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"The Influence of Trade With the EU-15
on Wages in the Czech Republic, Hungary, Poland,
and Slovakia between 1997 and 2005"

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Contents

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Abbreviations

ADF	Augmented Dickey-Fuller (Test)
AIC	Information Criterion A (Akaike)
BIC	Information Criterion B (Schwarz)
BTD	Bilateral Trade Database (of the OECD)
CADF	Cross Section ADF
CEEC	Central and Eastern European Country
CEEC-4	the four CEECs CZ, H, PL, and SK
CGE	Computable General Equilibrium
CPE	Centrally Planned Economy
CPI	Consumer Price Index
CZ	Czech Republic
d.o.f.	degree(s) of freedom
DOLS	Dynamic OLS
EU	European Union
EU-15	the first 15 member states of the EU
FD	First Difference
FDI	Foreign Direct Investment
FE	Fixed Effects
FMOLS	Fully Modified OLS
FPE	Factor Price Equalization
FRG	Federal Republic of Germany
GDP	Gross Domestic Product
GDR	German Democratic Republic
H	Hungary
HO	Heckscher-Ohlin

i.i.d.	independent and identically distributed
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification
n.e.c.	not elsewhere classified
NID	normally and independently distributed
NIE	Newly Industrialized Economy
NMS	New Member States (of the European Union)
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
p.a.	pro anno
p.c.	per capita
PHARE	Poland and Hungary - Assistance for Restructuring the Economy
PL	Poland
PLI	Price Level Index
POLS	Pooled OLS
R & D	Research and Development
SK	Slovakia
SST	Stolper-Samuelson Theorem
STAN	Structural Analysis (Database of the OECD)
TOR	Treaty Establishing the European Economic Community ("Treaty of Rome"), 3/25/1957
US	United States (of America)

The abbreviations and explanations of the variables used in the analysis can be found in Appendix C.

Introduction

When looking into the billions of glum and hungry faces in the world, one might raise the question whether globalization is really a bowl of cherries (cf. Rodrik, 1999). Thus, it is manifest that in recent years many leading economic scholars have focused on the connection between globalization and economic integration on the one hand, and the international distribution of welfare on the other hand (see Rodrik, 1997; Stiglitz, 2002; Collier, 2007 for example; Milanovic, 2006 for a good overview). Growing global inequality comprises two tendencies: growing inequality between countries and within countries (see Milanovic, 2002 and 2006: 21ff for a discussion) and an interaction between them is likely (cf. Bourguingnon, 2002).

The question about whether our global economic system supports the convergence of living standards has been of interest in economic theory; however, it empirically could not been answered sufficiently (cf. Raffer/Singer, 2001: 16 - 31, esp. 21). For certain industrialized countries the process of convergence is likely. Ben-David (1993), for example, finds evidence for the contribution of trade to convergence in the EU. Rassekh (1992) draws a similar conclusion for OECD countries. Furthermore, it is questionable if convergence within the EU (which also forms an important part of OECD countries) is due to market forces (and especially induced by trade) or rather to redistributive EU policies and subsidies (Raffer/Singer, 2001: 21/22).

In addition, recent research has highlighted the role of institutions in distribution (Fortin/Lemieux, 1997; Rodrik, 1997; Stiglitz, 2001; Pontusson, 2005: esp. 59 - 63; Collier, 2007; Krugman, 2007; Beramendi/Anderson, 2008; Ersado/Milanovic, 2008 e.g.). While institutional and geographical aspects generally gained importance in economic theory throughout the last years, barely any institution questioned the policy orientation towards economic openness and free trade. It is interesting that economic research focused on the role of free trade when trying to explain the growing income inequality of the - sparsely world market integrated[1] - US economy after 1980 (see section 1.2), while research about the influence of trade on income and their distribution stayed rather low (cf. section 3.5). In the case of CEECs where a major trade liberalization of the last century has taken place: the transition of Central and Eastern European CPEs to market economies and the associated integration of them into the world economy as well as the accession of 12 of them to the EU. These countries are very interesting for the world income distribution since they had a tremendous influence on it during the 1990s (Milanovic, 2002).

Furthermore, the lack of research in this area is interesting because the (neo-)classical theory of international trade would imply convergence (for CEECs) in both senses mentioned above: The *Factor Price Equalization Theorem* suggests that free

[1] Of course, world market integration rose in the US throughout the 1980s but remained rather low compared to other countries as a percentage of GDP.

trade leads to equalization of factor prices, thus wages[2]; the *Stolper-Samuelson Theorem* comprises the assumption that abundant unskilled labor in CEECs takes advantage of internationalization, leading to a wage increase relative to the better payed high-skilled workers.

I take these predictions as a motive to empirically investigate the influence of trade with the EU-15 on wages in four NMS of the EU: the Czech Republic, Hungary, Poland, and Slovakia. Thereby I focus on the two aspects mentioned above: factor price equalization between EU and NMS and distributional effects among the working population in CEECs.

The outline of this thesis is as follows: Chapter 1 places the research into a theoretical context and therefore reviews theoretical contributions to the question of income distribution in trade theory, mainly the Stolper-Samuelson and the Factor Price Equalization Theorem. Chapter 2 surveys empirical investigations on the issue outside CEECs and is concerned with the question of the possibilities and shortcomings of empirical investigations led by economic theory. Since economics has recently discovered that institutional (or, to put it even more provocatively: historical) context does matter[3]; chapter 3 outlines the economics of transition and trade liberalization in CEECs and also sums up the few empirical investigations of trade and wage development in CEECs. Summing up these theoretical considerations, chapter 4 roughly specifies the model structure to be estimated in chapter 6, whereas chapter 5 summarizes the used data and gives a first overview of its descriptive statistics and a preliminary analysis. Chapter 6 then provides the main contribution, i.e. the econometric analysis of the impact of exports (towards the EU-15) on wages in CEECs.

My hypothesis is that trade with the EU-15 generally had a positive impact on wages in the CEEC-4 leading to a convergence in wages between the EU-15 and CEECs. Furthermore, I expect that this positive impact was more emphasized in low-skilled (and thus lower income) industries leading to a compression (or: weakening the growing divergence) in income distribution. The empirical results of this investigation contradict this hypothesis. The obtained results rather do not allow to make a clear statement about the impact of exports towards the EU-15 on wages in the CEEC-4. While negative short-run effects are possible, a positive long-run relationship for Hungary and Poland is likely. These results are discussed more precisely in chapter 7, which also draws some policy conclusions.

It seems straightforward that the question investigated in this thesis has policy relevance (provided that inequality is a matter of interest, see Milanovic, 2006: 25ff for an overview), especially for the lobbies and associations of workers, above all trade unions. The results indicate that free trade market forces are not sufficient for an equal distribution of welfare across and within countries. It should be highlighted

[2]It should be noted that the micro convergence of factor prizes does not necessarily imply that GDP per capita will converge. See Rassekh/Thompson (1998) for a discussion.

[3]In fact, economic pioneer Adam Smith was well aware of the self-evident truth that his "invisible hand" ([1776] 1984: 194) can only work with a minimum rule of law (see his "three duties of the sovereign", 300 and Book Five, 301ff.). Ricardo already restrained the importance of the state to fiscal questions only. Smith ([1776] 1984) also argues that principles of economics such as the division of labor are determined historically (Book I, ch. II; 6) and shows (in Book I, ch. III) that this division is limited by the extent of the market. The latter is also not an everlasting principle of mankind but rather emerging historically - an insight that has painfully been recognized in the context of Central and Eastern European transition (cf. section 3.1). For Smith, contrary to many later economists, time and space are main determinants of economic development.

in this context that these findings are not a statement against trade liberalization as such, but indicate that workers' representations should be concerned about the context of these liberalizations and should claim for accompanying policy measures. This also might be for the benefit of public order. Bhagwati (2004) argues that there is no global government and thus nobody could be made responsible for claims. Moreover, globalization does not only consist of flows of goods and factors but also ideas and a cross-linked civil society. Historically, there was neither a *Grande Nation* nor a *Citoyen Francaise* before social inequality pushed the *Tiers Etat* to uprise during the French Revolution. Will growing global inequality lead to a similar uprise of the *Tiers Monde*[4] making our planet *One World*? Or will undemocratic, nationalistic, or fundamentalistic movements gain importance? Beramendi and Anderson (2008: 4-5) highlight that inequality is not only political in its origins but also in its consequences; other research suggested that excessive inequalities attack the foundations of democratic political regimes (Boix, 2003: see esp. 10, ch. 1, and 235/6).

Accordingly, global action against inequality is necessary and since trade is probably among the central transition mechanisms for convergence, it is manifest to focus on its distributional implications. This is especially true for the European Union, not only because legal forms of civil participation indeed exist here. The high expectations of the CEECs' population in the 1990s not only relied on catching up to Western European standards in an institutional, but also in a social sense; this long-cherished wish could not have been fulfilled by the socialist system (cf. Segert, 2002: 29-69 and 154-158). Therefore, it is important to know if and to what extent these expectations have been fulfilled and which role trade played in this context.

Boix (2003: 235-240) argues that if trade entails wage compression between the wealthy and the poor, the former have few incentives "to restrict the franchise to avoid the redistributive consequences of a fully democratic system" (p. 236)[5], especially when capital mobility is high. Furthermore, it is important to emphasize that not (only) absolute divergences in income matter, but (also) relative ones. The European Commission (2008: 149) itself refers to the *economics of happiness* literature and the *relative income theory of consumption*; the ranking effect seems important for job and overall worker's satisfaction: all the rest being equal, workers are 'unhappy' when paid less than their colleagues. Therefore, the relative position in the income distribution plays a key role in subjective employment quality and individuals are concerned more about their relative than their absolute consumption level.

This again has implications on economic growth since, for example, the desire to 'Keeping up with the Joneses' suggests that the share of income consumed depending on the individual's position in the income distribution of the population which has consequences on the saving rate and therefore on economic growth (cf. also Caleiro, 2007 for the relations of consumer confidence, spending and economic growth in the context of unemployment).

Finally, one topic touched in this thesis is also of recent importance for domestic policy in Austria and other EU-15 countries: If trade in goods serves as a partial (Ohlin, [1933] 1967: 26f) or even total (Samuelson, 1948, 1949) substitute for free factor mobility leading to FPE, working populations in the NMS will have no economic

[4]The expression *Tiers Monde*, poorly translated into other languages, traces back to Alfred Sauvy and his article "Trois mondes, une planète" in *L'Observateur*, August 14, 1952.

[5]Milanovic/Ersado (2008: 13) refer to other studies that suggest democracy being anti-inequality even though these results are not very robust and find themselves (20/25) a robust pro-equality effect of democracy.

incentive to emigrate to other countries, as labor markets open entirely in the EU-27. It seems like this expectation has not become fulfilled.

