Poland's Integration into the World Economy: Foreign Direct Investment and the Skill Premium

Inaugural-Dissertation
zur Erlangung des Grades
Doctor oeconomiae publicae (Dr. oec. publ.)
an der Ludwig-Maximilians-Universität
München

2005 vorgelegt von

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Promotionsabschlussberatung:	8. Februar 2006

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List of Abbreviations

CEE	Central and Eastern Europe
COMECON	Council for Mutual Economic Assistance
EU	European Union
IMF	International Monetary Fund
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GMM	General Method of Moments
IV	Instrumental Variables
MNE	Multinational Enterprise
NACE	Classification of Economic Activities in the European Community
NBER	National Bureau of Economic Research
NEG	New Economic Geography
NIE	Newly Industrialized Economies
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PAIiIZ	Polish Information and Foreign Investment Agency
PCSE	Panel-Corrected Standard Error
PGSS	Polish General Social Survey
PLN	Polish Zloty
PSO	Polish Statistical Office
R&D	Research and Development
SEZ	Special Economic Zones
ULC	Unit Labor Costs
UN COMTRADE	United Nations Commodity Trade Statistics Database
UNCTAD	United Nations Conference on Trade and Development
UK	United Kingdom
US	United States

Acknowledgments

During the course of writing this thesis I have benefited immensely from the support, suggestions and encouragement of many people. I am particularly indebted to my adviser Prof. Dalia Marin for her excellent academic guidance, very helpful advice and continuous support.

My special thanks go also to Daniel Sturm, who has been extremely generous with his time, for his insightful comments, encouragement in the most frustrating moments and support during my first steps as an empirical economist.

I would also like to thank my colleagues at the Chair for International Economics: Alexander Raubold, Frank Hauser and Peter Beermann, for their great both academic as well as personal support at various stages of this thesis. Without them the time spent at the University of Munich would have been much more difficult and much less fun. Furthermore, I thank Ariane Breitfelder for assisting my first steps with Latex, Ralph Leonhardt for his help with statistical programs and Alexander Protsenko for his very helpful advice during the last months.

A further important source of feedback and encouragement at the University of Munich have been the participants of the doctoral Seminar at the Chair for International Economics. This thesis would have been much less likely to come into existence without the early support that I received during my studies at University of Gdansk. I would like to thank Prof. Anna Zielińska-Głebocka for sharing her great passion for science with us and motivating me to pursue my own ideas and plans. Many thanks also to Anna Golejewska for suggestions and comments in the early stage of my work. I am also indebted to Alexander Roth and Jochen Roth for their help and

encouragement during first years of stay in Germany.

And last, but certainly not least, I would like to thank my mother and my sister for their belief in me, and Maciej Jankowski for his love and patience, for enlightening discussions and for the motivation and great support he gave me during the writing phase.

Chapter 1

Introduction

In 1989, Poland was the first country out of the former Soviet block to reestablish political democracy and initiate an economic and social changover to a market economy. Similarly to other Central and Eastern European (CEE) countries, the boundary conditions of this transition were dictated by virtual isolation from other parts of the world until the late 1980s.

While the countries of this region took their first steps in a highly challenging process of transition from a centrally planned economy into a full-fledged market economy, globalization exposed national economies worldwide to a much more intense competition than ever before, driven by an accelerating pace of technological change, by trade and investment liberalization, and by growing importance of supranational rules.

On the one hand, rapid advancement in the process of transition accompanied by full participation in the global economy enabled CEE countries and their economic agents to grasp the new opportunities and reap the benefits of globalization. On the other hand, the departure from the socialist system brought new threats such as unemployment, stratification of society, poverty, or growing disparities in regional development.

In Poland, the overall income inequality measured by the Gini coefficient appears to have increased quite modestly in the course of transition - considerably less, for example, than in Ukraine, Russia, the Baltic States and Bulgaria.[1] However, among transition countries, Poland did witness one of

[1]See Keane and Prasad (2001). As noted by Newell and Socha (2005), the main force contracting wage inequality in Poland through the 1990s was a decline in a participation of low skilled workers in the labor force.

the most pronounced increases in labor earnings inequality.

In particular, the skill premium[2], which had been artificially suppressed during the socialist rule, grew at an breathtaking average rate of 4.2 percent per year between 1990 and 2002, compared to an average of 0.72 percent per year between 1979 and 1990 in the United States, which was enough to be referred to as "dramatic" by several economists. The increase in relative wages was accompanied by an increase in relative demand for skilled workers. Even though the growth of relative employment was not so sharp and stable as the growth of relative wage, on average it increased by 0.92 percent which is all but a negligible number.

Regarding the spatial aspect of the transformation process in Poland, it has not diminished but rather reinforced old regional disparities. It is the urban agglomerations with a large share of market services and some of the western regions that have enjoyed the most favorable socio-economic situation in Poland. As part of the economic development strategy, the Polish government attempt to stimulate the economic activity by tax exemptions and public grants in lagging regions and those facing restructurization problems. In particular, policy makers aim at attracting foreign investment, which is assumed to be eminently beneficial for host locations in Poland. In this context, the factors determining the location decisions of multinational firms are of vital importance for design of appropriate policies to draw the attention of foreign firms to economically disadvantaged regions.

The two main questions addressed in this thesis are related to topics associated with Poland's transition process described above:

- To what extent is the increasing skill premium in Poland an effect of Poland's integration into the world economy?

- What are the determinants of spatial distribution of activity of horizontal and vertical FDI in Poland?

Chapters 2 and 3 are dedicated to verification of different explanations of increasing inequality between wages of high skilled and low skilled workers

[2]Measured here as non-production to production workers' wages in manufacturing.

proposed in the theoretical literature, while Chapter 4 investigates the driving forces behind the activities of foreign firms in Poland.

Even though economists agree that relative wage changes are due to an increase in the relative demand for skilled labor, we observe an ongoing discussion about the source of the demand shift itself. This debate is concentrated around three issues. The first one is that proliferation of computers and related technologies have caused a change in production techniques toward those biased in favor of skilled workers. The next one focuses on free trade and the Stolper-Samuelson theorem, according to which trade affects relative factor reward by changing relative prices of goods. The third one associates growing relative demand for high skilled labor with international outsourcing, either by relocating a part of firms' activities to foreign external suppliers of intermediaries, or by offshoring i.e. shifting fragments of production to a foreign country within the firm in the form of vertical direct investment. Outsourcing allows, among others, imports of labor intensive inputs from low wage countries.

Taking into account that the increase of wage inequality in Poland has been accompanied by dramatic economy-wide changes: overnight liberalization of prices and trade, a changing production structure and growing foreign involvement in the country, all the above described explanations may be relevant. On the other hand, under the socialist regime Poland was characterized by an extremely compressed wage distribution. Thus, one of the dimensions of the transition process was the liberalization of wage determination mechanism. As a consequence, the increase in wage inequality across skills in Poland might partly reflect pure labor market adjustments.

An increase of wage disparity itself is not a new phenomenon. Since 1980, many high income countries have experienced widening gaps between high skilled and low skilled workers in terms of wages and employment.[3] While

[3]This refers to Anglo-Saxon countries such as: the United States, Canada, the United Kingdom and Australia, while in the 1990s, continental European countries like Germany and Austria exhibited low and stagnating, or even decreasing (in the case of Austria) wage inequality. Marin (2004) and Lorentowicz, Marin and Raubold (2005) suggest that this is a result of human capital scarcity in these two countries. See also Bertola (2003) for comparison of wage inequalities among developed countries.

such events are worth paying attention to on their own, the fact that Poland and other transition countries, whose economic structures still differ from those of developed countries, repeated the experience of the latter regarding increasing skill premia makes it even more interesting. This is because the above described relative wage movements do not exhibit a pattern of development of factor prices that is usually expected by trade economists. The Heckscher-Ohlin theory states that trade between a high skilled labor abundant country and a low skilled labor abundant country should decrease the relative wage of low skilled workers in the skill rich trading partner. The opposite holds true for its skill poor trading counterpart. Following this scheme, if developed countries witness a rise in wage inequality between high skilled and low skilled workers, then their low skilled labor abundant and often less developed trading partners should observe the opposite trend.

Although, due to differences in structure and quality of education systems worldwide, it is rather difficult to obtain a clear-cut comparison of high skilled labor endowments among countries, data on educational composition of labor force collected by the International Labour Organization (ILO) presented in Table 1.1 suggests that Poland is less skill abundant than most of its trading partners coming predominantly from the pre-2004 European Union. That is, one would rather expect international trade to diminish the wage disparity in Poland than to raise it.

The increasing skill premium in Poland is nonetheless consistent with predictions of the model of international outsourcing developed by Feenstra and Hanson (1996a). In short, in this model advanced countries outsource their low skill intensive activities to low wage countries. From the perspective of the host country these activities are however high skill intensive, therefore the relative demand for high skilled labor increases in both, home and host country. Empirical analysis of the influence of outsourcing on the widening gap between high skilled and low skilled workers in Poland is presented in Chapter 2 of this thesis.

In a world of many products and production factors, the statement of the Heckscher-Ohlin theory, whose predictions for wage determination were

Table 1.1: Skill Endowments of Main Trading Partners of Poland in 1998

	share of high skills in total labor force [a]	*share in export* [b]	*share in import* [b]
Belgium	30.4	2.5	2.8
Czech Republic	10.5	3.6	3.1
Denmark	24.7	2.7	
France	23.7	4.7	6.5
Germany	23.4	36.3	25.8
Holland	25.7	4.8	3.8
Italy	10.5	5.9	9.4
Russia	54.0	5.6	5.1
Sweden	27.8		2.9
United Kingdom	24.3	3.9	4.9
United States	58.9[c]	2.7	3.8
Poland	**14.8**		

[a] Defined as a third level share in total labor force in percent, according to International Standard Classification of Education (ISCED-76).
[b] Top 10 shares in total export and import, in percent.
[c] In 2002, data for 1998 not available.
Source: LABORSTA, International Labour Organization

briefly outlined above, is not so strong. The Stolper-Samuelson theorem itself, which provides a link between changes in prices of goods and changes in prices of production factors, appears to hold much more generally. Therefore, in order to scrutinize the influence of international trade on development of relative wages, one has to analyze first, how price changes depend on international trade. Chapter 3 of this thesis employs the Stolper-Samuelson theorem to investigate the role of international trade and technology played in the increase of the skill premium in Poland.

Chapter 4 shifts the focus from the skill premium to the analysis of spatial determinants of FDI distribution. Given the above mentioned disparities in the regional development in Poland, understanding of FDI location decisions is of vital importance for policy makers who would like to employ direct in-

vestment of multinational firms to stimulate the economic development of disadvantaged regions. It can also assist in the assessment of the real competitiveness of regions in terms of location advantages able to complement organizational chains of multinational firms.

The theoretical literature distinguishes between two fundamental types of foreign investment. Market-seeking, or horizontal FDI replicates the production of the same goods and services in both the home and host country to access local markets. On the other hand, export-oriented, or vertical FDI fragments the production of goods or services into stages located in different countries and is targeted at re-exporting final or intermediate products into the home country or into other countries. Since these two basic types of FDI have different kinds of motivation, it is important to analyze their determinants separately. Chapter 4 investigates and compares the location factors of both types using data of Polish regions between 1996 and 2003.

Chapter 5 summarizes the main findings of the thesis.

Chapter 2

FDI and the Skill Premium in Poland

2.1 Introduction

During the 1990s, wages of high skilled workers in Poland increased dramatically relative to those of their less skilled counterparts. Economists analyzing such wage developments in other countries have concluded that the primary cause was a raise in relative demand for high skilled workers, since at the same time also relative employment of these workers increased. Three prominent explanations for this shift in relative demand proposed in the theoretical literature were outlined in Chapter 1. The first one is related to technological progress which is biased toward skilled labor. The second one is associated with the Stolper-Samuelson theorem which describes wage determination in the Heckscher-Ohlin framework and shows that decreasing prices of low skill intensive products induce a fall in wages of low skilled labor. The third explanation focuses on outsourcing activities by multinational firms.

In this chapter the outsourcing hypothesis is tested. In particular, I analyze the relationship between foreign direct investment and the rising demand for skilled labor in Poland. As noted in Chapter 1, over the past decade the occurrence of increasing wage inequality was accompanied by an advancing process of international economic integration of Poland. One of the major

elements of the latter was an enormous inflow of foreign capital. By incorporating the Polish labor force into the international labor division, foreign investors possibly had an impact on the observed labor market adjustments. Furthermore, as argued by Dunning (1958) and Hymer (1976) foreign firms have to be superior to local firms in terms of technology, management or organizational skills, in order to overcome the disadvantages related to activity in the relative unknown market. Marin, Lorentowicz and Raubold (2002) reported that in the case of about 30 percent of investment projects undertaken by German multinationals in Central and Eastern European (CEE) countries, the parent firm originates in a superior- or high-technology sector. They conclude, that German direct investment in CEE countries seems to be an important vehicle of technology spillovers for host countries. That is the development of foreign firms' activities is presumed to have stimulating effects on the economy as local firms gain better access to technology and management know-how and are integrated into global production and distribution networks.

The empirical analysis in this chapter is motivated by the model of international outsourcing developed by Feenstra and Hanson (1996a), where outsourcing activities by multinational firms from high skilled labor abundant, developed countries contribute to a worldwide increase in the demand for skilled labor.

Feenstra and Hanson (1997) performed a similar analysis for Mexico over the period 1975 - 1988. Both countries, Mexico and Poland at different points in time constituted a so-called natural experiment by opening their markets and liberalizing economic activities. Both countries also experienced an enormous increase in their skill premia. Feenstra and Hanson's (1997) results suggest that it was the outsourcing by North American companies that contributed to an increase in relative earnings of high skilled workers in Mexico. Taking into account the similarities in development between Poland and Mexico mentioned above, and the fact that the inflow of foreign investment in Poland between 1994 and 2002 was even larger than in Mexico, I expect to find a positive influence of FDI on relative demand for high skilled labor

also in Poland.[1]

This chapter is structured as follows. Section 2.2 reviews the existing empirical literature on the influence of outsourcing on the relative demand for skills. Section 2.3 briefly outlines Feentra and Hanson's (1996) model of international outsourcing. Some statistical data on FDI and a description of the pattern of development of wages and employment across skills in Poland are shown, respectively, in Section 2.4 and 2.5. Section 2.6 presents the sectoral development for foreign fixed assets, relative wages and employment of non-production workers. Section 2.7 follows with an explanation of empirical methodology employed in the analysis. Section 2.8 describes data and the estimation strategy along with explanatory variables. In Section 2.9 results obtained in the econometric analysis are reported. Finally, Section 2.10 concludes.

2.2 Review of the Empirical Literature

The empirical literature on wage inequality between high skilled and low skilled workers has up to now mostly dealt with the experience of the United States and other advanced countries. Many of these studies support the argument that skill biased technological change induces increases in the skill premia. Bound and Johnson (1992), Berman, Bound and Griliches (1994) for the United States and Berman, Bound and Machin (1997) for several developed countries document rising relative employment of skilled workers within sectors despite their rising relative wages. Complementing this, Berman, Bound and Griliches (1994), Krueger (1993) and Autor, Katz and Krueger (1998) found a correlation between skill upgrading and computerization or expenditures on research and development.

Economists have also conducted a battery of tests to see if Stolper-Samuelson logic lies behind the increase in wage inequalities. Empirically this theorem implies that a decline in relative prices of unskilled labor in-

[1]Between 1994 and 2002 FDI amounted to 17 percent of gross fixed capital formation in Poland on average, whereas Feenstra and Hanson (1997) claim 13.7 percent in 1987 in Mexico and 7.9 percent in 1991 in China to be sufficient to have had a major impact on recipient-country labor market.

tensive tradable goods should induce relative wage reductions of low skilled workers. Therefore, researchers try to gauge the effect of international trade on the rising skill premium by examining whether product prices in unskilled labor intensive sectors have fallen relative to prices in skilled labor intensive sectors. While reviewing the relative price change literature, Chapter 3 reports conflicting evidence on whether international trade raised the relative prices in skilled labor intensive sectors and thereby contributed to the increase in wage inequality.

More recent economic research is based on the idea that international outsourcing has contributed to the deteriorating situation of low skilled workers. Considering that firms in high wage countries move the low skill intensive activities to low wage countries in order to cut production costs and then import intermediate inputs, trade should shift employment towards high skilled workers in high income countries. Since this topic is more relevant for the analysis in this chapter, I describe these studies in the greater detail.

Following this reasoning Feenstra and Hanson (1996b) are the first researchers who analyze the influence of outsourcing on growing skilled labor demand in the US during two periods of time: 1972 through 1979 and 1979 - 1990. Their empirical model is based on a translog cost function, from which a cost share equation for skilled workers can be derived. This cost share proxies the relative demand for skilled workers. Outsourcing is measured by two variables, a share of imports in total US consumption and, more directly, a share of imported intermediate inputs in the total purchase of non-energy materials.

Although the outsourcing activity expanded over the whole examined period, the authors obtain different results for the 1970s and the 1980s. During the later period in the US, import in general as well as import of intermediaries substantially contributed to an increase in relative demand for high-skilled labor, while for the earlier time span the result is even negative. During the 1980s outsourcing accounted for about 30 to 50 percent of the increase in the non-production workers' wage share, which is considerably more than the portion explained by the import penetration variable. Feenstra and

Hanson (1996b) conclude that the discrepancy between the results for the two time periods might be explained by the construction of the outsourcing measure which does not distinguish between imports from advanced and low wage countries.

In their subsequent study, Feenstra and Hanson (1999) refine the measure of outsourcing by focusing on imported intermediate inputs from the same industry as a final good, what they call a narrow definition of outsourcing.[2] In this paper they find that outsourcing measured narrowly can explain about 15 percent of the observed increase in the cost share of non-production workers in US manufacturing between 1979 and 1990.

Anderton and Brenton (1999) in their paper about the impact of outsourcing on the relative wages and employment of low skilled labor in the UK, have proxied outsourcing indirectly by import share in domestic production. They also apply the translog cost function approach. The authors disaggregate the UK imports into those coming from industrialized and low wage countries, addressing the idea mentioned by Feenstra and Hanson (1996b) that the source of imports may be of importance. They concentrate on two broad sectors: textiles and non-electrical machinery arguing that the former are perceived as requiring the intensive use of unskilled labor, while the latter is usually treated as using large inputs of skilled labor.[3]

Furthermore, the authors test if the degree of outsourcing differs across industries, as one might expect that low skill intensive sectors are more prone to outsourcing than high skill intensive ones. In contrast to Feenstra and Hanson (1996b) for the US the authors find that in the case of the UK (1970 - 1986) total import penetration as well as imports from industrialized countries have no impact on relative demand for high skilled workers. Only imports from low wage countries appear to have positive and statistically significant influence on relative demand. Finally, in line with expectations, non-electrical machinery - being relatively skill intensive compared to textiles - is less exposed to outsourcing.

[2]This study is reviewed in greater detail in Chapter 3, Section 3.4.

[3]Disaggregated, these industries yield eleven sectors.

While in their paper of Anderton and Brenton (1999) focus on outsourcing, but do not explicitly measure it, Hijzen, Goerg and Hine (2003) provide a detailed study of the effects of outsourcing for the UK. Like Feenstra and Hanson (1999) they employ narrow and broad measures of outsourcing. Importantly, the authors include the 1990s in the analysis, when international fragmentation of production became a subject of political discussion. Furthermore, they labor market data allow to depart from a crude distinction between manual and non-manual workers and define skill groups according to occupations. In addition to outsourcing the authors include variables measuring import penetration and technological change to the regression, in order to account for other factors that might have shifted the production function. They conclude, that outsourcing in the narrow sense can account for "as much as half" of the increase in the UK wage inequality over the period 1982 - 1997.

Finally, in a very recent paper Geishecker (2005) analyzes how international outsourcing has affected the relative demand for manual workers in Germany during the 1990s. Germany, as Geishecker notes, differs considerably from the above studied countries, as it is more open to international trade, than for example the US, and has a more rigid labor market than Anglo-Saxon countries. Furthermore, because of its geographical position, it is extremely easy for German firms to take advantage of low wages in Central and Eastern European countries, by undertaking outsourcing activities.

Geishecker points out, that between 1975 and 2000 continuous skill upgrading in German manufacturing took place. In contrast, at the same time the relative wages of low skilled workers remained quite stable. In the tradition of Feenstra and Hanson, he also constructs a narrow and wide measure of outsourcing. Using these measures, in turn he approximates an outsourcing indicator for CEE and the rest of the world. His empirical model is, as in previously reviewed studies, based on the translog cost function. Furthermore he applies the General Method of Moments (GMM) in order to account for endogeneity of international outsourcing. Applying the narrow concept of outsourcing and not differentiating by region, Geishecker (2005)

finds only insignificant effects. When distinguishing between different geographical regions, outsourcing activity toward CEE significantly lowers the wage bill share of manual workers.

As mentioned in Chapter 1, the phenomenon of international outsourcing is closely related to the notion of offshoring. Offshoring can be defined as international outsourcing in form of vertical foreign direct investment. In other words, offshoring differs from outsourcing by the extent of control a firm has over the outsourcing activity. Such a form of outsourcing gained much attention of economists since multinational enterprises (MNEs) started to invest on a large scale in developing countries and in countries of Central and Eastern Europe.

There has been little analysis on the role of inward FDI on the wage gap between skilled and unskilled workers in developed countries. Blonigen and Slaughter (2001) examine this hypothesis on the US example. As one would expect, since the US is not generally perceived as a typical host for outsourcing activities,, even though the presence of foreign-owned affiliates in the US has grown more rapidly in significance for the US economy than trade flows, the authors do not find that inward FDI has contributed to shifts in the US relative labor demand toward skilled labor. This finding is consistent with recent models of multinational enterprises in which foreign affiliates focus on activities less skilled labor intensive than the activities of their parent firms. It also suggests, that in the case of advanced countries one should rather focus on outward FDI.

This is done by Slaughter (2000a). He analyzes whether the transfer of production stages within US MNEs to foreign affiliates has affected the US relative skilled labor demand. First, he finds that during the examined period: 1977 - 1994, the foreign affiliate employment of US multinationals actually declined. Second, the regression analysis does not confirm MNEs' offshoring activities having impact on skill upgrading in the US manufacturing.

In contrast, Head and Ries (2002) find a positive relationship between offshore production by Japanese multinationals and domestic skill intensity.

Their data set differ markedly from all other studies on outsourcing and its effect on relative skilled labor demand, as they use firm level data. In particular they find that FDI in low income countries raises skill intensity in the home country and this effect falls as investment shifts toward high income countries. Additionally, for high enough host country income levels, FDI can cause downgrading at home.

While inward FDI has been found to have no effect on domestic relative demand for skilled labor in the US, the opposite was been found by Feenstra and Hanson (1997) for one of the low wage trading partners of the United States, Mexico. To analyze the relative wage implications of FDI, the authors apply their theoretical model of international outsourcing[4], in which a high skilled labor abundant country outsources its low skilled intensive activities to an low skilled labor abundant country. For the host country, however, these activities are high skill-intensive, since it is specialized in production of low skilled intensive commodities compared to high skilled labor abundant countries. That is, outsourcing by multinational companies from skilled labor abundant countries contributes to a worldwide increase in the demand for skilled labor. This model is an important theoretical contribution, as it is able to explain the observed increase in wage inequality among extremely different countries. In their paper about Mexico, the authors measure FDI using regional data on foreign assembly plants, so called *maquiladoras*[5]. They conclude, that in regions where FDI is concentrated, it can account for over 50 percent of the increase in the skilled labor wage share that occurred between 1975 and 1988 in Mexico.

Being a popular destination of FDI, also transition countries have attracted the attention of economists. Bruno, Crino and Falzoni (2004) investigated the contribution of FDI to the increase in earning inequality in the Czech Republic, Hungary and Poland during the 1990s. They follow the

[4]This model will be outlined in the next section.

[5]*Maquiladoras* are factories, the majority of which are located in Mexican border towns, that imports materials and equipment on a duty- and tariff-free basis for assembly or manufacturing. These companies work under the *Maquila* Decree, requiring all products to be exported from Mexico. Maquiladoras can be 100 percent foreign-owned (usually by US companies). (Wikipedia, a free encyclopedia)

same empirical model as all other studies in this survey, where the dependent variable is the cost share of skilled workers in total variable cost. The authors measure foreign capital by inward FDI stocks.

Additionally, like Hijzen, Görg and Hine (2003), they control for some other effects associated with international trade and technological progress, by including export and import of final good and the total business enterprise expenditure on R&D. The authors apply fixed effects and instrumental variables approach, the latter to tackle the possible endogeneity of relative wages.[6] Their results suggest that FDI has no direct influence on labor demand shifts in the three examined countries. However, it did contribute to rising skill premium "through the active role played by multinational firms in the transition induced process". That is, MNEs have helped to push the labor market from a compressed wage structure at the beginning of the transformation process to form of wage determination that are typical for a market economy. Regarding other results, they find negative impact of imports and exports on the skilled labor share in accordance with the traditional factor-proportions model.

In this chapter, I am analyzing the impact of foreign capital inflows on increasing relative demand and skill premium of high skilled workers in Polish manufacturing between 1994 and 2002. My study differs from the one of Bruno, Crino and Falzoni (2004) in three important ways. First, I am able to measure foreign capital in a more direct way, with fixed assets instead of inward FDI stocks. Second, I apply a more formal approach by examining the model of international outsourcing developed by Feenstra and Hanson (1996a). Additionally, I use more disaggregated data and therefore have more observations which is crucial for instrumental variables approach. As will be shown, the analysis in this chapter differs from the above study concerning results. I find strong statistical evidence for FDI having contributed to the increase in relative high-skilled labor demand in Poland.

[6]This issue will be discussed in Section 2.9.2.

2.3 The Model of International Outsourcing

The theoretical base of the empirical research in this chapter is the international outsourcing model developed by Feenstra and Hanson (1996a). This section briefly outlines this model and its implications for relative demand for skilled labor.

In Feenstra and Hanson's (1996) model, the world economy consists of two countries: North and South. Each country is endowed in three production factors: capital, high skilled labor and low-skilled labor. These endowments are assumed to be sufficiently different so that factor prices are not equalized. Return to capital and relative wage of high skilled labor are higher in the South, reflecting a relative scarcity of capital and high skilled labor in the South. Initially there is no international factor mobility, but labor mobility between skill categories. In other words, the supply of skilled and unskilled workers can react to changes in the relative wages.

On the production side there is a single final good assembled from a continuous range of intermediate inputs at no additional cost. These inputs are produced using all factors and differ only with regard to the relative amounts of high skilled and low skilled labor engaged in their production since capital enters the production function with the same cost share for all inputs. They are indexed by $z \in [0, 1]$ and ranked in a way that high skilled labor intensity is increasing with z. Assuming that for constant wages the minimum cost of producing one unit of input is a continuous function of z and that all inputs are produced in both countries, Figure 2.1 depicts the minimum cost locus for intermediate goods produced in the North ($C^N C^N$) and in the South ($C^S C^S$). Inputs lying to the left of the "cutoff intermediate input" z^* where the minimum production cost is equal, engage less high skilled labor in the production than inputs with a higher z index. In this range, therefore, $C^S C^S$ lies below $C^N C^N$ since the relative wage of high skilled labor is higher in the South. The opposite holds for intermediates lying to the right of z^*. Thus, the South has a cost advantage in producing inputs that are relatively low skilled labor intensive and the North producing

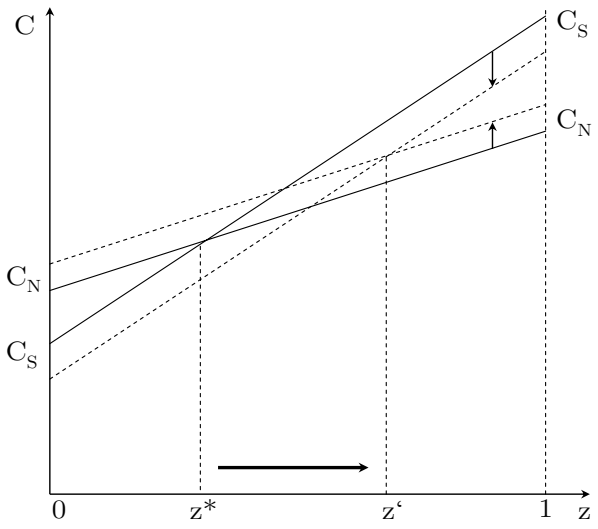


Figure 2.1: Outsourcing from the North to the South (Feenstra and Hanson (1996a))

inputs, the production techniques of which are relatively high skill intensive. The following trade pattern emerges: the South exports intermediate goods in the range $z \in [0, z^*)$ while the North exports those in the range $z \in (z^*, 1]$.

What will happen in the model if Northern firms are allowed to invest in the South? They will have an incentive to do so in order to earn the higher returns to capital in the South. The flow of capital from the North to the South will cause a reduction in the Southern return to capital and an increase in return to capital in the North. Consequently, at constant wages, this change will alter the minimum cost loci shown in Figure 2.1. $C^S C^S$ will move down and $C^N C^N$ up increasing the critical value of z^* to z'. That is, the production of inputs in range $[z^*, z')$ will now take place in the South rather than in the North. In other words, in the South, the range of intermediate production will spread toward inputs that engage a higher ratio of high skilled to low skilled labor. The inputs, that will be still produced in the North, will use a higher ratio of high skilled to low skilled labor relative to those that will leave.

Thus, both countries will experience an increase in the average skill intensity of production and an increase in the relative demand for high skilled labor. As a result, the relative wage of skilled labor will rise in both countries.

This will in turn affect both cost loci in Figure 2.1, but Feenstra and Hanson (1996a) show that even after accounting for this change in factor prices, z^* will still rise.

Summarizing, z^* is increasing with the Southern to Northern capital ratio. Furthermore, the relative wage of high skilled to low skilled labor is determined by z^* since its "location" affects relative labor demand. Thus, the relative wage of skilled workers will be positively affected by accumulation of capital in the South relative to the North. Feenstra and Hanson (1996a) show that this result also holds for exogenous relative capital accumulation in the South not necessarily caused by Northern firms' investment.

Following Feenstra and Hanson's (1996) model, the capital flow from the North to the South can be interpreted as a measure of the extent of outsourcing activities. That is, the activities that are outsourced by industrial countries to developing countries are relatively low skilled from the perspective of the home country and relatively high skilled for the host country. Thus, outsourcing increases the relative demand for high skilled workers in both countries resulting in a higher relative wage for high skilled labor.

2.4 FDI in Poland

"Few countries have taken better advantage of the new possibilities of engaging with the globalized world than Poland" - states the new report of International Labour Organization (ILO) World Commission (2004). Indeed, in the course of the 1990s, the role of foreign activities in Poland was gradually increasing. In the first years of transition, foreign investors preferred to establish their activities in Hungary and the Czech Republic. Starting from the mid 1990s, however, Poland became the major recipient of FDIs in the region, at least in absolute terms. The acceleration of FDI by the mid 1990s was partly supported by liberalization of capital movements as part of Poland's accession process to OECD in 1996 and EU in 2004, and partly by progress in large scale privatization schemes with involvement of foreign strategic investors. After 2000, due to continuing sluggishness of the global

economy, flows of FDIs worldwide cooled down considerably.[7] In Poland the inflow declined by 33 percent in 2001 compared to 41 percent worldwide. Nevertheless, already in 2002, despite the negative global trends and previous UNCTAD forecasts, the inflow of FDIs to CEE countries amounted to USD 29 billion i.e. 15 percent more than in the previous year.[8] It was the only region in the world that experienced an increase of the inflow of FDIs. The recovery of foreign investment in Poland came one year later. According to Josef Ackerman, the president of Deutsche Bank, the new wave of FDI is on the way: "The new Union is being discovered by investors. You are going to observe a steady growth of capital in Poland".[9]

2.4.1 The Role of FDI in the Polish Economy

Between 1990 and 1995 the average FDI inflow amounted to USD 1.33 billion per year compared to USD 7.45 billion between 1996 and 2002. Since then, as it can be seen from Table 2.1, foreign capital has became a very important source of funds in Poland. While in 1994 FDI stock accounted for 4.36 percent of GDP, in 2002 it reached 34 percent. Its share in gross fixed capital formation increased from 8.39 percent in 1994 to 16.68 percent in 2002, reaching a peak value of 27.03 percent in 2000.

Table 2.2 presents the structure of FDI in Poland according to the country of origin and sectoral distribution. By the end of 2002, nearly 70 percent of FDI originated from the EU member states led by France whose investments in Poland amounted to USD 12.2 billion (18.7 percent of total FDI stock), followed by the United States, with USD 8.7 billion (13.4 percent of total). Although in terms of investment volume Germany ranked only third with USD 7.8 billion (12 percent of total), considering the number of firms in 2002 it claimed the first place. Among 993 foreign firms with investments exceeding 1 million USD registered in Poland, as many as 231 were German. 128 American companies constituted the next strong group, followed by 93 French firms.

