dramatic consequences for the economic situation *inside* countries.

In this thesis, I concentrated on the *internal* effects of globalization. In particular, I examined the role of international outsourcing on the labor market and the economic geography. I have shown that outsourcing has a substantial skill-biased impact on the labor demand in Austria and Germany. Furthermore, the analysis on the location decision of Austrian and German investors in Eastern Europe has identified that outsourcing FDIs prefer clearly border regions as location.

The empirical analysis of Austria and Germany contributes to the existing literature by showing that human capital is losing from international outsourcing. This result stands in contrast to other studies in this field on developed and emerging countries. Furthermore, the result contradicts the predictions of the theoretical model of Feenstra and Hanson (1996a) which I outlined in Chapter 2. The findings might be surprising, however they shed some light on the factor endowment of Austria and Germany. Both countries appear to be poorly endowed with human capital relative to their trading partners.

In Chapter 3, I found that international outsourcing undertaken by Ger-

man firms disfavors high-skilled workers in domestic market. Three broad facts emerged from my empirical investigation. First, not only the relative demand but also the relative wages and employment of high-skilled workers are negatively affected by outsourcing. Thus, international outsourcing can account for 32 percent of the increase in relative employment and about 36 percent of the rise in skill premium. It suggests that relative wages for human capital would have increased more by one third in the absence of international outsourcing. Secondly, I have found that the negative impact of outsourcing on human capital occurred particularly in the recent years, while in the early 1990s, outsourcing favored high-skilled labor. This is related to the third revealed fact. I identified an substantial shift in the pattern of outsourcing sectors over time away from low-skill intensive towards human-capital intensive sectors. The estimations indicate that high-skilled workers employed in human-capital intensive sectors are most hurt by international outsourcing. This is a major contribution of the chapter.

The empirical investigation on Austria in Chapter 4 revealed that international outsourcing has hurt the economic fortunes of human capital also in Austria. Moreover, outsourcing has a negative impact on the skill premium and the relative employment of high-skilled workers. I have shown that outsourcing can account for roughly 35 percent of the change in the relative wage for high-skilled workers. It means that in the absence of outsourcing, the relative wages for human capital would have declined by 35 percent less in Austria.

What is Austria'a and Germany's role in the international value added chain? The findings suggest that both countries are increasingly specializing in low-skill intensive production stages. Therefore, the policy advice has to be to strengthen the country's endowment with human capital. However, the strong labor market institutions prevent a widening of the wage gap. Additionally, outsourcing reduces the skill premium. Thus, the unfavorable perspectives for human capital in Austria and Germany lowers the incentives to invest in human capital and education. However, the government could break this vicious cycle by enforcing the investments in the education system which marks a weakness as the often cited OECD Pisa-study revealed,

particularly in the case of Germany.

My investigation on Austria and Germany contributes to previous studies in this field by utilizing a sample period of more recent years. This allows to detect the impacts of the recent wave of outsourcing. Thus, the sectoral pattern of outsourcing activities have changed during the recent years. The analysis provides a detailed investigation of trends in individual sectors and their impacts on the aggregate results. Moreover, the present work makes the contribution of examining the effects of technological change on the relative demand for skilled labor in more detail. It is noteworthy that governmental R&D policy has different effects on skill-upgrading in Germany and Austria. While R&D subsidies have a positive impact on the relative demand for high-skilled labor in Austria, they affect negatively high-skilled labor in Germany.

Chapter 5 was concerned with the recent trends in industry location in Eastern Europe. The opening-up of Eastern Europe led to a new spatial organization of production in Central Europe. I identified that the industry location in Eastern Europe shifted substantially towards regions bordering on the EU-15. Consequently, in all Visegrád countries except Poland, the industry employment moved away from the capital regions. The findings are in line with Hanson (1998) who observed similar trends in Mexico when integrating with the US and Canada. Furthermore, I have shown that the spatial organization of production in Austria and Germany remained unchanged. However, Austrian and German companies invested enormously in the Eastern European border regions since the fall of the Iron Curtain.

A major goal of Chapter 5 was to identify the determinants of location choice of FDIs. Analyzing firm-level data on Austrian and German investors, I found a strong empirical evidence that vertical FDI locate mainly in regions that border on the EU-15. The avoidance of transport costs appears to play a crucial role in locating outsourcing- and export-oriented foreign affiliates. On the other hand, more technology-intensive and market-seeking investment projects tend to locate in capital regions. In summary, the choice of location appears not to be random. This analysis contributes to the literature on location choice by employing firm-level data that allow to inspect the role of intra-firm linkages in the choice.

In conclusion, I found empirical evidence that the *external* shocks of globalization have substantial impacts on economic perspectives *inside* countries. International outsourcing as a major force of globalization, hurts the economic fortunes of human capital in Austria and Germany. Furthermore, I identified that industry employment in Eastern Europe relocates substantially towards border regions which host mainly outsourcing FDIs.

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