Chapter 1

Economic Theory of Trade and Factor Prices

1.1 Mercantilists and Physiocrats

From the very beginning of reasoning about international trade, distributional questions have always played a certain role. For mercantilist economists this question was an issue rivaling between countries about the highest trade surplus. This trade surplus was considered as necessary condition to redistribute the existing global supplies of bullion which were exchanged for goods (cf. Gömmel/Klupp, 1994: 91) and were considered as means of welfare accumulation and constituting power differences of states (cf. Gömmel/Klupp, 1994: 25f, 88f). This view entailed import substitution (cf. Gömmel/Klupp, 1994: 93) and protectionist measures (cf. Gömmel/Klupp, 1994: 79f, 94, 142) to reduce the drain of bullion.

The physiocratic *laissez-faire et laissez passer*[1] principle in foreign trade theory[2] also was mainly led by national self-interest, namely the intention to sell agricultural excess-supply abroad to prevent a domestic price deterioration while the mercantilist concern about international distribution of bullion was not of interest for the physiocrats (cf. Gömmel/Klupp, 1994: 132, 142).

Generally it should be noted that abstract considerations about national welfare were the key concern of these early economist branches whereas distributional effects in the narrower sense or factor prices did not play a decisive role.

1.2 Adam Smith: Absolute Advantages

This view does not conceptually change with Adam Smith, often referred to as the first to develop an approach to an international division of labor that allows both countries engaged to profit. Combating the protectionist ideas of mercantilists, Smith argues for free trade.[3] Generally, for Smith, the division of labor was the main source for

[1] The quote is accredited to Vincent de Gournay (cf. Gömmel/Klupp, 1994: 71).

[2] "Qu'on maintienne l'entière liberté de commerce; car la police du commerce intérieure et extérieure la plus sure, la plus exacte, la plus profitable à la Nation et l'état, consiste dans la pleine liberté de la concurrence" (Quesnay, ([1775], 1969: 336).

[3] Smith's ([1776], 1984) idea that restraints upon the importation from foreign countries would give "great encouragement" to the respective industry (192) that would therefore employ a greater share of labor and stock than otherwise would have gone to it (192/3) already came close to modern trade theory. He sees only two cases where burdens on imports are advantageous for the encouragement of domestic industry: if the industry is of necessity for the country's defense or if a tax is imposed on the production of a domestic industry, making it reasonable to impose an equal tax upon imports

social welfare (cf. Book One, ch. I-III) involving the international division of labor, and thus trade.[4] If one country has advantages over another in producing particular commodities, "it will always be more advantageous for the latter rather to buy of the former than to make" (Smith, [1776] 1984: 195). For Smith, who argues based on the value theory of labor[5], this advantage is regarded as absolute, i.e. the "natural price" of the commodity is lower in the country that has an absolute advantage in producing it. This concept is therefore considered as *absolute advantage*[6] and was later transcended by David Ricardo.

1.3 David Ricardo: Comparative Advantages

Ricardo's theoretical insight forms the base of today's economic theory of foreign trade. Going beyond Smith, Ricardo ([1817], 1996: 94f) points out that under restricted movement of production factors in a two country, two commodity framework it may be advantageous for a country to import one good, even though it has an absolute advantage in producing both goods, if the advantage in the production of the imported good is relatively lower compared to the advantage in the production of the other good that is thus exported to finance imports. This consideration of international differences in relative opportunity costs (Dixit/Norman, 1980: 1) became famous as the theory of *comparative advantage*.[7] Even though this theory undergoes strong limitations[8] and is "of limited use in employing data to analyze the overall structure of foreign trade" (Helpman, 1999: 123) at least in its simplest formulation, its main consideration became the core of trade theory. It is considered as "the first, oldest, and most basic proposition in the theory of international trade" (Dixit/Norman, 1980: 2).

It should also be noted that in contrast to the statement of Deardorff (1994, cf. Cline, 1997: 37), Ricardo was the first to systematically consider and investigate

(197f).

[4] "It is the maxim of every prudent master of a family never to attempt to make at home what it will cost him more to make than to buy. ... All ... [professions] find it for their interest to employ their whole industry in a way in which they have some advantage over their neighbors, and to purchase with a part of its produce ... whatever else they have occasion for. What is prudence in the conduct of every private family can scarce be folly in that of a great kingdom." (Smith, [1776], 1984: 194)

[5] "The real price of everything, what everything really costs to the man who wants to acquire it, is the toil and trouble of acquiring it. What everything is really worth to the man who has acquired it, and who wants to dispose of it or exchange it for something else, is the toil and trouble which it can save to himself, and which it can impose upon other people. What is bought with money or with goods is purchased by labour as much as what we acquire by the toil of our own body. That money or those goods indeed save us this toil. They contain the value of a certain quantity of labour which we exchange for what is supposed at the time to contain the value of an equal quantity. It was not by gold or by silver, but by labour, that all the wealth of the world was originally purchased; and its value, to those who possess it, and who want to exchange it for some new productions, is precisely equal to the quantity of labour which it can enable them to purchase or command" (Smith, [1776], 1984: 13). "The natural price ... is ... the central price, to which the prices of all commodities are continually gravitating" (l.c., p. 24) If the commodity is sold for its natural price, it "is then sold for what it is worth, or what it really costs the person who brings it to market" (l.c., p. 23).

[6] Smith ([1776], 1984: 257) himself does not use this term in the cited context but distinguishes absolute from relative advantage in another sense.

[7] Ricardo himself does not use this term in his chapter "On Foreign Trade" but only once in another context (cf. Ricardo, [1817], 1996: 183).

[8] For the case of decreasing returns see Raffer (1994) for a comprehensive overview. Samuelson (1949: 183) mentions that constant returns to scale are a very serious limitation on the production functions. Further on, the framework does not allow for intra-industrial trade and assumes full employment. As Daly (1999) points out, if the assumption of restrictions of factor movement is violated, international trade (governed by comparative advantages) becomes interregional trade, governed by absolute advantages.

distributional effects of foreign trade on different groups of society, depicting for example that a decrease in food or basic necessity prices due to foreign trade will lead to a rise in profits (Ricardo, [1817], 1996: 92); and this indicates that trade liberalization will lead to a downturn in English agriculture, which was in the interest of English industrial capitalists at that time.

1.4 The Heckscher-Ohlin Model

About a century after the publication of Ricardo's magnum opus "Principles of Political Economy and Taxation", the Swedish economists Eli Heckscher and Bertil Ohlin expanded the considerations of Ricardo in various ways:

1. Like Smith, Ricardo ([1817], 1996: 17/18) found the value of a commodity possessing utility to depend on the relative quantity of labor which is necessary for its production and on its scarcity - a classical view which was considered antiquated by neoclassical mainstream economics of the 20^{th} century. Ohlin (1931: 161) definitely moved away from this view, providing a neoclassical foundation for the theory of international trade based on the relative scarcity of factors of production.

2. In this context they extended the theory of comparative advantage to the case of two countries with different endowments of two production factors. They argue that these differences in factor endowments, together with specialization, are the reasons for international trade (Ohlin, 1931: 162f). Accordingly, a country has an advantage in producing those goods which production is using the abundant factor of this country relatively intensive (Ohlin, 1931: 163).

3. While classical theory has mainly considered factors as rigid, Heckscher and Ohlin paid much attention to the movements of these factors in relation with international trade.

4. Therefore the question of returns to these factors, i.e. the distributional effects of trade, gained a new dimension in the theory of international trade.

The idea that the relatively abundant factor of a country makes it cheaper to produce the good intensively using this factor "has proved the most enlightening explanation of comparative advantage, in that it yields the greatest variety of testable propositions" (Dixit/Norman, 1980: 4). This advantage simultaneously turned out as the theory's weak point in the sense that empirical investigations have mainly conflicted with the predictions of the Heckscher-Ohlin model[9]. Heckscher and Ohlin themselves advised against overstretching their explanations.[10] Nevertheless, the HO model became the major framework for models in trade theory in the 20th century. Also the two central theorems presented in this thesis, the SST and the FPE theorem are based on the HO framework.

[9] Probably the best known example is the Leontief (1953) paradox. Cf. also Trefer (1993). Wood and Mayer (2001), however, find that HO theory has been successfully used to explain at least the broad composition of exports in some cases.

[10] see Raffer/Singer (2001: 49); cf. also Samuelson (1948: 181 and 182/3).

1.5 Factor Price Equalization and the Stolper-Samuelson Theorem

In textbooks on international trade these theorems are generally presented apart from each other, beginning with the SST which corresponds to the historical order of invention. In this subsections I break this mold because I would suggest interpreting the FPE as the more advanced theorem in the sense that it nests the SST in some way. This is not true in the strict sense[11] but FPE generally follows the same rationale as the SST and the underlying forces at work are considered to be the same.

Based on the work of Ohlin ([1933], 1967) showing that "the mobility of goods to some extent compensates for the lack of interregional mobility of the factors" (Ohlin, [1933], 1967: 29) and will lead to a partial equalization of relative (and absolute) factor prices, it was believed for a long time that while free factor movements fully equalize factor prices, free commodity movements equalize them only partially (Samuelson, 1948: 163). Even Samuelson (cf. 1948: 164, 169) shared this belief until the late 1940's. In 1941 Stolper and Samuelson still stated that as a result of the reallocation of production factors after trade liberalization "there will be a tendency - *necessarily incomplete* - towards an equalisation of factor prices between the two or more trading countries. It is clear that *the equalisation is only partial* because otherwise we would be involved in the contradiction that differences in comparative cost would disappear, and there would be no trade" (Stolper/Samuelson, 1941: 59, italics mine). Years later, feeling uncomfortable about the lack of proof for this proposition in the literature (Samuelson, 1948: 169), Samuelson tried to provide this proof - and discovered that the proposition was false. He argues that "so long as there is partial specialization, with each country producing something of both goods, factor prices will be equalized, absolutely and relatively, by free international trade" in goods even without trade in factors of production (Samuelson, 1948: 169).

Before turning to the question of partial or total equalization it seems helpful to understand the assumptions and underlying processes that cause factor prices to equalize. Therefore suppose two countries I and II both producing two goods A and B with the production factors L and H that are considered to be fixed in quantities and totally mobile across industries. The availability of factor L relative to factor H is assumed to be higher in country I than in country II:

$$\frac{L^I}{H^I} > \frac{L^{II}}{H^{II}}.$$

Furthermore, the production of good A is assumed to require relatively more input of factor H than production of good B:

$$\frac{H_A}{L_A} > \frac{H_B}{L_B},$$

and production functions, i.e. technologies of production, are considered to be the same in both countries. For simplicity only consider the situation in country I, which is relatively abundant in factor L (thus having a comparative advantage in the production of good B) when the country moves from autarky to trade with county II

[11] For example, the FPE theorem requires more restrictive assumptions than the SST. Furthermore, SST predicts not only a relative decrease of income of the scarce factor as a result of trade liberalization but an absolute one (in real terms). However, it is possible that under certain assumptions (especially increasing returns to scale) FPE occurs, while both factors gain from trade (cf. Helpman/Krugman, 1985: 190).