[7] UNCTAD (2002)
[8] PAIiIZ
[9] Rzeczpospolita, 6. October 2004.

Table 2.1: Foreign Direct Investment in Poland

	1990	1992	1994	1996	1998	2000	2002
inflows[a]	89	678	1491	5197	9574	10601	6064
stock[a]	120	1605	4321	12028	30651	49392	65087
% of GDP[b]	0.20	1.90	4.36	8.36	19.24	29.65	34.00
% of GFCF[cd]	0.72	4.79	8.39	17.43	23.90	27.03	16.68

[a] In USD million.
[b] FDI stock.
[c] FDI inflow.
[d] GFCF - Gross Fixed Capital Formation.
Source: Polish Information and Foreign Investment Agency (PAIiIZ), International Financial Statistics, International Monetary Fund (IMF).

The biggest part of foreign capital has been absorbed by the manufacturing industry (40 percent) even though its share declined in favor of services at the end of the last decade.[10] In 2002 the share of foreign firms in sales in manufacturing reached 41 percent and about 44 percent of fixed assets were in foreign hands. Transportation equipment and food processing attracted nearly half of the capital invested in the manufacturing industry. The other non-metallic mineral products sector received almost 14 percent, chemicals and chemical products - 8 percent. In services, the largest recipient of FDI was the financial sector, with 22 percent of total cumulated FDI, followed by trade and repairs - 12 percent.

While the strategy of foreign investors initially focused on serving the domestic market, the largest consumer pool in Central and Eastern Europe, they have turned increasingly to foreign markets. In 2002, they generated 59 percent of total exports and 56 percent of total imports compared to 38 and 47 percent respectively in 1996.[11] Their share was even higher for some groups of commodities, like the automotive industry, where foreign firms accounted for 97 percent of exports.

[10] By the end of 1998, the manufacturing accounted for 62.4 percent of capital invested in Poland.
[11] Foreign Trade Research Institute

Table 2.2: Structure of Foreign Direct Investment Stock[a] (end of 2002)

by sector		*by country of origin*	
manufacturing	40.28	European Union	71.62
of which:		*of which:*	
transportation equipment	25.13	France	27.66
food processing	24.17	Germany	17.82
other non-metallic products	13.67	Netherlands	13.28
chemical products	7.78	UK	9.21
pulp and paper	6.98	Italy	8.40
electrical machinery	6.78	Sweden	6.34
wood	5.41	Denmark	4.18
rubber and plastic	2.62	Belgium	3.74
metal and metal products	2.21	Ireland	2.41
machinery and equipment	2.12	Cyprus	2.27
other	3.13	Austria	1.81
financial intermediation	21.80	Spain	1.35
trade and repairs	12.35	Greece	1.27
transport and storage	10.17	USA	14.22
construction	5.33	South Korea	3.33
power, gas and water	3.70	Russia	2.15
community, social and personal services	2.97	Switzerland	1.52
real estate and business activities	1.91	Japan	0.57
other	1.49	other	6.59

[a] In percent of total investment exceeding USD 1 million.
Source: Polish Information and Foreign Investment Agency (PAIiIZ).

Accounting for 9.4 percent[12] of total employment, foreign firms have not only largely contributed to the restructuring and modernization of the economy by bringing in capital, expertise and management know-how, but they have also had a major impact on the Polish labor market, as will be shown in this chapter.

2.5 Skills, Wages and Employment in Poland

Prior to 1989, wage distribution across skills in Poland was very compressed due to "central planner's" preference toward equalization. In 1988, non-production workers' earnings in manufacturing were actually equal to earnings of production workers. Only fourteen years later, in 2002, they earned twice as much.[13]

Table 2.3: Wages and Composition of Employment According to Educational Levels in Poland [a]

	wage relative to average wage		*share in total employment*	
educational level	1996	2001	1996	2001
tertiary	144.0	149.0	11.6	15.6
post-secondary	99.0	94.0	28.2	29.8
secondary	99.0	98.0	6.0	6.8
basic vocational	89.0	79.0	34.0	33.9
primary and incomplete primary	83.0	73.0	20.2	13.9

[a] In percent.
Source: Polish Statistical Office (Rocznik Statystyczny Pracy).

Table 2.3 reports wages of persons with different educational levels relative to average wage and composition of total employment according to distinct educational levels. Whereas earnings of persons with tertiary education have grown slightly more than the average, low skilled persons saw

[12] Share of employment in firms with foreign participation in total employment in 2002.
[13] In common with most studies on this issue, I am forced to measure skills with the nature of the work activity, since data on wages according to occupation and educational level were not published before 1996. Even after 1996, they were not available at the disaggregation level necessary for my econometric analysis.

their wages declining considerably relative to the average wage. At the same time, we observed a substantial growth of skilled workers' participation in total employment. Between 1996 and 2001, when the total employment declined by about 7 percent, the number of employed persons with university degree increased by about 26 percent. In contrast, persons with primary and incomplete primary education faced a 36 percent decline in the number of jobs offered. The fact, that the only group that experienced an increase of wage relative to average wage are university graduates underlines the growing importance of skills in the Polish labor market.

2.5.1 Wages and Employment in Manufacturing

The deteriorating situation of low skilled workers is even more conspicuous in the manufacturing sector. Figure 2.2 plots the evolution of real wages in the manufacturing sector since 1990. The top line represents the non-production workers' wage, while the bottom line the production workers' wage. The line in between depicts the manufacturing average wage. This graph has three striking features. First, the non-production workers' wages increased stronger than average and production workers' wages throughout the whole examined period.

Second, after 1999 we observe that the growth rate of all types of wages decreased. And finally, since 1999 only skilled workers' wage was increasing, while the growth of average wage in manufacturing had stagnated and unskilled workers started even to lose in real terms. Figure 2.3 shows that in 1990 the relative wage of high-skilled workers in manufacturing amounted to 1.24 and in 2002 already 2.03. That is, it increased by 4.1 percent per year on average. In order to assess the economic size of this increase one can compare it with the growth of wage inequality in the United States between 1979 and 1990 which increased by "only" 0.72 percent on average per year, and was called "dramatic" by several economists.

As the next figure shows, the increase in relative wages was accompanied by an increase in relative demand for skilled workers. Both the non-

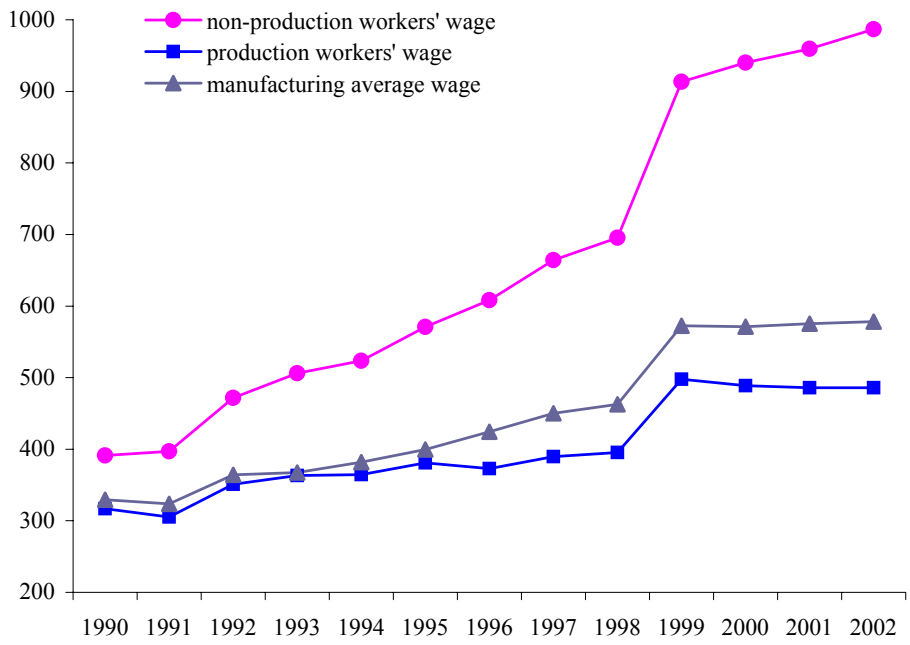


Figure 2.2: The Evolution of Real Wages in Polish Manufacturing (in PLN, 1993 prices)

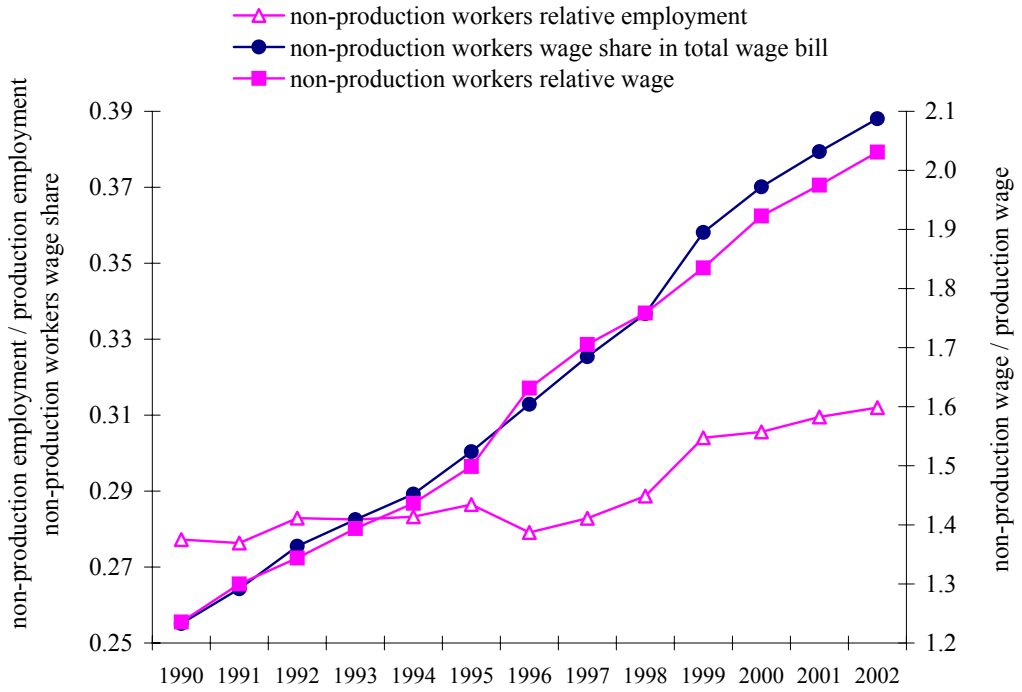


Figure 2.3: Relative Wages, Relative Employment and Non-Production Workers' Wage Share in Polish Manufacturing

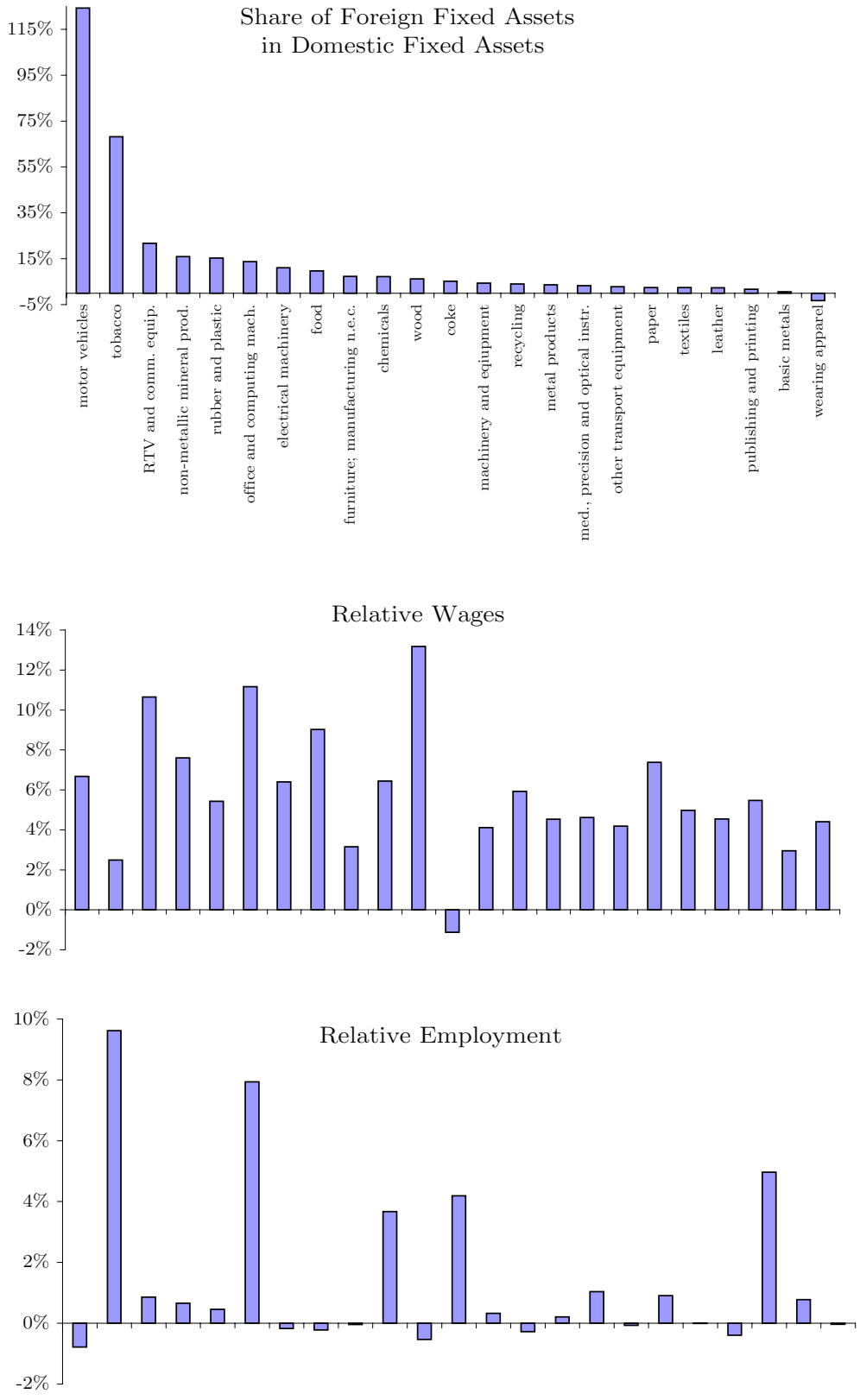
production workers' wage share in the total wage bill[14] and the relative employment of high skilled workers have been increasing between 1990 and 2002, even though the growth of the relative employment was not so sharp and stable as the growth of the relative wages. Still, the relative employment of non-production workers in manufacturing increased by 0.92 percent on average per year.

2.6 Foreign Fixed Assets and the Labor Market

In Sections 2.4 and 2.5 the aggregate development of FDI and relative wages and employment of non-production workers in Poland have been presented. In the anticipation of the econometric analysis it is useful to look at the variation of the variables at a disaggregated level. Figure 2.4 ranks the 23 NACE manufacturing sectors, that constitute the cross section in the panel used for econometric analysis, according to their changes in the extent of offshoring activities, measured by the share of foreign fixed assets in domestic fixed assets.

In the period examined (1994 - 2002), in all sectors but one: wearing apparel, multinationals increased outsourcing. The observed increase of foreign capital was the highest in two sectors: motor vehicles and tobacco. Figure 2.4 presents also the sectoral variation of changes in relative wages and employment of non-production workers. In general, these graphs suggest that an enhanced offshoring activity corresponds to a increasing wage gap between non-production and production workers, while the positive relationship between offshoring and relative employment of these workers is slightly less pronounced. The next part of this chapter provides an econometric analysis of these relationships.

[14]Because the increase in relative wage of non-production workers might induce substitution away from non-production labor and therefore the relative employment of non-production workers would probably underrepresent the shift in the demand toward skilled labor, Figure 2.3 contains also an alternative measure of changes in demand: the non-production labor wage share in the total wage bill.



Note: Average annual changes in percentage points (1994 - 2002), sectors ranked by foreign fixed assets share in domestic fixed assets.

Figure 2.4: Foreign Fixed Assets, Relative Wages and Relative Employment of Non-Production Workers in Manufacturing Sectors in Poland

2.7 Empirical Model

The empirical analysis in this chapter is based on a translog variable cost function approach, introduced by Berman, Bound and Griliches (1994). This methodology is employed widely by the empirical literature investigating the effects of international outsourcing on the wage gap between high skilled and low skilled workers.

In the model of Feenstra and Hanson (1996a) outlined in Section 2.3 countries are endowed with three factors of production: high skilled labor, low skilled labor and capital. In the production process these factors are combined, which leads to the following cost function for each sector i:

$$C_i^V = C(w_i^{HS}, w_i^{LS}, K_i, Y_i) \tag{2.1}$$

where w_i^{HS} and w_i^{LS} are wages paid for high skilled and low skilled labor, respectively, K_i is the capital stock and Y_i - output. The capital is assumed to be a fixed factor in the short run while both types of labor are to be treated as variable factors. This cost function can be approximated by a translog function:

$$\begin{aligned} lnC_i^V &= \beta_0 + \beta_{HS} lnw_i^{HS} + \beta_{LS} lnw_i^{LS} + \beta_K lnK_i + \beta_Y lnY_i \\ &+ \frac{1}{2}\beta_{HSLS} lnw_i^{HS} lnw_i^{LS} + \frac{1}{2}\beta_{LSHS} lnw_i^{LS} lnw_i^{HS} \\ &+ \frac{1}{2}\beta_{HSHS} lnw_i^{HS} lnw_i^{HS} + \frac{1}{2}\beta_{LSLS} lnw_i^{LS} lnw_i^{LS} \\ &+ \frac{1}{2}\beta_{YY} lnY_i + \frac{1}{2}\beta_{KK} lnK_i + \beta_{KHS} lnK_i lnw_i^{HS} \\ &+ \beta_{KLS} lnK_i lnw_i^{LS} + \beta_{YHS} lnY_i lnw_i^{HS} \\ &+ \beta_{YLS} lnY_i lnw_i^{LS} + \beta_{KY} lnK_i lnY_i \end{aligned} \tag{2.2}$$

By applying Shepard's Lemma[15] to (2.2) I obtain:

$$\begin{aligned} WBS_i^{HS} &= \beta_{HS} + \frac{1}{2}\beta_{HSLS} lnw_i^{LS} + \frac{1}{2}\beta_{LSHS} lnw_i^{LS} + \beta_{HSHS} lnw_i^{HS} \\ &\quad + \beta_{KHS} lnK_i + \beta_{YHS} lnY_i \end{aligned} \tag{2.3}$$

(2.3) presents the high skilled labor demand equation in the form of its share in the total variable cost. Since the two types of labor are the only variable factors, WBS_i^{HS} is defined as the high skilled workers' wage bill in the total wage bill. Imposing the symmetry and homogeneity restrictions on the cost function, the equation (2.3) can be further simplified[16]:

$$WBS_i^{HS} = \beta_{HS} + +\beta_{HSHS} ln(\frac{w_{it}^{HS}}{w_{it}^{LS}}) + \beta_{KHS} lnK_i + \beta_{YHS} lnY_i \tag{2.4}$$

Adding a time dimension and a stochastic error term ϵ_i and disaggregating the capital stock (K_i) into domestic capital (K_i^D) and foreign capital (K_i^{FDI})[17] yields the following estimating equation:

$$\begin{aligned} WBS_{it}^{HS} &= \beta_0 + \beta_1 ln(\frac{w_{it}^{HS}}{w_{it}^{LS}}) + \beta_3 ln(1 + \frac{K_{it}^{FDI}}{K_{it}^D}) \\ &\quad + \beta_3 lnK_i^D + \beta_4 lnY_i + \epsilon_{it} \end{aligned} \tag{2.5}$$

The dependent variable in this equation is a composite measure, as it incorporates relative wages of non-production workers as well as their relative employment.

[15]Shepard's Lemma provides the link between the variable cost function parameters and factor demands. The lemma states, that the cost-minimizing demand for factor input HS (high skilled labor) is such that $L^{HS} = \frac{\partial C^V}{\partial w^{HS}}$ where L^{HS} is defined as the number of high skilled workers. Noting that: $\frac{\partial lnC^V}{\partial lnw^{HS}} = \frac{w^{HS}}{C^V} \times \frac{\partial C^V}{\partial w^{HS}}$, the lemma can also be written as stating that the logarithmic partial derivative of variable cost function equals the factor share: $\frac{\partial lnC^V}{\partial lnw^{HS}} = \frac{w^{HS} L^{HS}}{C^V}$.

[16]In order to impose symmetry and homogeneity on the cost function following parameter restrictions are required: $\beta_{HSLS} = \beta_{LSHS}$, for symmetry and $\beta_{HSHS} + \beta_{HSLS} = 0$, for homogeneity.

[17]$ln(K_i^D + K_i^{FDI}) = ln(K_i^D) + ln(1 + \frac{K_i^{FDI}}{K_i^D})$

2.8 Data, Explanatory Variables and Estimation Strategy

2.8.1 Data and Explanatory Variables

I study the influence of international outsourcing, measured by foreign capital accumulation, on the relative demand for skills in Poland in the manufacturing industry in Poland. The sample consists of an unbalanced panel[18] of 23 NACE (2-digit) industries over a 9 years' period (1994-2002).[19]

The dependent variable, relative demand for high skilled workers, is proxied by the high skilled labor wage share, measured as the non-production workers' wage share in the total wage bill. One component of the dependent variable, the employment of high skilled (low skilled) workers, is measured by annual average employment of non-production (production) workers. The second component, the wage of high skilled (low skilled) workers is measured by an annual average gross wage of non-production (production) workers. Unfortunately, especially at the level of disaggregation necessary for econometric analysis, no better proxies for high-skilled and low-skilled labor are available.

The data set obtained from Polish Statistical Office (PSO)[20] allows for direct measurement of foreign capital and also enables separation of foreign and domestic owned fixed assets.[21] However, I cannot distinguish foreign affiliates that explicitly engage in outsourcing, or more precisely offshoring[22], from other foreign subsidiaries. Therefore, I treat all foreign firms as offshoring firms, even if the latter actually constitute only a subset in my data

[18]Some numbers are not made public for confidentiality reasons.

[19]As mentioned in Section 2.2 Bruno, Crino and Falzoni (2004) examine a similar question for Poland, the Czech Republic and Hungary. However, they have data on 6 ISIC industries and in the case of Poland they cover the period 1994 to 2001.

[20]Data has been partly collected from various publications of PSO and partly obtained from PSO in electronic form. For details see Appendix.

[21]Feenstra and Hanson (1997) for lack of data could not directly measure the capital stock in foreign ownership and thus used the number of foreign firms as a proxy. Bruno, Crino and Falzoni (2004) measure foreign capital with foreign direct investment stock.

[22]As previously noted, offshoring can be defined as international outsourcing of activities within the boundaries of multinational firm in the form of vertical FDI.

set. $(1+\frac{K_i^{FDI}}{K_i^D})$ and K^D representing the ratio of foreign to domestic capital and domestic capital, respectively, compose my basic specification.

In addition to the basic variables I include several control variables. Feenstra and Hanson (2001) argue that one should include any structural variables that capture other factors that might influence the production costs. In order to account for the restructuring processes in Polish manufacturing I use a measure of privatization (the share of private firms in the total number of firms). I assume that private enterprises have stronger incentives to rationalize and modernize their production than their public counterparts so that their activities might have affected the relative high skilled labor demand.

Furthermore, it is necessary to include variables that, following theoretical and empirical literature, could also have an impact on relative demand for high skilled labor. For this purpose I include the share of $R\&D$ expenditures in sales in order to account for technological improvement, and import and export penetration ratios to control for potential influence of international integration and of exposure to international competition.

It is common practice to include output in this type of the regression, as the variable cost function condition on total output. However, due to high correlation between output (measured by sales) and domestic fixed assets, which enter the regression in levels, I excluded the output variable from regression. Thus my modified estimating equation is:

$$\begin{aligned} WBS_{it}^{HS} &= \beta_1 + \beta_4 ln(\frac{w_{it}^{HS}}{w_{it}^{LS}}) + \beta_2 ln(1+\frac{K_{it}^{FDI}}{K_{it}^D}) + \beta_3 lnK_{it}^D \\ &\quad + \beta_5 lnPRIVFIRM/FIRM_{it} + \beta_6 lnR\&D/Y_{it} \\ &\quad + \beta_7 lnIMP/Y_{it} + \beta_8 lnEXP/Y_{it} + \epsilon_{it} \end{aligned} \tag{2.6}$$

where $PRIVFIRM/FIRM$ denotes the share of private firms in the total number of firms, $R\&D/Y$ is defined as the $R\&D$ expenditures over sales, IMP/Y represents import share in sales and EXP/Y - export share in sales.

2.8.2 Estimation Strategy

The above regression will be 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 terms of size or skilled labor and capital intensities, estimating with OLS would relegate the unobserved heterogeneity to the error term and the coefficients would be biased.[23]

Furthermore, I also incorporate time fixed effects. There are two important reasons for doing so. First, I have neglected the fact, that foreign capital might be determined by some foreign factors. Due to obvious reasons I cannot include these variables in the regression. By inclusion of time dummies, I assume that the impact of foreign variables is the same across industries and varies only over time. Second, one should not forget that Poland is a transition economy with institutions and the economic system as a whole being still "work in progress". Hence, there might exist some aggregate exogenous factors that are correlated with the industry-level relative labor demand. Accounting for industry and time fixed effects helps also to resolve potential problems arising from omitting output in the regression.

Not surprisingly, statistical tests show that there is a heteroscedasticity problem plaguing our data. In order to assure the efficiency of diagnostic tests all standard errors reported in the results are robust to heteroscedasticity. Finally, the relative wages of high skilled workers are likely to be endogenous in the wage share regression, and failure to control for this may lead to simultaneity bias. I am avoiding this problem by excluding the relative wages variable while estimating with OLS. This in turn may cause omitted variable bias. It is therefore necessary to verify the robustness of the OLS estimates by instrumental variables method.

[23]The big advantage of the fixed effects versus random effects is that any potential correlation of the explanatory variables with the individual effects is rendered harmless since the fixed effects and therefore their correlation with the explanatory variables are annihilated. Additionally, the Hausman test rejects the null hypothesis that the estimates from the two models are the same, that is, the random effects estimator is not a viable solution and fixed effects should be more efficient (Beck and Katz (1995)).

2.9 Results of Estimation

2.9.1 Fixed Effects Estimates

Table 2.4 reports the fixed effects estimation results for the wage share of high skilled labor. Column (1) presents the basic specification with the two independent variables: foreign $(1 + \frac{K^{FDI}}{K^D})$ and domestic capital (K^D). Columns (2) to (4) present the results when adding several control variables to the basic specification. The coefficient on the foreign capital variable is positive and statistically significant in all regressions, in line with the prediction of the theoretical model outlined in Section 2.3. Its magnitude ranges from 0.029 to 0.044, but what is actually interesting is its economic significance. The number obtained by multiplying the most conservative estimate of the coefficient of the foreign fixed assets (0.029) by the average growth of the share of foreign fixed assets between 1994 and 2002 (116.5 percent) is the contribution of foreign capital to changes in relative demand for skills. It implies that FDI can account for at least 34 percent of the observed increase in non-production workers' wage share (0.099) in the Polish manufacturing sector between 1994 and 2002.

The coefficient of domestic capital is also positive in all specifications but not statistically significant. The sign of domestic capital coefficient corroborates the theoretical result, that any accumulation of capital, be it domestic or foreign owned, leads to an increase in the relative demand for skilled labor. Its statistical insignificance, however, underlines the special role of foreign capital for the changes in relative high skilled labor demand.

The inclusion of control variables does not change the results obtained for the basic regressors. $PRIVFIRM/FIRM$ has a positive and significant impact on the high skilled wage share. The result on the $R\&D/Y$ variable suggests that the increase in the relative high skilled labor demand was partly due to technological upgrading. The negative coefficient on the import share can be seen from the Heckscher-Ohlin perspective. Given that Poland is low skilled labor abundant compared to its trading partners, international trade would exert a downward pressure on earnings of high skilled workers relative

Table 2.4: Foreign Investors and Demand for High-Skilled Labor

dependent variable: *wage bill share of high skilled workers*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ln\ (1+\frac{K^{FDI}}{K^{D}})$	0.044***	0.048**	0.046**	0.029**				
	(0.015)	(0.014)	(0.014)	(0.012)				
$ln\ (1+\frac{E^{FDI}}{E^{D}})$					0.114*	0.141***	0.124**	0.107***
					(0.062)	(0.049)	(0.048)	(0.039)
$ln\ K^{D}$	0.011	0.016	0.016	0.004	0.001	0.007	0.007	0.002
	(0.016)	(0.013)	(0.013)	(0.013)	(0.016)	(0.014)	(0.014)	(0.012)
$ln\ PRIVFIRM/FIRM$		0.041**	0.036**	0.043**		0.045**	0.042*	0.050**
		(0.016)	(0.018)	(0.018)		(0.019)	(0.022)	(0.019)
$ln\ R\&D/Y$			0.008**	0.007**			0.006***	0.006**
			(0.003)	(0.003)			(0.003)	(0.003)
$ln\ IMP/Y$				−0.046***				−0.053***
				(0.011)				(0.012)
$ln\ EXP/Y$				0.001				−0.003
				(0.017)				(0.016)
year dummies	yes***	yes***	yes***	yes***	yes***	yes***	yes***	yes***
constant	0.365	−0.004	0.041	0.237	0.251	0.223	0.163	0.321
	(0.332)	(0.276)	(0.273)	(0.259)	(0.335)	(0.293)	(0.298)	(0.238)
Adj. R^2	0.917	0.920	0.920	0.926	0.910	0.931	0.918	0.949
N	194	192	185	171	194	192	185	171

Notes: Parameters are estimated by fixed effects regressions; *** (**,*) significant at 1 (5, 10) percent level; standard errors robust to heteroscedasticity in parentheses; N - number of observations; for expositional ease coefficient estimates for industry and year dummies are not shown.

Table 2.5: Foreign Investors and Decomposed Demand for High-Skilled Labor

dependent variables: *(1)−(4): relative employment, (5)−(8): relative wages of high skilled workers*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ln\ (1+\frac{K^{FDI}}{K^D})$	0.083**	0.094**	0.090**	0.045	0.183***	0.180***	0.174***	0.170***
	(0.041)	(0.039)	(0.035)	(0.033)	(0.042)	(0.045)	(0.045)	(0.051)
$ln\ K^D$	0.056	0.068	0.069	0.039	0.164***	0.161***	0.162***	0.166***
	(0.049)	(0.045)	(0.043)	(0.045)	(0.035)	(0.060)	(0.060)	(0.060)
$ln\ PRIVFIRM/FIRM$		0.095**	0.083*	0.102**		−0.023	−0.034	−0.039
		(0.042)	(0.045)	(0.045)		(0.048)	(0.052)	(0.055)
$ln\ R\&D/Y$			0.027**	0.025**			0.006	0.010
			(0.010)	(0.010)			(0.011)	(0.012)
$ln\ IMP/Y$				−0.119***				−0.011
				(0.021)				(0.056)
$ln\ EXP/Y$				0.026				0.005
				(0.047)				(0.069)
year dummies	yes	yes	yes	yes	yes***	yes***	yes***	yes***
constant	−0.835	−1.010	−0.861	−0.376	−1.042	−1.902	−1.746	−1.996
	(1.024)	(0.907)	(0.879)	(0.876)	(1.743)	(0.826)	(0.877)	(1.231)
Adj. R^2	0.836	0.838	0.837	0.847	0.773	0.769	0.771	0.775
N	194	192	185	171	194	192	185	171

Notes: Parameters are estimated by fixed effects regressions; *** (**,*) significant at 1 (5, 10) percent level; standard errors robust to heteroscedasticity in parentheses; N - number of observations; for expositional ease coefficient estimates for industry and year dummies are not shown.

to the earnings of low skilled workers. Nevertheless, the result on the export share is inconclusive. Finally, as argued in Section 2.8.2 the inclusion of time dummies is crucial when analyzing the role of outsourcing for relative demand for skilled workers in Poland. The positive coefficients of the year dummies suggest that the transition to market economy, has favored high skilled workers.

In the remaining specifications of Table 2.4 I substitute $(1 + \frac{K^{FDI}}{K^D})$ with the ratio of the number of foreign to domestic firms $(1 + \frac{E^{FDI}}{E^D})$, as a first robustness check. Inspection of columns (5) to (8) shows that the results are robust to this alternative measure of outsourcing.