(which can be assumed to be the rest of the world). In autarky, the price of good B (relative to the price of good A) will be lower in country I than in country II since H is the relatively scarce factor in country I. Under autarky, H will therefore earn a relatively high income (as compared to country II and also to the free trade equilibrium). Now consider the countries opening up for trade. This entails for country I that its autarky prices will no longer hold and the price of good B will rise (to the level of country II or any price in between). Accordingly, production factors will move away from the production of good A to the production of good B, exporting the excess demand of B to obtain A from country II in exchange. Note that this reaction corresponds to the predictions of HO theory about specialization patterns and clearly follows from the perfect competition (i.e. zero-profit) assumption and occurs until the point is reached, where the marginal productivities of the two factors are the same in every industry A, B:

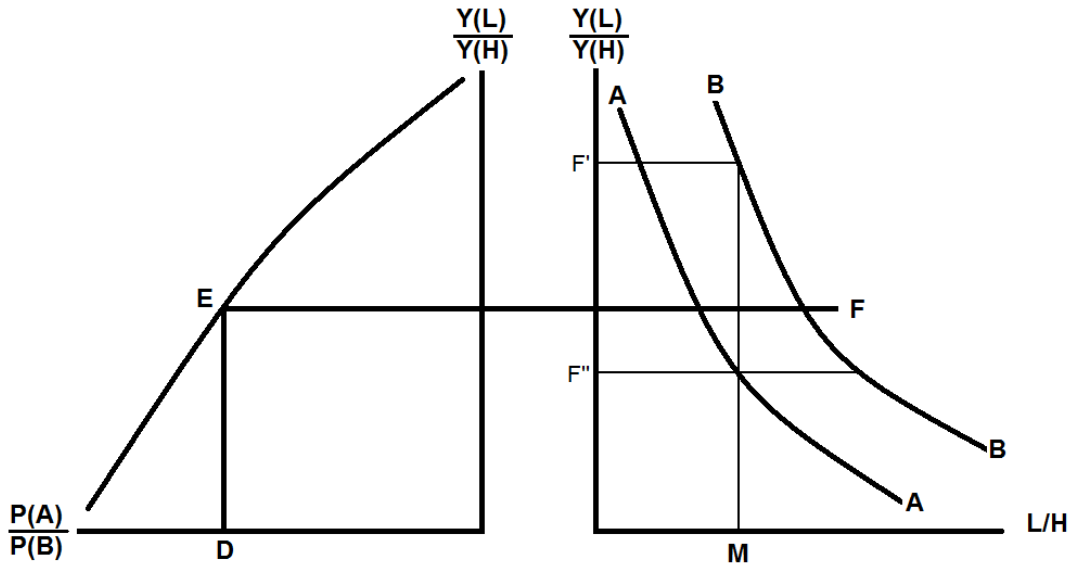
$$\frac{\frac{\partial A(L_A,H_A)}{\partial L_A}}{\frac{\partial A(L_A,H_A)}{\partial H_A}} = \frac{\frac{\partial B(L_B,H_B)}{\partial L_B}}{\frac{\partial B(L_B,H_B)}{\partial H_B}}. \tag{1.1}$$

Moving production factors away from sector A indicates that a relatively higher proportion of factor H gets freed up and clearly cannot be redeployed one-to-one in sector B since otherwise the above mentioned equality of marginal productivities would be violated. The excess supply of H is distributed across the sectors in a way that equality 1.1 holds and this leads the paradox situation that even though the proportion of total production factors remains the same in the society, nevertheless the opening up to trade lowers the proportion of L relative to H in each sector (cf. Stolper/Samuelson, 1941: 68). Diminishing the scarcity of factor H, this clearly entails a relative loss of income of factor H. Stolper and Samuelson showed for the first time that this loss will not only be relative (to the other factor of production) but will unequivocally be *absolute* in real terms (cf. Stolper/Samuelson, 1941: 69; the interested reader is referred to the original work for the proof of this statement).

Of course these findings were only obtained under rather restrictive assumptions and it should be illustrated which assumptions they are: First of all, full employment of production factors has to be given. Factor mobility among sectors was already mentioned above. Production functions homogeneous of degree one, i.e. constant returns to scale are assumed and productivity has to be marginally diminishing. Stolper/Samuelson do neither explicitly mention the latter assumption nor perfect competition, i.e. zero-profits which is clearly implied. They do mention the fact though, that trade liberalization has to lead to a contraction instead of a destruction of the formerly protected industry and that the small country assumption must hold, i.e. country I does not affect the international terms of trade. The implications of strong theoretical assumptions and the possible divorce from reality is discussed in chapter 2 of this thesis, however, it is important to stress that under these special assumptions Stolper and Samuelson could contribute undoubtful theoretical progress providing a *definite statement* "concerning the effects of international trade upon the relative remunerations of productive agencies, and more important, upon their absolute real incomes" which was quite surprising since the literature of that time only derived "statements of possibilities and presumptions rather than of necessities" (Stolper/Samuelson, 1941: 58).

What does factor prices prevent from fully equalizing in this framework? In the quote cited above, Stolper and Samuelson could not imagine occuring equalization in comparative costs in a free trade equilibrium. It is surprising that even these outstanding economists fall for such fatuous mistakes. Of course, as long as the marginal

Figure 1.1: Samuelson's FPE graph



production costs of one good relative to the other (i.e. the slope of the production possibility curve) are different between both countries they will have an incentive to further specialize until their equalization occurs. What Stolper and Samuelson considered as impossible in 1941 is no less than the main point of free trade equilibrium. Equalization of the marginal production costs entails equalization of commodity prices between both countries. This requires the further assumption of no transportation costs (and generally no tariffs or NTBs). If identical technological production functions and qualitatively identical inputs in both countries are assumed supplementary, as long as no factor intensity reversals occur and no full specialization takes place, we obtain a unique (Samuelson, 1949: 192) equilibrium where "*real factor prices must be exactly the same in both countries*" (182, italics not in original).

Figure 1.1 (following Samuelson, 1948: 173, 1949: 188) illustrates the dynamics. On the right hand side the horizontal axis measures the ratio of L to H. On the vertical axis the ratio of (real) income of L relative to the (real) income of H is measured.[12] Due to the different marginal rates of substitution for each good, we obtain two different curves, one for A and one for B. Suppose, in country I the L-to-H ratio is given by point M. We can be sure about one thing: a greater L/H ratio will be employed in B than in A. Since the ratio of income of L to the income of H has to be uniform in the country, say F[13], it is straightforward to see that every sector will employ a different L/H ratio.[14]

The left hand side shows the one-directional relation between commodity prices

[12]This ratio is equal to the ratio of the marginal physical productivity of L to the marginal physical productivity of H.

[13]We can assume that F lies within F' and F" since it is assumed that a positive quantity of every good is produced.

[14]Thus, M can be interpreted as a weighted average which falls between the L/H ratios in each industry, where the proportion of employed H in each sector relative to the total H are the exact weights for every sector. To intuitively understand the dynamics, suppose the income ratio moves from F" to F'. This will increase production of B to the point F' where only B is produced, i.e. all resources are devoted to B, i.e. the weight of H employed in A is 0 and the weight of H employed in B is 1.

and factor prices.[15] Under the cited assumptions, there is a unique mapping from the equilibrium factor-price ratio to a corresponding product-price ratio. For example, a rise of the L/H income share (and thus a movement upwards of the horizontal line in both diagrams) would only be consistent with a lower price ratio of A to B (P(A)/P(B)) measured leftwards on the horizontal axis on the left hand side. The essential "crux" in the FPE theorem and the associated Stolper-Samuelson effect, often ignored in empirical applications, is "the unique correspondence between product price and factor price" (Cline, 1997: 42): It follows, that when we specify a common price ratio, say D, we can move backwards unambiguously (from E to F) to a factor-price ratio (Samuelson, 1949: 189). Since the left chart applies to both countries as do the curves for both goods on the right hand side (due to the technologies of production being equal in both countries)[16], this backward move will be common for both countries. This leads to a *common factor-price ratio* and a common factor proportion set-up in the two countries (Samuelson, 1949: 189; italics ont in original).

Originally, Samuelson (1948) explained his FPE theorem more intuitively (cf. esp. p. 175) setting USA as country II (Europe being country I), L as labor, H as land (with wages and rents respectively), A as food and B as clothes but also giving an arithmetic illustration (175-178).[17] In 1949 (189-191) he presented a more elaborated mathematical proof of his theorem.

1.5.1 Generalizations

Generally, the FPE theorem also holds for more than two goods or, more generally, as long as the number of goods exceeds the number of factors (Samuelson, 1949: 192). However, for three productive factors with two goods the FPE theorem does not hold (Samuelson, 1949: 193). Stolper and Samuelson (1941: 69f) already mention that their theorem also holds for three or more goods but admit "that three or more factors of production within a single country do seriously modify the inevitability" of their conclusions (p. 72).

Based on the work of Samuelson from the 1950s, Hukukane Nikaido (1972) has generalized the SST for all numbers of goods equals the number of factors. In this framework for any change in the price of each good there will exist some factor that gains in real terms and another one that loses and FPE is obtained ("Samuelson-Nikaido Lemma", cf. Feenstra, 2004: 68f). Jones and Scheinkman (1977) proved thereafter that for each factor, there must be a good so that an increase in the price of that good will lower the return to the factor, which is referred to as "natural enemy". However, not every factor must have a "natural friend" (cf. Feenstra, 2004: 70). But if the number of factors exceeds the number of goods (Ricardo-Viner model), the generalized version of the SST holds but the Jones-Scheinkman theorem does not (cf. Feenstra, 2004: 71f).

As far as market structure is concerned, Helpman and Krugman (1985) investigate how different assumptions affect FPE and generally show that some of the restrictive assumptions concerning the market structure even might be violated. If, for example, increasing returns to scale arise solely from external economies (pp. 59-63), FPE may hold if "each industry that is subject to external economies ... [is] located in a single country" and therefore the FPE set may be very small (60). Furthermore, under the assumption of differentiated products where imperfectly competitive firms

[15] The exact shape of this curve is determined by the two curves on the right hand side; this quantitative detail is disregarded here.

[16] Note, that it is not necessary that L/H is equal in both countries.

[17] The outline in the Stolper/Samuelson (1941) paper is somewhat different: countries I, II remained unspecified (but reversed in factor abundance relative to the presentation here), A was considered to be wheat, B was considered to be watches. L was labor, H was capital.

are able to differentiate their products and their outputs therefore become imperfect substitutes, increasing returns may reverse some standard results about trade and distribution. More precisely, FPE holds under certain assumptions if differentiated products are the reason for increasing returns while contrary to the SST scarce, as well as abundant factors, may gain from trade if countries are sufficiently similar in factor abundance and economies of scale are sufficiently large (pp. 190-195).

Chapter 2

Theory and Empiricism

The debate about theory and empiricism in philosophy, social, and natural science has been a very vivid one in the twentieth century.[1] Interestingly, the question was hardly posed in econometrics (cf. Spanos, [1986], 1993: 659) even though the latter was emerged directly at the borderline between economic theory and empiricism. However, one should not forget that approaching the latter is mainly not only motivated by an economic model but also implies a *statistical* model, i.e. a probabilistic formulation purporting to adequately analyze and estimate the matter under investigation (cf. Spanos, [1986], 1993: 19-21). Thus, one has to investigate whether the available data supports the *statistical* model[2] well before one can decide which conclusions can be drawn from empirical data for the *economic* model. The latter issue is especially challenging in the present context of trade theory since we are here dealing with *theorems* within a general equilibrium *model* which dynamics operate through very specific and theoretically determined channels.

2.1 On Theorems

First of all, one should not forget that the SST and the FPE theorems are *theorems* - logically *proven* statements *based on previously accepted or established* statements; in the SST and FPE case the HO framework and some further assumptions. Insofar, there is no need to empirically "test" for these theorems to be true.[3] This would be just as much nonsense as testing for the assumption of Pierre de Fermat that no three positive integers a, b, and c can satisfy the equation $a^n + b^n = c^n$ for any integer value of $n > 2$. Even though confirmed up to $n = 4,000,000$ in 1993, this assumption finally has not become a theorem through empirical affirmation of course, but due to the *theoretical* proof of Wiles (1995). To give a last example, probably no one would

[1] To consider only the German-speaking part, one may think of the issues of the *Wiener Kreis* (Vienna Circle), Popper ([1990], 2002: 26ff e.g.), the related *Positivismusstreit* (Positivism Dispute), or the discussions in subatomic physics as illustrated by Heisenberg (1969: 79-87) e.g.

[2] This issue will be addressed in chapters 4 and 6 and neither corresponds to the philosophical questions or quantum-physical problems (where in fact observation destroys interference, a problem that barely arises in economics due to its mainly non-experimental character) mentioned in the footnote before.

[3] Generally one should be cautious in the empirical affirmation of assumptions. For example, what do we learn about the distribution of prime numbers or the Gaussian assumption that his formula $N/log(N)$ always overestimates the sum of prime numbers in the series of natural numbers up to N if empirically affirmed up to $N = 10^{74}$? Actually not very much since John E. Littlewood and Stanley Skewes showed *theoretically* in the 1930s that this proposition does not hold for numbers higher than the *Skewes number* being around 10^{78} and have therefore given caution about being convinced by a overwhelming number of data. Another case, of course, is the refutation of theoretical *assumptions* (not theorems). For example, the fact that $2,682,440^4 + 15,365,639^4 + 18,796760^4 = 21,615,673^4$ clearly disproves Euler's assumption that no $a, b, c, d \in \mathbb{Z} \neg 0$ satisfies $a^4 + b^4 + c^4 = d^4$.

come up with the ludicrous idea to empirically prove the Gauss-Markov theorem (see Appendix A).[4]

Even though some studies claim to "test" for the SST or FPE theorem, the above explanations should illustrate why it makes no sense to empirically "test" for the SST or FPE theorem in the strict sense. Besides being an absolute *no-idea* theoretically, the assumptions of these theorems are too strong to be given in practice. Moreover, if the assumptions are violated in the strict sense the whole theorem becomes obsolete.

Samuelson (1949: 182f) was well aware of this point, seeing his contribution as "a purely logical one": "Is 'If H, then inevitably C' a correct statement? The issue is not whether C (factor-price equalisation) will actually hold; nor even whether H (the hypothesis) is a valid empirical generalisation. It is whether C can fail to be true when H is assumed true. Being a logical question, it admits of only one answer: either the theorem is true or it is false."

Nevertheless, another - more empirical - approach could address the issue in how far the underlying assumptions are appropriate, or - to what extent the theorems' central conclusions still apply under the violation of its assumptions. Samuelson himself was well aware that his theorems stand on shaky ground, namely that the HO framework is quite inadequate (cf. Samuelson, 1948: 181), and even warned that it was "dangerous to draw sweeping practical conclusions concerning factor-price equalization" (Samuelson, 1949: 195). He called this model (1964: 152) "unrealistic" which is also indicated by the fact that the original Stolper-Samuelson article was even rejected for publication in the *American Economic Review*. Their editors thought that despite being a brilliant theorem, it had nothing to say about real world implications of trade theory (cf. Cline, 1997: 43). Even for confirmed trade economists like Deardorff and Hakura (1994: 17) the high reliance of the SST and the FPE theorems "on the strong implications of the two sector, H-O model" appears "somewhat uncomfortable".

2.2 Tests for FPE

Due to this pessimism of leading trade theorists about its empirical relevance, it is not particularly surprising that FPE did not receive much empirical attention in the very beginning (cf. Rassekh/Thompson: 11f, cf. also Berger/Westermann (2001)), even though the FPE theorem is a necessary outcome of the HO model which gained empirical attention at least with Leontief's (1953) paradox shortly after Samuelson's papers were published. This skepticism somewhat declined in the 1970s[5] after Krueger (1968) had attributed more than half of the per capita income differences between the USA and many developing countries to differences in human capital endowment indicating differences in income to be correlated with factor endowment. On the theoretical front, Samuelson's (1971) contribution directed attention from FPE to the

[4] In applied research another problem aggravates the problem, namely that due to the non-experimental character of most branches of economics, our "test arrangements" barely satisfy the common theoretical assumptions. Referring to the above examples, verification efforts for Fermat's theorem become severely delicate if one only has a set of observations $L = \{a, b, c\} : L \subset \mathbb{Q} \neg \mathbb{Z}$. Also, in the Gauss-Markov theorem one might face the problem that it is rarely the case in practice that one knows the true model $Y_{n\times 1} = X_{n\times k}\beta_{k\times 1} + u_{n\times 1}$ and has all sets of k variables available. If one has instead observed only $k - p$ variables $\forall\, p : 1 \leq p < k$, $rank(X) = k$ does no longer hold and the OLS estimator will be inconsistent (and probably biased).

[5] See Rassekh/Thompson (1993: 13ff) for an excellent overview of the developments.

more realistic issue of factor price convergence caused by trade expansion.[6] Kotlikoff, Leamer and Sachs (1981) showed that manufacturing wages and capital-to-labor ratios converged in the 1960s and 70s, arguing that the latter only partially explains the former. Dollar, Wolff, and Baumoll (1988) refer to the statement cited above that FPE implies that relatively capital abundant countries must be producing relatively more capital intensive goods instead of using more capital per worker in each industry. Calculating the correlation in the capital-to-labor ratio in total manufacturing and every single of 28 industries (for 13 industrial countries in 1980), they obtain statistically significant correlation mostly exceeding 0.5 and thus reject this FPE implication. Mokhtari and Rassekh (1989) argue that between 1961 and 1984 the increase in trade and the convergence of the capital-to-labor ratios contributed to explain convergence of manufacturing wages in 16 OECD countries. Focusing on the period 1870-1913, O'Rourke and Williamson (1992) directly refer to commodity price changes in explaining changes of the wage-rental ratio between the UK and the US and attribute about half of the convergence in the latter to the convergence of the former. Rassekh (1993) finds that FPE is capable of explaining cross-country variation in industry-level wages for a sample of 11 industries in 14 OECD countries over the period 1970-1985.

More recent empirical studies include Davis et al. (1997), Debaere/Demiroglu (1997), Cunat (2001), and Hanson/Slaughter (2002). Contrary to these studies, Bernard et al. (2002) correct for some variation in factor quality and technology differences.[7] Using a methodological framework that is robust to unobserved differences in factor quality, production technology, and unobserved local variation in consumer price indices, they found evidence against wage equality across geographic areas of the United Kingdom; despite the UK is a relatively small, densely-populated country with highly integrated goods markets and the potential for factor mobility. The authors hold multiple HO cones of diversification and spatial variation in workers' relative cost of living (causing variations in the skill premia) responsible for these findings (cf. section 2.4).
Berger/Westermann (2001) use cointegration techniques to estimate the long-run relationships between factor prices in six major industrialized countries. Rightly chastising other investigations for using nominal instead of real data, the authors stress that results for real labor unit costs are less favorable for FPE to hold than nominal data and find "very little evidence of significant co-movements in real labor costs across the countries in their sample", with real unit labor cost equalization found between the US and Canada and between the US and France only.

2.3 Trade, US Income Distribution and the Equilibrium

Unlike the FPE theorem, the SST was subject of a vivid controversy among economists in the US in the 1990s. This predominant empirical debate emerged because of the increase of wage inequality during the 1980s in the United States and mainly discusses the reasons for this surge in inequality.[8] After some labor economists like Mincer (1991), Bound and Johnson (1992), Berman, Bound, and Griliches (1994) suggested skill-biased technological change as a possible explanation, another group of labor

[6] Rassekh and Thompson (1993: 1-7) discuss *near FPE* and *factor price convergence* as different modifications of the FPE theorem.

[7] These corrections seem pretty important due to more recent developments in trade theory, cf. section 2.4.

[8] An excellent overview of the empirical background to this debate and the debate itself is given in Cline (1997).

economists placed more emphasis on the role of trade and immigration. Katz and Murphy (1992) e.g. examinined US wage data in the period 1963-91 using cointegration techniques and found that the durable-goods trade deficit as a percentage of GDP is the only variable considered sharing the same long-run trend with wage-inequality. Borjas (1994) theoretically emphasizes the far-reaching and long-lasting impact of immigration on employment opportunities of natives. Using plant level data in US manufacturing in the 1980s, Bernard and Jensen (1994) found that exporters account almost exclusively for increase in the wage gap between high- and low-skilled workers; they show that demand changes associated with increased exports are strongly associated with wage gap increases. From these findings it might seem relevant to refer to the FPE and SST: Suppose the USA was country II, L was low-skilled, H was high-skilled labor, A was a skill-intensive and B a low-tech good (in the framework presented in section 1.5). The FPE and SSTs then predict that under the relevant assumptions an increase in trade with less skill abundant countries will lead to a price increase in high-tech goods and a labor reallocation towards those more skill-intensive occupations, increasing the wage gap between low- and high-skilled workers. Other studies in this context include Murphy and Welch (1991), Borjas, Freeman, and Katz (1992, 1997), and Borjas and Ramey (1994).

Trade economists like Lawrence and Slaughter (1993), and Bhagwati and Dehejia (1994) mounted a critical attack on these studies pointing out that labor economists ignored central assumptions and mechanisms of the SST. Among them is the fact that the very concepts of trade theory call for a consistent use of general, rather than partial equilibrium analysis which is often forgotten when only parts of the whole equilibrium, namely comparative statics, are being studied (see Dixit/Norman, 1980: v, 1 or Krugman, 1995). Suppose that we would observe that ceterus paribus growing trade as a result of a trade liberalization has had a significantly larger positive impact on wages in low income industries than in high income industries. Can we therefore conclude that trade liberalization was the right policy choice to reduce income inequality? Besides from the fact that trade is never a first-best nor second-best mean of achieving domestic distribution goals (Dixit/Norman, 1980: 25), it is also hard to say what would have happened without trade liberalization. Maybe then the compression would have been even greater. Thus, a general equilibrium appoach is the appropriate way to address the question. In this respect Balcerowicz (1994: 19/20) might be right, stating that a common fallacy in the debate about the transition to a market economy was to evaluate any policy based on the comparison of a present situation with the past.
It is questionable, however, how reliable a computable general equilibrium model would be for as volatile developments as those in the Central and Eastern European transition economies with only short time series to estimate elasticities (cf. Braber et al., 1993), and thus disagreement among modelers about adequate model structures prevail and would be a thesis topic in itself (cf. Bayar/Mohora, 2007 for a survey on CGE models for CEECs). To sum up, it should be noted that any empirical results of the subsequent analysis should be treated with caution - however, this would also have been the case if more sophisticated and laborious CGE models would have been applied.