In Table 2.5 I replace the wage share of high-skilled workers as dependent variable by decomposing it into relative employment and wages of non-production workers and estimate similar regressions as in columns (1) to (4) of Table 2.4. As can be seen, the results for the relative employment, reported in the first four columns, practically mirror those for the wage share. Only the magnitude of the coefficients is twice as high (in the case of $R\&D/Y$ even triple) and the year dummies lose their significance. The regressions with high-skilled workers' relative wages in columns (5) to (8) give a different picture. The coefficients on domestic capital become significant at one-percent level, while the influence of privatization becomes negative and not significant. $R\&D/Y$ retains its positive sign but it is no more significant, whereas the year dummies are positive and highly significant.

The different results on the time dummies are not surprising. Under the socialist regime Poland had an extremely compressed wage distribution. Thus, one of the dimensions of the transition process was the liberalization of wage setting schemes. In the regression with relative wages, significant and positive time dummies may reflect the general, sector invariant, labor market adjustments to a market economy. Simultaneously, the relative employment underwent changes that were rather sector specific and therefore, better captured by industry specific measures. Summarizing, the main message of this table is the positive and significant impact of foreign capital $(1 + \frac{K^{FDI}}{K^D})$ on relative wages and its positive although less statistically significant impact

on relative employment of non-production workers.

2.9.2 Robustness

So far I have neglected the potential influence of relative wages of high skilled workers. Such an approach, as argued above, may however cause omitted variable bias. In order to address this problem, in this section the relative wages are included in the regression. Since the inclusion of relative wages might in turn cause endogeneity bias we reestimate the above regressions with instrumental variables (IV) method. In addition to other right hand side variables I include the second and third lags of relative wages as instruments.

It is also likely that foreign capital is endogenous. Bruno, Crino and Falzoni (2004) and Pavcnik (2003) argue that foreign firms invest in some industries because of their high skill intensity not the other way round. Tests for exogeneity, indeed, indicated that both relative wages and foreign capital variables are endogenous. Therefore, I also added first, second and third lags of the foreign capital variable to the existing set of instruments. For the purpose of controlling for heteroscedasticity, I apply General Method of Moments (GMM) estimates.

Table 2.6 shows IV-GMM estimates for high skilled workers' wage share. It appears that the coefficients on foreign capital remain positive, roughly of the same value and statistically significant. The inclusion of relative wages, however, deprived privatization and year dummies of their explanatory power with the $PRIVFIRM/FIRM$ coefficient becoming even even negative. The year dummies were actually excluded from the regression, since their presence led to rejection of the joint hypothesis of correct model specification and orthogonality conditions. This confirms the above result that the transition process is partly responsible for the increase in non-production workers' wage bill share, because it liberalized the wage setting mechanism.

Turning to Table 2.7 reporting IV-GMM results for relative employment and wage, the inclusion of relative wages to the regression has similar consequences for relative employment as for relative demand with one major difference. Increasing relative wages have slightly (statistically insignificantly) re-

Table 2.6: Foreign Investors and Demand for High-Skilled Labor (GMM)

dependent variable: *wage bill share of high skilled workers*				
	(1)	(2)	(3)	(4)
$ln\ (1+\frac{K^{FDI}}{K^D})$	0.040*	0.038*	0.035*	0.031*
	(0.021)	(0.023)	(0.020)	(0.015)
$ln\ \frac{W^S}{W^{US}}$	0.199**	0.191**	0.223***	0.246**
	(0.084)	(0.091)	(0.079)	(0.096)
$ln\ K^D$	0.006	0.006	0.011	0.009
	(0.013)	(0.014)	(0.013)	(0.014)
$ln\ PRIVFIRM/FIRM$		−0.007	−0.011	−0.006
		(0.006)	(0.009)	(0.007)
$ln\ R\&D/Y$			0.005***	0.005***
			(0.002)	(0.002)
$ln\ IMP/Y$				−0.020*
				(0.010)
$ln\ EXP/Y$				−0.002
				(0.009)
year dummies	no	no	no	no
constant	0.059	0.336	−0.031	−0.027
	(0.265)	(0.204)	(0.269)	(0.251)
$Centered\ R^2$	0.961	0.958	0.958	0.958
$Hansen\ J\ statistic$	2.424	2.716	2.047	1.769
$P-value$	[0.489]	[0.437]	[0.562]	[0.621]
N	124	126	120	110

Notes: Parameters are estimated by instrumental variable regressions (GMM); Instruments: 1st, 2nd and 3rd lag of log foreign fixed assets share in domestic fixed assets and 2nd and 3rd lag of log relative wage; *** (**,*) significant at 1 (5, 10) percent level; all regressions include industry dummies; standard errors robust to heteroscedasticity in parentheses; N - number of observations; for expositional ease coefficient estimates for industry dummies are not shown.

Table 2.7: Foreign Investors and Decomposed Demand for High-Skilled Labor (GMM)

dependent variables: *(1)-(4): relative employment, (5)-(8): relative wages of high skilled workers*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ln\ (1+\frac{K^{FDI}}{K^{D}})$	0.101*	0.097*	0.091*	0.072	0.325**	0.333**	0.296**	0.385*
	(0.052)	(0.057)	(0.050)	(0.048)	(0.159)	(0.169)	(0.148)	(0.217)
$ln\ \frac{W^{S}}{W^{US}}$	−0.137	−0.157	−0.078	0.004				
	(0.203)	(0.229)	(0.191)	(0.238)				
$ln\ K^{D}$	0.016	0.017	0.019	0.007	0.177	0.186	0.175	0.250
	(0.035)	(0.036)	(0.035)	(0.035)	(0.123)	(0.134)	(0.122)	(0.175)
$ln\ PRIVFIRM/FIRM$		−0.014	−0.020	−0.012		0.001	−0.011	−0.040
		(0.015)	(0.014)	(0.016)		(0.032)	(0.030)	(0.042)
$ln\ R\&D/Y$			0.011**	0.011**			−0.002	0.009
			(0.005)	(0.005)			(0.006)	(0.008)
$ln\ IMP/Y$				−0.046				0.124
				(0.029)				(0.0101)
$ln\ EXP/Y$				0.023				−0.085
				(0.028)				(0.069)
year dummies	no	no	no	no	yes***	yes***	yes***	yes***
constant	−0.043	−0.045	−0.059	0.110	−2.170	−2.377	−2.195	−3.681
	(0.713)	(0.742)	(0.717)	(0.641)	(2.782)	(3.127)	(2.812)	(3.910)
Centered R^2	0.903	0.903	0.880	0.882	0.816	0.808	0.829	0.827
Hansen J statistic	2.502	2.612	2.080	1.924	0.061	0.020	0.014	0.142
P-value	[0.475]	[0.455]	[0.556]	[0.588]	[0.805]	[0.886]	[0.904]	[0.707]
N	124	124	120	110	124	124	120	110

Notes: Parameters are estimated by instrumental variable regressions (GMM); Instruments: 1st, 2nd and 3rd lag of log foreign fixed assets share in domestic fixed assets and 2nd and 3rd lag of log relative wage; *** (**,*) significant at 1 (5, 10) percent level; all regressions include industry dummies; standard errors robust to heteroscedasticity in parentheses; N - number of observations; for expositional ease coefficient estimates for industry and year dummies are not shown.

tarded the increase of relative employment of non-production workers. Their development in turn, was driven mainly by foreign capital and aggregate shocks related to the transition process.

I have also carried out a regression with all independent variables lagged one period, as Bruno, Crino and Falzoni (2004) did in order to compare their results with mine. The results for the two approaches differ in the value of coefficients of the foreign capital variable. They are higher when using lags. I also reestimated my regressions with panel-corrected standard error estimation (PCSE), which allows correction for contemporaneous correlation across cross-sectional units and for autocorrelation. The results are similar to those presented in this chapter.

2.10 Conclusions

During the last decade in Poland, as in many high income countries before, skilled workers enjoyed a substantial increase of their earnings compared to less skilled workers' wages. This development stands in contrast to what trade theory predicts since according to the factor-proportions theory, international trade between a low skill abundant country and high skill abundant country should favor low skilled workers in the former and high skilled workers in the latter country.

However, the observed pattern is in accordance with the implications of the model of international outsourcing developed by Feenstra and Hanson (1996a). As stated by this model, the activities outsourced by developed countries are relatively low skilled for the home country and relatively high skilled for the host country leading to an increase of relative demand for skilled workers in both countries. Indeed, the increase of wage inequality between skills in Poland was accompanied by an enormous inflow of foreign capital into the country.

In this chapter, I analyzed the relationship between inward FDI and the increasing demand for high skilled workers in Poland. The empirical analysis shows that offshoring activities undertaken by MNEs are an important explanatory factor for the observed increase in relative demand for non-

production workers in the Polish manufacturing. Controlling for demand effects of privatization, technological change and international trade, time and industry fixed effects, FDI is found to have raised the non-production workers' wage bill share by 34 percent between 1994 and 2002. Accounting for endogeneity of foreign investment and relative wages by applying GMM techniques yields similar results.

In addition to FDI, as expected, the transition process to market economy has contributed substantially to the increase in high skilled workers' wages by freeing wage determination mechanisms and thus allowing for labor market adjustments. Furthermore, the analysis shows a negative influence of import penetration on the relative demand for high skilled workers which corroborates the predictions of the neoclassical trade theory. Finally, the R&D expenditures measuring technological change are positively correlated with non-production workers' wage bill share confirming the idea that technological change favors high skilled workers. The results concerning the influence of trade and technology are however not stable when analyzing relative wages. A more formal approach to investigation of the impact of technology and international trade on the skill premium in Poland is presented in the next chapter.

2.11 Appendix

Table 2.8: Definition and Source of Variables

Variable	Description	Source
wage bill share	share of non-production workers' wage bill in total wage bill	PSO, Rocznik Statystyczny Polski, various years
relativewages	non-production workers' wages relative to production workers' wages	PSO, Rocznik Statystyczny Polski, various years
relative employment	number of non-production workers relative to production workers	PSO, Rocznik Statystyczny Polski, various years
$(1+\frac{K^{FDI}}{K^D})$	one plus the ratio of foreign-owned fixed assets to domestic fixed assets	PSO, data obtained in the electronic form
$(1+\frac{E^{FDI}}{E^D})$	one plus the ratio of number of foreign firms to domestic firms	PSO, data obtained in the electronic form
K^D	domestic fixed assets	PSO, data obtained in the electronic form
$PRIVFIRM/FIRM$	share of private firms in total number of firms	PSO, Rocznik Statystyczny Przemysłu, various years
$R\&D/Y$	share of R&D expenditures in sales	PSO, Nauka i Technika, various years
IMP/Y	share of imports in sales	OECD, STAN database
EXP/Y	share of exports in sales	OECD, STAN database

PSO - Polish Statistical Office
OECD - Organisation for Economic Cooperation and Development

Chapter 3

Technology and Trade: Predicted Wage Inequality Changes in Poland

3.1 Introduction

In the previous chapter it was shown that, repeating the experience of high-income developed countries, Poland and other transition economies witnessed a sharp increase in the inequality of wages between skilled and unskilled workers after the fall of the socialist regime. Chapter 2 analyzed one of the possible causes proposed in the theoretical literature, international investment activity. The main finding of this chapter was that direct investment of foreign firms in Poland, as predicted by the theoretical model of Feenstra and Hanson (1997), have contributed significantly to the widening of the gap between skilled and unskilled workers' earnings.

This chapter shifts the focus from outsourcing to other prominent explanations for the change in wage inequality: international trade and technical change. In the previous chapter it was stressed, that during the 1990s Poland not only received a huge influx of FDI, but also experienced strong and sustained growth of imports and exports. The share of imports in GDP rose sharply in the 1990s, from 25 percent in 1991 to around 33 percent in

2003. Exports also grew, but at a slower rate than imports. Furthermore, the pattern of trade significantly evolved following the disintegration of the COMECON market. The European Union has become Poland's main trading partner, accounting for two thirds of its imports and exports.

In the case of developed countries, the debate on the role of international trade in general, and import from low-wage countries in particular, is not new. In the US and UK, relative wages of low-skilled workers fell dramatically during the 1980s and 1990s. At the same time the trade composition of developed countries with newly industrialized economies (NIE) started to change. NIEs began to export not only raw materials and agricultural products, but also manufacturing goods. For many economists the conclusion was straightforward: they have interpreted the observed wage changes in developed countries as a movement toward factor price equalization. That is, trade between developed countries that are well endowed in skilled labor and unskilled labor abundant developing countries was rising the wages of high skilled workers and lowering the earnings of low skilled workers in developed countries, as the factor-proportions model predicts.

Most empirical studies, however, attributed only a minor role to the international trade, and argued that the main driving force lies somewhere else. This skepticism was partly due to the lack of evidence of a reduction in wage inequality in less-developed countries. Moreover, the factor-proportions model says that international trade affects the income distribution via a change in relative prices of goods. So if international trade was the main cause of the increasing wage gap, we should observe a rise in the prices of skill-intensive products compared to those of unskilled labor-intensive goods. Studies on international price data, however, failed to find clear evidence of such a change in relative prices.

In terms of the traditional textbook factor-proportions model, the change of geographical trade orientation in Poland should rather diminish the wage inequality because for more than ten years Poland has mostly traded with countries that are relatively better endowed with human capital. Therefore, I expect that, like many empirical studies on developed countries, technical

change will prove to be the main driving force behind the increase in relative wages of skilled workers in Poland.

This chapter provides an econometric assessment of the influence of international trade and technological change on the wage gap between skilled and unskilled workers. For this purpose, an approach is used that links product prices, productivity changes and factor prices through zero-profit conditions. In the first step, the contributions of international trade and technology improvements to product prices and total factor productivity are estimated. In the second step it is analyzed to what extent these contributions have influenced the wage changes.

The rest of the chapter is organized as follows. The next section presents the Stolper-Samuelson theorem which is the theoretical base for the empirical analysis in this chapter and shows the relative skilled labor demand schedule in the Heckscher-Ohlin framework. In Section 3.3 an empirical model based on zero-profit conditions is derived. Section 3.4 provides an overview of the empirical literature concentrated around the Stolper-Samuelson theorem and demonstrates the evolution of the zero-profit conditions methodology. In Section 3.6 the estimation equations are discussed and a description of the variables is provided. Section 3.7 presents the estimation results. Finally, Section 3.8 concludes.

3.2 The Stolper-Samuelson Theorem

The first step in the reasoning is to clarify the circumstances under which international trade can influence wages. The theoretical framework guiding the empirical analysis in this chapter is the Stolper-Samuelson theorem which was originally derived to analyze the effects of a tariff on factor prices in the context of the Heckscher-Ohlin model (Stolper and Samuelson (1941)). More generally, however, this theorem tells us the effects on factor prices of any change in the prices of final goods, regardless of the reason. Therefore, as argued in the introduction, it is an important task for the empirical part to scrutinize the influence of international trade on domestic prices.

The Stolper-Samuelson theorem in its original setting (two factors and two sectors) can be explained intuitively as follows. Suppose that there are two sectors in a country, one produces machinery, the other one food. Both sectors exhibit constant returns to scale. Furthermore, we assume we have only two factors of production which are fully mobile between sectors: skilled and unskilled labor. The machinery sector is relatively skilled labor intensive, that is it employs a higher ratio of skilled to unskilled labor than the food sector for any factor prices, i.e. there are no factor intensity reversals. What will be the effect of a tariff or some other change that increases the relative price of the machinery sector's output in such a setup?

Clearly, it will stimulate the expansion of production in this sector. Given the economy is at or close to full employment of both factors, this increase has to come at the expense of the food sector. The combined expansion of the relatively skilled labor intensive sector and contraction of the relatively unskilled labor intensive sector raises the aggregate demand for skilled labor relative to unskilled labor, and so exerts an upward pressure on the skilled wage. Because skilled labor becomes more expensive, the ratio of skilled to unskilled workers falls in both sectors. Therefore the marginal product of skilled labor increases in terms of both goods, and therefore also the real wage of skilled workers rises in terms of both goods. The reverse is true for unskilled labor. All in all, the skilled workers gain and unskilled workers lose, regardless of which goods they consume.

The implications of this theorem are disturbing for skill-rich countries. While the Heckscher-Ohlin theory predicts that free trade between high skilled labor abundant countries and low skilled labor abundant countries would increase aggregate efficiency so that national wealth will grow for both countries, in the high skilled labor abundant countries this would be at the expense of falling low skilled wages and increasing inequality.

Furthermore, as Leamer and Levinsohn (1995) point out, if factor prices under free trade are set on world markets, then skilled and unskilled workers' wages in a small open economy will be, at least to some extent, insensitive to changes in relative factor endowments. This implication, called the Factor In-

sensitivity Theorem, is a necessary condition for the zero profit approach. In order to illustrate this argument, an economy-wide relative demand schedule needs to be derived.

3.2.1 Relative Labor Demand Schedule in Heckscher-Ohlin Model

Building on the previous example, when the machinery price increases relative to price of food, profit-seeking firms will move their production to markets that temporarily have a higher price. Therefore, as mentioned before, the output of the machinery sector expands and the relative demand for skilled labor increases. Since the model assumes the existence of perfect competition, which results in zero profits in equilibrium, at fixed factor supplies relative wages have to adjust to restore equilibrium.

Hence, the zero-profit conditions linking product prices to domestic factor prices take the following form:

$$p_j = \sum_{i \in I} a_{ij} w_i \tag{3.1}$$

where p_j is the price in sector j (machinery or food), w_i is the unit cost of the production factor i (unskilled and skilled labor), a_{ij} is the i factor requirement per unit of output of sector j.[1] For a small open economy p_j is not only a domestic but also a world price. Furthermore, since we assume that there is perfect mobility of factors between sectors, w_i are not indexed by sector j. If the economy is not fully specialized, that is produces both goods, then we have two zero profit conditions (applying to each sector) with two unknowns: skilled and unskilled workers' wages. Therefore, wages (w_i) are completely determined by the prices (p_j) and technology (a_{ij}). In other words, wages are insensitive to factor supply changes. However, if the economy specializes in production of only one good, we only have one zero profit condition with two unknowns, which implies that relative wages depend also on relative factor supply.

[1] a_{ij} is optimally chosen by profit-maximizing/cost-minimizing firms (assuming Cobb-Douglas production function).

Figure 3.1 shows the relative high skilled labor demand schedule for the two goods, two factors model outlined above, where machinery is skilled labor intensive (M) compared to food (F). $\frac{w^{HS}}{w^{LS}}$ is defined as the relative wage of high skilled workers, while $E(\frac{HS}{LS})$ denotes their relative endowment. The relative labor demand lines slope down, reflecting factor substitution within both industries. Consider the blue solid line, where the relative supply of skilled workers is very low. Below E^* country will only produce food. For food production, a relatively high number of unskilled workers is used and the relatively scarce skilled labor earns high wages.

Moving slightly to the right (so that we remain to the left of E^*) will increase the output of the food sector which will employ a higher ratio of skilled to unskilled workers than before and decrease the relative wages of skilled workers in order to maintain their employment. However, the relative wage of skilled workers will still be too high to make machinery production profitable (to the left of E^* profits in this sector are negative).

Machinery will not be produced until relative endowments are such as between E^* and E^{**}. Within this range both goods will be produced and so there will be only room for Rybczyński effect. That is, endowment changes within these boundaries will be completely absorbed by an increase in machinery sector output and contraction of food output without causing adjustments of relative factor prices. In this segment relative demand for skilled labor is perfectly elastic which is shown by the solid dark blue line. Furthermore, if the relative demand is higher than E^{**}, the unskilled labor will be relatively expensive so that profits in food production will fall below zero, and consequently only machinery will be produced. Here, again, the relative factor prices will depend also on relative factor endowment and not only on prices and technology (the solid black line).

Summarizing, when the relative endowments in skilled or unskilled labor are low, the economy specializes in one product only ($E < E^*$ or $E > E^{**}$) and the relative wages are determined by product prices, technology and relative labor endowment, while between these two extremes the economy produces both goods ($E^* < E < E^{**}$), so that the relative wages depend

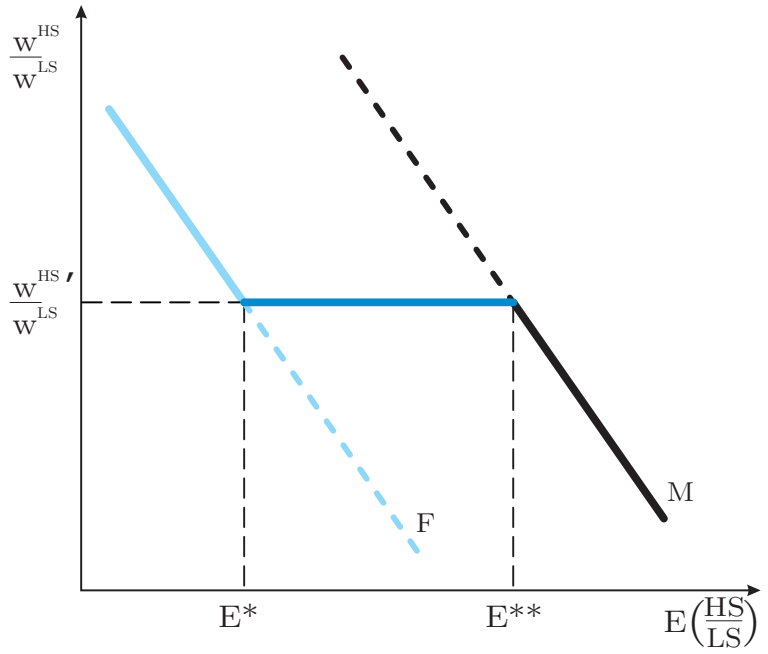


Figure 3.1: Relative Labor Demand in Heckscher-Ohlin Model

solely on product prices and technology and are insensitive to relative supply changes. Changes in prices or technology will also influence the position of relative demand schedule. In terms of Figure 3.1, the flat portion of relative demand for skilled labor will shift up when price and/or total factor productivity (TFP) growth is concentrated in the skill-intensive machinery sector, while it will move down when this growth is concentrated in the low skill-intensive food sector.

Haskel and Slaughter (2001) point out, that the above reasoning can be generalized for the case of I production factors and J sectors.[2] Then, if the number of factors is less or equal than the number of sectors ($I \leq J$), the factor rewards are completely determined by zero profit conditions, while for a larger number of factors than products ($I > J$) also factor supplies matter. Thus, assuming that the labor market is characterized by a flat portion of relative labor demand, equation (3.1) allows for assessment of relative wage

[2]Ethier (1974) and Jones and Scheinkman (1977) highlighted the central prediction of the generalized theorem which is valid for such relaxations: with many goods and factors a tariff change will always raise the real return of at least one factor and lower the real return of at least one other factor.

effects of change in prices and technology.

3.3 Empirical Model

This section provides a formalization of the arguments outlined above. The point of departure is an economy's entire set of zero profit conditions:

$$p_j = \sum_{i \in I} a_{ij} w_i + \sum_{k \in K} b_{kj} p_k \tag{3.2}$$

In comparison to (3.1) this equation contains an extra term: b_{kj} denoting the number of units of intermediate input k required to produce one unit of product j. The original version of Stolper-Samuelson theorem does not consider intermediate inputs, in the real world they are however important (Slaughter (2000b)).[3] This set of zero-profit conditions can be rewritten as follows:

$$p_j^{VA} = p_j - \sum_{k \in K} b_{kj} p_k = \sum_{i \in I} a_{ij} w_i \tag{3.3}$$

where p_j^{VA} designates value added prices.

Totally differentiating equation (3.3) and using the standard measurement of the growth of TFP[4] we obtain:

$$\widehat{p}_j^{VA} = \sum_{i \in I} \Theta_{ij} \widehat{w}_i - \widehat{TFP}_j \tag{3.4}$$

where Θ is a share of factor i in a cost of product j, and w is a change of wage of factor i.[5]

We can express this equation as a regression treating $\widehat{w}_i$ as the coefficient of the random variable Θ_{ij}:

$$\widehat{p}_j^{VA} = \sum_{i \in I} \Theta_{ij} \beta_i - \widehat{TFP}_j + \epsilon_j \tag{3.5}$$

[3] In Poland in 1990s intermediate inputs accounted on average for over 60 percent of sales (Rocznik Statystyczny Przemysłu).

[4] TFP is defined as the growth in output minus growth in production factors weighted by factor cost shares.

[5] Equation (3.4) is derived for infinitesimal changes. With discrete changes an extra term appears: $\widehat{p}_j^{VA} = \sum_i \Theta_{ij} \widehat{w}_i - \widehat{TFP}_j + \sum_i \Theta_{ij} \widehat{w}_i \widehat{a}_{ij}$.

where ϵ_j measures deviations of industry-specific factor price changes from their manufacturing-wide changes.[6] β_i, the coefficients on the factor cost shares (Θ_{ij}), are then to be interpreted as economy wide factor price changes predicted by the changes in prices and TFP. In other words, these are factor price changes that maintain zero profit conditions in all sectors following changes in prices and productivity. Feenstra and Hanson (1999) show that when fully specified, this regression becomes an identity. That is, they measure ϵ_j with available data for the US and subtract it from TFP obtaining a so called effective TFP. Using this measure in estimating equation (3.5) they obtain β that are similar to actual factor price changes. Therefore, regression (3.5) merely presents how prices and productivity move in accord with factor prices. Consequently, in order to identify the influence of international trade and technology on factor prices it is necessary to analyze the impact they have on product prices and productivity.

For this purpose Feenstra and Hanson (1999) develop the following **two stage** methodology. In the **first step**, price and TFP changes are endogenized. The impact of underlying regressors Z_{jl}, which are assumed to drive TFP changes over the examined period is modeled as:

$$\widehat{TFP}_j = \sum_{l \in L} Z_{jl}\delta_l + \nu_j \tag{3.6}$$

Furthermore, the productivity improvements might have an impact on price changes. Growth of productivity can be "passed through" to industry prices, if a country is large enough to influence world prices, or if technology shocks are common across countries (Krugman (2000)). Thus, TFP together with the structural variables Z_{jl} has further influence on price changes:

$$\widehat{p}_j^{VA} = \lambda \widehat{TFP}_j + \sum_{l \in L} Z_{jl}\gamma_l + \eta_j \tag{3.7}$$

where λ is the pass-through coefficient of productivity changes to price changes. Note, that in this equation Z_{jl} have a direct impact on prices and an

[6] These deviations can be explained by unobserved variation in factor quality or sector-specific rent. Following Feenstra and Hanson (1999) I assume that the only source of variation in factor prices is factor quality across industries, since this is consistent with the assumption of perfect mobility of factors among industries.

indirect impact through productivity. The need to include this direct impact comes from the possible presence of non-neutral technological progress. In the case of Hicks-neutral change any technological progress will be offset by a drop in price, so that γ will equal 0. In contrast, in the case of non-neutral, skill-biased technological progress, after an initial price decrease in response to technological change, price has to increase again because the relative demand for skilled labor has risen and therefore its wage. In this case γ is different from 0.[7] Thus, this approach enables to account for sector-biased as well as skill-biased technological change.

Merging the above equations, the total impact of the structural variables on prices and productivity can be expressed as:

$$\widehat{p}_j + \widehat{TFP}_j = \sum_{l \in L} Z_{jl}\phi_l + \mu_j \tag{3.8}$$

where $\phi = (1 + \lambda)\delta + \gamma$.

In the **second stage** the structural variables' contributions to $\widehat{p}_j + \widehat{TFP}_j$ are regressed on factor-cost shares (Θ_{ij}):

$$Z_{jl}\phi_l = \sum_{i \in I} \Theta_{ij}\rho_i + \upsilon_j \tag{3.9}$$

The second-stage coefficients (ρ_i) obtained from these regressions are then interpreted as changes in factor prices predicted by the structural variables working via changes of product prices and productivity growth, holding everything else constant.

This type of regression might appear counter-intuitive since the variable of interest, factor-price changes, is estimated rather than being the dependent variable. A standard regression cannot be used because the dimensionality of data hinders inversion of the factor requirements matrix. For example, my data set contains 95 manufacturing industries, but only 3 primary factors. Thus, this type of regression can be interpreted as math exercise, rather than as identifying causation usually assumed by the regression.

Summarizing, in the first stage contributions of each underlying structural variable to changes in value added prices and TFP are calculated, while the

[7] For a detailed discussion see Feenstra and Hanson (1999).

second stage estimates what changes in factor prices are predicted by these contributions.

3.4 Review of Product Price Studies

In recent years many economists have analyzed the role of international trade and technology in rising wage inequality. Most of these studies consider the experience of the United States. In this section I concentrate on papers which also apply the product price methodology.[8]

While Bhagwati (1991) was the first economist who links the rising wage inequality in the US to the apparent development in import and export prices, Lawrence and Slaughter (1993) are the first researchers to employ product price changes in econometric analysis in order to examine the Stolper-Samuelson theorem. As outlined in Section 3.2, according to this theorem an observed increase in relative wages of skilled workers should be correlated with a relative decline of prices in unskilled labor intensive sectors. The authors investigate whether prices of skilled labor-intensive commodities have increased relative to prices of products that intensively employ unskilled labor. For this purpose they regress domestic, import and export price changes on relative employment of skilled workers in US manufacturing over the 1980s and find that relatively skill-intensive sectors did not exhibit larger price increases than relatively low skill intensive ones. The authors assume that product price changes are completely determined by foreign developments and therefore they conclude that international trade in the 1980s in the US was not responsible for the increase in the wage gap between skilled and unskilled workers.

Using more or less the same data for the US, following a similar methodology and relying on the same assumption as the previous study, Sachs and Schatz (1994), obtain a contradictory result.[9] They come to this finding by simply adding a dummy for the computer industry to the price regression.

[8]For more extensive review see Slaughter (2002b).

[9]Sachs and Schatz (1994) define the 1980s as 1978 through 1989, while Lawrence and Slaughter (1993) employ data covering 1980 - 1989.

The authors argue that in the 1980s, the computer sector experienced a substantial decline in relative prices of computers corresponding to impressive productivity gains, although an exact measurement of the price and productivity change in this sector is difficult. For that reason, it seems to be appropriate to exclude this sector from the regression. Thus, they conclude that in the course of 1980s, that among remaining (non-computer) sectors characterized by a large share of production workers in total employment witnessed lower relative price increases than sectors where non-production workers dominate.

The approach of Feenstra and Hanson (1996a) is different. First, they do not assume that changes in domestic prices merely track changes in international prices. Second, in their framework countries produce different sets of goods rather than are assumed to belong to the same diversification cone. Their analysis is based on the model of international outsourcing presented in the same paper (this model was briefly outlined in the previous section). A corollary of the shift in relative demands and corresponding increase in relative wage of skilled workers in both countries, North and South, is that "the price index of the Northern inputs relative to that of the South" rises. The authors perceive this as a modified Stolper-Samuelson theorem with the difference to the original that prices refer to the intermediate rather than final goods. They observe that in the 1980s, US-domestic prices rose stronger than import prices and conclude that this fact supports the idea that outsourcing of production of relatively low-skill intensive intermediaries and importing them back have contributed to an increase in US wage inequality.

Leamer (1998) also uses the zero profit conditions methodology. Unlike Lawrence and Slaughter (1993) and Sachs and Schatz (1994) who assumed that US is a small price taking economy where domestic prices are completely determined by international developments, he allows the technological progress to have an impact on price changes. He introduces a "pass-through" coefficient that describes how much of TFP growth is assumed to be transferred into product price declines. Leamer (1998) considers different pass-through coefficients of 0 and 1. The portion of product price changes

not accounted for by TFP changes is then interpreted as generally associated with globalization. The price regressions in his study estimate the factor price changes "mandated" by product price changes, and depending on the pass-through coefficient and/or technology. He weights industries by employment or value added. The estimated coefficients in those regressions are then tested by comparison with apparent factor price changes. He analyzes the wage implications of product-price shifts during the 1960s, 1970s and 1980s in US using different combinations of primary factors of production, skills, and pass-through rate.[10] He concludes that results concerning 1960s are unclear, because various combinations yield contradictory predictions about inequality, while 1970s appear to be a Stolper-Samuelson decade "with product price changes causing increases in inequality". The results for the 1980s vary between different skill measures with the non-production - production workers measure "mandating" rising inequality. Furthermore, globalization effects tend to dominate technology effects through all three decades.

Krueger (1997) applies both types of regression presented above to analyze the influence of price changes on wage inequality in the US in the 1990s (defined as 1989 through 1994). He regresses product price changes on relative industry factor employment, the share of production workers in particular, both with and without a dummy variable for the computer industry. Both regressions yield negative statistically significant coefficients, which implies that prices of skill-intensive goods did increase in the examined period.