An essential point of the HO-Samuelson framework in the transition from the autarky to the free trade equilibrium is that trade's impact on factor prices operates through changes in product prices. As already stressed above, Deardorff (1993: 6) emphasized that it is the "increase in the relative price of a good [that] increases the real wage of the factor used intensively in producing that good, and lowers the real

wage of the other factor" in the Stolper-Samuelson/FPE framework. While the strong assumptions of this framework led other trade economists to apply more pragmatic approaches to the question of the impact of trade on income distribution (see Feenstra and Hanson 1995, and Johnson and Stafford 1993 for example), Krugman (1995a) brought the debate back to a general equilibrium framework. Setting out a stylized, minimalist CGE model of world trade, wages and employment and suggesting some approximations for the parameters of that model, Krugman examines the impact of low-wage exports from the newly industrialized economies to the OECD (instead of the US) and asks to what extent changes in relative wages and prices in the OECD were explained by these imports. The answer turns out to be surprisingly small as long as wages are flexible: Assuming wages of skilled workers rise by 3 % relative to unskilled workers in the OECD due to liberalizing OECD-NIE trade, this would imply imports from newly industrialized economies equal to 2.2 percent of OECD gross output - which is more than the actual level - and would be associated with a rise of only 1 % in the relative price of skill-intensive goods.[9] Krugman (1995a: 359) therefore concludes that studies that try to explain the impact of trade on income distribution in industrialized countries by looking at price levels "have failed to find any clear-cut effects" since "the change in relative prices associated with the growth of NIE trade should be well within measurement error".[10]
Cline (1997) allows for some modifications of the Krugman model and changes the parameters used by Krugman and therefore comes to a somewhat other finding, namely "that trade and immigration (especially unskilled) have had a significant impact over the past decade in the observed rise of skilled wages relative to unskilled wages" (238).

2.4 Theory Revisited

Even though Spanos ([1986], 1993: 660), disputing on the logical positivist branch of econometrics, states that "no economic theory was ever abandoned because it was rejected by some empirical econometric tests", it should be noted that the generally somewhat "bleak" gap between theoretical predictions on trade flows and the empirical data (Helpman, 1999: 133) left trade economists not unaffected. Helpman (1999: 133) e.g. suggested "to model more carefully the cross-country differences in techniques of production", since "allowing for differences in techniques of production can dramatically improve the fit of factor content equations". In fact, referring to this idea, Davis and Weinstein (2001) introduced technical differences in a HO-Vanek model[11] and obtain results more corresponding to reality but under the assumption of differences in production techniques, the classical FPE breaks down. Generally, major advances in recent trade theory such as economies of scale (Helpman, 1984 gives a review), or differentiated products and monopolistic competition (cf. e.g. Dixit/Norman, 1980: ch. 9; Krugman, 1995b reviews the literature) are not compatible with the classical assumptions of the SST and FPE theorem and only lead to similar results under supplementary assumptions (cf. subsection 1.5.1 of this thesis).

[9] Krugman also estimates the effect of OECD imports from newly industrialized counties on employment and concludes that under the relatively strong assumption of rigidly fixed relative wages ("European assumption") these imports led to a fall in employment of 1.43 %.

[10] This conclusion, however, must not leave us unpromising for the question under consideration in this thesis since NIE trade only accounts for a small proportion of US or OECD GDP whereas EU-15 trade amounts to a considerable fraction of CEEC-4 trade (cf. subsection 5.2.1 of this thesis).

[11] The HO-Vanek model generalizes the HO model to N goods and M factors and originally assumed identical technologies and thus FPE to hold. Its general goal is to relate the factor content of trade to the countries' factor endowment. The HO-Vanek theorem then states that the factor content of a country's trade (i.e. its net exports) is equal to its factor content minus the factor content of the rest of the world weighted by the considered country's share of world production.

2.4.1 Shortcomings and Alternative Approaches

The theoretical shortcomings of the FPE and SSTs and its lack of empirical support have also shifted more attention towards the limitations of the model:

Even though *transportation costs* might have drastically decreased in the last decades, it should still be noted that their existence prevents commodity prices and thus factor prices from full equalization (cf. Samuelson 1948: 175, 178; 1949: 195) even though freeing trade will reduce the gap.

Samuelson (1948: 175, 178-180) himself also mentions that *complete specialization* truncates the convergence of factor prices before equalization is obtained. This might occur if both trading partners are extremely different in factor endowments, or both commodities use factors of production in almost the same proportions. Also Krugman (1995a: 359f) refers to full specialization as "an important limitation to the factor price equalization theorem". However, his findings suggest that the wage gap between high- and low-skilled workers must grow dramatically in OECD countries to make them specialize in the high-skill production exclusively and this increase would be interconnected with a dramatic increase of NIE imports far beyond any realistic level.

Generally, since the 1980s, *economies of scale* have become an important topic in the theory of international trade. However, "where scale is important it is obviously possible for real wages to differ greatly between large free-trade areas and small ones, even with the same relative endowments of productive factors" (Samuelson, 1949: 196; cf. also subsection 1.5.1 of this thesis).

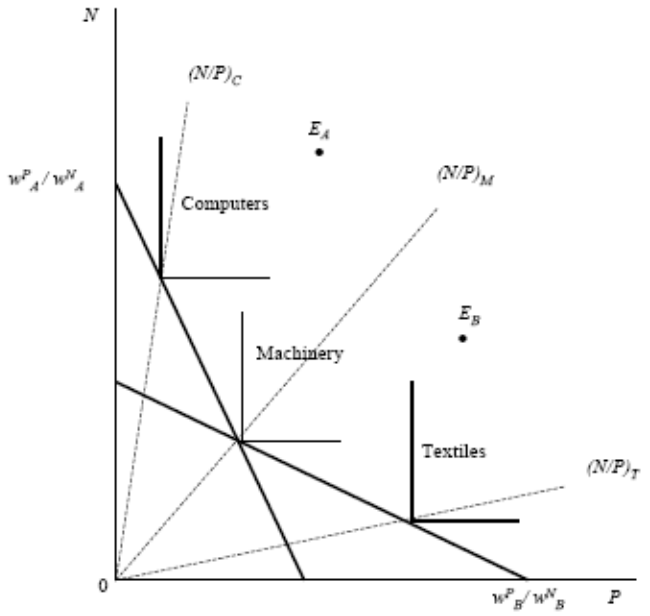
Connected to the implications of imperfect competition under economies of scale, *heterogeneous products* might break down FPE: If a country systematically produces goods which are intensive in skilled labor in every industry then wages will be higher (cf. Bernard et al, 2002: 23). This problem in empirical application aggravates with the aggregation level of industry data (cf. chapter 5 of this thesis).

These shortcomings generally raise concerns about the appropriateness or possible *inadequacies and limitations of the HO framework* (cf. Samuelson, 1948: 181).

The violation of another assumption of the HO model has been stressed in the context of empirical studies finding no evidence for FPE (cf. e.g. Bernard et al, 2002: 11, 20f), namely the mobility of all factors of production across industries. If at least one factor is immobile, factor prices are prevented from converging towards a common value. This problem is referred to as the concept of *multiple HO cones* and can be described as follows (cf. figure 2.1 [taken from Bernard et al (2002)]): The immobility of at least one factor prevents factor prices from converging towards a common international value. Skilled (N) and unskilled (P) labor are available in proportions E_A and E_B in countries A and B respectively. Three goods are produced: computers (skilled labor intensive), textiles (unskilled labor intensive), and machinery (intermediate skill intensity). For simplicity, Leontieff unit value isoquants are assumed. Even with same commodity prices and identical technologies, sufficiently large endowment differences will induce countries to specialize in different mixes of goods with different equilibrium relative factor prices.

Related to the problem of factor immobility, relative factor prices will neither equalize if *technology is not common* across countries, and workers cannot re-locate to arbitrage away wage differences. Recent empirical studies such as Davis and Weinstein (2001) show that the assumption of technical differences is adequate to describe the actual pattern of world trade in a HO-Vanek model. It is questionable in how far FDIs and activities of multinationals lead to a convergence in technologies, especially in higher skilled industries.

Figure 2.1: Multiple HO Cones



Another problem might be *systematically different amenities*: Under equal real wages, the (non-observable or non-quantifiable) living conditions or the supply of public goods might still differ. This effect might compensate for differences in real wages leading to the observation of unequal factor prices even though living (or realization) conditions for production factors are equalized. E.g. clean environment or freely accessible beaches might compensate local workers for a lower wage, lower profit or income taxes might compensate capital owners.[12]

Also, some authors have taken the rigidities of the FPE/SST and its somewhat disappointing empirical substantiation as a justification for bringing back other frameworks into the debate. Trade economists such as Deardorff and Leamer emphasize the need to consider other theoretical frameworks such as the Ricardo-Viner sector specific model (Cline, 1997: 44, 118). Furthermore, Sachs and Shatz (1996: 234/5) e.g. mention three examples for possible linkages between trade and relative wages that fall outside of the traditional HO-Samuelson framework. In all these examples increased trade reduces the relative wage of low-skilled labor even without reducing the relative price of low-skill intensive output in the US market:[13]

- Consider a low-skill intensive product produced with physical capital that is internationally mobile. If a NIE liberalizes trade and investment regulations, US firms will move production towards this lower-wage NIE. Therefore the unskilled-intensive sector in the US shrinks, unemployment for low-skilled workers rises and finally pushes down their wages while the relative prices of the goods need not change since their total supply remains unchanged due to the substitution by foreign-based production. This approach follows the rationale of outsourcing models.

[12] This problem is related to the spatial variation in nominal but not real wages within one country or a common currency union observed by Bernard et al (2002: 23).

[13] Examples for and references to other models of distributional effects of outsourcing are given in Egger/Stehrer (2003: 61f).

- If a monopolistic producer in the low-skilled sector in the US faces foreign competition he might optimally cut down production one-for-one with the increased imports, again increasing unemployment of the low skilled leading to the same outcome as above.

- Globalization may create incentives for skill-biased technological change taking advantage of economies of scale and requiring a fixed investment of high-skilled workers (like engineers) rather than a fixed combination of high-skilled and low-skilled workers.

A very different and less formalized approach concerning equalization of wages has recently emerged out of very different intellectual influences such as dependency theory, development economics, trade theory, literature on multinational corporations and industrial organization. Trying to reflect the changes in the organizational and government structure of the world economy in the past several decades, this *Commodity Chain Approach*[14] highlights the role of transnational corporations and production networks in the global economy and tries to stem an observed *immiserizing growth*[15] by improving (especially developing countries') firms positions in global commodity chains, i.e. by upgrading (cf. Bair, 2005: 164ff). Even though this approach considerably differs from traditional approaches in trade theory, it should be noted that the latter began to investigate similar issues especially since the publication of the Helpman/Krugman handbook (1985: part IV; see also the Navaretti/Venables (2005) handbook e.g.) and also empirical results such as Dulleck et al. (2005), Egger/Stehrer (2003), and Esposito (2007) highlight the role of upgrading and outsourcing for welfare distribution (in CEECs).

Due to the disagreement on the accuracy of the theoretical HO-Samuelson assumptions, empirical economic research might shed light on the question which forces are essential in influencing factor prices and income distribution in the context of trade liberalization, which might challenge theoretical economists to model these underlying factors adequately. The present thesis should be seen in the context of this "continuing debate" (Cline, 1997: 46).

Finally it should be stressed that the FPE and SST and their general equilibrium nature only consider (the increase in) trade to account *ceterus paribus* for changes in factor prices. However, in reality this assumption will not be met, especially if we consider the volatile nature of the transition economies with many different and interacting forces at work. The subsequent chapter therefore discusses this context before chapter four outlines theoretical considerations on an estimable model.[16]

[14] For a general introduction see Gereffi (2005). For an overview over the different camps in commodity chain research see Bair (2005).

[15] The term, originally referring to Bhagwati's correspondent 1958 *Review of Economic Studies* article, claims to depict an increase in economic activity in terms of output and employment that happens simultaneously with falling economic return. Cf. Gereffi (2005: 164).

[16] Spanos ([1986], 1993: 21) distinguishes an *estimable* model as a particular form of the *theoretical* model which is potentially estimable in view of the actual data generating process and the observed data chosen explicitly from the *theoretical* model, the *statistical* model, and the *empirical econometric* model.

Chapter 3

The Context of Transition

3.1 Economic Transition in CEEC: An Overview

Considerations of CEECs, in public opinion as well as in academics, generally have and have had a tendency to treat these countries as a rather monolithic block. In accordance with prominent traditions of Western studies on Eastern and Central Europe,[1] this approach might have some value in economic analysis since it is mainly concerned about common (market) forces at work and prescinds from differing historical and institutional contexts - a lesson grievously taught by the transition experience. However, certain similarities of the transition economies in Central and Eastern Europe cannot be neglected since they were all CPEs from World War II until the breakdown of state socialism in 1990[2], they all suffered from the immediate removal of formal economic institutions leading to an institutional collapse and severe macroeconomic imbalances.

3.1.1 Macroeconomic Imbalances

In the latter context the dramatic fall in economic output might not be ignored. Table 3.1 presents some overview about the development of GDP p.c. in the CEEC-4 and selected other CEECs.[3] It can be seen, that Poland is the first country that has reached its 1990 level of p.c. GDP, namely in 1992,[4] followed by Bosnia and Herzegovina (1995) and Slovenia (1996). Hungary did not reach its 1990 level of per capita GDP until 1998, the Czech Republic not until 2000. Slovakia archived its 1990 level in 2001, as did Estonia. Russia was severely hit and did not reach its 1990 level

[1] Longworth (1992) e.g. constitutes the demarcation between Eastern and Western Europe historically reciprocal as a process of over 1,600 years that has developed a specific form of political culture which is different to the West. Segert (1993) criticizes this view as being too deterministic and presenting the present as the product of a deadlocked path with no alternatives. Ágh (1998) differentiates Eastern Europe in Central Europe (including the Visegrád Group [CZ, H, PL, SK] and the Baltic states), South-Eastern Europe (the Balkans), and the 'proper' Eastern Europe. Segert (2002: ch. 1) stresses that the debate about Central Europe to some extent reflects the wishes in these countries to separate themselves from Eastern Europe. Consistently, 1989 was seen as a *return to Europe*. Other authors have highlighted the Eastern European experience as an attempt of catching-up development (cf. Segert, 2002: 29-68 and 154-158).
An overview of the debate on where the field is going after the breakdown of state socialism can be found in Creuzberger (2000).

[2] Although the proportion between central and regional planning and the relevance of market forces varied over countries and periods.

[3] A more detailed table about the development of GDP p.c. can be found in the Annex B.

[4] It should be noted though that Poland's per capita GDP in 1990 (as well as in the end of the 1980s generally) was pretty low; it was barely above Romanian GDP and about half of the GDP in Czech Republic, Hungary and Slovakia.

of GDP until 2005. It is controversial in economic literature, what has caused this downturn in production.[5]

	GDP p.c. 1990	GDP p.c. 2003	Δ p.a.	1995 index	2000 index	1990 level achieved
CZ	13,498	14,642	0.6 %	93	101	2000
H	10,087	13,016	2.0 %	95	113	1998
PL	5,897	9,217	3.5 %	115	146	1992
SK	9,903	10,943	0.8 %	83	98	2001
Bosnia & H.	1,640	3,492	6.0 %	101	185	1995
Croatia	10,722	9,778	-0.7 %	69	84	2004
Estonia	11,389	12,791	0.9 %	76	97	2001
Macedonia	5,522	5,253	-0.4 %	85	95	2005
Romania	5,637	5,211	0.6 %	93	92	2002
Russia	12,315	9,263	-0.3 %	69	75	2005
Serbia & M.	4,419	2,987	-3.0 %	48	48	201?
Slovenia	15,271	19,757	2.0 %	98	119	1996

Source: own calculations based on Heston/Summers/Aten (2006) and national sources.
GDP in US-$ and 2000 constant prices calculated using Laspeyres Price Indices
Column 3 shows real GDP p.c. growth between 1990 and 2003 p.a.,
Columns 4 and 5 show the index of real p.c. GDP, where 1990 = 100.
Column 6 expresses when the 1990 level of real p.c. GDP was achieved.

Table 3.1: Macroeconomic Overview

Another aspect of the macroeconomic imbalances was the size of government. Using measures of openness, demography, and political and institutional variables to estimate an optimal size of government among OECD countries, Begg and Wyplosz (1999) show, that the size of government in transition countries was significantly above this optimal level in 1997 despite a decline throughout the 1990s.

The Labor Market

Of course, the mentioned output fall had effects on the labor market. It should be mentioned that in this domain of the economy, markets existed already under the CPEs since labor supply decisions were mainly voluntary and economically driven; labor markets were very distorted and little was known about the adjustment process in transition (OECD, 1992: 239). Accordingly, CEECs inherited relatively large employment shares of heavy and energy-intensive industries and agriculture; Hungary had the most similar employment structure to Western OECD countries. Generally, the industries mentioned suffered most from economic recession. Even though there

[5]Two of the most important models trying to explain the output fall were the Blanchard/Kremer (1997) and the Roland/Verdier (1999) models emphasizing the disorganization effect of liberalization on existing production and allocation links. Another explanation (c.f. Li, 1999 or Blanchard, 1997) holds the monopoly behavior of enterprises after liberalization responsible for the output fall: central planers had behaved like a single vertically integrated monopoly, whereas liberalization led to multiple monopolies charging monopoly prices to downstream monopolies. Markets emerged quickly after liberalization and there was a supply response through entry of small private businesses. Moreover, the disruption effects of liberalization on existing production links (inefficiencies in bargaining where deficient legal systems exist or a combination of search frictions and relation-specificity in enterprise investment are present, see Roland, 2000: 193) were largely underestimated. Roland (2000: 169/170) emphasizes that most models give an answer to the initial output fall but cannot explain the long-term difference between, for example, Poland and Russia.

was a small shift towards promoting light industry, the production of consumer goods and the expansion of services even before the start of reforms, large employment falls in industry and agriculture could not be absorbed by these branches (OECD, 1992: 243, Nesporova, 1999: 5-7, 11f). Trade liberalization combined with sluggish domestic demand due to faltering or even decreasing real wages might have undermined the performance capability of these sectors. In Hungary and Poland, employment fell rapidly in light industry and food-processing; two sectors considered to have much developmental potential due to comparative advantage (OECD, 1992: 245). Generally, output fell faster than employment - aggravated by persistence of extensive labor hoarding in many enterprises -, thus labor productivity declined substantially, even though new labor-saving technologies were introduced (OECD, 1992: 241, Nesporova, 1999: 7).

	Open Unemployed			Employment		
	1990	1991	1992	1989-93	1993-97	1989-97
Czechoslovakia	n.a.	119	523	- 10.3 %	+ 3.0 %	- 7.6 %
Hungary	23	101	442	- 24.4 %	- 4.0 %	- 27.4 %
Poland	56	1,196	2,230	- 15.7 %	+ 4.7 %	- 11.7 %

Sources: OECD, 1992: Table 6.6, page 249; Nesporova, 1999: Table 1.1, page 8
all numbers registered unemployed total increase or decline over the period
in thousands as of January Hungary ranges only up to 1996

Table 3.2: Unemployment in Early Transition

Women, young people, and those having only a basic or vocational level of education faced the highest risk of unemployment (OECD, 1992: 251ff).

The most important sectors absorbing parts of the unemployed were not in manufacturing, but mainly private, rather small enterprises, especially in the service sector (OECD, 1992: 245ff, Nesporova, 1999: 12f).

Another legacy of the communist past was the "strong geographical concentration of those industries that are bound to experience the most severe job losses" during the transition process, leading to "sizeable regional differences in the distribution of unemployment and vacancies" (OECD, 1992: 256). The unemployment rate tended to be lowest in centers of agglomeration (cf. Brülhart and Koenig's (2006) Comecon hypothesis), regions with a more diversified industrial economy[6], areas bordering on more developed countries, and regions offering good opportunities for tourism and leisure (Nesporova, 1999: 19f). Insufficient labor mobility, handicapped also by housing prices in developing areas (Nesporova, 1999: 51) and missing regional development policies (infrastructure, education) led to a continuation of the problem. Mainly regional EU assistance can be seen as a factor foiling this development.

The unpromising situation on the labor market led to lower labor market participation rates (Nesporova, 1999: 10), endeavors to obtain further income sources,[7] increased self-employment in the very first years (Nesporova, 1999: 15f), and more flexible forms of employment deteriorating the conditions for the latter (Nesporova, 1999: 13f) and thus to a general weakened position of workers. After some years, the acceleration of unemployment halted and remained at a level around 10 %; this was

[6] Actually this is an interesting finding in view of predictions concerning comparative advantage and specialization patterns from trade theory.