Furthermore, he employs the methodology of Leamer (1998), however he is not trying to identify the sources of product price changes. Thus, he uses only price changes as a dependent variable (domestic producer prices mostly in final goods sectors). The author includes "more skilled" and "less skilled" labor, capital and materials as independent variables. He finds that price

[10]Leamer (1998) uses the following combinations of primary factors: capital and labor, capital plus labor disaggregated according to the rule that industries characterized by higher wages are also more skill-intensive, and finally capital, non-production and production workers.

changes have warranted the rise in inequality between skilled and unskilled workers. Comparing his results from both approaches with the observed wage development, Krueger (1997) concludes that the extent of price changes is approximately comparable with apparent wage changes, thus, his analysis corroborates the theoretical implications of the Stolper-Samuelson theorem.

The studies presented above, however, do not provide any direct evidence to what extent product prices depend on international trade. Instead, they just assume that changes in domestic prices trace international developments. The first attempt to distinguish between technology and what he calls globalization effects was done by Leamer, but he does not attribute the latter to any specific factor associated with international trade, such as trade barriers. Feenstra and Hanson (1999) were the first researchers to endogenize price and productivity developments. They argue that outsourcing of low-skill intensive activities by changing the output mix of US economy influences total factor productivity growth.[11] Furthermore, they allow productivity to affect product prices, without constraining its influence to any a priori assumed rate.

The authors refine the zero profit condition framework used by Leamer (1998) to the two stage methodology outlined in the previous section. In the first step, they regress product-price changes plus observed TFP growth on structural variables: outsourcing and real expenditures on high-technology equipment, presumably measuring the influence of international trade and technological progress. Outsourcing is proxied by imported intermediate inputs relative to total expenditure on non-energy intermediaries, to which they refer as a broad measure. And also by imported intermediate inputs from the same sector relative to total expenditure on non-energy intermediaries which they call a narrow measure. The rationale behind this is the concept that foreign outsourcing is supposed to measure activities that are transferred abroad but could have been done in the US. They find, that both outsourcing and high-tech equipment positively influence the sum of product-

[11] Again, Feenstra and Hanson (1999) build on their model of international outsourcing presented in the previous chapter.

price changes and TFP growth. Thus, in the first stage the observed changes in prices and TFP are decomposed into portions contributed by outsourcing and high-tech equipment.

In the second stage these components are regressed on factor-cost shares and the obtained coefficients are interpreted as warranted wage changes that can be attributed to international trade and technological progress. Here it appears that for the US between 1979 and 1990, the narrow outsourcing measure predicts about 15 percent of the increase in wage gap between skilled and unskilled workers, while 35 percent can be ascribed to technology.

Haskel and Slaughter (2001) apply the two stage methodology to study the sources of changes in wage inequality in the UK in the 1970s, when the wage gap between skilled and unskilled workers declined and 1980s, when the wage disparity increased. Their approach differs from Feenstra and Hanson (1999) in terms of assumptions. They assume that productivity growth cannot influence product price changes and assess predicted wage and inequality changes separately for trade and technology. The authors find that price changes mandated an increase in inequality in the 1970s and 1980s, while growth in productivity predicted a rise in inequality in the 1970s and a decline during 1980s in the UK. The positive effect of TFP changes in 1970s is attributed to innovation activity and international competition. The negative effect of productivity growth in 1980s is due to union density. Regarding price changes, the authors find that trade played its role in the 1970s through the sector bias pressures on domestic prices, but not in the 1980s. That is, the question of what determined the positive influence of price developments on wage inequality in the 1980s remains unanswered.

3.4.1 Summary of Literature

The studies by Lawrence and Slaughter (1993) and Sachs and Schatz (1994) merely check the consistency of product price changes and observed developments in wage inequality. They do so by investigating the relationship between price changes in industries and their skill intensity. That is, if the price of products employing skilled workers relatively intensively is found

to increase, they interpret this as a manifestation of the Stolper-Samuelson theorem and because of the small price taking country assumption also as influence of international trade. These studies, however, cannot assess to what extent the product prices possibly contributed to factor price changes. Furthermore, they only broadly capture the gist of the Stolper-Samuelson theorem, as they relate price changes to factor employment levels, while equation (3.4) provides a link between price changes and factor cost shares (Slaughter (2000b)) and employ only final good factor intensities ignoring those incorporated in intermediate inputs. Finally, such analysis does not contain any evidence about the sources of observed price changes.

The "mandated" wages methodology surpasses "consistency check" regressions in a few important aspects. First, the former approach is based on zero profit conditions and therefore closer to the Stolper-Samuelson theorem. Second, this framework can be utilized not only for analyzing the impact of price changes, but of productivity growth as well, as shown by Leamer (1998) and Feenstra and Hanson (1999). Third, these studies enable assessment of the contribution of technology and prices to wage development as the wage changes predicted by price and technological progress can be compared with observed wage changes. Finally, the two stage procedure elaborated by Feenstra and Hanson (1999) provides a link between factor price changes and international trade and technology, as it allows to attribute product price and productivity developments to factors associated with international trade and technology indicators.

3.5 Estimation Strategy

As argued in the discussion in the previous section, the two stage approach proposed by Feenstra and Hanson (1999) provides the best approximation of factor price changes predicted by increase in international trade and technological progress to maintain the zero profit condition in each producing sector. Therefore, I will apply this estimation technique to Polish manufacturing industries for the period from 1994 to 2002. All the below equations constitute

cross sectional models which can be estimated by OLS across sectors.

I will precede the analysis with a so called "consistency check" regression, cited in the review of empirical literature, in order to show that results change substantially when accounting for the presence of intermediate inputs and using factor cost shares rather than relative factor intensities. This regression takes the form:

$$\Delta \, ln \, p_j = \alpha \left(\frac{L^{HS}}{L^{LS}} \right)_j + \varepsilon_j \tag{3.10}$$

where $\Delta \, ln \, p_j$ is the final good price growth rate between 1994 and 2002 and $\left(\frac{L^{HS}}{L^{LS}} \right)_j$ is the average non-production to production employment ratio in industry j over this period.

Next, the model derived from the zero profit conditions under the assumption of exogeneity of TFP and value added price changes will be estimated to show that such an approach leads to a prediction of wage changes that are necessarily similar to observed wage adjustments. Following equation (3.4) I will estimate three regressions:

$$\Delta \, ln \, TFP_j = \sum_{i \in I} \Theta_{ij} \beta_i + \varepsilon_j \tag{3.11}$$

$$\Delta \, ln \, p_j^{VA} = \sum_{i \in I} \Theta_{ij} \beta_i + \varepsilon_j \tag{3.12}$$

$$\Delta \, ln \, p_j^{VA} = \lambda \Delta \, ln \, TFP_j + \sum_{i \in I} \Theta_{ij} \beta_i + \varepsilon_j \tag{3.13}$$

where $\Delta \, ln \, TFP_j$ is the TFP growth rate in each industry j between 1994 and 2002 and Θ_{ij} denotes the factor cost shares, while λ is again defined as the "pass-through" coefficient of TFP growth to value added prices.

Finally, I will adopt the two stage approach to the data. In the first stage, as outlined above, I regress TFP growth and value added price changes on a set of underlying regressors.

$$\Delta \, ln \, p_j^{VA} + \Delta \, ln \, TFP_j = \sum_{m \in M} Z_{mj} \delta_m + \varepsilon_j \tag{3.14}$$

where Z_{mj} is a set of structural variables m.

I will also present the estimates decomposing the dependent variable from (3.14):

$$\Delta \, ln \, TFP_j = \sum_{m \in M} Z_{mj} \phi_m + \varepsilon_j \tag{3.15}$$

$$\Delta \, ln \, p_j^{VA} = \sum_{m \in M} Z_{mj} \gamma_m + \varepsilon_j \tag{3.16}$$

Additionaly, in order to address the hypothesis of skill-biased technological change, following equation (3.7) I will estimate:

$$\Delta \, ln \, p_j^{VA} = \lambda \Delta \, ln \, TFP_j + \sum_{m \in M} Z_{mj} \rho_m + \varepsilon_j \tag{3.17}$$

If ρ in this regression are significantly different from 0 I will interpret this as presence of non-neutral technical change and justification of the assumption of TFP determinants also having direct influence on value added prices.

Finally, the second stage will be estimated:

$$\delta_m Z_{mj} = \sum_{i \in I} \Theta_{ij} \sigma_i + \varepsilon_{mj} \tag{3.18}$$

where $\delta_m Z_{mj}$ are the contributions of structural variables m to value added price and TFP changes from regression (3.14). The estimated coefficients, σ_i, are then interpreted as factor-price changes predicted by international trade and technology development that are transmitted to domestic product price changes and growth of TFP.

3.6 Variables and Data

The first stage requires the identification of variables that can provide a link between international trade and technology development and product price changes plus TFP growth. The first component of the dependent variable - changes of value added prices - has been computed from the volume of value added in current and constant prices. The second component is a primal TFP measure defined as the growth of value added minus the factor cost share weighted average growth of primary inputs: non-production and production workers and capital. I impose the assumption of perfect competition, so that

revenue equals costs, and thus cost shares are measured by revenue shares. The cost share of capital is then one minus the cost share of non-production and production workers.

3.6.1 Structural Variables for the First Stage

The influence of international trade is measured by changes in prices of imports ($IMPORT\ PRICES$) and the share of exports and import in sales (EXP/Y and IMP/Y, respectively). Concerning the import prices, recall that Lawrence and Slaughter (1993) and Sachs and Schatz (1994) simply assume that US domestic prices track changes on international markets. By introducing this variable I want to measure to what extent the changes in domestic prices really reflect international developments. For example the differences between domestic and import prices can be explained by existence of trade restrictions.[12]

Another explanation is that importers and wholesalers face a series of binding internal constraints when they want to increase their sales. Then, declines in world prices will be only imperfectly transmitted to domestic prices because, if existing sales are constrained by marketing capacity, importers will compensate the rising marketing costs by raising their selling prices. Potentially, this bottleneck approach can apply to a variety of costs, such as processing, distribution and transportation, all of which play a significant role in setting domestic prices in commodity markets.

Regarding import and export, I include these variables to test the hypothesis that international trade induces changes in productivity. It can be understand twofold. First, imports and exports can enhance productivity of domestic producers through the competition channel. In this context, of course, also import prices may have impact on TFP. In sectors characterized by declining world prices competition is more fierce. On the other hand, export and import, as argued by Feenstra and Hanson (1999), can also have influence on the output mix. That is, goods that were previously produced at home are gradually replaced by imports, because they can be produced

[12]Due to the lack of data I cannot include tariffs or import quotas in my analysis.

more efficiently abroad, which results in an increase of productivity as the home country is concentrating on goods in which it has a cost advantage.

The different technological opportunities in various industries are measured by two variables: share of R&D expenditures in sales ($R\&D/Y$)and computer intensity of sales ($COMPIND/Y$). The latter is included for robustness, since Poland in general is not perceived as a worldwide technology leader and most of its technical improvements in production processes are probably coming from purchases of new technology, imitation, technology spillovers or are brought to the country by foreign firms.

Moreover, I added the privatization and foreign capital measures in order to account for the transition and liberalization process in Poland, which both could have influenced the observed increasing skill premium. Privatization is measured by the share of private employment in the total employment ($PRIVEMP/EMP$) and the foreign capital by the foreign share in total equity ($FORCAP/CAP$). The rationale here is that privatization and FDI might have led to organizational change which has an effect similar to skill-biased technical change. Empirical literature provides a lot of evidence on the role of the increasing diffusion of new organizational practices within firms in the increasing demand for skilled workers.

For instance, Greenan and Guellec (1998) find that organizational change - such as greater worker autonomy and increased communication among workers - was positively correlated with skill upgrading in France. Again with regard to France, Thesmar and Thoenig (2000) and Caroli et al. (2001), find respectively a strong negative correlation between product turnover and the number of blue-collar workers, and a skill bias effect resulting from organizational change in association with a reduction in the firm's size, which probably suggests an evolution toward more flexible firms. Caroli and Van Reenen (2001) compare two panels of French and British firms, focusing mainly on organizational change. Their results, which supported the skill-biased technological change hypothesis, prove to be econometrically significant in both panels.

Furthermore, it has been recognized that FDI has a great potential to

enhance the catching-up process in transition countries, since it brings technology and managerial know-how. Private firms, as argued in the previous chapter, have stronger incentives to reorganize and modernize aiming at efficiency improvement than their public counterparts. In a recent paper, Brown, Earle, Telegdy (2004) analyze the impact of privatization on productivity in Romania, Hungary, Ukraine and Russia. They find privatization substantially raising productivity in Romania and Hungary. Moreover, privatization to foreign rather than domestic investors appears to have a stronger impact.

3.6.2 Dependent Variables for the Second Stage

In the second stage, the portions of the sum of value-added prices and TFP changes explained by independent variables from the first stage are regressed on the factor cost shares in value added. The dependent variable is obtained by multiplying the first-stage coefficients with respective first-stage independent variables, while factor cost shares are average values over the period 1994 to 2002.

3.6.3 Data

Data on non-production and production workers, sales, value added, employment, R&D expenditures and industrial computers are provided in electronic form at 3-digit NACE level by the Polish Statistical Office (PSO), while the information about imports and exports has been computed from the UN Commodity Trade Statistics Database (UN COMTRADE).[13]

3.7 Estimation Results

Before presenting results from the two stage procedure, in Table 3.1 the "consistency check" regressions are reported. These regressions investigate whether prices of skilled labor intensive commodities have increased relative to prices of goods that predominantly require unskilled labor in their

[13]For detailed description of data and variables see Appendix.

production.

Table 3.1: "Consistency Check" Regressions

dependent variables: *changes in product prices*		
	(1)	(2)
share of non − production workers in production employment	0.059* (0.032)	0.086*** (0.028)
computer industry dummy		-1.026*** (0.094)
R^2	0.013	0.183
N	95	95

Notes: Parameters are estimated by OLS regressions; *** (**,*) significant at 1 (5, 10) percent level; standard errors robust to heteroscedasticity in parentheses; N - number of observations.

In column (1) of Table 3.1 product price changes are regressed on the relative skill intensity of sectors measured by the share of non-production workers in production workers' employment as equation (3.10) shows. In column (2) following Sachs and Schatz (1994) the dummy variable for the computer industry is included. These regressions suggest that in the period between 1994 and 2002 relative prices of goods that relatively intensively employ skilled workers increased in Poland. However, as has been criticized above, such an approach only broadly captures the Stolper-Samuelson logic and therefore may not be as informative as the zero profit conditions approach. Gradual refinement of the empirical methodology in the subsequent part of chapter will show that the result obtained from the "consistency check" regression cannot be used to infer on the role of international trade in the development of factor prices.

3.7.1 One-Stage Mandated Wage Regressions

For the purpose of this section it is assumed that value-added price changes and TFP growth are exogenous, that is equations (3.11), (3.12) and (3.13) are estimated. Table 3.2 reports the results of these one stage regressions for

Poland. Dependent variables are TFP in the two first and price changes in the four remaining columns. They are regressed on three primary factors: non-production workers' cost share, production workers' cost share and capital cost share. The estimated coefficients should be interpreted as respective factor renumeration changes "mandated" by the change in dependent variable.

In order to read this table first consider column (1). The coefficient on non-production workers' share indicates that the productivity changes predicted a rise in the skilled wage of 435 percent to maintain zero profit conditions in all sectors. Similarly, the predicted change in the production workers' wage was a fall of about 8 percent. This coefficient is however statistically insignificant. In the last row, the change in wage inequality is reported. Here, the growth of productivity predicted an increase of inequality by 442 percent (equal to 434.5 rise in skilled wage minus a 7.9 percent drop in unskilled wage).

In the second regression, following Sachs and Schatz (1994), the dummy variable for the computer industry is added. The coefficient on the dummy appears to be insignificant but its inclusion diminishes the growth of predicted inequality to 330 percent. Regarding price changes reported in columns (3) to (6), in specification (3) they predict a fall in non-production wage by 76 percent and an increase in production wage by 27 percent, both insignificantly. This means that price changes predicted a fall in inequality by 103 percent, at least in the regression without the computer dummy. The addition of the computer industry dummy in column (4) substantially decreases the predicted change in inequality to 2 percent only.

In the last two columns I allowed productivity changes to have an impact on prices. The coefficient on TFP can be interpreted as λ, the pass-through coefficient from equation (3.13). Its statistical significance in both regressions implies that, at least to some extent, the growth of TFP is translated into a fall in product prices. Adding TFP to price regression considerably changes the result. In specifications (5) and (6) changes in prices predicted a rise in inequality by 60 and 76 percent, respectively. The argument of Feenstra

Table 3.2: One-Stage Mandated Wage Regressions

dependent variables: *(1)-(2): changes in TFP, (3)-(6): changes in value added prices*						
	(1)	(2)	(3)	(4)	(5)	(6)
TFP					-0.154^{**}	-0.105^{*}
					(0.071)	(0.050)
$non-production\ workers'\ share$	4.345^{**}	3.569^{*}	-0.765	-0.057	0.869^{*}	1.068^{**}
	(1.810)	(1.911)	(1.065)	(0.881)	(0.374)	(0.412)
$production\ workers'\ share$	-0.079	0.269	0.267	-0.033	0.269^{**}	0.304
	(0.669)	(0.754)	(0.330)	(0.288)	(0.115)	(0.202)
$capital\ share$	-0.481	-0.496	1.338^{*}	1.317^{*}	0.215	0.247
	(0.735)	(0.727)	(0.648)	(0.651)	(0.168)	(0.154)
$computer\ industry\ dummy$		0.700		-0.677^{***}		-0.371^{***}
		(0.700)		(0.139)		(0.104)
$predicted\ change\ in\ inequality$	4.424	3.300	-1.032	-0.024	0.600	0.764
R^2	0.748	0.772	0.567	0.597	0.887	0.917
N	95	95	95	95	95	95

Notes: Parameters are estimated by OLS regressions; *** (**,*) significant at 1 (5, 10) percent level; standard errors robust to heteroscedasticity in parentheses; N - number of observations.

and Hanson (1999) outlined above, that if fully specified such a regression necessarily predicts wage changes that have actually occurred, is visible in column (5). The estimated wage changes in this specification, 87 percent for non-production workers and 27 percent for production workers are almost equal to the observed wage changes: 63 and 29 percent, respectively.[14]

Table 3.2 and the above discussion clearly show that in order to analyze the influence of international trade and technology on skilled and unskilled wages it is necessary to endogenize the changes in value added prices and TFP, which is done below.

3.7.2 First Stage Regressions

Table 3.3 reports results of estimating equations (3.14), where the changes in value added prices and growth in TFP are regressed on a set of structural variables. Additionally, the estimations for both components: TFP growth and changes in value added prices are presented separately, as in equations (3.15) - (3.17). In the first two columns the dependent variable is the sum of value added price changes and the growth of TFP, in specifications (3) and (4) it has been replaced by the TFP growth and in the last four columns by changes in value added prices.

First consider columns (1) and (2). Both technology variables, share of R&D expenditures in sales as well as a number of industrial computers divided by sales, have a positive and statistically significant influence on changes in value added prices plus TFP growth. The magnitude of foreign presence is also positively and significantly correlated with the dependent variable, while the extent of privatization negatively influences the sum of value added price changes and TFP growth. Furthermore, the coefficient on the share of imports is negative and statistically significant. Considering the share of exports in sales its coefficient has a positive sign but is statistically insignificant. Finally, the import prices coefficient has a negative sign while being statistically significant in column (1) and only slightly over the 10

[14]The estimates of wage changes from columns (5) and (6) are slightly different from observed wage changes due to deviations of industry specific wage changes from their manufacturing wide changes.

Table 3.3: First Stage Regressions

dependent variables:	*changes in value added prices + changes in TFP in columns (1) and (2)* *changes in TFP in columns (3) and (4)* *changes in value added prices in columns (5) - (8)*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$R\&D/Y$	35.202***		43.246**		−20.030		15.028	
	(10.013)		(15.247)		(12.201)		(9.620)	
$INDCOMP/Y$		2.449**		3.891**		−0.866		0.106
		(1.005)		(1.398)		(1.249)		(0.903)
$FORCAP/CAP$	1.934***	2.146***	1.702***	1.978***	0.846*	0.807	1.141***	0.955**
	(0.223)	(0.338)	(0.321)	(0.412)	(0.450)	(0.491)	(0.260)	(0.350)
$PRIVEMP/EMP$	−0.529**	−0.764***	0.223	−0.063	−1.434***	−1.377***	−0.633***	−0.725***
	(0.176)	(0.223)	(0.426)	(0.427)	(0.446)	(0.454)	(0.149)	(0.160)
IMP/Y	−0.038**	−0.146***	0.161***	−0.007	−0.238***	−0.204**	−0.113***	−0.141***
	(0.016)	(0.041)	(0.021)	(0.060)	(0.033)	(0.071)	(0.027)	(0.021)
EXP/Y	0.089	0.288	0.496**	0.734***	−0.514*	−0.655**	−0.143	−0.153
	(0.159)	(0.180)	(0.197)	(0.231)	(0.263)	(0.266)	(0.154)	(0.165)
$IMPORT\ PRICES$	−0.116**	−0.108	−0.195**	−0.156	0.121*	0.142*	−0.025	−0.014
	(0.047)	(0.062)	(0.070)	(0.095)	(0.067)	(0.080)	(0.040)	(0.036)
TFP							−0.534***	−0.398**
							(0.134)	(0.141)
constant	1.115	1.214	−0.316	−0.242	1.81	1.762	1.262	1.36
	(0.115)	(0.155)	(0.309)	(0.322)	(0.300)	(0.286)	(0.125)	(0.146)
R^2	0.913	0.846	0.887	0.853	0.832	0.814	0.932	0.913
N	90	90	90	90	90	90	90	90

Notes: Parameters are estimated by OLS regressions; *** (**,*) significant at 1 (5, 10) percent level; standard errors robust to heteroscedasticity in parentheses; N - number of observations.

percent threshold in specification (2).

Columns (3) to (6) provide background information for first two specifications by presenting estimation results for decomposed dependent variable from columns (1) and (2). Specifications (3) and (4) show that as expected both measurements of technology have enhanced TFP growth. The same applies to foreign capital, TFP growth appears to be stronger in industries that are characterized by a relatively high share of foreign capital. The $PRIVEMP/EMP$ coefficient delivers an ambiguous result. In specification (3) it is positive, while in column (4) it is negative, and in both it is statistically insignificant. That is, contrary to the expectations, privatization does not seem to raise productivity. Considering the import share, in column (3) the coefficient on this variable is positive and statistically significant, while in column (4) it becomes negative and very low and it is no longer significant. The export share in sales yields a more consistent result, as it is positive and statistically significant in both specifications. With regard to import prices, their changes negatively influence TFP growth, again being statistically significant in column (3) and narrowly missing the 10 percent significance level in specification (4). Overall, in sectors more exposed to international competition TFP growth tends to be higher, as expected.

In columns (5) and (6), changes in value added prices are regressed on structural variables. All variables except import prices and the share of foreign capital in total equity negatively influence the dependent variable. That is, in sectors with high shares of private employment and large shares of export and import, the value added prices tend to grow slower, while in industries characterized by relatively large share of foreign capital, value added prices increase faster. The technology variables also influence value added prices in a negative way, insignificantly so. The intuitive explanation here is that these both variables are important determinants of TFP growth, and the positive changes in TFP as shown by next two columns, are to some extent transmitted as a negative effect on value added price changes. Regarding the $IMPORT\ PRICES$ coefficient, recall that it measures the extent to which development in world prices is conveyed to domestic prices. It

appears that changes in domestic value added prices are positively correlated with import prices, the coefficient is however significant only at 10 percent level. This result suggests that although a link exists between international and domestic commodity markets, it is less strong as one would expect.

Finally, in the last two columns I test for the presence of skill biased technological change. As argued in Section 3.3, structural variables can have a direct and indirect, through TFP growth, impact on value added prices. When estimating columns (1) and (2) I assumed that both effects take place, that is the value added price changes are influenced by sector biased and skill biased technological change. Following equation (3.17) I add TFP growth as an independent variable to regressions determining changes in value added prices in columns (6) and (7). The statistical significance of structural variables in those specifications indicates that even after accounting for TFP growth those variables have influence on changes in value added prices through non-neutral technical change. The results in the last two columns confirm that indeed, in the case of foreign capital, privatization and imports, my assumption was correct.

3.7.3 Second Stage Regressions

Table 3.4 reports the estimation results of equation (3.18) for each of the determinants of the sum of value added price changes and TFP growth from Table 3.3. The upper part of this table employs portions of value added price and TFP changes explained by row regressors from column (1), while the lower part shows the estimation results for independent variables taken from column (2) of Table 3.3. Again, the coefficients presented in this table should be interpreted as changes of remuneration of respective production factors that have been "mandated" by changes in value added prices and productivity attributed to structural variables from Table 3.3 to maintain zero profit conditions in each sector. In other words, for each structural variable its warranted change in non-production workers' wages, production workers' wages and the change in inequality is predicted.

Three significant results can be derived from Table 3.4. First, both vari-

Table 3.4: Second Stage Regressions

dependent variable: *portions of changes in value added prices + changes in TFP explained by* [a]*:*	$R\&D/Y$	$FORCAP/CAP$	$PRIVEMP/EMP$	IMP/Y	EXP/Y	$IMPORT\ PRICES$
$non-production$ $workers'\ share$	1.066** (0.391)	1.302* (0.739)	−0.364 (0.575)	−0.259 (0.178)	0.022 (0.032)	0.162 (0.231)
$production$ $workers'\ share$	0.059 (0.150)	0.055 (0.295)	−0.332 (0.318)	0.065 (0.072)	0.086*** (0.016)	−0.118 (0.117)
$inequality$	1.007	1.247	−0.032	−0.324	−0.064	0.280
dependent variable: *portions of changes in value added prices + changes in TFP explained by* [a]*:*	$INDCOMP/Y$	$FORCAP/CAP$	$PRIVEMP/EMP$	IMP/Y	EXP/Y	$IMPORT\ PRICES$
$non-production$ $workers'\ share$	1.664* (0.884)	1.445* (0.821)	−0.525 (0.831)	−0.990 (0.679)	0.070 (0.103)	0.151 (0.215)
$production$ $workers'\ share$	−0.492 (0.374)	0.061 (0.328)	−0.479 (0.459)	0.247 (0.275)	0.280*** (0.053)	−0.110 (0.109)
$inequality$	2.156	1.384	−0.046	−1.237	−0.210	0.261

[a] Dependent variables have been constructed by multiplying the coefficients from Table 3.3 by the respective variable (for the upper part of table coefficients from column (1) have been used, while for the lower part - coefficients from column (2)).
Notes: Parameters are estimated by OLS regressions; *** (**,*) significant at 1 (5, 10) percent level; standard errors robust to heteroscedasticity in parentheses.

ables measuring technology parameters, $R\&D/Y$ and $INDCOMP/Y$, predicted a substantial increase in non-production workers' wages compared to production workers. In the case of industrial computers it even "mandated" a fall in earnings of unskilled workers, however insignificantly. It appears that growth of TFP induced by R&D and high-tech equipment was concentrated in skill-intensive industries throughout the examined period, and therefore raised inequality.

Second, also foreign capital predicted an increase in the gap between skilled and unskilled workers' earnings by "mandating" a considerable increase in skilled wages. As argued above, the interpretation here is that during the period examined, the magnitude of foreign activities led to organizational change that was biased toward non-production workers. This is confirmed in column (5) and (6) of Table 3.3 where this variable appears to be significant which indicates the presence of skill biased technological change in sectors with high shares of foreign capital in total equity. Additionally, specifications (3) and (4) of the same table support the idea that foreign firms also generated sector biased technological change in skill intensive industries.

Finally, the export share in sales, as pointed out in the introduction, predicted a fall in inequality "mandating" a stronger increase of production workers' wages than non-production workers' wages, which is in line with predictions of the Heckscher-Ohlin theory that in Poland, as a low skilled labor abundant country in comparison to its trading partners, low skilled workers would benefit from trade. This result can be regarded as an indication that the growth in productivity enhanced by exports took place in low skill intensive, rather than high skill intensive sectors. For the sake of completeness it must be mentioned that, the other structural variables, $PRIVEMP/EMP$, IMP/Y and $IMPORT\ PRICES$, yield insignificant results regarding changes in skilled and unskilled workers' reward.

To conclude this section, it is important to discuss the differences between the "mandated" changes in wage inequality presented in Table 3.4 and the actual changes, 63 percent and 29 percent for non-production and production workers, respectively, corresponding to a 34 percent growth in wage disparity.

The fact, that the predicted changes in the case of both technology measures as well as foreign capital measure amount to more than 100 percent of actual growth of wage inequality can be explained in two ways. On one hand, the coefficients from Table 3.3 used for calculation of dependent variables for Table 3.4 were estimated holding other independent variables constant and thus the predicted changes in inequality are calculated neglecting other changes that might also influence them.

On the other hand, for the purpose of analysis in this chapter it was assumed, that any labor supply shifts cause only Rybczyński effects, that is an increase in skilled workers supply would induce expansion of production in sectors relatively intensively employing skilled workers. However, with the assumed labor demand function, when labor supply shock is large enough it can even stimulate a country to produce a different set of products, which in terms of Figure 3.1 would mean movement to another flat part of the function. Thus, as the relative number of skilled workers steadily increased in the course of transformation in Poland, the growth of inequality could have been dampened.

3.8 Conclusion

This chapter is a contribution to the intense economic debate about the impact of international trade and technology on growth of inequality between earnings of high skilled and low skilled workers that was observed in many countries during the last 25 years. During the last decade, also high skilled workers in Poland benefited from a sharp increase of their earnings compared to low skilled workers, as wage inequality grew by 4.1 percent per year on average. The theoretical literature offers three possible explanations of this phenomena, related to technology, international trade and international outsourcing. This chapter is dedicated to the analysis of the role international trade and technology have for the apparent labor market adjustment in Poland, while the outsourcing hypothesis was the subject of Chapter 2.

For this purpose, a two stage approach to zero profit conditions methodology elaborated by Feenstra and Hanson (1999) in the context of the US

is applied to data from Polish manufacturing spanning 1994 to 2002. This method is superior to earlier approaches as it allows to identify what underlying forces cause changes in productivity and prices in each sector which in turn influence factor price changes.

The analysis shows that in Poland both technology and international trade have contributed to development of wage inequality between skilled and unskilled workers. These forces, however worked against each other: the technology variables contributed substantially to TFP growth in skilled intensive sectors and therefore predicted the increase in wage inequality, while productivity changes induced by export were apparently concentrated in low skilled intensive sectors causing exports to "mandate" a fall in inequality. Given that Poland is relatively low skilled labor abundant, the latter result confirms a textbook prediction of the Heckscher - Ohlin model, that the abundant factor will benefit from international trade. However, this negative effect on wage disparity is small compared to technology contribution, which prevails.

3.9 Appendix

Calculation of TFP growth

TFP growth was constructed as:

$$\Delta \, ln \, TFP_j = \Delta \, ln \, VA_j - (\Delta \, ln \, L_j^{HS} \Theta_{HSj} + \Delta \, ln \, L_j^{LS} \Theta_{LSj} + \Delta \, ln \, K_j \Theta_{Kj})$$

where VA_j is defined as value added in sector j, L_j^{HS} and L_j^{LS} denote non-production workers and production workers in sector j, respectively, K_j stands for capital stock in sector j, and Θ_{ij} denotes every factor share in cost function. Since the assumption of perfect competition is imposed, revenue equals cost and cost shares are measured by revenue shares. The cost share of capital is one minus the cost shares of non-production and production workers. The capital stock is obtained by multiplying the cost share of capital with value added.

Calculation of changes in value added prices

The data set obtained from Polish Statistical Office (PSO) in electronic form contained the volume of value added expressed in current and constant prices. In order to calculate changes in value added prices, the growth of value added measured in constant prices has been subtracted from the growth of value added in current prices.

Calculation of import prices

The import prices, changes of which were used in the regressions, were obtained as follows: Data from the UN COMTRADE database was downloaded in 5 digit-SITC Rev.3 classification. The data set included the value and quantity of import, respectively expressed in USD and in various units (number of items, volume in liters, weight in kilograms). The data were then converted to 4-digit ISIC Rev.3, using conversion tables from the Eurostat COMEXT CD.

The final aggregation to 3 digit ISIC yielded the import prices, according to the following formula:

$$p_j^{IMP} = \sum_i \left(\frac{V_{ji}}{Q_{ji}} \times \frac{V_{ji}}{\sum_i V_{ji}} \right)$$

where p_j^{IMP} is import price in sector j (3-digit ISIC), V_{ji} is defined as the value of import in sector ji (4-digit ISIC) and Q_{ji} denotes the quantity of import in sector ji (4-digit ISIC). This weighting procedure was chosen to overcome the diversity of trade quantity measures in the input data (different units). The weighted import prices in USD were eventually converted to PLN using exchange rates reported by the National Bank of Poland.