[7] Nesporova (1999: 24) mentions, that between 1989 and 1995 the proportion of wages in total income fell from 46.7 % to 30.3 % in Poland and from 66.5 % to 46.1 % in the Czech Republic.

not due to a recovered labor demand but rather to more restrictive unemployment compensations resulting from the fact that persistent unemployment under restraints in public budged had depleted labor market fonds (cf. Nesporova, 1999: 17 and 51). Decreased unemployment benefits and low unemployment turnover (so that the long-term unemplovment was high, cf. Nesporova, 1999: 20) increased poverty, which was a problem especially in Poland (cf. Nesporova, 1999: 25ff) and labor weakness, both of course mutually effecting each other. Government policies aggrevated the situation by only partial indexation of minimum wages to prices and a punitive labor tax on wage increases above a special level (Nesporova, 1999: 22). Furthermore, restrictions to wage increases in profitable enterprises were implemented, whereas badly performing enterprises could rise wages (Nesporova, 1999: 23). This restriction hindered income driven labor allocations towards expanding industries, which was severely transition-impeding due to widespread skill mismatches, meaning that newly required skills were often undersupplied in expanding industries (cf. Nesporova, 1999: 20). By 1997 real wages reached their 1989 level only in Czech Republic (103.2), whereas they were significantly below that level in Poland (83.2) and Hungary (77.9; Nesporova, 1999: 23). Finally, also the restrictive monetary and fiscal policies damped the demand for labor since they restrained the access of developing enterprises to credit (Nesporova, 1999: 24).

To sum up, unemployment increased dramatically in the first stage of transition and remained at a high level in the 1990s. Implemented labor market policies could not sufficiently tackle the problem and did not only create harsh bargaining conditions for labor and unions, a factor already "created as a weak actor" in the transition context (Ost/Crowley, 2001: 228), but also partially prevented labor from reallocation towards expanding sectors.

3.1.2 The Quest for Economic Stability

Approaches to macroeconomic stabilization, which were more concerned with hyper-inflation than recession (not to mention employment; cf. Nesporova, 1999: 49) in the very beginning, were mainly "derived from basic textbook economics" and highlighted the importance of price liberalization, macroeconomic stabilization (fiscal and monetary policy), and privatization (Roland, 2000: xviii). To make matters no better, John Williamson had just finished his list of ten policy prescriptions which is usually referred to as the *Washington Consensus* and that can be summed up by two aspects (cf. Raffer/Singer, 2001 : 51f for a full list): *Fiscal discipline* should be guaranteed by setting public expenditure priorities and by privatization and *liberalization* should take place in financial markets, where foreign investment should be enabled to obtain the same rights as domestic firms, as well as in goods markets where especially NTBs should be abandoned and unified and competitive exchange rates should be introduced. The only institutional aspect of the agenda was to guarantee property rights. It is thus barely exaggerated to speak of a *radical market orientation without markets* that was to a large extent enforced by the allegedly good advice of Western policy advocates and pressure from international organizations such as the World Bank and the IMF.[8] The experience of this vision of transition "has revealed important shortcomings ... . Liberalization mostly did not yield a positive supply response;

[8]However, one should also not forget, that the slogan "There is no alternative" (TINA) had some eligibility. Admittedly this was hardly the case because of profound argumentation of the neoliberal agenda but rather due to the fact that just a couple of years before heterodox, i.e. non liberal, stabilization plans failed in Argentina, Brazil and Peru (cf. McKinnon, 1993: 3). Socialist ideas were declassed after the collapse of CPEs, while structuralist and dependencía approaches still suffered from the physical and ideological wipe-out by the military juntas in Latin America.

it led to a major unpredicted fall in output" (Roland, 2000: xix). If anything, experience of transition shows that policies of liberalization, stabilization, and privatization that are not grounded in adequate institutions may not deliver successful outcomes (Roland, 2000: xix). In the mid-1990s, however, more institutional approaches to the transition problem gained importance ("New Institutional Economics").[9]

3.1.3 Different Legacies From the Past?

Neglecting the differences between CEECs certainly has its weaknesses. Leaving besides the special path that Yugoslavia has taken (especially after 1965, cf. Lampe, 2000), one should not forget about market oriented reforms taking place in Hungary in 1968 already and in Poland 1980, followed by the Soviet Union, while the Czech Republic clinged to a more plan oriented development until the bitter end (see Kornai, 1992, for the different intensities of economic reform in CPEs). Roland (2000: 11) points out that these differences are also connected to differences in the transition strategy adopted (cf. also Ekiert, 1996, Smith/Swain, 1998: 27, and Segert, 2002: 191-213): countries with a history of reform prior to transition tended to start transition with serious macro imbalances, requiring tough stabilization packages, while countries not having this reform history (GDR, CZ, Romania) didn't have such a stabilization problem. Nevertheless, after Poland, the Czech Republic is considered to be the next-best example of a *big bang policy*, characterized by liberalization, stabilization and privatization all occurring between 1991 and 1992. After the split of the country, Slovakia switched to a more gradualist approach, especially regarding privatization policies (Roland, 2000: 16). Hungary (as well as Slovenia and also China) is an example of a generally more *gradualist strategy*, that is characterized by implementing stabilization policies in the middle of the transition process rather than in the beginning (Roland, 2000: 14ff).

Economists such as Dehejia (1995) and Fernandez/Rodrik (1991) have used new political economy approaches to address the question of whether a gradual or a big bang strategy is chosen to reform might sustainably influence the possible outcome. Fernandez and Rodrik (1991) model the trade liberalization process and show that there would be no democratic majority if the liberalization is enforced in two parts (gradualist approach) while the median voter might well vote for the reform if it is enforced at once (big bang). Based on Mussa (1978), Dehejia (1995) on the other hand, shows in a general equilibrium model of trade liberalization, that the latter suffers the political constraint that the discounted lifetime value of workers in the import competing sector after reform has to exceed that under the status quo (i.e. the existing tariff and/or NTBs) at any point in time, which due to smoothing adjustment costs for workers makes gradualism politically feasible when the big bang is not. In reality, the ability to enforce political reform of course hinges on the social balance of power, that can vary widely between CEECs (cf. Becker, 2006).

[9] Cf. Coase (1992: 714): "The value of including ... institutional factors in the corpus of mainstream economics is made clear by recent events in Eastern Europe. These ex-communist countries are advised to move to a market economy, and their leaders wish to do so, but without the appropriate institutions no market economy of any significance is possible", or Roland (2000): The events of transition "have further contributed to a change in focus in thinking about economics and have very much reinforced the institutionalist perspective, emphasizing the importance of the various institutions underpinning a successful capitalist economy. ... Thus, there is a shift of emphasis from markets and price theory to contracting and the legal, social, and political environment of contracting". See also Rodrik, 2006.

Authors more oriented towards the regulation school and political science such as King and Szelényi (1995), Bohle and Greskovits (2007), and Becker (2007, 2008) have thus stressed differences between types of post-socialist development in CEECs, mainly shaped by the constellation of protagonists from the old elites during the crisis of the socialist system, paths of emergence of private property and markets, and the influence of international investors. Similarly, authors referring to the "Varieties of Capitalism" approach (such as Bandelj, 2003, Kovács, 2006, 2008) ask, inhowfar different forms of market organization can be distinguished in Central and Eastern Europe.

3.2 Transition and Trade

Considering the great importance that foreign trade and trade liberalization have played in the transition process,[10] it is surprising how little economic theory on the role of trade liberalization in the context of transition and/or economic stabilization exists. An exception worth emphasizing is the contribution of McKinnon (1993), even though it deals with stabilization in general and not transition especially (and it makes in fact a difference if markets are distorted or non existent). Trying to derive an optimal order of liberalization and stressing that this may vary by country, he points out that the liberalization of foreign exchange should take place *after* the stabilization of central governments finances, privatization, the development of a regularized tax system, the opening of domestic capital markets, and the liberalization of domestic trade and finance have *successfully* taken place (4-7, italics not in original).
Winiecki (2002), another contribution worth mentioning, agrees that "surprisingly few [works] have been devoted to surveying the foreign trade issues emerging during the transition process" (p. 1) but is generally not able to fill this gap even though alluding to some interesting and central points.

In the transition context, policy recommendations were limited to basic textbook statements like that price liberalization should be complemented by liberalization of foreign trade (Balcerowicz, 1994: 28, 40 for example). While the theory of international trade, as outlined in chapter 1 of this thesis, was always concerned about welfare and how it could be raised by freeing trade,[11] one could get the impression that economic policy advice, seeing liberalization as a policy aim rather than its mean, was more concerned with dogma than welfare and has priggishly taken some particular theorems of trade theory for always granted while proponents of this theory have warned to do so.

3.3 Accession and Admission to the EU

Even though endeavors to acces the EU were made by the CEECs right after the breakdown of CPEs, the European Union was occupied with other concerns than spending too much effort on the possible accession of the CEECs at that time: The internal struggles about the balance of power (cf. Wielgoss, 1997: 9-13) as well as the *Treaty of Maastricht* bound resources, especially after the corresponding referendum in Denmark failed. In addition the former GDR had to be incorporated into the FRG and the fourth enlargement (Austria, Finland, Sweden) also had to be realized (cf.

[10] This includes the importance in arguments about stabilization as well as the orientation of CEECs towards foreign markets in practice.

[11] Stolper and Samuelson (1941) are no exception to this tradition, stating that "it is always possible to bribe the suffering factor by subsidy or other redistributive devices so as to leave all factors better off as a result of trade" (73).

Merli/Huster, 2008: 27f).

3.3.1 PHARE

First hesitant steps of approximation were made with the PHARE Program (see Wielgoss, 1997: 14-16) which consisted of non repayable financial aid and was initially enacted for Poland and Hungary in 1989 but extended to nine further recipient countries until 1993. While also other assistances such as loans from the European Investment Bank or the European Bank for Reconstruction and Development were granted and important for the restructuring process, PHARE was the "most important instrument" of cooperation (Cameron, 1995: 426). In the very beginning the program focused on macroeconomic stabilization (intended by liberalization of prices and foreign trade, constituting an institutional framework and a restrictive financial and monetary policy) rather than on restructuring the economy as originally intended by the program (and reflected by its name). The latter, however, got more and more important as economic conditions normalized (cf. Wielgoss, 1997: 15). Furthermore, a shift is identifiable as far as the importance of the program is considered: Being a self-contained central program in the beginning, it became more and more an accompanying measure.

3.3.2 Europe Agreements

After being signed in 1991,[12] the Europe Agreements became the major tool of EU-CEECs cooperation. Replacing less extensive agreements on trade and cooperation (cf. Merli/Huster, 2009: 37), the Europe Agreements were focused on economic matters: they envisioned the abolition of tariffs and quotas, the construction of a free-trade area, and financial liberalization (Merli/Huster, 2008: 37; cf. also Nagel, 2003: 317). More precisely, they consisted of an asymmetric liberalization in goods trade (but not in services or personal mobility), where the EU abolished NTB to trade immediately and tariffs within five years while the CEECs had more time to fulfill these tasks. Therefore, the Europe Agreements should in the present context be seen as probably the most important agreements on free trade between the CEEC-4 and the EU-12 (by then) until the Accession Treaties came into force, even though goods considered "sensitive", such as textiles, coal, and steel, as well as agricultural goods obtained special treatment,[13] and furthermore some of the protection clauses were operated rather pedantic sometimes, and some agreements suffered lacks of realization (cf. Brasche, 2008: 284f, Merli/Huster, 2009: 37f). Finally, anti-dumping clauses prevented EU markets from too harsh competition (see Ehrenhaft et al. 1997: esp. ch. 3 on the issue).