NACE versus ISIC

NACE Rev.1 is the classification of economic activities corresponding to ISIC Rev.3 at European level. It is totally in line with ISIC Rev.3 and can thus be regarded as its European counterpart. In particular, the third (3-digit) and fourth (4-digit) levels of ISIC Rev.3 are subdivided in NACE Rev.1 according to European requirements. However, the third and fourth levels of NACE Rev.1 can always be aggregated into the groups and classes of ISIC Rev.3 from which they were derived.[15]

[15]See *ISIC / NACE relationship* (2002).

Chapter 4

Location Determinants of Export-oriented versus Market-seeking FDI in Poland

4.1 Introduction

As part of their economic development strategies, governments of many countries attempt to stimulate the economic activity in lagging regions by tax exemptions, public grants or factor subsidies. In particular, policy makers aim at attracting foreign investment which is perceived as being eminently beneficial for host locations. In virtually every country countless institutions and agencies, on the governmental as well as regional and local level, are involved in this process. A key prerequisite for such policy efforts is to understand the determinants of FDI location.

The driving forces, however, may differ for different types of FDI. The theoretical literature distinguishes two types of foreign investment: horizontal and vertical FDI. Differentiation between these types of investment is of even greater importance as the effects of FDI on the host country depend on the kind of undertaken activity. Market-seeking, also called horizontal FDI aims at accessing local markets by replicating the production of the same goods and services in both the home and host country and arises because

trade barriers make exporting costly. On the other hand, export-oriented, or vertical FDI fragments the production of a good or service into stages located in different countries and is targeted at re-exporting final or intermediate products into the home country or into other countries. In this case, FDI emerges to take advantage of international factor price differences.[1]

In this chapter I utilize recent regional data to estimate the determinants of horizontal and vertical FDI in Poland. While there exists ample empirical literature investigating why firms becomes multinational, analyzes of where firms locate are quite scarce, despite the recent revival of interest in the new economic geography. Among studies on foreign firms' location choice, only few studies discuss the evidence from transition countries and more importantly only few of them compare different types of investment.

In 1989, Poland was the first country out of the former Soviet block to initiate an economic transition to a market economy. The sudden policy changes were followed by large inflows of foreign direct investment and a subsequent uneven spatial distribution of FDI. This sequence of events provides a kind of a natural experiment, since in contrast to developed countries, the inflow of foreign investment to Poland as well as other transition countries is a recent phenomenon which allows to explore the motives of multinationals from the very beginning.

The structure of this chapter is as follows. Section 4.2 surveys the theoretical framework used for the analysis in this chapter, and the empirical literature that has been accumulated so far. Section 4.3 provides detailed background on regional development in Poland with particular focus on indicators used in the econometric part of the chapter. The estimation strategy along with a description of data and a discussion of explanatory variables are presented in Section 4.4. Section 4.5 reports the results of the analysis and Section 4.6 concludes.

[1]These both types of FDI are typically interpreted as applying to manufacturing. However, data used for the analysis in this chapter also contains foreign firms engaged in the service sector. In this context services can be seen as a commodity which is characterized by very high export costs. For further discussion on how my data set relates to the notion of vertical and horizontal FDI see Section 4.4.2.

4.2 Related Literature

As a departing point for further analysis, this section provides a survey of the existing literature of location decisions of multinational firms. I will first look at the theoretical framework that has been developed in the literature so far. The second part will be devoted to a discussion of previous empirical studies.

4.2.1 Theoretical Foundations

The theoretical literature on multinational firms and in particular on FDI is quite extensive and the profound understanding of motives and effects of foreign investment requires a very complex approach involving a number of economic models. Thus, in this section I will concentrate only on selected topics, directly related to the subject of this chapter. In particular the location theory of economic activities and its more recent extension, the new economic geography, as well as the theories of vertical and horizontal FDI will be reviewed.

The key question of the location theory is: why do particular economic activities choose to establish themselves in certain places of a given area? Plenty of effort has been invested in answering this question since 1826, when von Thünen published a pioneer work in this field. The general approach of virtually all theoretical models since the 1960s seems to be simple: the goal is to select a location that maximizes profit. Since the profit can be generally viewed as the difference between revenue and cost, the determinants that boost revenue and decrease production cost will be the ones that influence location choices of economic activities.

On the cost side, the most obvious candidates are those related to production factors and transportation costs. Firms will more likely locate their activities on a site characterized by low wages, high productivity and good access to raw materials, qualified labor and intermediate inputs. The great importance of transportation costs was emphasized already a century ago by Webber (1909). In his least-cost model he established the key trade-off

faced by a firm while taking the decision about its localization: being close to consumers or being close to production inputs.

On the revenue side, one factor affecting the desirability of locating a plant at a specific location is the market potential. The idea that market size matters for the location of industry dates back at least to Harris (1954). Regions where demand for a firm's good is high should offer greater opportunities for turnover. For producers of final goods this means that they would likely locate their activities near sites where they find a large pool of customers, whereas an intermediate goods producer would seek to locate in the proximity of final goods producers. The extent of the impact of market access on the location decision depends again on the level of transport costs. With very high transport costs the economic activity will likely spread out, while with negligible transport costs the distribution of firms will be random since the proximity to markets and production inputs will not matter.

In traditional location models production was assumed to occur under conditions of constant returns to scale. However, with such an assumption firms have no incentive to concentrate the activity in just a few places and their location decisions are merely related to the existence of non-zero transportation costs. That is, assuming constant returns to scale in production will result in "many small plants supplying local markets" (Fujita and Thisse (1996)). Obviously, this stands in contrast to empirical observations.

The study of location decisions has come to the forefront again with the development of the new economic geography following the seminal paper by Krugman (1991a). Due to the progress in modeling increasing returns to scale, the theoretical deadlock of traditional location models was overcome. NEG models were used by Krugman (1991a), Fujita, Krugman and Venables (1999), and by Midelfart-Knarvik, Overman and Venables (2000) to explain location of overall economic activity, industrial clusters and location of various manufacturing sectors, respectively.

The NEG stresses the "interaction between transport costs and firm-level scale economies as a source of agglomeration" (Head and Mayer (2003)). Furthermore, these are closely related with forward and backward linkages.

For a better understanding how agglomeration forces work, let us consider a simple framework with two regions (Fujita, Krugman and Venables (1999)). Suppose that at an initial point these regions are asymmetric, that is one region has more firms and a larger population. The large pool of firms makes it easier for a firm to find a deliverer for intermediate goods locally. Thus, the firm saves on transportation costs and lowers the final prices. The increasing number of firms makes the competition among them more fierce which leads to a further decline of prices and higher wages. This in turn raises the living standard and attracts people from the other region. The increase of the labor force causes lower wages but at the same time enlarges the pool of potential consumers. Hence, the larger market will lure new firms into the region. In this way, an agglomeration can form through a process of circular causation.

However, in addition to the centripetal forces described above, also centrifugal forces become visible when analyzing the economics of agglomeration. The excessive competition in a large region resulting in falling prices of the final output can cause some firms to settle in a small region. Benefits of lower competition will offset the disadvantage of a smaller pool of suppliers and customers.

There are also some alternative explanations of agglomeration and location decisions of firms. The most compelling one is known as "first nature" (Krugman (1993)) and relates to the natural advantage: the physical geography of coasts, mountains, and endowments of natural resources. Economic activity is located over given area according to the dispersion or concentration of these underlying features. The concept of "first nature" is closely related to the factor-proportions theory which takes the spatial distribution of resources as exogenous and employs it to explain the geographic distribution of production.

Another plausible hypothesis is focused on potential external economies generated by the agglomeration process. At an industry level, firms can exploit scale economies thanks to the size of the industry at a particular location. Such externalities modeled by Marshall (1890), Arrow (1962), and Romer (1986) arise principally within the same industry. Gains from local-

ization can result e.g. from technological or knowledge spillovers. Also, a large specialized labor market is a possible source of externalities. The "human capital externalities" models, in particular, claim that locations well endowed with high-skilled workers attract more firms employing these workers (Krugman (1991b)).

All the above listed components imply that the location problem of firms and industries is not trivial. New aspects emerge when considering the location decisions of multinational firms, where one has to distinguish between horizontal and vertical investments.

As mentioned in the introduction, the first type, horizontal foreign investment, occurs when it is less costly to serve a foreign market by producing there than by exports. Theoretical models of horizontal FDI are based on similar logic as those treating location choices of firms in general. They also emphasize the importance of transportation costs of serving a group of consumers from a distance, here augmented by tariffs and other barriers to trade, while at the same time benefiting from concentration of production in one plant. These transportation costs are then compared with fixed costs that arise from setting a new plant abroad and with the loss of scale economies caused by splitting production between two locations (for an example see Brainard (1993)). Such models imply that horizontal FDI are more likely to emerge in countries characterized by a large local market that permits to reap the economies of scale.

The vertical FDI takes place when a multinational firm shifts some or all of its production to a low-cost location with the output sold in the parent or third countries. The first models of vertical FDI were proposed by Helpman (1984, 1985) and Helpman and Krugman (1985). In the case of vertical FDI, the theoretical approach is based on the assumption that subsequent stages of production vary in terms of requirements of production factors. Therefore, given that factor prices differ between countries, the geographical fragmentation of production will be beneficial. The international variation of input prices arises in turn from different factor endowments. Consequently, in such models the differences in factor endowments between countries have

to be sufficiently large, so that trade in goods will not lead to factor price equalization.

Markusen, Venables, Eby-Konan and Zhang (1996) and Markusen (1997) merges both types of FDI, vertical and horizontal, into one theoretical framework - the Knowledge Capital Model. In this model three types of firms are distinguished: horizontal FDI, vertical FDI and firms from the home country that can reach consumers in a foreign country by exports. Results depend on the relative country characteristics. When the differences between countries' endowments are large, then the vertical FDI dominates. At the other end, where countries are alike and in the presence of transport costs, horizontal FDI will prevail. Between both extremes, the firms' landscape is mixed. The implications of this model for the determinants of FDI location are similar to those of models of horizontal and vertical FDI outlined above. Horizontal FDI emerges between large, equal countries, whereas vertical FDI is conducted between countries that differ in factor prices.

Summarizing, the vital location decisions assisting maximization of profits can be based on criteria such as transportation costs, local market size as well as natural resources and endowments. The agglomeration size also plays an important role, resulting in counteracting concentration and decentralization processes. Concerning cross-border decisions, two major types of FDI can be identified: vertical, driven by production costs and consequently more sensitive to provision of investment incentives by local governments, and horizontal, mainly influenced by transportation costs and impediments to trade. The above surveyed theoretical models of FDI consider different countries as alternative destinations. However, the major differences between vertical and horizontal FDI are still relevant when considering regions within one country which are the focus of this chapter.

4.2.2 Survey of Empirical Literature

The location choice of multinational firms has attracted a lot of attention in the empirical literature. Hence, this short survey is by no means exhaustive. It aims at addressing the key aspects based upon the evidence from a variety

of countries. The studies outlined below have been divided into three groups. The first subsection reviews papers that study FDI location determinants in developed countries, the second subsection discusses the evidence from transition countries, while the third subsection deals with export-oriented investments.

Regarding the estimation techniques, most of the studies presented in the first two subsections employ discrete choice methodology, in particular the conditional logit model proposed by McFadden (1974). This framework assumes that the decision makers' evaluation of available alternatives may be represented by a utility function and the decision maker chooses the alternative with the highest utility. In such an empirical model the dependent variable takes the value one for the site chosen by foreign investor and zero for all alternative locations. Some papers have also employed a nested version of the logit model, where the decision process assumes a hierarchical structure: the decision maker chooses first the nest and then a specific alternative within this nest. The dependent variables in empirical studies presented in the last subsection are of continuous nature, therefore they predominantly use OLS approach.

Developed Countries

Most of the empirical papers in this field deal with the experience of developed countries. This is partly due to the fact, that FDI flows to developing and transition countries are a more recent phenomenon, while FDI among developed countries has a longer tradition. Thus, sufficient data for statistical analysis could be collected.

The usual procedure in those papers is to focus on one or two aspects of the location decision, adding other factors that influence the profit function as controls. Since NEG emerged, a vast number of papers has been dedicated to identification of the role of agglomeration forces. Another popular topic is the effectiveness of public incentives in attracting foreign investors.

One example of a study that concentrates on analysis of centripetal forces is a paper by Guimaraes, Figueiredo, and Woodward (2000) who explore the

determinants of location of foreign-owned greenfield plants in the urban areas and outlying regions of Portugal within the period between 1985 and 1992. They identify four types of agglomeration forces: total manufacturing agglomeration, industry specific agglomeration, foreign specific agglomeration and service agglomeration. Moreover, they control for labor market characteristics, land costs, distance to two principal urban areas: Porto and Lisabon, and include dummy variables for these two cities for additional unobserved urbanization economies. First, their results provide evidence that agglomeration forces are a determining factor in the location of foreign investments. Among them, service agglomeration economies apparently have the strongest effect, followed by industry level economies, while FDI specific agglomeration appears to be insignificant. Concerning the remaining variables, they find that higher labor costs actually attract foreign investors rather than discourage them. Hereupon they argue that wages may also be interpreted as a proxy for qualifications and skills of the work force. Also land costs, measured by population density, when significant are positively correlated with the probability of new establishments of foreign-owned plants. Furthermore, as far as major cities are concerned, the probability of location decreases with distance to them, and their dummies are statistically significant. Summarizing, the findings suggest that foreign investors exhibit strong urban orientation.

Barrios, Görg and Strobl (2003), besides focusing on agglomeration, also assess the effectiveness of creation of designated areas where multinationals were offered public grants.[2] They examine the case of Ireland and use the longest data set among all presented in this short survey. They are able to trace the establishment date, employment and location of virtually all domestic- and foreign-owned plants that existed in the Irish manufacturing between 1972 and 1998. For the whole time span they find that location choices of foreign firms are positively influenced by proximity to other firms from the same industry and by urban diversity in manufacturing activities.

[2]The authors note, that these grants vary between different designated areas, as they arise from bilateral agreements between a particular multinational and public authorities.

Furthermore, multinationals tend to cluster in the same locations with firms of the same "nationality" and generally where activities of foreign firms are more intensive. The distance to a major port or airport is negatively correlated with the probability of location choice.

Regarding labor market characteristics, similarly as Guimaraes, Figueiredo, and Woodward (2000), Barrios, Görg and Strobl (2003) surprisingly find that high wages attract multinationals. Some additional results become apparent when the sample is split into high-tech and low-tech industries. Their findings imply that the regional policy has an effect only in enhancing low-tech investment. Furthermore, the urbanization economies are more important for high-tech industries, while clustering within the same industry is significant only for low-tech industries.

As the study reviewed previously, in addition to agglomeration forces and determinants of the profit function, Crozet, Mayer and Mucchielli (2004) include investment incentives provided by public authorities. They study the determinants of foreign investors' location choice over French *départements* between 1985 and 1995. The major contribution of this paper is the identification of clustering patterns among firms that originate in the same country and industry. It appears that although on average firms incline to follow the competitors of the same nationality, there are some substantial differences depending on the country of origin of the investor. In contrast to the previously presented study, computers, car parts, machine tools and office machinery exhibit the strongest agglomeration effects within the same industry.

Additionally, the location choice of foreign firms is positively correlated with local demand, whereas the distance to the home country and local wages have a negative impact on the attractiveness of a particular region for foreign investors. Regarding incentive policies, which take the form of labor-related grants provided by the French government for creating or maintaining jobs in lagging regions, as well as various grants related to EU's regional policy, the authors find a negligible positive effect. Finally, for some European countries they identify a "learning process" of foreign direct investment, as the FDI locations gradually become more remote from the country of origin during

the period they study.

Head, Ries and Swenson (1999) assess the effectiveness of US state promotion efforts in the presence of a strong agglomeration trend in Japanese investment. Their regressions consider the influence of corporate taxes, labor and capital subsidies as well as foreign trade zones. Along with these variables, they include covariates measuring agglomeration effects, market potential and labor market characteristics. Unlike previous studies, their also control for regional fixed effects. The main conclusion they draw from their results is that states that offered public incentives received significant increases in investment. However, since individual state policies were often adopted by other states, they tended to offset each other, so that their effect on the spatial distribution of Japanese investment appears small. Additionally, the authors find that the magnitude and sign of the coefficients measuring policy effects are sensitive to the inclusion of the agglomeration variables and fixed effects.

Concerning results on agglomeration forces, Japanese investments tend to cluster with other Japanese firms, particularly those in the same 4-digit industry class or *keiretsu*.[3] Finally, as for labor market variables, they are also responsive to the inclusion of agglomeration variables and regional fixed effects. This sensitivity of variables measuring public incentives and labor costs implies, as the authors note, that the inclusion of detailed agglomeration measures and controls for unobservable factors appears important for obtaining accurate estimates of policy variables.

Coughlin and Segev (2000) follow a slightly different strategy, as they assign equal importance to all possible factors that might have an impact on foreign firms' decisions. In contrast to previously reviewed studies, they employ negative binominal regression methodology rather than logit, because they have the information on the number of foreign-owned plants in a certain region. The authors show that the location choices of new foreign plants across the United States for the period of 1989 to 1994 respond to the

[3] *Keiretsu* is a Japanese term for a set of companies with interlocking business relationships and shareholdings. It means also a company that has many branches (Wikipedia, the free encyclopedia).

majority of variables that might have affected the profitability in the given location. However, regarding the labor market, unlike previous studies, the authors use unit labor costs instead of wages. They find that higher unit labor costs and taxes discourage foreign investment, while the economic size, labor force quality, agglomeration forces, urbanization economies and transportation infrastructure positively influence the decisions of foreign firms. Finally, the possibility that climate could affect the choice of foreign firms is explored, following the reasoning of the "first nature". This effect, however, turns out to be statistically insignificant.

Transition Economies

Empirical studies exploring location choices of multinational firms in Central and Eastern European (CEE) countries started to emerge only recently due to data limitations.

A paper by Disdier and Mayer (2003) compares the determinants of foreign firm location in Western and Eastern Europe on the example of French multinationals. The empirical evidence presented implies that French firms first choose the region of investment location, i.e. Western or Eastern Europe, and then the country within the region, whereupon the determinants of location choice differ between these two regions. In both, the local demand is positively correlated with the firms' choices, but the magnitude of effect is actually higher in CEE countries. Disdier and Mayer (2003) note that this fact stands in contrast with the opinion about Eastern Europe being mostly seen as a host of cost saving, vertical FDI.

On the other hand, agglomeration effects are stronger in Western Europe. The authors provide two possible explanations. It could be the case that competition tends to be stronger in CEE countries or that the French firms in Eastern Europe heavily depend on intermediaries produced in France or Western Europe. Distance to France is a further source of differences between these two groups of countries. Its negative impact is more pronounced in Eastern Europe and interpreted as evidence of higher transaction costs. Moreover, the average wages have a stronger negative influence on location

decisions in CEE countries than in Western Europe revealing a higher sensitivity to production costs in the former. Additionally, Disdier and Mayer (2003) include variables measuring the quality of the institutional framework in the estimating equation. This yields rather mixed results with the coefficient on cumulative liberalization index being even negative. Finally, they are able to measure the gap between Eastern and Western Europe in the opinion of French investors and show that this gap decreases over time.

Using a data set comprising Bulgarian, Hungarian, Polish and Romanian regions Pusterla and Resmini (2005) investigate the location choice of foreign firms between 1995 and 2001. First, they show that for foreign investors "Hungarian and Polish regions are more similar to each other than to Bulgarian and Romanian regions". They argue, that this result implies that Hungary and Poland compete for foreign investment with countries belonging to the European Union rather than with Bulgaria and Romania. Moreover, the authors confirm the importance of agglomeration forces that are mainly FDI specific. Their results also indicate that the probability that a multinational locates in a transition country is mainly driven by cost advantages. However, in contrast to the previous study, they do not directly examine the hypothesis of market potential influence.

For Hungary, Békés (2004) considers questions related to agglomeration effects, market potential and input-output linkages using data on newly established foreign-owned plants. On the supply side he distinguishes between local supplier access, local raw material access and local business services access. The market potential is measured by consumer income, size of county and national market access. The results suggest that even in the case of a relatively small country like Hungary, the market potential - both local and non-local - plays an important role for location decisions of foreign firms. Among variables measuring input linkages, only local supplier access has a positive and statistically significant impact on the location decision. Because of the country's size, the production sector in Hungary relies heavily on imports, for the same reason a large part of its output is exported. In order to account for the proximity to export and import markets, Békés (2004)

includes the distance from "the key western external border". He treats this variable as an additional measure for upstream as well as downstream linkages. The coefficient on distance takes the expected negative sign. Finally, after various measures of wages have been tested, the author finds that lower industry specific wages are conducive to FDI.

In a very recent paper Hilber and Voicu (2005), focusing on greenfield plants, examine different types of agglomeration and labor market effects on the example of regions in Romania. Due to data limitations, they cannot use a logit approach and following Coughlin and Segev (2000) employ negative binominal regression. The authors' findings show that industry specific foreign agglomeration as well as service agglomeration forces are conducive to foreign investments. Like Head, Ries and Swenson (1998), they add fixed regional effects which turn out to have expected signs in their estimating equation. The results reveal that including fixed effects augments and renders the coefficients on labor market variables statistically significant. The estimates obtained from the regression with fixed effects confirm the theoretical prediction for wages that increases in labor costs decrease a region's attractiveness to FDI.

Using data on Japanese multinationals, Cieślik and Ryan (2005) focus on Polish regions. In their paper they try to assess the effectiveness of public investment incentives (in form of special economic zones (SEZs) provided by the government in a few regions) in attracting foreign firms. Regarding the estimation methodology, again, they have data on the number of Japanese FDI, but not on when the activity began, so they use a negative binominal regression in place of conditional logit. Their results are somewhat different from the main stream of empirical literature, showing that GDP as the measure of size and wealthiness of the region loses its significance when they control for "the center-periphery" pattern with shares of industry and services in local employment. Among agglomeration forces, included in their estimation, only the industry specific one appears to have an impact on foreign investment. Furthermore, like in many other studies, high wages seem to attract foreign investors also in Poland. However, as in the case of GDP, this

effect is no longer significant when variables measuring centrifugal and centripetal forces are included. Concerning SEZs, although they are positively correlated with the Japanese FDI, the result is not significant in majority of specifications.

Finally, in their paper about foreign ventures in China's cities, Head and Ries (1996) explore agglomeration externalities and the role of incentives provided to attract FDI. Their sample comprises manufacturing investments coming primarily from the US and Japan. Along with tax exemptions, Chinese cities offered also "import duty reductions, reduced land user fees, elimination of red-tape, and relaxed rules on labor management" to foreign investors. The authors find these incentives make a city more attractive to investors. However, as in the case of Japanese investment in the US reviewed above, agglomeration effects magnify the impact of local incentives. The results also show, that foreign investors are not only likely to settle near other foreign investors, but also cluster with domestic enterprises. Furthermore, they prefer cities with a high concentration of industrial production. That is, foreign investors are drawn to areas which have a large existing pool of potential input suppliers. Industrial wages and industrial productivity, also included in the regression, have little influence on the pattern of investment, while the infrastructure facilitating exports is conducive to foreign investments.

Export-oriented FDI

While in both above subsections most papers investigate determinants of location choice of MNEs originating from different countries among regions of single host country, there exists no study that would explore the decision logic of export-oriented FDI within one country. Here I am presenting a few examples of studies that, with the exception of Woodward and Rolfe (1993), use a broader sample of countries receiving investments from just one or two countries. Empirical papers covered by this paragraph can be split into two groups. First two studies, by Kumar (1994) and Woodward and Rolfe (1993), follow the tradition of location theory, while the remaining two are

closely related to theories of horizontal and vertical FDI. At the beginning of this section I mentioned, that papers reviewed in this paragraph employ OLS rather than logit methodology, the most popular one among location choice studies. This is because in the real world a clear distinction between firms producing solely for exports and their counterparts selling exclusively on the local market is not always possible. Thus, the dependent variable in the case of vertical FDI is rather measured directly by exports or share of exports in total sales of MNE's foreign affiliates.

One study from the first group done by Kumar (1994) investigates the inter-country pattern of export-oriented production by US multinationals in 1982 across industrialized as well as developing countries. His empirical findings imply that low-wage countries rich in raw materials attract this type of investment. Also countries with a well established industrial infrastructure enjoy the advantage over others. Furthermore, he shows that export processing zones, equipped with a more efficient infrastructure, port facilities and tax and custom privileges, have managed to entice export-oriented FDI.

Woodward and Rolfe (1993) analyze the determinants of country selection in direct investment cases in the Caribbean Basin. They find that the probability of country selection varies inversely with wage rates and increases with quality of infrastructure, size of export processing zones and length of tax holidays. Furthermore, GDP per capita appears to attract export-oriented multinationals. The latter result is not very intuitive, as this variable is usually associated with the effect related to market potential. Authors argue that in the case of export-oriented FDI, it may reflect the provision of various kinds of infrastructure necessary for export-related activities rather than local market conditions.

Regarding the second group of studies, determinants of vertical versus horizontal investments are explored as a byproduct of empirical testing of the underlying theoretical models.

For example, Braconier, Norbäck and Urban (2002) use data on US and Swedish multinationals in 1986, 1990, 1994 and 1998. Different types of vertical FDI, and horizontal FDI for comparison, are then regressed on home

and host country characteristics.[4] In particular they include GDP of the home and host country, the distance between them, relative wage premium, investment costs and trade barriers. Their main result is that foreign firms' affiliates' exports to home and third countries as well as imports from the parent country are positively influenced by the relative wage premium of the host to the home country. This result suggests that vertical FDI is larger in host countries with high skill premia, that is countries with relatively cheap unskilled labor.[5] The latter corroborates the theoretical implications that vertical FDI is a cost saving FDI. Regarding other results, both GDP measures correlate positively with vertical FDI, where the effect of the home country is much stronger. Unfortunately, the authors do not give any explanation why the size of the host country should have a positive impact on the exports. Finally, the distance to the home country, investment costs and trade barriers have the expected negative signs, with the trade barriers' coefficient being insignificant.

In another study, Slaughter (2003) compares the determinants of US FDI in Europe in various industrial sectors and with different external orientation. As opposed to Braconier, Norbäck and Urban (2002), whose dependent variables enter the regression in levels, Slaughter (2003) compares how the result changes if one uses variables expressed as respective shares. He argues, that regressands in absolute levels deliver little information about the option facing affiliates, that is to export or sell into the host market, and such a regression simply confirms that foreign firms in certain types of countries "do more of everything: exporting, and selling in all industries". So that,

[4]They estimate a log-linear gravity equation and the Knowledge Capital Model, where the home market effect is also considered. This is because the larger the home country, the more home-based MNEs will emerge, and consequently, the more affiliates abroad will arise. Additionally, a larger home country means a higher demand for affiliates' exports.

[5]More precisely, the elasticities of the three listed variables with respect to relative wage premium are of different magnitude in their analysis. Since the main goal of their paper is to test the validity of theory of vertical FDI, the estimated elasticities provide the information of "how vertical" these activities really are. This relates to the discussion that takes place in the economic literature on how vertical FDI should be measured. Nevertheless, the results of Braconier, Norbäck and Urban (2002) suggest that affiliates exporting to home and third countries, as well as affiliates that draw inputs from the parent country all can be viewed as vertical FDI, as they are sensitive to differences in factor prices between the parent and receiving country, to a different extent however.

he shows, when using the share of exports[6] in foreign firms' affiliates' sales, the GDP of the host country has a negative impact, while in the case of levels its effect is positive. The first result implies that in smaller countries foreign firms aim at export more than local sales. In contrast, the coefficient on GDP per capita is positive in both regressions indicating that in more productive countries sales are directed toward export. Corporate taxes have a negative impact in both cases, as could be expected, since higher taxes diminish profit.

Summary of the Main Findings of Empirical Literature

The empirical evidence concerning some of determinants of foreign firms' activities is uniform and in line with theoretical predictions, while in the case of other elements of location decision it is mixed, as the overview in Table 4.1 highlights.

For example, it has been well documented in the empirical literature that agglomeration forces in general do matter for the location choice of MNEs. In particular, foreign affiliates tend to cluster in sites with a high density of other foreign firms. Among them, firms of the same nationality are likely to settle close to one another, however, this effect depends on the country of origin. It has been also shown, that industry specific externalities are important. Additionally, a number of papers identify a positive effect of urbanization economies. Furthermore, the demand potential appears to have substantially contributed to location choices of FDI in general, while the effect on export-oriented FDI is uncertain.

Turning to the cost side of the profit function, variables that proxy for transportation costs, like vicinity of the home country and various measures of the quality or availability of infrastructure, have a positive influence on the location choices of MNEs. As far as labor costs are concerned, export-oriented FDI exhibit a clearly negative correlation. In studies where no distinction between the geographical destination of sales was made, however, the outcome is not so clear. In many location decision studies the wages'

[6]Slaughter (2003) does not distinguish between exports to parent country and to third countries.

Table 4.1: Empirical Evidence on Determinants of FDI's Location Choices

	sample	*market potential*	*public policy*	*labor costs*	*agglomeration and urbanization*	*distance*	*infrastructure*
Developed Countries							
Guimaraes *et al.* (2000)	foreign-owned greenfield plants in Portugal			+	+		
Barrios *et al.* (2003)	foreign-owned new plants in Ireland		+ [a]	+	+	−	
Crozet *et al.* (2004)	FDI in manufacturing in France	+	+ [b]	−	+	−	
Head *et al.* (1999)	Japanese FDI in US	(+)	+	+	+		
Coughlin and Segev (2000)	foreign-owned new plants in US	+	+	− [c]	+		+
Transition Economies							
Disdier and Mayer (2003)	FDI in Western and Eastern Europe	+		−	+	−	
Pusterla and Resmini (2005)	FDI in manufacturing in Bulgaria, Hungary, Poland and Romania			−	+		
Békés (2004)	FDI in manufacturing in Hungary	+		−	+	−	
Hilber and Voicu (2005),	foreign-owned greenfield plants in Romania			−	+		
Cieślik and Ryan (2005)	Japanese FDI in Poland	(+)	(+)	(+)	+		
Head and Ries (1996)	FDI in manufacturing in Chinese cities		+	(−/+)	+		+
Export-oriented FDI							
Kumar (1994)	US outward FDI		+	−			+
Woodward and Rolfe (1993)	FDI in Caribbean Basin	+	+	−			+
Braconier *et al.* (2002)	US and Swedish outward FDI	+		− [d]		−	
Slaughter (2003)	US outward FDI in Europe	−/+ [e]	+			−	

Notes: Cell entries show coefficient signs if obtained by particular study. Insignificant coefficients in parentheses.
[a] For low-tech industries only
[b] Negligible
[c] This study uses unit labor costs, while all other studies employ average wages.
[d] Concerning low skilled workers.
[e] Slaughter (2003) uses GDP to measure host market size and GDP per capita, which is usually interpreted as purchasing power by location choice literature, as a proxy for host productivity. They appear to have a negative and positive influence on export share of FDI, respectively.

coefficients exhibit the expected negative sign, on the other hand, in many others they take a positive value. Two explanations have been proposed for the latter result. First, instead of treating wages as a cost factor, they can be interpreted as a signal of quality of labor force, or the quality of location more generally. Second, in the case of regional setting, wages may well be a determinant of the decision to locate in particular country as opposed to other countries, but not a part of the decision to select a certain area within this country.

Last but not least, some studies have investigated the effectiveness of public policies like taxation or state support. While in most cases lower taxes and investments costs plus various incentives attract MNEs, in two cases the effect of this variables was negligible. Furthermore, in two papers it is pointed out, that agglomeration forces in general considerably augment the effectiveness of such policies.

Finally, it appears that determinants of location of foreign affiliates in transition countries are becoming more similar to those in developed economies. That is, even though MNEs in transition economies are still more sensitive to labor costs, in some countries, more advanced in transition like Poland and Hungary, they are also interested in local demand.

4.3 Background on Regional Development in Poland

After the collapse of the socialist regime Poland underwent substantial changes. Before I move on to the econometric results, it is useful to provide some knowledge regarding the spatial development during transition in Poland. The important question is: was this development equal for all regions? This section presents a description of the spatial pattern of changes that occurred during transformation. In particular, the regional development of variables related to the empirical analysis such as geographical distribution of foreign firms' activities, GDP and GDP per capita, average wages and

unit labor costs are reported.

After a close inspection of the pattern of regional development in Poland today one cannot help the impression that it is still, at least to some extent, shaped by the historical heritage. The contemporary condition of regional economies and their ability to meet the requirements of a global economy seem to be stamped by the legacy of the 19th century. In 1795, Poland was divided between Prussia, Russia and Austria and disappeared from the map of Europe as an independent country. This deep-rooted division is still visible on the map of Poland.[7]

Neither the shift of the Polish borders after the Second World War, nor the years of the planning economy changed the pattern. Poland is still divided into the better developed western part, extended in the south and the north-eastern one that is lagging behind.

Among the leaders of Polish transformation there are regions with great agglomerations of Warsaw (Mazowieckie voivodship), Poznań (Wielkopolskie), Wrocław (Dolnośląskie), Gdansk (Pomorskie) and Cracow (Małopolskie). These agglomerations became strong economic, cultural, scientific and academic centers. Attracting high levels of investment, they were able to boost the economy of their regions as a whole. With the notable exception of Warsaw, they are situated in the western and southern parts of the country. Regarding the Mazowieckie voivodship, although centrally located it holds clearly the dominant position benefiting from being the political center of Poland.

At the other end of the development scale we find a group of rural regions in Eastern Poland: Podlaskie, Lubelskie, Podkarpackie, and Świetokrzyskie. These voivodships are characterized by low population density, a relatively high share of agriculture in economic activities and poor infrastructure. In addition, the comparatively unfavorable geographical location of these re-

[7]Yet another territorial change took place in 1831, when the Tsar of Russia annexed the Congress Kingdom of Poland (dependent from Russia state, which was created at the Congress of Vienna in 1815 following the Napoleonic wars). Poland, after being absent from the map of Europe for 123 years, regained its independence first in 1918. For the interested reader Figures 4.9 and 4.10 show the detailed division of Polish territory between its three neighbors from 1831 to 1917 and for comparison its geographical position today.

gions (proximity to economically less developed Belarus, Ukraine and Russia) limits the opportunities for fruitful trans-border cooperation and joint economic activities. It comes as no surprise that they could not benefit from the transformation to the same extent as the more developed regions.

Although this pattern of development seems to have remained stable in the course of transition, there were some changes in the economic map of Poland. Along with economic transition, regional and social disparities in Poland became increasingly evident. The next subsections will look at some indicators of regional development in greater detail.

4.3.1 GDP and GDP per Capita

Figure 4.1 shows the distribution of GDP among Polish regions at two points in time: 1995 and 2002. It illustrates two main facts. First, the general pattern of GDP distribution did not change between 1995 and 2002. In 1995 as well as in 2002 Mazowieckie, Ślaskie, Wielkopolskie and Dolnośląskie voivodships were the economically strongest regions, together contributing to about 49 percent of the Polish GDP. The four regions that ranked last also remained unchanged. These regions make up about 11 percent of the Polish GDP. On the other hand, the disparities have grown over time. Looking at the box-plots presented in Figure 4.1, we can see that it was the regions above the median that contributed to a growing dispersion.

Additionally, in 2002 compared to 1995 there is a change in outliers, mainly due to outstanding growth of GDP in Mazowieckie. Ślaskie, although it did not lose its relatively high position (it ranked second in 2002 as well as in 1995), is most often referred to as a region that has been most adversely affected by the process of economic transition. Being a traditional industrial core of Poland, it was the focus of planned development, and to a large extent, the driver of economic activity. During the transformation period, the region was severely influenced by the reorientation of trade away from formerly secure markets and by the reduction of subsidies. Apart from restructuring problems, the Ślaskie Voivodship is characterized by severe degeneration of the environment inherited from the scale and poor technology

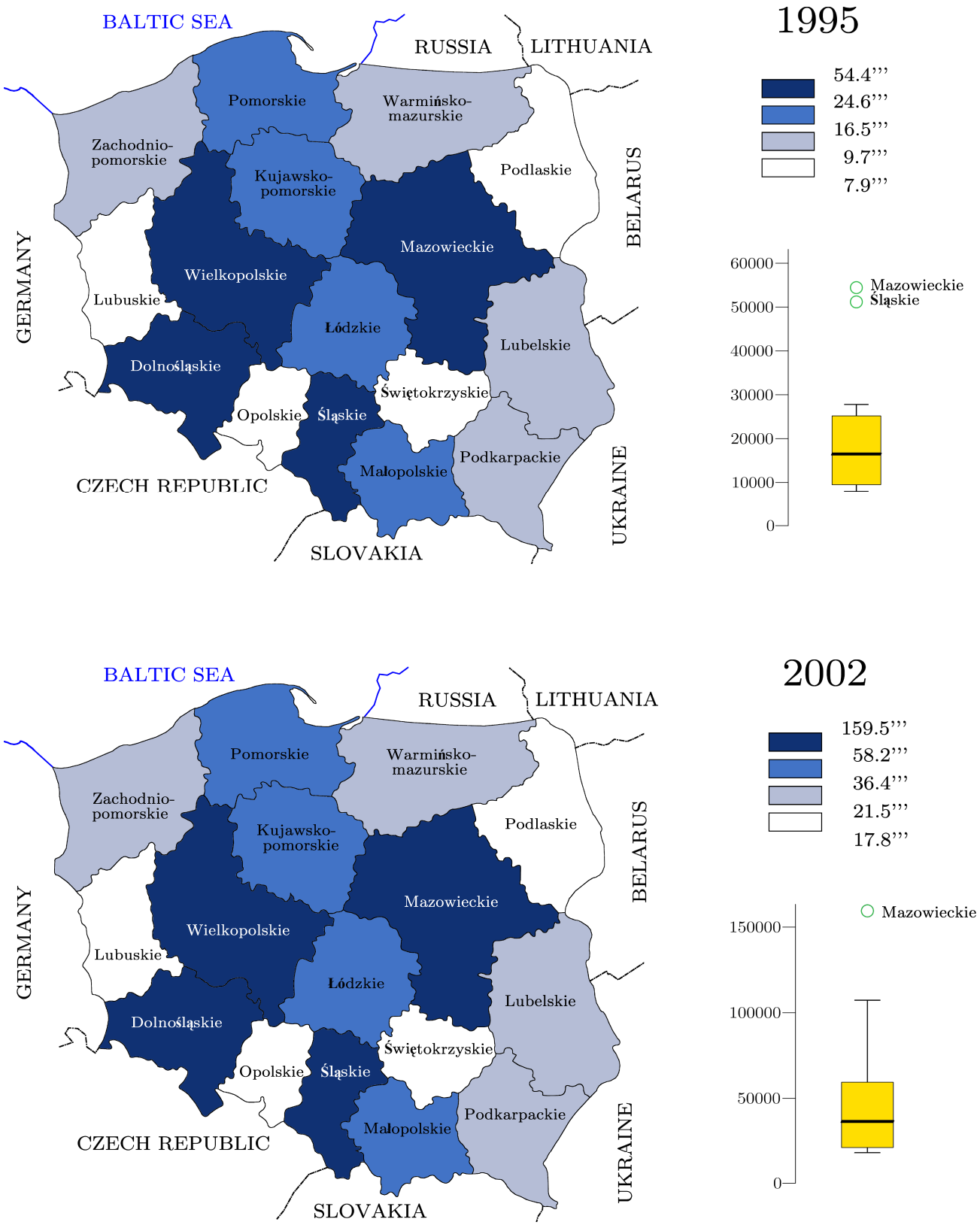


Figure 4.1: Regional GDP in Poland in 1995 and 2002

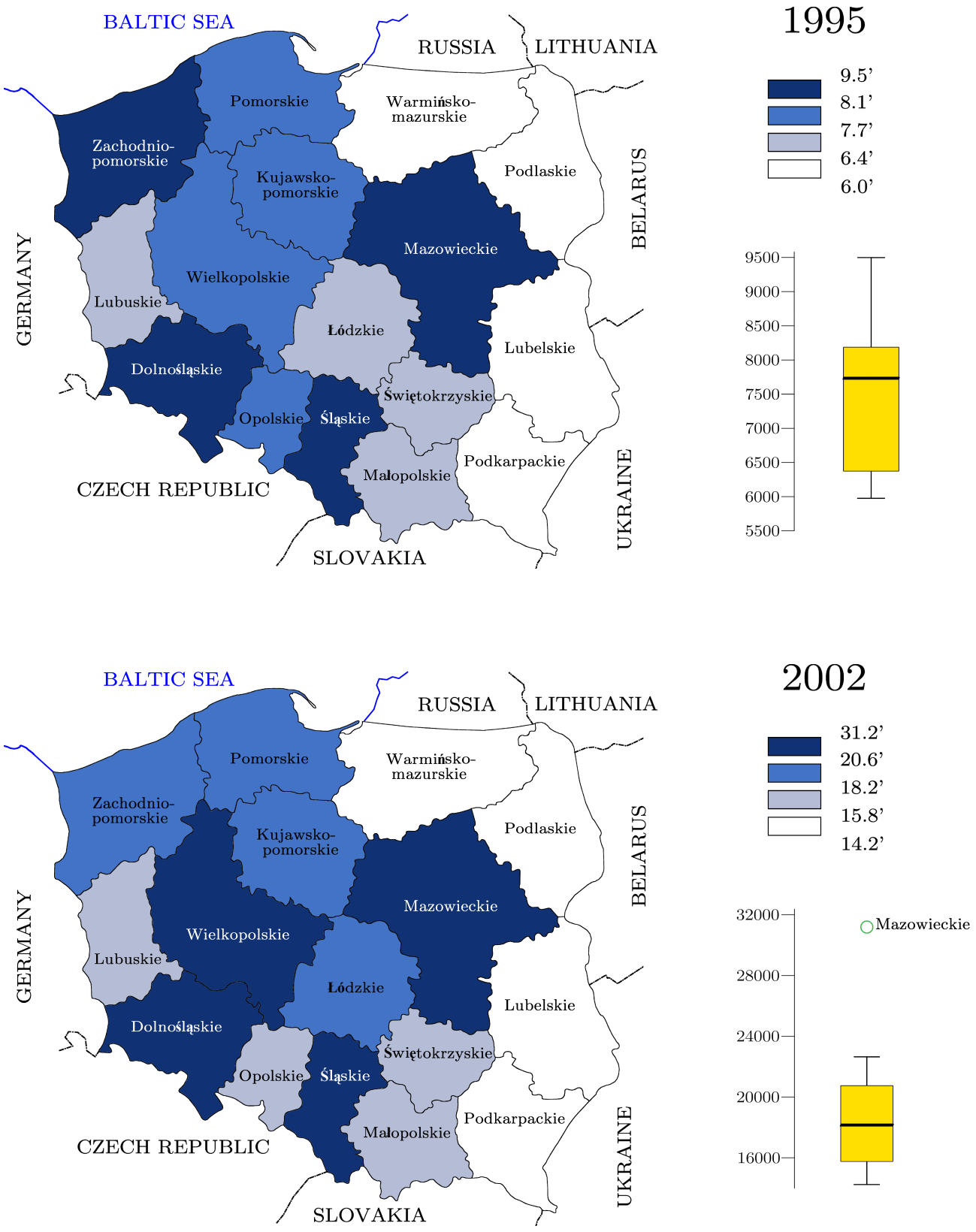


Figure 4.2: Regional GDP per Capita in Poland in 1995 and 2002

of former industrial production.

The growing disproportion between regions is even better illustrated in Figure 4.2, where I present the spatial distribution of GDP per capita. In the years 1995 - 2002 voivodships characterized by a high share in gross domestic product were in general also characterized by a high level of GDP per capita. Among leaders, between 1995 and 2002 only Zachodniopomorskie lost its relatively high rank and was surpassed by Wielkopolskie. In 1995 and in 2002 the highest level of GDP per capita was recorded in Mazowieckie, at 119 percent of the national average in 1995 and nearing 160 percent in 2002. While in the beginning of the examined period Ślaskie, ranked second, was only slightly behind Mazowieckie with 117 percent of the national average, in 2002 it was far behind - with only 110 percent. The dominant position of Mazowieckie in 2002 is clearly depicted by the lower box-plot in Figure 4.2. The disparities between remaining 12 voivodships did not change substantially. Concerning GDP per capita, the lagging regions of Warmińsko-mazurskie, Podlaskie, Lubelskie and Podkarpackie achieved between 75 and 80 percent of the national average in 1995 and between 70 and 77 percent in 2002.

4.3.2 Employment Structure

The Polish employment is gradually evolving into a structure typical for other EU countries. Particularly, there has been a reduction of the share of industry as well as agriculture in favor of employment in services. In 1995 the share of agriculture in Polish employment was almost 23 percent, but over the next eight years it dropped by 26 percent down to 18 percent. Despite this rapid decline, the share of agriculture in the Polish employment remains much higher compared to other European countries. In the same period, the share of industry and construction in employment fell from 32 to 29 percent, whereas the share of employment in services increased from 45 to 53 percent. Figure 4.3 shows the employment breakdown across regions. The following picture emerges from this figure: as depicted by the green bars, the share of agriculture in employment was higher in the eastern part of Poland in 1995 as well as in 2003. In particular Lubelskie, Podlaskie, Świetokrzyskie and

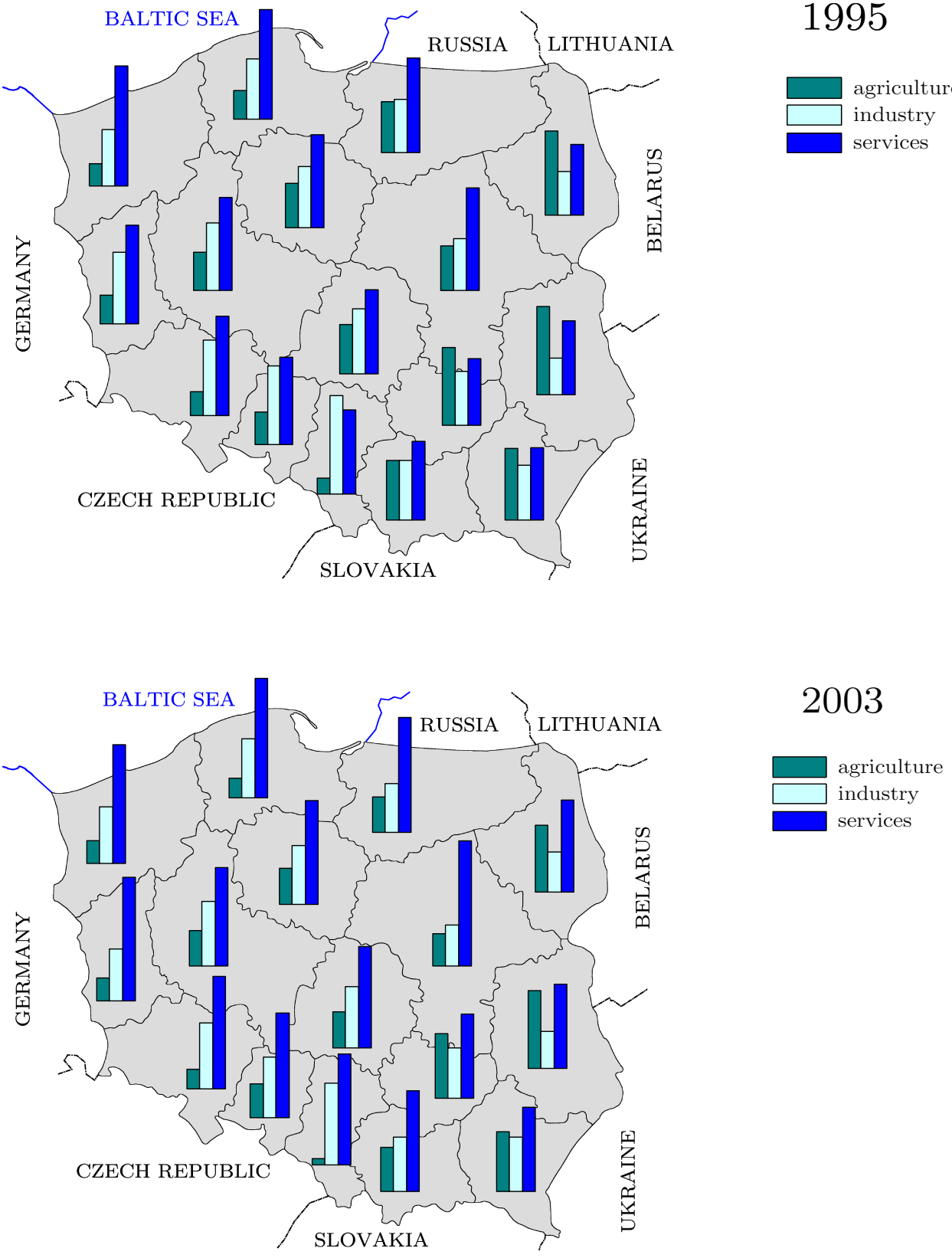


Figure 4.3: Employment by Kinds of Activity in Polish Regions in 1995 and 2003

Podkarpackie remained the most rural Polish areas. Among other voivodships with a relatively high share of agricultural employment Warmińsko-mazurskie and Małopolskie have managed to reduce it substantially. In 1995 these voivodships had about the same share of employment in industry and agriculture, while in 2003, the shares of these sectors declined in favor of services. The most industrialized regions are predominantly situated in the western part, with the exception of centrally located Łódzkie, while the most service-oriented voivodships are Mazowieckie, Lubuskie, Zachodniopomorskie, Pomorskie and Warmińsko-mazurskie. The last three, situated on the coast and in the Masurian Lake District, are benefiting from their natural advantage, as the increase in their service sector is to a large extent due to the booming tourism sector. The dynamic growth of the service sector in western voivodships is also related to the proximity to Germany thanks to a relatively large price gap.

4.3.3 Labor Costs and Infrastructure

As the theory suggests, one of the determinants of location of foreign affiliates of MNEs, in particular vertical FDI, are labor costs. Figure 4.4 presents the regional wage differentials in Poland. The striking feature of this figure is the fact that it closely resembles the one depicting GDP per capita. Only Kujawsko-pomorskie brakes the pattern, characterized by a relatively large GDP per capita and relatively low wages. This is actually in line with predictions of NEG. In Section 4.2.1 it is pointed out, that regions that concentrate a lot of economic activities will be characterized by higher wages, because firms in those regions have to compete for labor force. Figure 4.4 also shows that measuring labor costs with wages might be inappropriate, since regions with higher wages are also characterized by higher productivity. Therefore it is more reasonable to look at unit labor costs, since this measure incorporates wages as well as productivity. Figure 4.5 illustrates the distribution of unit labor costs in Poland: the further east we go, the more expensive labor becomes. A similar result arises from Table 4.11, which provides detailed information about the development of infrastructure in Poland. The

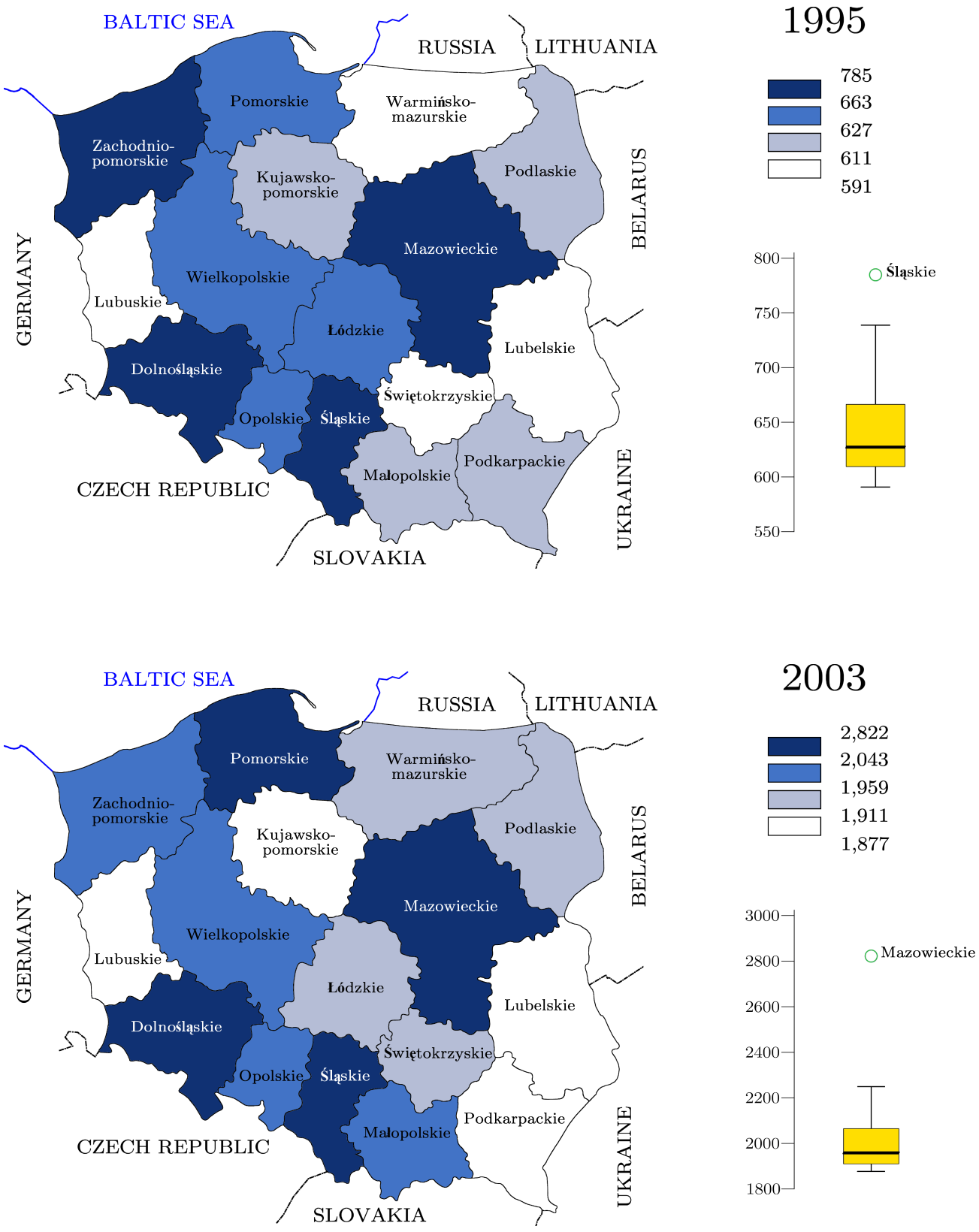


Figure 4.4: Average Wages across Polish Regions in 1995 and 2003

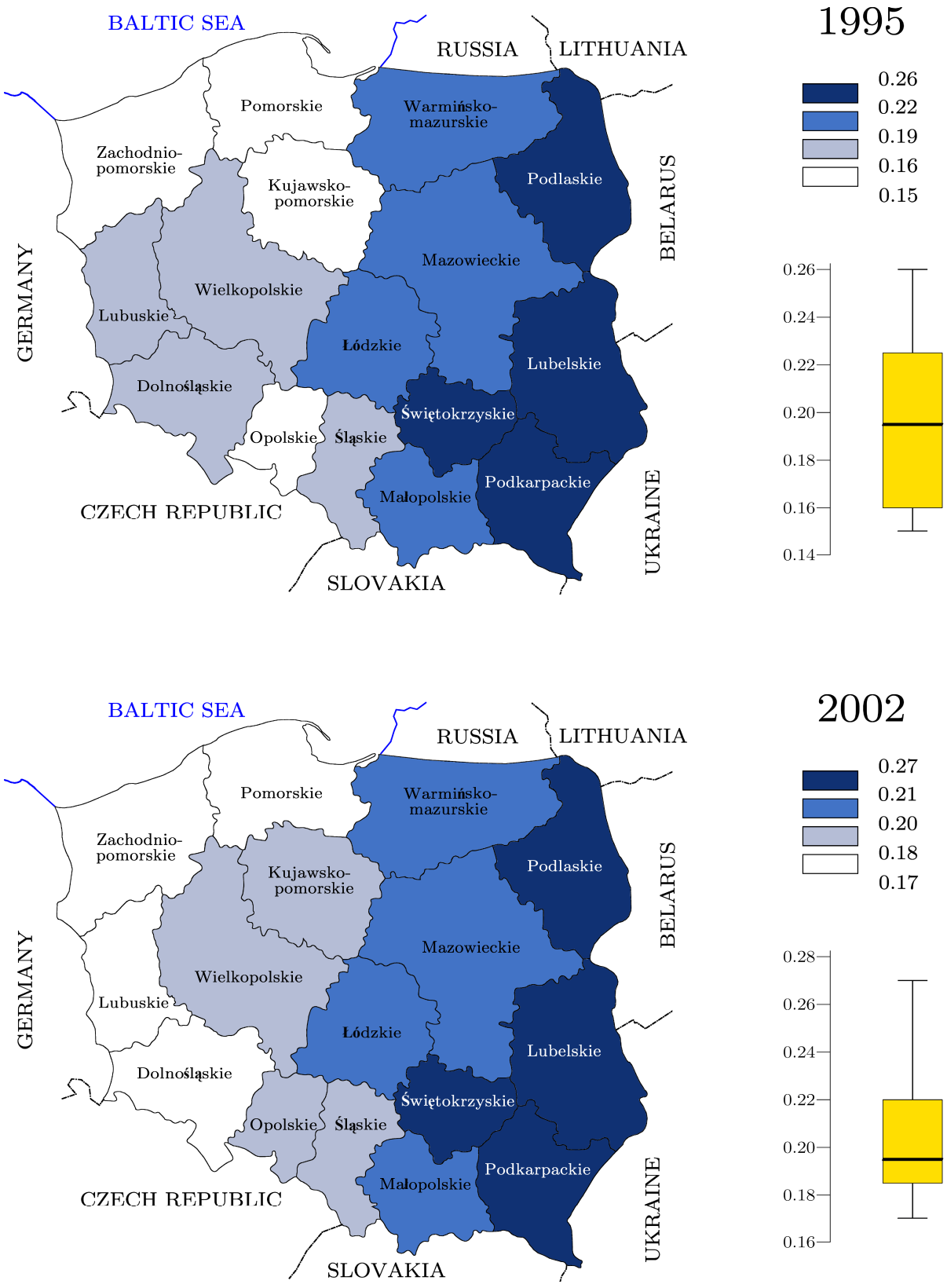


Figure 4.5: Unit Labor Costs across Polish Regions in 1995 and 2002

upper part of this table shows key characteristics for the year 1995, while the lower part those for the year 2003. It appears that compared to western and south-western regions, the eastern ones, with the exception of Mazowieckie, have mainly poor infrastructure.[8] This pattern seems to persist over time as well. Four eastern regions: Warmińsko-mazurskie, Podlaskie, Lubelskie and Podkarpackie occupy the last places at the beginning and the end of the examined period.

4.3.4 Foreign Investors

Next, we turn to the regional distribution of activities of foreign firms in Poland. Among Polish voivodships, Mazowieckie and more specifically Warsaw and its surroundings, is by all means the most favored location for foreign investment, as in 2003 it concentrated almost 32 percent of all companies with foreign capital participation. Other high concentrations of foreign investors are found in urban areas in Dolnośląskie, Wielkopolskie and Śląskie. These three regions together accumulated further 30 percent of firms with foreign participation. However, assuming other determinants away, it seems obvious that larger, more populated voivodships will automatically host a larger number of firms, be it domestic or foreign. For that reason, Figure 4.6 shows the spatial distribution of foreign activities in Poland in terms of their share in local employment. Between 1996 and 2003 only Pomorskie left the very top to be replaced by Dolnośląskie. Also Śląskie and Warmińsko-mazurskie gained, displacing Kujawsko-pomorskie and Łódzkie. All in all, foreign activities in Poland are skewed to the west.

Now, let us consider only export-oriented or vertical FDI. Again, if we examine export of foreign affiliates in levels, we will find that it concentrates in voivodships that in general accumulate the majority of foreign activities. If we, however, look at the share of exports in foreign firms' revenues, the emerging spatial distribution is quite different as Figure 4.7 illustrates. It appears that the geographical pattern of foreign affiliates whose majority of sales is exported is more dispersed compared to the spatial compo-

[8]For classification details, refer to Section 4.4.

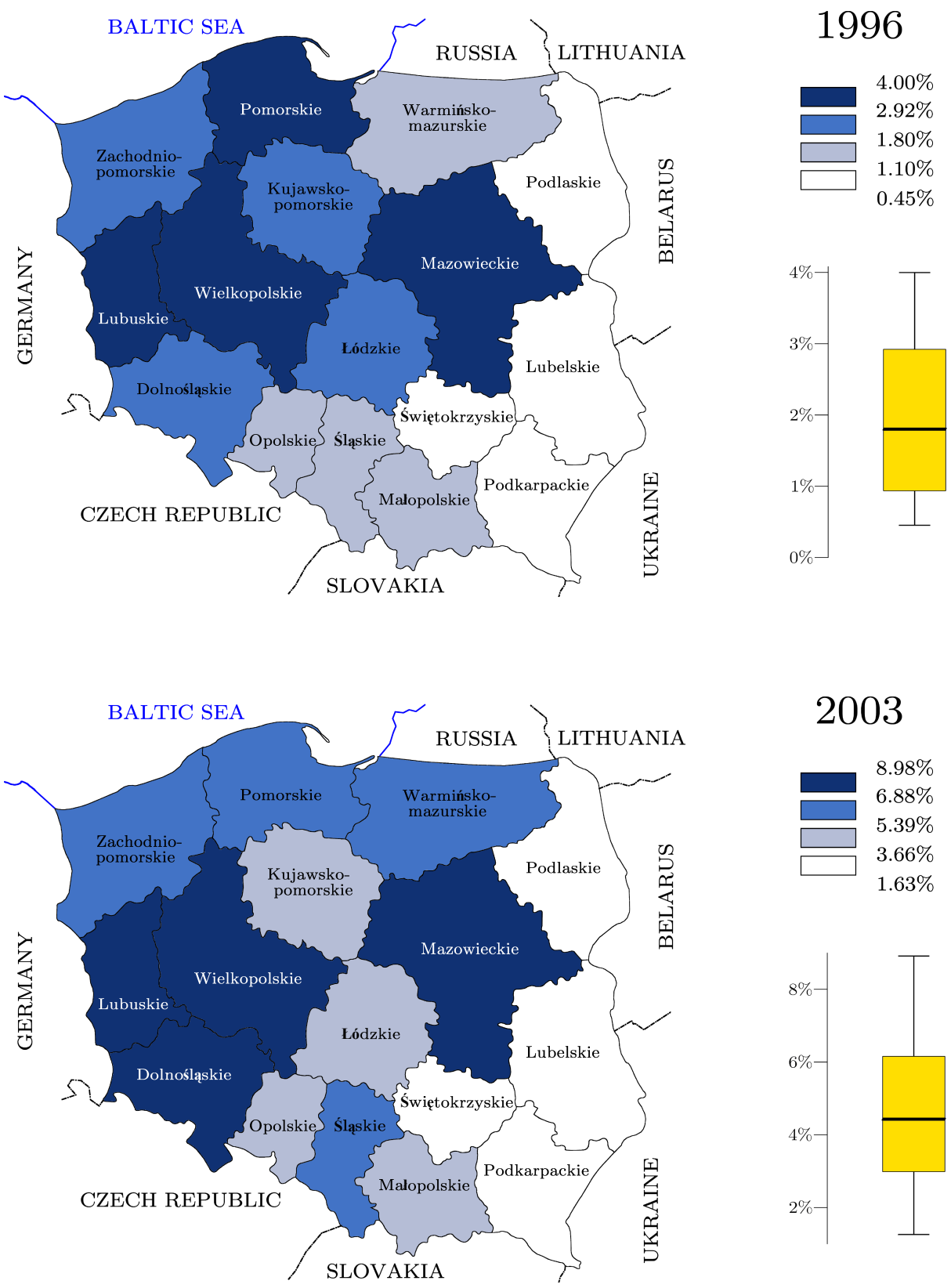


Figure 4.6: Shares of Employment in Foreign Firms in Total Employment in Polish Regions in 1996 and 2003

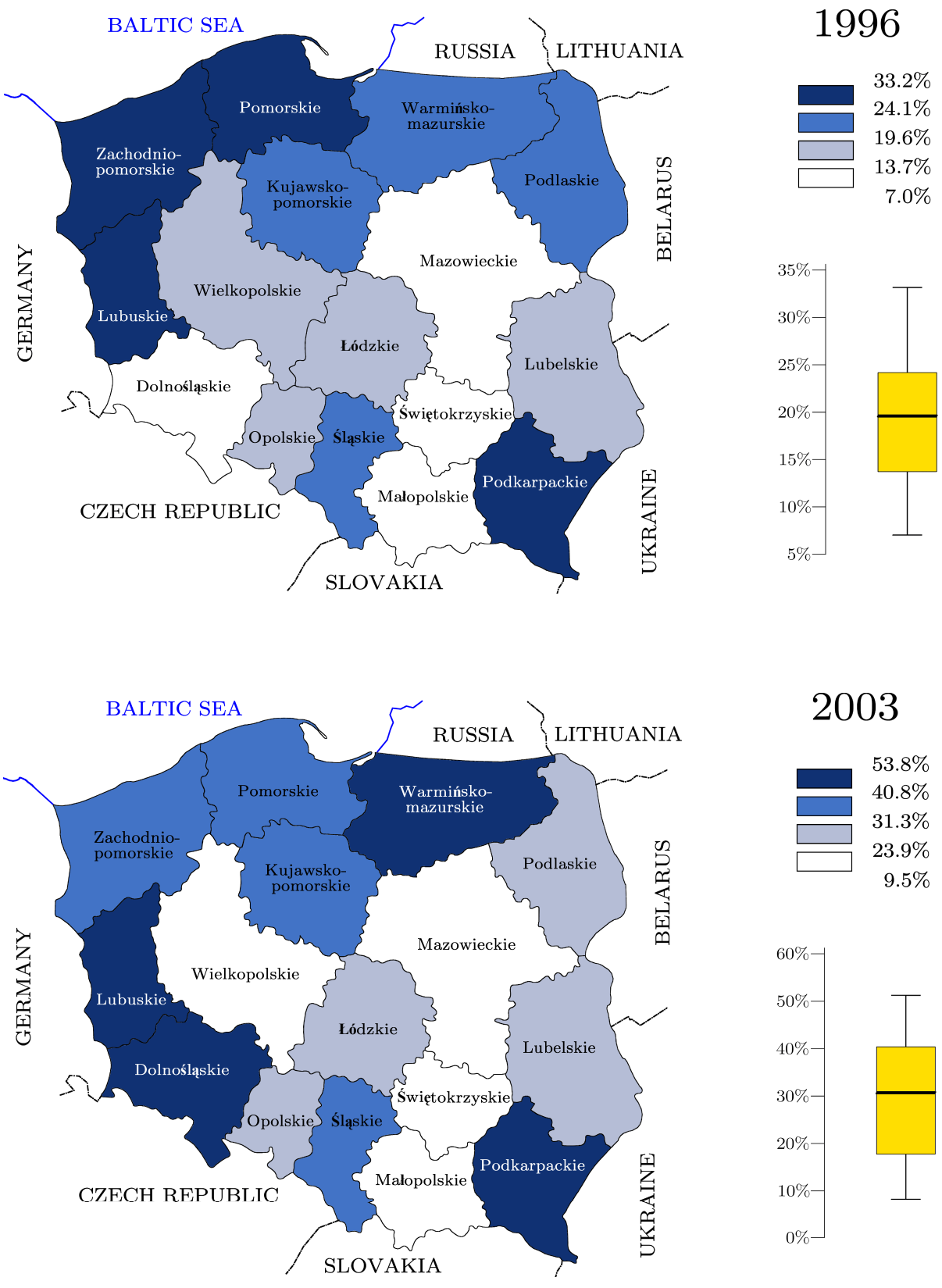


Figure 4.7: Shares of Exports in Foreign Firms' Revenues in Polish Regions in 1996 and 2003

sition of overall FDI activities. The largest share of exports in 2003 was recorded in Lubuskie voivodship - 54 percent compared to 33 percent in 1996. Furthermore, Dolnośląskie, Warmińsko-mazurskie and Podkarpackie exhibit shares of over 40 percent, while Mazowieckie, Malopolskie, Świetokrzyskie and Wielkopolskie constitute the bottom group with shares ranging from 9 to 24 percent. In other words, vertical FDI have clearly different determinants than the horizontal ones, as they operate not only in the west of the country but also choose eastern locations.

Regarding the sectoral distribution of FDI (measured by employment in foreign affiliates) in all voivodships except Mazowieckie, the bulk of FDI targets manufacturing, accounting for 30 to 93 percent.[9] As Table 4.2 shows in 2002 the highest share of manufacturing was recorded in Podkarpackie and Warmińsko-mazurskie - about 93 percent, followed by Podlaskie, Kujawsko-pomorskie, Lubuskie and Opolskie with more than 80 percent, while in Mazowieckie this sector accounted only for 30 percent. This particular voivodship exhibits high shares of wholesale and retail trade and repair (28 percent), transport and telecommunications (18 percent) as well as business activities (9 percent). Furthermore, foreign affiliates from the trade sector appear to be heavily concentrated in Małopolskie and exhibit strong presence in other voivodships with big agglomerations. Also foreign firms operating in the business activities sector prefer locations with large urban areas.

Table 4.3 shifts the focus from the sectoral distribution of FDI to the composition according to the country of origin. For every voivodship it reports shares of certain countries in total foreign equity. One notable feature of this table is that the distribution of FDI in most voivodships is concentrated around one, two or three countries. Małopolskie constitutes an extreme example where as much as 75 percent of total foreign equity is owned by Holland. Germany, with a share of about 30 - 40 percent, is strongly represented in virtually all western voivodships, while its shares are getting

[9]However, data published by the Polish Statistical Office (PSO) do not comprise FDI in banking and insurance. According to Polish Information and Foreign Investment Agency (PAIiIZ) investment in those sectors accounts for about 20 percent of all FDI, see Chapter 1. Since I have no information about geographical distribution of activities in banking and insurance, I refer here to the rest as a 100 percent.

Table 4.2: Sectoral Breakdown of Employment in Foreign Firms in Polish Voivodships (2002), in Percent

voivodship	*manufacturing*	*construction*	*electricity*	*trade*	*hotels and restaurants*	*transport and telecommunications*	*business activities*	*other*[a]
Dolnoślaskie	65.0	2.9	1.7	12.6	6.1	0.8	4.0	6.8
Kujawsko-pomorskie	88.7	2.2		6.3	0.1	0.3	1.7	0.6
Lubelskie	72.4	2.5		16.4	0.1	2.4	1.4	4.8
Lubuskie	84.3	0.8	1.5	4.3	0.6	3.8	2.0	2.7
Łódzkie	76.0	1.6		15.7	0.1	2.8	2.0	1.9
Małopolskie	43.9	2.5	2.2	46.4	0.6	1.0	2.9	0.5
Mazowieckie	30.2	2.5	1.1	28.8	4.9	18.1	8.9	5.5
Opolskie	80.9	2.7		9.0	0.4	1.8	3.8	1.4
Podkarpackie	93.0	0.7		5.0		0.3	1.1	
Podlaskie	89.4			4.3			6.4	
Pomorskie	71.7	1.1	5.4	10.7	0.7	2.4	4.7	3.3
Ślaskie	71.8	3.3	4.3	8.4	0.2	3.5	4.9	3.7
Świetokrzyskie	74.6	11.5		12.6			1.3	
Warmińsko-mazurskie	92.3	0.5		3.7	0.5	1.0	0.3	1.7
Wielkopolskie	66.2	2.3	0.7	25.0	0.1	2.8	1.4	1.6
Zachodniopomorskie	71.3	2.3	2.6	10.6	1.2	2.3	3.5	6.4

[a]Agriculture, hunting and forestry, fishing, mining and quarrying, financial intermediation except insurance and banking, education, health and social work, and other community, social and personal service activities.
Source: Polish Statistical Office.

Table 4.3: Composition of Foreign Firms' Equity in Voivodships by Country (2002), in Percent

voivodship	*Holland*	*Germany*	*France*	*USA*	*UK*	*Sweden*	*Denmark*	*Italy*	*Korea*	*Belgium*	*other*[a]
Dolnośląskie	23.0	40.1	5.4	4.8	1.1	4.2	1.1	1.2		7.7	11.4
Kujawsko-pomorskie	29.2	38.4	2.8	1.0	3.8	0.7	4.0	0.2		2.5	17.4
Lubelskie	9.6	15.9	9.9	4.7	0.8	0.3	0.2	6.9	16.6	7.9	27.3
Lubuskie	12.0	16.6	3.2	0.6	0.4	20.6	6.6	13.4		6.2	20.4
Łódzkie	14.0	27.2	1.4	4.4	4.4	0.7	7.3	15.5	2.1	0.7	22.2
Małopolskie	75.3	11.0	0.6	2.3	0.9	0.4	0.2	0.7		0.5	8.1
Mazowieckie	16.7	15.2	30.2	10.0	7.1	3.3	3.5	1.1	4.2	1.1	7.7
Opolskie	23.5	42.1	2.2	10.5	0.1	0.2	1.5	0.2		2.5	17.1
Podkarpackie	15.2	18.0	9.1	18.2		1.1		1.3			37.1
Podlaskie	40.3	22.9	29.3	2.5		1.7		0.3			2.9
Pomorskie	28.2	30.2	8.4	4.6	4.5	6.3	5.4	1.0		0.6	10.9
Ślaskie	13.2	21.7	7.7	5.1	2.5	4.7	2.3	17.8		0.9	24.1
Świetokrzyskie	26.0	12.6	4.3	1.7	5.7	4.5	0.5	2.1		34.7	7.9
Warmińsko-mazurskie	30.1	15.4	11.1	0.4	0.3	0.5	13.4	2.3		2.9	23.7
Wielkopolskie	35.2	29.1	7.7	1.6	4.8	3.9	2.6			8.5	6.6
Zachodniopomorskie	13.9	29.2	0.9	1.6	6.4	8.0	15.4	1.6		0.4	22.6

[a] Austria, Cyprus, Japan, Luxembourg, Spain and Switzerland, and others.
Source: Polish Statistical Office.

smaller when moving east. Among western voivodships only in Lubuskie Germany accounts for less than 20 percent of the whole foreign equity. This voivodship appears to have the most heterogeneous population of foreign firms, with Sweden as the largest investor. In general Holland and Germany are present in all regions with the smallest share at about 10 percent. In Mazowieckie France is the biggest shareholder with 30 percent, probably thanks to investment of France Télécom in the Polish telecommunications sector (this investment is also visible in Table 4.2). Furthermore, France is also the second largest investor in Podlaskie, where it accounts for 29 percent. Regarding US, it is represented with 18 percent share in Podkarpackie and 10 percent shares in Mazowieckie and Opolskie. The last column of Table 4.3 reports the rest of the foreign equity. Unfortunately, the PSO does not publish detailed distributions of foreign investors in Polish voivodships, which is a source of serious uncertainty about the origin of invested capital in the case of Podkarpackie, as "other" accounts for as much as 37 percent. A short investigation reveals that the bulk of those 37 percent can be attributed to Cyprus.

This sizable cross-voivodship variation in foreign affiliate industry and country composition contradicts the idea that all FDI into Poland are driven by the same forces and are thus likely to look the same across regions. Instead, it suggests that MNEs base their establishment decisions on a set of location characteristics, that will be addressed econometrically in next sections.

4.4 Estimation and Data

4.4.1 Estimation Strategy

To examine the influence of regional characteristics on the extent of foreign firms' activity I estimate the following equation:

$$FORACT_{jt} = \beta Z_{jt-1} + \lambda_j + \theta_t + u_{jt} \tag{4.1}$$

where $FORACT_{jt}$ denotes foreign activity in region j in the year t, Z is defined as a vector of regional characteristics and λ and θ are fixed regional and time effects, respectively.

The activities of foreign investors (generally represented by $FORACT$) are measured by three variables. First, I employ the share of employment in foreign firms in total employment ($EMPFOR$) to cover the entire FDI activity. Second, I use a share of exports in foreign firms' revenues ($EXPFOR$) in order to make a distinction between FDI directed toward serving external markets (vertical) and the one supplying the local market (horizontal), measured by $LOCFOR$ complementary to $EXPFOR$.[10]

Dependent variables measured in shares instead of levels imply, that agglomeration forces or other unobserved variables in the same way affecting domestic and foreign activities, or export-related and local market-oriented sales of foreign firms, are deflated. In particular, $EMPFOR$ captures the impact of regional characteristics on foreign activities only, as the dependent variable implicitly controls for unobserved variables that affect foreign as well as domestic activity. $EXPFOR$ and $LOCFOR$ examine solely what impact the regional characteristics have on export and local sales, respectively, when unobserved effects that influence FDI in general are excluded because of the form of dependent variable.

There are important reasons for such an approach. First, I do not have enough data to measure agglomeration in a direct way, as proposed by empirical literature. Second, there exists abundant literature on agglomeration forces, and virtually every study finds them to be conducive to FDI. The

[10]For definitions of vertical and horizontal FDI see the next section.

significance of centripetal forces is already clearly visible in a descriptive analysis of regional pattern of development in Poland presented in Section 4.3. Last but not least, in context of sparsely populated, lagging regions, it is important to look beyond agglomeration forces, in order to identify what else is driving the decisions of foreign firms. Otherwise, the results would be dominated by regions where the intensity of economic activity is already very high.

When using data scaled to two shares, one important aspect must be taken into account. In the case of $EXPFOR$ and $LOCFOR$, these shares will always return one and as a consequence both regressions behave like a seemingly unrelated system, with the constraint imposed that the coefficient estimates for each regressor sum to zero. The signs of the coefficient estimates will be determined by the dominant addend - its share will have coefficients of the same signs as in the case, where the regression is performed for it as an unscaled dependent variable.

The dominating addend will be the one exhibiting a higher dependence on the independent variables. Thus, if such imbalance is given, the share approach can be used to determine the sign of dependencies for the dominant component, but in order to determine the dependencies of the subordinate component, other normalization methods must be employed. Therefore, in order to check the robustness of estimated coefficients, I perform additional regressions where $EXPFOR$ and $LOCFOR$ are replaced by $EXPFOR/PROD$ and $LOCFOR/PROD$, generated by normalizing the export and local sales of foreign firms to global regional production. This way, we still control for unobserved effects such as agglomeration forces, which influence both the domestic and foreign activity.

Following the previous empirical studies on horizontal and vertical FDI, I estimate equation (4.1) with OLS. Since it is unlikely that the included explanatory variables will capture all regional characteristics that influence the extent of foreign activities at a particular location, my empirical equation also includes unit fixed effects. For example, it is likely that some local governments are more active in promoting their regions or some locations are

more attractive because of natural advantage than others.[11] The inclusion of voivodship specific fixed effects should alleviate the omitted variables problem. Consequently, in order to be able to include time invariant variables together with fixed voivodships effects in one regression, I have to multiply them by the time trend.

Additionally, I also add fixed time effects because government policies in general, not only on voivodship level, may affect the attractiveness of particular regions more than others. For instance, it has been widely criticized that promotion for investors conducted by the Polish institutions was focused on such assets as the volume of the domestic market, its strategic location and economic growth. Such an approach was conducive to an inflow of investment maintaining a non-innovative type of economy or based solely on exploitation of its extensive features. To make it more obvious, it is clear that huge supermarket chains like: Geant and REWE have different location criteria than Intel Corporation or Infineon Technologies.

All independent variables are included in lags, in order to avoid simultaneity. Additionally, lagging all independent variables by one period has helped to augment the number of observations. That is because all variables which are generated by national accounts, e.g. GDP, GDP per capita and global production used for unit labor cost calculation are available only till 2002, while variables related to foreign firms activities have been reported only since 1996. In other words, thanks to the lagging procedure I could use all the available information.

4.4.2 Remarks on Definition of Vertical and Horizontal FDI

As mentioned in Section 4.2.2, the empirical distinction between horizontal and vertical FDI is not always possible. This is because there are some

[11] In 1998 the act of regional self-government was adopted, according to which programming of regional policies is under the responsibility of regional parliaments and voivodships' Marshalls. In order to receive funding from the state budget, Voivodship Boards apply for funds, stating the objectives and tasks to be covered by the support, as well as sources and amounts of finance for the tasks.

foreign firms that are cost-saving and market-seeking at the same time, as well as there exist foreign affiliates that sell locally and also export.

In the empirical literature related to this subject, there is a discussion about the scope of vertical FDI. Braconier, Norbäck and Urban (2002) propose four basic activities that could help empirically separate vertical from horizontal FDI: exports to parent country, exports to third countries, local sales and imports from the home country. The first kind of these activities is called "pure" vertical FDI, while the export-oriented FDI aimed at serving a third market is called an "export-platform FDI" with the indication that this type of activity should be referred to as a vertical linkage, just as the imports from the parent country. Local sales are rather of horizontal nature, although to some extent they could comprise also vertical linkages in form of import from home country.

Marin (2004) is able to directly identify those vertical linkages between the parent firm and the foreign affiliate. She measures the extent of vertical activity by intra-firm trade: parent firm exports of intermediates and imports of inputs or final goods from a foreign affiliate to the parent firm. However, for the purpose of this study, this definition is not applicable, since my data do not contain the information about the geographical destination of exports by multinationals in Poland.

Protsenko (2003) and Hauser (2005) use a more simple, and from the point of view of this study more useful, distinction between horizontal and vertical FDI. For firm level data, they declare a foreign affiliate as vertical FDI if it is exporting more than 50 percent of its output. Otherwise an investment is called horizontal. As noted above, data collected for the purpose of this study allows me to discriminate between local foreign firms' sales and their export. Following the approach of Protsenko (2003) and Hauser (2005), I use local sales to define horizontal FDI, and sales on export for vertical FDI.

4.4.3 Explanatory Variables

The choice of right hand side variables Z in this chapter is inspired by the empirical literature related to location choice presented in Section 4.2.2. The extent of foreign activities in a specific region depends on the levels of this region's characteristics relative to other alternative locations. These variables can be categorized into those affecting the revenue prospects and those governing the costs of doing business.

On the cost side, first I include unit labor costs (ULC) instead of average wages. The apparent popularity of wages among researchers can be explained by the fact that the theoretical prediction of their influence is straightforward: higher wages increase costs, thus, they are negatively correlated with the magnitude of foreign activities. The empirical evidence reviewed in Section 4.2.2 shows however, that results regarding the sign of the wage coefficient are mixed. Because of these conflicting results and uncertainty of what average wage actually measures, I have decided to use unit labor costs in place of wages. The variable ULC is defined as the annual average wage divided by the productivity. Productivity in turn is measured by overall global production divided by average employment.

Furthermore, the host region's labor supply may have an impact on foreign firms' location decisions through the quality of the labor force. This invokes one of the so called "Marshallian" externalities: MNEs choose to establish their affiliates in certain areas because there they will be more likely to find the labor force with the specific skills they require. Coughlin and Segev (2000) obtained the results indicating that the measure of quality of labor force based on education level is an important determinant of location of new plants. Thus, I have incorporated the percentage of population having at least a secondary degree ($POPEDU/POP$) as an independent variable in my estimation equation.

Congestion costs, inevitable in agglomeration areas, represent another potential location determinant on the cost side of the profit function. Higher land and housing costs, higher service costs or pollution will likely daunt firms from locating in a specific region. Unfortunately, the information about real

estate prices, which could be a good proxy for congestion costs, was available only for 2001 and 2002. Thus, I use the population density as a proxy ($POPDENS$). The rationale here is that population density likely reflects congestion costs because already established residents and commercial users compete for local capacities. Two of the above reviewed studies, Figueiredo, Guimaraes and Woodward (2000) and Pusterla and Resmini (2005), follow this strategy but obtain a positive estimate on population density. The latter result is in line with an alternative interpretation of this variable as the one capturing urbanization or the proximity of customers. That way, the expected sign of this variable will depend on the type of FDI: positive for horizontal and negative for vertical investment.

As emphasized in Section 4.2.1, firms consider also transportation costs. They can be proxied by the public infrastructure quality, according to the rule that better infrastructure results in better accessibility and therefore, transport of raw materials, intermediaries and final products to and from their respective markets should be easier and less costly. I measure infrastructure endowment using three indicators. Two simple indicators of the infrastructure quality in a region are the length of railways and the length of roads per 100 square km. Additionally, I include the development of the telephone network as an indicator of convenience and frequency of business and social contacts in a particular region, measured by the number of telephones per 1000 inhabitants. These three indicators are used to classify voivodships according to the quality of their infrastructure. Using a Borda electoral count, the sum of the three ranks establishes the overall score for each region. Thus, the highest possible score is 3, when a region is always ranked first, and the lowest possible score is 48. Table 4.11 provides detailed background data of every criterion used for construction of the final measure of the regional infrastructure development $INFRAST$. The expected sign of $INFRAST$ coefficient will be negative, since the smallest score means the most developed infrastructure.

To control for distance-dependent transportation costs, I have incorporated the distance to the nearest border crossing with Germany or Austria

($DISTEU$) and the distance from Warsaw ($DISTCAP$). The former variable is a good proxy of transportation costs in the case of export-oriented FDI that seeks to serve the "old" EU market and for foreign firms that rely on intermediaries imported from the EU.

Alternatively, as Disdier and Mayer (2003) argue, distance can be seen as a proxy of transaction costs. In this context one could think of information costs which are related to the distance from headquarters (about 70 percent of FDI in Poland originate in Western Europe) or language barrier. Regarding the latter, language skills of local population could be an important determinant for foreign firms to locate in particular area. The Polish General Social Survey (PGSS) reveals that the western and south-western regions enjoy an advantage over the rest in this respect. $DISTEU$ can capture these both aspects and is defined as the road distance between the main city in the region and nearest major border crossing with the "old" Europe.

The reason to include $DISTCAP$, defined as the distance from Warsaw, is straightforward. In Poland, a significant part of the economic activity is concentrated in Warsaw and its surroundings and as the descriptive analysis in the previous section showed, Mazowieckie voivodship has the largest local market and the wealthiest population. It also has a "capital bonus" - the proximity to the place where all decisions are taken.[12]

On the revenue side, the most important factor affecting the desirability of undertaking economic activity in a specific location is the demand for the firm's good. I measure the potential demand of regions using two variables, GDP and GDP per capita (GDP, $GDPCAP$), capturing the size of the local market and the purchasing power.

One has to note, that in the case of the intra-country analysis GDP per capita is probably a better measure of local market potential of the region than GDP. This is because it is unlikely that the market served by the foreign

[12]The inclusion of this variable is also inspired by Hanson (1997) who tests on the example of Mexican regions, among others, the hypothesis based on agglomeration effects, that regional nominal wages decrease with growing transportation costs to industry centers. In order to measure this effect, he includes the distance from Mexico-City and the distance to US border, approximating the distance to the areas of highest concentration of industry in Mexico. He finds that both are negatively correlated with wages.

firm coincides with the boundaries of the region considered. Furthermore, within one country, without internal borders constituting impediments to trade, market-seeking FDI will be more likely to settle were potential "deep pockets" are and not necessarily in the region that is large but not so wealthy. I expect these variables to be positively correlated with the location decisions of foreign investors if the geographical destination of foreign firm sales is the host country market. In the case of export-oriented FDI, local market potential should have no effect.

Next, I would like to explore the effect of public investment incentives. The empirical studies have shown that at least in some cases, public incentives are conducive to foreign investment. Considering Poland and other transition economies, in the first place a liberal regime for foreign investment had to be established. In Poland the last restrictions like a limited screening mechanism on foreign investors and limits on foreign ownership in particular sectors were eliminated in May 1996 following accession to the OECD.[13] Furthermore, in order to combat the growing structural unemployment and support restructuring efforts, in 1995 the Polish government launched an investment incentive program addressed to domestic as well as foreign investors. In the course of this program 14 Special Economic Zones (SEZs) and 2 technological parks have been established, in which business activities can be conducted on preferential terms. These designed areas can be seen as enclaves providing not only tax exemptions and customs duty reliefs but also non-tax incentives related to creation of employment and investment procedures. This policy instrument is targeted spatially in response to large disparities in regional development.

As can be seen in Figure 4.8 which shows the geographical distribution of SEZs, 11 out of 16 voivodships have at least one. Unfortunately, as Cieślik and Ryan (2005) noted, investment incentives varied between SEZs and over time. Information about actual extent of public support is also scarce. Thus, all one can do to account for the effect of this policy is to include a dummy variable taking the value of 1 when a particular region has at least one SEZ

[13]Even after 1996 foreign participation was still capped in a few sectors.

Figure 4.8: The Distribution of Special Economic Zones in Poland

(SEZ). In view of the specific objective of SEZs to attract new investment, this dummy is expected to have a positive impact on foreign investments.

Finally, as an alternative to $DISTEU$, I also include covariates measuring border effects. The vicinity of a country border can influence the presence of foreign investors in two contradictory ways. First, due to tariffs, additional transport costs, information cost etc., it can exert a downward pressure on the trade volume between two neighboring regions of different countries, that is also on their economic activity.

On the other hand, the removal of national barriers and the development of greater economic and political trans-border cooperation has led to reconsideration of spatial identity and of the definition of regional economies or markets. As a result of the process of European integration, the Polish borders in the west will gradually disappear, while those in the east, with Russia, Belarus and Ukraine, will become even more closed, as an external border of the EU. This uneven development can have an influence on relative attrac-

tiveness of certain regions to foreign investors. Border effects are measured by the length of border a particular voivodship has with the neighboring country.[14]

4.4.4 Data

The data set used for analysis in this chapter consists of a balanced panel of 16 Polish regions (voivodships) collected from various statistical publications of the PSO (Polish Statistical Office) covering the period between 1996 and 2003 (the details on the source of data are to be found in Appendix). It contains the basic voivodship characteristics as well as data on education, detailed information regarding the infrastructure network and firms with foreign participation. The foreign firm sample consists of the manufacturing sector and the service sector excluding banking and insurance.

An important issue has to be considered regarding this data set: the Polish regional structure did not remain constant in the period of interest. On January 1, 1999 a new administrative division of Polish territory was implemented, where 49 small voivodships were replaced by 16 larger units. Unfortunately for a researcher the areas of new voivodships emerged as a result of political interactions rather than by joining several old voivodships. For this reason, conversion of data for 1998 and earlier years by simple additive aggregation would yield inaccurate results. The PSO has published some data recalculated according to the new regional units back to 1995.

4.5 Results

Equation (4.1) was estimated with different configurations of independent variables, presented in columns (1) to (6) in Tables 4.4, 4.5, 4.6 and 4.7. In the two first tables the dependent variable is the general measure of FDI ($EMPFOR$), while the two other tables estimate export-oriented FDI ($EXPFOR$).

[14] $RUS-BORD$ - Russia, $LIT-BORD$ - Lithuania, $BEL-BORD$ - Belarus, $UKR-BORD$ - Ukraine, $SLO-BORD$ - Slovakia, $CZR-BORD$ - the Czech Republic, $GER-BORD$ - Germany, $SEA-BORD$ - sea border

4.5.1 All Foreign Firms

The first column of 4.4 contains the baseline estimates of effects of local demand, unit labor costs, infrastructure, labor quality and congestion costs on employment share of FDI. The following five columns list the coefficients where distance variables, public incentives and border effects are incorporated sequentially as follows: columns (2) and (3) include distance variables, columns (3), (4) and (6) add SEZ dummy, while columns (5) and (6) contain border effects.

Note that in this table, only $GDPCAP$ is included. From Section 4.3 it is clear that variables that measure local demand are highly correlated, for that reason $GDPCAP$ and GDP have been estimated separately. Regression results containing GDP are presented in Table 4.5.

Turning to estimates, in the baseline model the $GDPCAP$ coefficient measuring local market potential appears to be positive and statistically significant at one percent level. Concerning the ULC coefficient, it has the expected negative sign but is not statistically significant. Supporting theoretical predictions, the result on $INFRAST$ is negative and statistically significant, $POPEDU/POP$ proves to have a positive and statistically significant impact, while the $POPDENS$ coefficient is negative as anticipated, although insignificant.

The inclusion of distance variables, $DISTEU$ and $DISTCAP$, in specification (2) and (3) does not substantially change the results concerning variables from column (1). Both variables have a negative influence on the scale of foreign activities, $DISTEU$ is always significant and $DISTCAP$ only in column (3). That is, the distance to the western border deters location decisions of foreign firms as expected. Concerning the distance to Warsaw, from the descriptive analysis it is clear that Mazowieckie voivodship is characterized by the highest share of foreign firms in overall employment, but its neighboring regions, in particularly those in the east, are not among leaders in this category. It appears that Mazowieckie alone cannot outweigh the gravity of the western border.

In specifications (5) and (6) distance variables are substituted with border

Table 4.4: Location Decision: Employment Share (I)

dependent variable: *share of employment in foreign firms in total employment*						
	(1)	(2)	(3)	(4)	(5)	(6)
$GDPCAP$	0.179***	0.112**	0.123***	0.194***	0.135***	0.147***
	(0.037)	(0.046)	(0.041)	(0.042)	(0.029)	(0.032)
ULC	−4.331	−4.845	0.331	−2.561	0.043	0.941
	(3.702)	(2.961)	(2.758)	(4.029)	(2.182)	(2.124)
$INFRAST$	−0.027**	−0.026**	−0.006	−0.021	−0.019**	−0.013
	(0.012)	(0.011)	(0.012)	(0.014)	(0.009)	(0.010)
$POPEDU/POP$	0.055*	0.046**	0.066***	0.061**	0.047***	0.048***
	(0.029)	(0.022)	(0.023)	(0.029)	(0.017)	(0.017)
$POPDENS$	−0.005	0.002	0.004	−0.005	0.002	0.003
	(0.007)	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)
$DISTEU \times year$		−0.068***	−0.094***			
		(0.014)	(0.015)			
$DISTCAP \times year$		−0.037	−0.067***			
		(0.026)	(0.025)			
$SEZ \times year$			0.153***	0.046		0.041
			(0.038)	(0.054)		(0.036)
$RUS - BORD \times year$					0.001*	0.000
					(0.000)	(0.000)
$LIT - BORD \times year$					0.000	0.000
					(0.001)	(0.001)
$BEL - BORD \times year$					−0.001***	−0.001***
					(0.000)	(0.000)
$UKR - BORD \times year$					0.000	0.000
					(0.000)	(0.000)
$SLO - BORD \times year$					−0.000***	−0.001***
					(0.000)	(0.000)
$CZR - BORD \times year$					0.001***	0.001***
					(0.000)	(0.000)
$GER - BORD \times year$					0.000**	0.000**
					(0.000)	(0.000)
$SEA - BORD \times year$					−0.000**	−0.000***
					(0.000)	(0.000)
constant	2.368	697.760	845.579	−55.823	27.589	−12.094
	(1.534)	(234.064)	(222.834)	(69.078)	(41.301)	(63.911)
Adj. R^2	0.958	0.971	0.975	0.959	0.983	0.983
N	128	128	128	128	128	128

Notes: Parameters are estimated by OLS regressions; all specifications include voivodship and time fixed effects; *** (**,*) significant at 1 (5, 10) percent level; standard errors in parentheses are robust to heteroscedasticity; N - number of observations.

Table 4.5: Location Decision: Employment Share (II)

dependent variable: *share of employment in foreign firms in total employment*						
	(1)	(2)	(3)	(4)	(5)	(6)
GDP	0.021***	0.018**	0.021***	0.022***	0.019***	0.021***
	(0.005)	(0.007)	(0.006)	(0.006)	(0.004)	(0.005)
ULC	−5.877	−5.319*	0.105	−4.811	−0.751	0.056
	(4.293)	(2.941)	(2.564)	(4.707)	(2.152)	(2.074)
$INFRAST$	−0.026**	−0.023**	−0.001	−0.022	−0.019**	−0.014
	(0.013)	(0.011)	(0.011)	(0.014)	(0.009)	(0.010)
$POPEDU/POP$	0.080***	0.057**	0.078***	0.085***	0.053***	0.055***
	(0.030)	(0.023)	(0.023)	(0.032)	(0.017)	(0.017)
$POPDENS$	−0.010	−0.002	0.000	−0.010	0.001	0.002
	(0.007)	(0.006)	(0.005)	(0.006)	(0.004)	(0.005)
$DISTEU \times year$		−0.070***	−0.096***			
		(0.014)	(0.013)			
$DISTCAP \times year$		−0.028	−0.056**			
		(0.029)	(0.027)			
$SEZ \times year$			0.160***	0.030		0.040
			(0.038)	(0.057)		(0.035)
$RUS - BORD \times year$					0.001*	0.000
					(0.000)	(0.000)
$LIT - BORD \times year$					0.001	0.000
					(0.001)	(0.001)
$BEL - BORD \times year$					−0.001***	−0.001***
					(0.000)	(0.000)
$UKR - BORD \times year$					−0.000*	−0.000**
					(0.000)	(0.000)
$SLO - BORD \times year$					−0.001***	−0.001***
					(0.000)	(0.000)
$CZR - BORD \times year$					0.001***	0.000***
					(0.000)	(0.000)
$GER - BORD \times year$					0.001***	0.001***
					(0.000)	(0.000)
$SEA - BORD \times year$					−0.000*	−0.000**
					(0.000)	(0.000)
constant	4.733	661.474	795.081	−32.738	35.518	−2.360
	(1.512)	(239.666)	(218.928)	(72.080)	(40.001)	(60.760)
Adj. R^2	0.955	0.972	0.977	0.955	0.984	0.984
N	128	128	128	128	128	128

Notes: Parameters are estimated by OLS regressions; all specifications include voivodship and time fixed effects; *** (**,*) significant at 1 (5, 10) percent level; standard errors in parentheses are robust to heteroscedasticity; N - number of observations.

variables. Also in this case, results for variables common with the first column are similar. Only the direct proximity to Germany, Czech Republic and less so to Russia (the coefficient on $RUS-BORD$ is statistically significant at 10 percent level in column (5)) is conducive for FDI. Furthermore, the border to Lithuania and Ukraine has a positive but not significant effect, while being close to Belarus, Slovakia, and Baltic Sea is discouraging for multinationals. This result corroborates findings related to $DISTEU$, that proximity to the core of the EU attracts foreign investment.

The attractiveness of the western region of Poland is also a result of integration of Poland with neighboring regions as part of preparation for the EU accession. Although the eastern regions were also recipients of funds for reconstruction, the simultaneous strengthening of the eastern border as a future EU external border seems to be more important, causing adverse effects in the east (in regions near to Belarus).

In columns (3), (4) and (6) SEZ, which measures the provision of public incentives for FDI, is added. In all three specifications the SEZ coefficient has a positive sign, but it is statistically significant only in the column also controlling for distance variables, which agrees with the result obtained by Cieślik and Ryan (2005). As argued in Section 4.4.3, due to inevitable data limitations, measurement of the provision of public incentives solely by dummy variables for special economic zones might be insufficient. In other words, one must be quite cautious in concluding about the effectiveness of SEZs formation in attracting FDI based on such a weak measure. Furthermore, the inclusion of SEZ slightly worsens the explanatory power of $INFRAST$.

For the sake of completeness it must be stated that substituting $GDPCAP$ with GDP in Table 4.5 generally yields similar results, with one difference. The coefficient of the Ukrainian border ($UKR-BORD$) becomes statistically significant and changes its sign to negative.

Summarizing, Tables 4.4 and 4.5 show that foreign investors in Poland, above all, value characteristics related to local demand, qualified labor force and also the proximity to core of the EU. Furthermore, the negative result

on $INFRAST$ supports the hypothesis, that better infrastructure lowers transport costs, and therefore enhances the attractiveness of a certain region for foreign firms. This coefficient, however, is not always statistically significant. The effect of labor and congestion costs is not clear, since the coefficients of both variables assume both positive and negative values and are predominantly insignificant. As it will be shown in the next section, where a distinction between market-seeking and export-oriented FDI is made, these partly inconclusive results are a consequence of a heterogeneous sample of FDI used in this section.

4.5.2 Market-seeking versus Export-oriented FDI

Tables 4.6 and 4.7 report results obtained with the share of exports in foreign firms' revenues ($EXPFOR$) used as the dependent variable. Again, in the first table, $GDPCAP$ is included, while in Table 4.7 - GDP.

Recall, that a regression on the share of local sales in foreign firms' revenues ($LOCFOR$) would yield coefficients of exactly the same magnitude and with opposite signs as in the case of export share, therefore the results are omitted.

The main message of Tables 4.6 and 4.7 is that the determinants of location of both types of FDI are indeed different. In the case of $EXPFOR$, the $GDPCAP$ coefficient is negative and statistically significant in all specifications but last. This would imply that wealthiness of the region even discourages export-oriented FDI. This result, however, could also be an effect of the dominant $LOCFOR$ variable, as discussed previously. In order to eliminate this uncertainty, a robustness check is performed in the next section.

ULC appears to have negative and statistically significant influence on export-oriented FDI. The estimates of the coefficient on $POPEDU/POP$ are positive and statistically significant in all columns, which implies that vertical FDI save on costs but also value a well educated, high quality labor force. The next variable, the population density, seems to capture the congestion problem appropriately well since its coefficient is negative and statistically

Table 4.6: Location Decision: Export Share (I)

dependent variable: *share of exports in foreign firms' revenues*						
	(1)	(2)	(3)	(4)	(5)	(6)
$GDPCAP$	−1.109***	−1.332***	−1.252***	−0.932***	−0.570**	−0.431
	(0.277)	(0.370)	(0.391)	(0.305)	(0.277)	(0.313)
ULC	−100.178***	−98.949***	−59.957*	−79.367**	−83.353***	−73.026***
	(30.604)	(29.700)	(34.089)	(35.116)	(22.991)	(21.715)
$INFRAST$	−0.200	−0.192	−0.037	−0.127	−0.237*	−0.173
	(0.125)	(0.124)	(0.138)	(0.135)	(0.123)	(0.123)
$POPEDU/POP$	0.876***	0.813***	0.963***	0.949***	0.525**	0.537**
	(0.227)	(0.216)	(0.246)	(0.241)	(0.257)	(0.259)
$POPDENS$	−0.165***	−0.133***	−0.119***	−0.168***	−0.113**	−0.104**
	(0.058)	(0.050)	(0.043)	(0.056)	(0.045)	(0.043)
$DISTEU \times year$		−0.334***	−0.525***			
		(0.126)	(0.155)			
$DISTCAP \times year$		−0.075	−0.299			
		(0.204)	(0.228)			
$SEZ \times year$			1.154**	0.538		0.469
			(0.450)	(0.401)		(0.372)
$RUS - BORD \times year$					0.013***	0.012***
					(0.002)	(0.002)
$LIT - BORD \times year$					0.001	−0.006
					(0.011)	(0.012)
$BEL - BORD \times year$					−0.002	−0.001
					(0.004)	(0.004)
$UKR - BORD \times year$					0.005**	0.005**
					(0.002)	(0.002)
$SLO - BORD \times year$					−0.001	−0.002
					(0.001)	(0.001)
$CZR - BORD \times year$					0.007***	0.006***
					(0.001)	(0.001)
$GER - BORD \times year$					0.008***	0.008***
					(0.002)	(0.002)
$SEA - BORD \times year$					0.002	0.001
					(0.002)	(0.002)
constant	70.038	2896.194	4009.680	−614.518	−1617.715	−2074.143
	(14.084)	(1882.900)	(1983.429)	(510.289)	(336.874)	(537.301)
Adj. R^2	0.881	0.893	0.902	0.882	0.834	0.935
N	128	128	128	128	128	128

Notes: Parameters are estimated by OLS regressions; all specifications include voivodship and time fixed effects; *** (**,*) significant at 1 (5, 10) percent level; standard errors in parentheses are robust to heteroscedasticity; N - number of observations.

Table 4.7: Location Decision: Export Share (II)

dependent variable: *share of exports in foreign firms' revenues*						
	(1)	(2)	(3)	(4)	(5)	(6)
GDP	−0.144***	−0.122**	−0.104*	−0.119***	−0.058	−0.038
	(0.037)	(0.057)	(0.057)	(0.039)	(0.041)	(0.045)
ULC	−91.405***	−84.829***	−45.509	−70.286**	−79.183***	−68.662***
	(29.391)	(30.536)	(35.845)	(33.117)	(22.609)	(21.299)
$INFRAST$	−0.214*	−0.195	−0.036	−0.132	−0.236*	−0.164
	(0.124)	(0.126)	(0.141)	(0.133)	(0.123)	(0.123)
$POPEDU/POP$	0.734***	0.646***	0.803***	0.837***	0.455*	0.479*
	(0.216)	(0.213)	(0.233)	(0.238)	(0.253)	(0.253)
$POPDENS$	−0.136**	−0.117**	−0.107**	−0.144**	−0.106**	−0.097**
	(0.061)	(0.058)	(0.049)	(0.058)	(0.046)	(0.043)
$DISTEU \times year$		−0.211*	−0.398**			
		(0.119)	(0.155)			
$DISTCAP \times year$		0.071	−0.133			
		(0.222)	(0.235)			
$SEZ \times year$			1.159**	0.585		0.523
			(0.469)	(0.389)		(0.370)
$RUS - BORD \times year$					0.013***	0.012***
					(0.002)	(0.002)
$LIT - BORD \times year$					0.001	−0.007
					(0.011)	(0.012)
$BEL - BORD \times year$					−0.002	0.000
					(0.004)	(0.004)
$UKR - BORD \times year$					0.006**	0.005**
					(0.002)	(0.002)
$SLO - BORD \times year$					−0.001	−0.002
					(0.001)	(0.001)
$CZR - BORD \times year$					0.007***	0.007***
					(0.001)	(0.001)
$GER - BORD \times year$					0.008***	0.008***
					(0.002)	(0.002)
$SEA - BORD \times year$					0.001	0.001
					(0.002)	(0.002)
constant	55.824	1206.914	2175.579	−686.207	−1713.956	−2207.527
	(12.384)	(1900.786)	(1964.110)	(493.065)	(323.857)	(518.607)
Adj. R^2	0.879	0.887	0.895	0.881	0.933	0.934
N	128	128	128	128	128	128

Notes: Parameters are estimated by OLS regressions; all specifications include voivodship and time fixed effects; *** (**,*) significant at 1 (5, 10) percent level; standard errors in parentheses are robust to heteroscedasticity; N - number of observations.

significant in all specifications.

Concerning $INFRAST$, although this variable is negatively correlated with $EXPFOR$ as expected, it is significant only in one specification, narrowly exceeding the 10 percent threshold in columns (1) and (2). Among voivodships with high shares of exports in foreign firms' revenues there are two eastern regions characterized by unfavorable infrastructure scores compared to the rest of the country: Warmińsko-mazurskie and Podkarpackie. In the case of these voivodships, their road or railways connections with the eastern neighbors may play a bigger role than the infrastructure score can reveal. Excluding those voivodships from the sample results in a highly significant coefficient on $INFRAST$. This indicates that the quality of infrastructure is important for exporting foreign firms, but it is by no means a decisive factor for investment.

Turning to distance variables, both $DISTEU$ and $DISTCAP$ have negative influence. The former is highly statistically significant in both columns (2) and (3), while the latter is not statistically significant in any specification. The result on $DISTEU$ corroborates the expectations that export-oriented foreign firms are drawn to regions near the western border, where the cost of transporting goods to the EU core is minimized. The negative sign of the coefficient on distance to Warsaw depicts a strong export orientation of two eastern voivodships: Warmińsko-mazurskie and Podkarpackie (which recorded 47 and 42 percent shares of exports in foreign firms' revenues, respectively, in 2003).

In columns (5) and (6) the estimates of the border effects are presented. It turns out that in the case of vertical FDI the coefficients on border variables for Germany, the Czech Republic, Russia and Ukraine are positive and statistically significant. Estimates for Belarus and Slovakia are negative, while the effect of the sea border is positive, all of them not statistically significant at any usually accepted levels of significance. Finally, the coefficient measuring the influence of the frontier with Lithuania is insignificant and assumes both positive and negative values.

There are two notable features of this pattern. First, the proximity effects

of the western border are proven to be very important again. Second, the positive and significant influence of the eastern border (in the case of Russia and Ukraine) supports the argument of the role of Poland as the European "Gateway to the East". Because of its geographical position, good railway and road connections to neighboring countries, inherited from the centrally planned era, and the relative political stability compared to Russia, Belarus and Ukraine, the eastern part of Poland is attractive for firms that aim at exporting to the Eastern Europe.

As already mentioned, the information about the geographical destination of foreign firms' exports is not available. It appears, however, that eastern voivodships are generally deeply involved in trade with the eastern neighbors of Poland. For example, among trading partners of Podkarpackie, Ukraine holds the first place.[15] Concerning Warmińsko-mazurskie, Russia and other Eastern European countries ranked second after Germany.[16] As for Podlaskie and Lubelskie, the export share with former USSR countries is 35 and 40 percent, respectively.[17] These relatively high shares of exports indicate that the voivodships mentioned have specialized experience that is necessary for conducting bussiness on the eastern markets, combined with the advantage of operating from a stable environment, which could enhance the attractiveness of regions in the eyes of foreign investors.

Finally, as in the previous section, the coefficient on SEZ is positive and statistically significant at one percent level in column (3) but it loses its significance in columns (4) and (6).

In Table 4.7 $GDPCAP$ was replaced by GDP. In general the results presented in this table are similar to those shown above. Only GDP, as argued in Section 4.4, turns out to be not such a good measure for local market potential as $GDPCAP$, as it is slightly less significant.

[15]Podkarpacki Serwis Gospodarczy
[16]See Nowicki *et al.* (2003).
[17]See Umiński *et al.* (2003a) and (2003b).

4.5.3 Robustness

In this section, $EXPFOR$ was replaced by the share of foreign firms' exports in regional global production ($EXPFOR/PROD$) and the share of foreign firms' local sales in regional global production ($LOCFOR/PROD$) in order to check the robustness of the results presented in the previous section.

The results obtained are slightly different from those in Section 4.5.2. It appears that negative coefficients on $GDPCAP$ and GDP are indeed an effect of domination of local sales. Here in the case of vertical FDI (Table 4.8), consistent with expectations, market potential has no effect on activities of foreign firms. For horizontal FDI (Table 4.9) the market potential remains the main determinant. The qualitative influence of ULC remains the same also for this dependent variable, negative for vertical FDI and positive for the horizontal one.

As far as the other variables are concerned, the influence of $POPEDU/POP$ is positive for both types of FDI, but here it is statistically significant in all specifications for vertical FDI and for horizontal FDI only in the last two specifications. The $INFRAST$ coefficient takes a negative value in the case of export-oriented FDI, it is however only partly significant. For market-seeking FDI $INFRAST$ is never significant and switches its sign.

Congestion costs measured by $POPDENS$ remain to be a deterring factor for vertical FDI. Additionally, as expected, they also show negative influence on horizontal investment, significantly so only in column (6). Regarding the distance variables, the coefficient of $DISTEU$ is negative for both horizontal and vertical FDI, but it is statistically significant only for the latter in specification (3) containing also SEZ. $DISTCAP$ shows a more interesting pattern in this section than in the previous one. In the case of vertical FDI it is even positive and statistically significant in column (2), while it is negative and insignificant in column (3). Thus, specifications (2) and (3) in Table 4.8 show that export-oriented FDI are rather geographically dispersed, as we expected. Turning to horizontal FDI, the $DISTCAP$ coefficient is negative and statistically significant at one percent level, that is it implies forces drawing market-seeking FDI towards Warsaw.

Table 4.8: Location Decision: Foreign Firms' Export Share in Regional Production

dependent variable: *share of foreign firms' exports in regional production*						
	(1)	(2)	(3)	(4)	(5)	(6)
$GDPCAP$	−0.135**	−0.070	0.048	−0.048	−0.019	0.069
	(0.063)	(0.074)	(0.066)	(0.061)	(0.058)	(0.052)
ULC	−40.785***	−32.308***	−4.677*	−31.372***	−23.139**	−15.630*
	(6.157)	(6.048)	(2.657)	(6.024)	(8.765)	(8.290)
$INFRAST$	−0.046**	−0.046**	0.003	−0.024	−0.044*	−0.011
	(0.020)	(0.021)	(0.022)	(0.021)	(0.023)	(0.023)
$POPEDU/POP$	0.181***	0.167***	0.204***	0.203***	0.135***	0.143***
	(0.042)	(0.038)	(0.035)	(0.042)	(0.050)	(0.044)
$POPDENS$	−0.031***	−0.029***	−0.021***	−0.033***	−0.020**	−0.017**
	(0.010)	(0.009)	(0.007)	(0.009)	(0.009)	(0.008)
$DISTEU \times year$		−0.018	−0.111***			
		(0.024)	(0.029)			
$DISTCAP \times year$		0.053*	−0.038			
		(0.029)	(0.037)			
$SEZ \times year$			0.391***	0.200***		0.251***
			(0.078)	(0.066)		(0.071)
$RUS - BORD \times year$					0.001**	0.000
					(0.000)	(0.001)
$LIT - BORD \times year$					0.003	0.000
					(0.002)	(0.002)
$BEL - BORD \times year$					−0.001	−0.001
					(0.001)	(0.001)
$UKR - BORD \times year$					0.000	0.000
					(0.001)	(0.001)
$SLO - BORD \times year$					0.000	0.000
					(0.000)	(0.000)
$CZR - BORD \times year$					0.001***	0.001***
					(0.000)	(0.000)
$GER - BORD \times year$					0.002***	0.002***
					(0.001)	(0.000)
$SEA - BORD \times year$					0.000	0.000
					(0.001)	(0.000)
constant	21.243	−135.838	522.318	−236.726	−221.333	−449.396
	(4.823)	(292.669)	(338.917)	(84.893)	(71.301)	(119.483)
Adj. R^2	0.906	0.913	0.932	0.914	0.928	0.938
N	128	128	128128	128	128	

Notes: Parameters are estimated by OLS regressions; all specifications include voivodship and time fixed effects; *** (**,*) significant at 1 (5, 10) percent level; standard errors in parentheses are robust to heteroscedasticity; N - number of observations.

Table 4.9: Location Decision: Foreign Firms' Local Sales Share in Regional Production

dependent variable: *share of foreign firms' local sales in regional production*						
	(1)	(2)	(3)	(4)	(5)	(6)
$GDPCAP$	1.929***	1.778***	1.839***	2.175***	1.808***	1.869***
	(0.459)	(0.421)	(0.436)	(0.495)	(0.510)	(0.521)
ULC	71.470**	31.692	45.883	98.061***	113.324***	118.604***
	(27.638)	(26.718)	(33.588)	(29.394)	(30.535)	(32.360)
$INFRAST$	0.051	0.048	0.073	0.114	0.122	0.145
	(0.089)	(0.090)	(0.101)	(0.098)	(0.088)	(0.097)
$POPEDU/POP$	0.101	0.162	0.18	0.163	0.453**	0.459**
	(0.181)	(0.183)	(0.178)	(0.185)	(0.209)	(0.211)
$POPDENS$	−0.047	−0.035	−0.040	−0.045	−0.094	−0.099*
	(0.047)	(0.040)	(0.042)	(0.045)	(0.057)	(0.058)
$DISTEU \times year$		−0.066	−0.003			
		(0.100)	(0.106)			
$DISTCAP \times year$		−0.650***	−0.588***			
		(0.231)	(0.201)			
$SEZ \times year$			−0.265	−0.214		−0.399
			(0.412)	(0.402)		(0.403)
$RUS - BORD \times year$					−0.005***	−0.004*
					(0.002)	(0.002)
$LIT - BORD \times year$					0.007	0.012
					(0.009)	(0.009)
$BEL - BORD \times year$					−0.003	−0.004
					(0.004)	(0.004)
$UKR - BORD \times year$					−0.006***	−0.006***
					(0.002)	(0.002)
$SLO - BORD \times year$					0.003**	0.004**
					(0.001)	(0.002)
$CZR - BORD \times year$					−0.002**	−0.002**
					(0.001)	(0.001)
$GER - BORD \times year$					−0.004	−0.004*
					(0.002)	(0.002)
$SEA - BORD \times year$					−0.007**	−0.006***
					(0.003)	(0.002)
constant	−32.804	3922.907	3478.020	243.117	1154.117	1516.393
	(26.826)	(1802.771)	(1564.264)	(509.037)	(340.831)	(592.692)
Adj. R^2	0.959	0.961	0.961	0.959	0.971	0.971
N	128	128	128	128	128	128

Notes: Parameters are estimated by OLS regressions; all specifications include voivodship and time fixed effects; *** (**,*) significant at 1 (5, 10) percent level; standard errors in parentheses are robust to heteroscedasticity; N - number of observations.

The influence of border variables on vertical investment turns out to be positive for all but the border to Belarus, with only the Russian (in one specification), Czech and German borders showing significance. In contrast, for horizontal investment, almost all borders have negative impact on foreign activities. Only the coefficients related to the Slovak and Lithuanian borders take positive values, the Slovak one significantly. Its positive effect on market-oriented FDI can be explained by the fact that Małopolskie voivodship, having the longest frontier with Slovakia, contains the large agglomeration of Cracow.

In contrast to the previous section, SEZ shows positive and statistically significant influence on vertical FDI in all specifications, showing that the ability of such policies to attract investment is limited to export-oriented foreign ventures. As the special economic zones were founded in disadvantaged regions which are unattractive for market-seeking activities, it comes as no surprise that their coefficient for horizontal investments is negative and statistically insignificant.

The econometric analysis presented in the last two subsections confirms the theoretical predictions concerning vertical and horizontal FDI. It shows that determinants that influence the costs of conducting business in a given region are very important for vertical investment. In particular, the export-oriented FDI combine low labor and congestion costs with high quality of labor force. Furthermore, in order to lower the transportation costs, those investments are placed near their destination markets, in Western as well as Eastern Europe. Additionally, as the robustness check shows, they respond to regional incentives provided by the government. In contrast, horizontal FDI are motivated purely by local market potential. They are concentrated in regions characterized by large market size and high purchasing power, despite the fact that those locations typically suffer from high labor costs.

4.6 Conclusion

The transition of Poland and other CEE countries from a centrally planned to market economy coincided with a period characterized by increasing transna-

tional flows of capital. While the role of FDI in economic development has been debated at length by its supporters and opponents alike, in Poland foreign investment is commonly and unquestionably perceived as one of the major pillars of the national development strategy. Thus, the focus is shifted to design of effective policies attracting foreign investment to stimulate the economic activity in disadvantaged regions, and for that purpose, it becomes crucial to recognize the logic and criteria behind the investment decisions of multinational firms.

The determinants of FDI can be perceived both from the perspective of a transnational corporation that undertakes the investment, and in terms of characteristics of the home country and the host country. This chapter is focused on the latter and analyzes, which features enhanced the attractiveness of certain regions in Poland for foreign investments between 1996 and 2003, based on data extracted from various publications of the Polish Statistical Office.

For the first time, location determinants of horizontal and vertical FDI within a host country were analyzed empirically, motivated by theoretical models describing the different driving forces behind these two types of foreign investment. The analysis presented in this chapter supports the theoretical implications. It shows that export-oriented FDI are cost-saving investments, as they choose regions with relatively low labor and in general operating costs, at the same time preferring locations characterized by a relatively high quality of labor. The major driving force behind the market-seeking FDI appears to be the local market potential, defined by its size and purchasing power, which outweighs the high labor costs, typically accompanying these characteristics.

Also the geographical position of a region plays an important role for the magnitude of foreign activities. Voivodships located more centrally draw rather horizontal investments, while the vertical investment is encouraged by the vicinity of export markets and therefore it is dispersed towards the national borders. In this respect the western border has a stronger effect than the eastern one. This finding can have two explanations: one is that in the

course of EU integration the eastern border of Poland has been strengthened as a future external EU border, inhibiting cooperation with neighboring regions. The second one is that eastern voivodships are less developed, have poor infrastructure and exhibit low institutional capacity and as a consequence are less attractive for the the foreign firms. However, inspection of the dynamic spatial distribution of export-oriented FDI gives the outlook that Polish regions situated on the eastern border have a potential to become the "Gateway to the East" for foreign firms.

Due to the data limitations, a final statement about the influence of the Special Economic Zones could not be derived. The significant results of the robustness check indicate, however, that such policies are conducive to vertical, and not to horizontal FDI.

This chapter demonstrates that, given their positive impact on development[18], export-oriented foreign direct investment can be perceived as a chance for economically lagging regions in Poland. This is due to the fact that this type of investment chooses, among others, also locations remote to agglomerations of economic activity.

[18]Protsenko (2003) is the only study that distinguishes between the effects of vertical and horizontal foreign investment. He argues that vertical FDI is "at least as attractive" for the host country concerning productivity spillovers to domestic firms, R&D expenditures and employment, as the horizontal counterpart.

4.7 Appendix

Table 4.10: Definition and Source of Variables

Variable	Description	Source
$EMPFOR$	share of employment in foreign firms in total employment	PSO, Działalność Gospodarcza Spółek z Udziałem Kapitału Zagranicznego
$EXPFOR$	share of exports in foreign firms' revenues	PSO, Działalność Gospodarcza Spółek z Udziałem Kapitału Zagranicznego
$LOCFOR$	share of local sales in foreign firms' revenues	PSO, Działalność Gospodarcza Spółek z Udziałem Kapitału Zagranicznego
$EXPFOR/PROD$	share of foreign firms' local sales in local global production	PSO, Działalność Gospodarcza Spółek z Udziałem Kapitału Zagranicznego, Produkt Krajowy Brutto w Przekroju Terytorialnym, and Bank of Regional Data
$LOCFOR/PROD$	share of foreign firms' local sales in local global production	PSO, Działalność Gospodarcza Spółek z Udziałem Kapitału Zagranicznego, Produkt Krajowy Brutto w Przekroju Terytorialnym, and Bank of Regional Data
GDP	Gross Domestic Product	PSO, Produkt Krajowy Brutto w Przekroju Terytorialnym, and Bank of Regional Data, various years
$GDPCAP$	Gross Domestic Product per capita	PSO, Produkt Krajowy Brutto w Przekroju Terytorialnym, and Bank of Regional Data
ULC	Unit Labor Cost (annual average wage divided by productivity, productivity defined as global production divided by average employment)	PSO, Produkt Krajowy Brutto w Przekroju Terytorialnym, Roczniki Statystyczne Województw
$POPEDU/POP$	share of population older than 15, having at least a secondary degree	PSO, Bank of Regional Data

Definition and Source of Variables, continued

Variable	**Description**	**Source**
$POPDENS$	population density	PSO, Bank of Regional Data
$INFRAST$	infrastructure rank (see Table 4.11)	PSO, Roczniki Statystyczne Województw and online regional database
$DISTEU$	road distance between the main city in the region and the nearest major major border-crossing with Germany or Austria	ViaMichelin, Route Planner
$DISTCAP$	road distance between the main city in the region and Warsaw	ViaMichelin, Route Planner
SEZ	dummy variable for Special Economic Zones	PAIiIZ
e.g. $RUS - BORD$	the length of border with Russia	PSO, Roczniki Statystyczne Województw

PSO - Polish Statistical Office
PAIiIZ - Polish Information and Foreign Investment Agency

Figure 4.9: Poland in 1831

Figure 4.10: Poland today

Table 4.11: Infrastructure Taxonomy of Polish Regions

	length of road network [1]	*road rank*	*length of railways* [1]	*railway rank*	*telecom* [2]	*telecom* [2] *rank*	*infrastructure rank*
			1995				
Dolnośląskie	89.7	3	12.5	2	149.2	7	**12**
Ślaskie	140.8	1	14.2	1	112.8	14	**16**
Małopolskie	126.8	2	5.9	10	171.3	5	**17**
Łódzkie	81.5	6	5.7	11	215.6	1	**18**
Opolskie	88.5	5	11.2	3	123.1	13	**21**
Kujawsko-pomorskie	69.9	10	8.4	5	142.8	8	**23**
Świetokrzyskie	89.5	4	6.3	9	136.4	10	**23**
Zachodniopomorskie	56.0	13	7.0	8	198.7	2	**23**
Mazowieckie	76.6	8	5.3	14	183.4	3	**25**
Wielkopolskie	74.9	9	7.6	7	141.5	9	**25**
Pomorskie	61.3	12	8.3	6	131.9	11	**29**
Lubuskie	54.9	14	8.8	4	108.6	15	**33**
Warmińsko-mazurskie	47.0	16	5.5	12	160.5	6	**34**
Podlaskie	54.5	15	4.3	16	182.8	4	**35**
Podkarpackie	77.8	7	5.4	13	93.0	16	**36**
Lubelskie	68.4	11	4.7	15	131.3	12	**38**
			2003				
Dolnośląskie	90.7	4	9.0	3	366.5	2	**9**
Ślaskie	161.9	1	18.4	1	316.8	8	**10**
Małopolskie	141.7	2	7.5	4	325.3	7	**13**
Pomorskie	61.9	12	7.2	5	348.9	3	**20**
Opolskie	90.4	5	9.1	2	278.0	14	**21**
Łódzkie	89.0	6	5.9	10	332.4	6	**22**
Mazowieckie	78.5	8	4.8	14	375.4	1	**23**
Wielkopolskie	81.8	7	6.8	7	311.7	10	**24**
Kujawsko-pomorskie	75.7	10	6.9	6	303.7	11	**27**
Lubuskie	56.3	14	6.5	8	333.3	5	**27**
Świetokrzyskie	100.1	3	6.2	9	248.1	16	**28**
Zachodniopomorskie	56.9	13	5.3	13	333.6	4	**30**
Podkarpackie	77.6	9	5.3	12	248.8	15	**36**
Lubelskie	71.2	11	4.2	15	279.2	13	**39**
Warmiśko-mazurskie	50.5	16	5.5	11	301.2	12	**39**
Podlaskie	52.9	15	3.4	16	314.1	9	**40**

[1] per 100 square km
[2] number of telephones per 1000 inhabitants

Chapter 5

Summary of Results and the Contribution of the Thesis

In 1989, Poland, followed by other Central and Eastern European countries, started the challenging process of transformation from an isolated, centrally planned economy to an open, market economy. The clear boundary defined by the fall of communism and the associated reforms created a natural experiment that can serve economists for empirical investigations of numerous theoretical questions.

In this thesis I also take advantage of these quasi laboratory conditions to investigate two important issues related to Poland's transition process and its growing participation in the global economy. The first part of the thesis is a contribution to an intense economic debate about the sources of the observed worldwide increase in relative demand for high skilled labor. During the last decade, Polish high skilled workers in manufacturing enjoyed an increase of their earnings compared to low skilled workers, repeating the earlier experiences of their counterparts from developed countries, at a much faster pace.

The empirical analysis in the first two chapters of the thesis is the first complex treatment of theories explaining changes of skill premia in transition countries. It is dedicated to the question, to what extent the enormous increase in the skill premium was an effect of Poland's integration into the

world economy and bases its explanations on international outsourcing, technology and international trade.

In Chapter 2 the outsourcing hypothesis was evaluated on the foundation of a model developed by Feenstra and Hanson (1996a). As described by this model, activities outsourced by developed countries are relatively low skilled for the home country and relatively high skilled for the host country leading to an increase of relative demand for skilled workers in both countries. According to predictions of the model, direct investments undertaken by multinational firms were an important explanatory factor for the observed increase in relative demand for non-production workers in Poland - FDI is found to have raised the non-production workers' wage bill share in manufacturing by 34 percent between 1994 and 2002.

In Chapter 3, for the purpose of analysis of the role of international trade and technology in the observed labor market adjustment in Poland, a two stage approach to zero profit conditions methodology elaborated also by Feenstra and Hanson (1999) was employed. This method is preferable to earlier approaches as it allows to identify what structural forces induce changes in total factor productivity and prices in each industrial sector which in turn affect factor price changes.

The analyzes have shown that in Poland not only FDI, but also technology and international trade have contributed to development of wage inequality between skilled and unskilled workers. These forces, however, worked in opposite directions. While technology has contributed substantially to inequality growth, export induced a fall in inequality. The latter result confirms the predictions of Heckscher-Ohlin model showing that in Poland, as a relatively low skilled labor abundant country, it is this factor that should benefit from international trade. However, the negative effect of exports on wage disparity is small compared to the contribution of technology, so that the latter dominates.

The second goal of this thesis was to identify the determinants of spatial distribution of activity of foreign firms in Poland between 1996 and 2003. Since the theoretical literature on FDI suggests that factors governing the

emergence of horizontal and vertical FDI are different, Chapter 4 analyzes these two fundamental types of direct investment separately. The empirical literature on the location choices of FDI accumulated so far seemed to mostly overlook the need to distinguish between different types of FDI. On the other hand, empirical studies aimed at testing the validity of horizontal versus vertical FDI theoretical models were not concerned with the criteria of location choice within one country. My analysis fills the above gap in the case of FDI in Poland.

Therefore, in this thesis location determinants of horizontal and vertical FDI within a host country were analyzed empirically, taking into account not only factors directly derived from theoretical models describing horizontal and vertical investments, but also controlling for location effects suggested by the location theory. The empirical analysis agrees well with the theoretical implications, simultaneously confirming the importance of distinction between horizontal and vertical FDI. It shows that export-oriented FDI are cost-saving investments, as they choose regions with relatively low labor and in general operating costs. Additionally, they value locations characterized by a relatively high quality of labor. The major driving force behind the market-seeking FDI appears to be the local market potential, defined by its size and purchasing power.

Furthermore, the geographical position of a region appeared to have an important role for the extent of foreign activities. The central position of the region was conducive to horizontal investment, while vertical investment was drawn by the proximity of export markets and therefore it was concentrated near national borders, with the western border having a stronger influence than the eastern one.

This analysis gives decision makers valuable information for design of effective policies to attract foreign investment in those regions, by demonstrating that only vertical investment is drawn by economically lagging regions in Poland. Nonetheless, the location decisions of both types of FDIs should be subject of further research to investigate the role of local policies and agglomeration forces. The analysis of the latter will be possible soon - since

1999, the Polish Statistical Office has been collecting more detailed data on foreign capital, including its national and sectoral breakdown.

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