The Europe Agreements also covered issues of political dialogue and other aspects of cooperation (European Communities, 2009) and consistently belong to the category of association agreements (under article 238 TOR) rather than the inferior sole trade

[12] The Europe Agreements were signed with Hungary, Poland, Bulgaria and Romania on 12/16/1991. An agreement was signed by then also with the Czechoslovak Republic but had to be formally renewed with its successor states, Czech Republic and Slovakia on 10/6/1993 after the separation of the country on January 1, 1993.

[13] Some authors emphasize that these were especially the sectors where CEECs had comparative advantages and economic development was therefore undermined. In fact, goods considered "sensitive" amounted to about one third in CEEC-4 exports towards the EU-15 in 1991 (cf. Wielgoss, 1997: 85). However, in all these sectors economies of scale are unlikely and even decreasing returns are possible so that these "barriers" might even have fostered a sustainable long term development, cf. Raffer (1994).

agreements (subject to article 113 TOR) and were therefore considered as the "basic legal instruments defining relations between the Union and the candidate countries" (European Communities, 2009). However, they did not explicitly admit the claim of CEECs access the European Union and contained only a "vague membership-formula" (Lippert/Schneider, 1995: 27).

3.3.3 The Accession Process

The shift in the skeptical French position towards enlargement (Wielgoss, 1997: 23) enabled the Union to open its doors to the CEECs: In June 1993 the European Council of Copenhagen "agreed that the associated countries in Central and Eastern Europe that so desire shall become members of the European Union" (European Council, 1993: 7.A.iii). Of course, the vision of admission to the EU was bound to certain conditions, made conditional in the so-called *Copenhagen Criteria* requiring a stable democracy with a working and competitive market economy and the adoption of the common rules, standards and policies of the body of the EU laws (European Communities, 2009; Merli/Huster, 2008: 29). Deriving the necessity of a working and competitive market economy directly from the TOR (article 3.f for example), the Copenhagen Criteria went well beyond economic aspects that formed the body of the Union but also included an institutional perspective.

Formal applications for the accession to the EU were filed in 1994 by Hungary and Poland (3/31 and 4/5 respectively), by Slovakia on 6/27/1995, and by the Czech Republic on 1/17/1996. These applications officially opened the procedure for accession (pursuant to Article 49 of the consolidated version of the Treaty on European Union) whose stages have been concretized at the European Council of Essen in December 1994: The initiated *White Paper* on "Preparing the associated countries of Central and Eastern Europe for integration into the internal market of the Union" defined central criteria for the CEECs to transform their economy and institutions in consideration of a possible accession to the European Union. Intra-European trade played a key role in this process: "On accession, the acceding countries will become part of the Internal Market. Therefore preparation for the Internal Market must be at the heart of pre-accession strategy" (European Council, 1994: Annex IV:3). Yearly *Progress Reports* monitoring the progress made became further parts of the pre-accession strategy.

The role of trade for the CEEC-4 was also boosted by their accession to the newly founded World Trade Organization (WTO) in 1995: the Czech Republic, Hungary and Slovakia joined in the very beginning (1/1), Poland half a year thereafter (7/1).

The Council of Madrid in December 1995 tied in with the Essen outcomes and took them a step further since for the very first time the EU aimed for a time frame that was substantiated and confirmed half a year thereafter at the Council of Florence. Also, in Madrid a first interim report on the impact of the accession of the CEECs to the EU on the policies of the latter was presented, as has been requested at the Essen Council. The analysis of these impacts was deepened until 1997 and peaked in the Agenda 2000, published by the European Commission on July 16, 1997.

The decision to begin negotiations was made at the summit of the European Council in Luxembourg in December 1997 for the Czech Republic, Hungary, Poland and three other countries ("Luxembourg Group") and at the summit in Helsinki in December 1999 for Slovakia and five other countries ("Helsinki Group"). Negotiations started on 3/31/1998 and 2/15/2000 respectively (Merli/Huster, 2008: 32). In the course of these negotiations the Commission discussed the relevant *acquis com-*

munitaire,[14] ordered in 31 chapters, together with the accession candidates point by point.

PHARE became the main financial instrument of accession strategy, especially after the Agenda 2000 was launched. It was then complemented by the Instrument for Structural Policies for Pre-Accession (ISPA) and the Special Assistance Programme for Agriculture and Rural Development (SAPARD). These funds were in effect from 2000 to 2006 with a budget of 10 billion Euro for this period.[15] Its main priorities were institutional and capacity-building and investment financing.

Despite these efforts, the second cohesion progress report of the European Commission (2003) highlighted the widening of economic disparities within an enlarged European Union. While advice for future cohesion policy mentions the contribution of strengthening economic integration, more priority is given to political aspects of redistribution (ch. III). Although the need for "development of ... infrastructure networks, [and] improved access for remote regions" is emphasized (ch. III), the role of trade and trade capacity building in this context remains surprisingly insignificant. The report further highlights the significance of objective 1 assistance[16] to real convergence (ch. 1.4).

The European Council meeting in Copenhagen in December 2002 found the CEEC-4 together with six other candidate countries ready to join the EU. After signing their *Accession Treaties* on April 16, 2003 in Athens, the CEEC-4 and four other CEECs officially accessed the EU on May 1, 2004 together with Cyprus and Malta,[17] to be followed by Bulgaria and Romania on January 1, 2007.

To sum up, after an unassertive beginning, the 1990s were finally marked by a vast trade liberalization for some CEECs, especially (but not exclusive) the CEEC-4 under consideration and this liberalization was especially significant for trade with the European Union after the signing of the Europe Agreements and ultimately their admission to the EU in 2004.

3.4 Expected Patterns of Foreign Trade

This trade liberalization could not remain without an effect on resource allocation in the CEECs. One might argue that this effect is overlapped by a strong noise due to the volatile influences of the transition process. However, in the middle of the 1990s the CEEC-4 were back on a relatively stable track of macroeconomic development. Being highly dependent on foreign markets (cf. subsection 5.2.1 of this thesis), it is

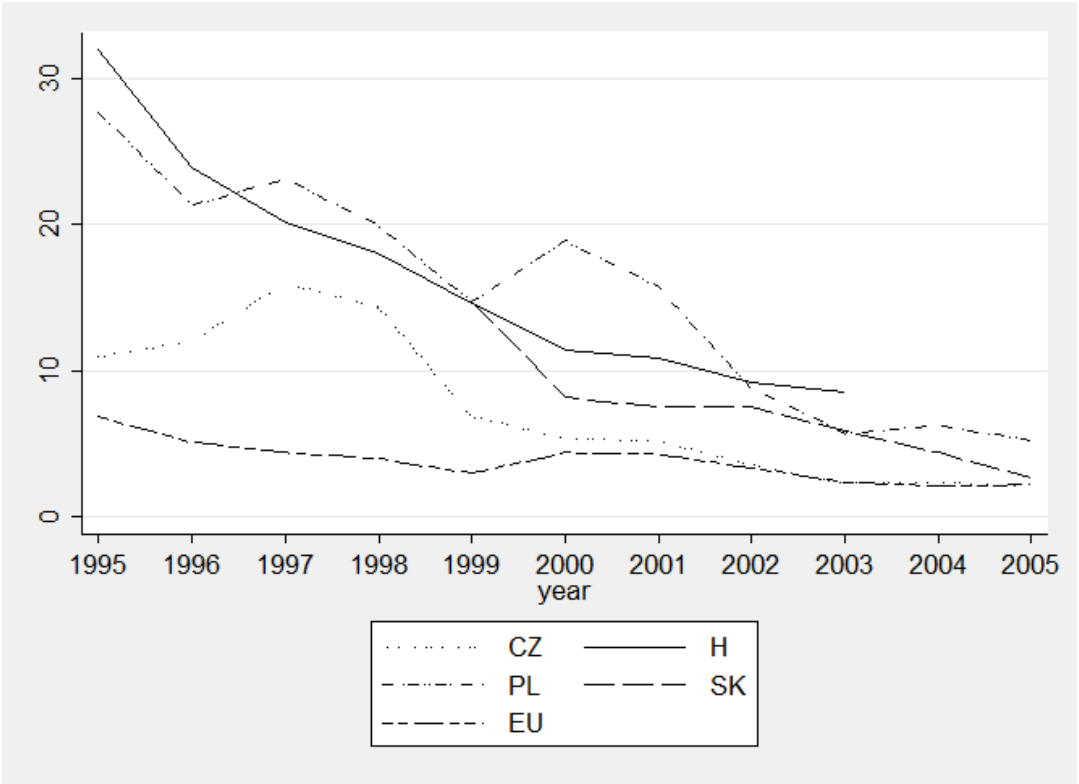
[14] The *acquis communitaire* "is the body of common rights and obligations which bind all the Member States together within the European Union" (European Communities, 2009).

[15] This corresponds to roughly 6 % of the Slovak GDP throughout the same period. About one third of the money was devoted to ISPA and two thirds to SAPARD.

[16] The aim of Objective 1 Assistance is "to promote the development and structural adjustment of regions whose development is lagging behind" (EU website). 75 % of all allocated EU funds on regional policy are devoted to Objective 1 Assistance. From the CEEC-4 only the regions Praha and Bratislava don't fall under the criteria for Objective 1 Assistance.

[17] Before, plebiscites had to confirm the ratification of the Accession Treaties. In Hungary only 45.6 % of citizens eligible to vote participated in the plebiscite on April 12, 2003 but 83.8 % of them voted in favor of the Accession Treaty (Merli/Huster, 2008: 650). On May 16-17, 2003 52 % of eligible Slovak voters went to pools, voting 92.5 % in favor of the Treaty (Merli/Huster, 2008: 628). On Jule 7-8, 2003 almost 59 % of Poles entitled to vote confirmed the Treaty by 77,5 % (Merli/Huster, 2008: 614f). Also in June, 58 % of eligible Czech voters went to pols for their very first nationwide referendum to vote for the Treaty by 77 % (Merli/Huster, 2008: 645f).

Figure 3.1: Short-Term Interest Rates



thus likely that foreign trade significantly influenced national development.

What were the expectations of traditional HO theory? CEECs are generally considered as being relatively labor abundant countries suffering from shortages in capital. Therefore we set CEECs in the framework presented in section 1.5 equal to I, the EU equal to II. Let B be the labor intensive, and A the capital intensive product, and L be labor and H capital. Accordingly, until trade has equalized marginal productivities and thus factor prices, we would expect capital to be more expensive, labor being less expensive in CEECs than in the EU-15. The latter is confirmed by figures 5.1 and 5.2 on p. 40f. If the short term p.a. interest rate is used to measure the price of capital, the former is also confirmed in figure 3.1 and shows a clear tendency of convergence.

From the framework presented in section 1.5 we would expect trade with the EU-15 to lower the cost of capital and increase wages in CEECs. Furthermore, if only labor is considered and separated into low-skilled (L) and high-skilled (H) labor, it is assumed that CEECs are relatively low-skill intensive compared to the EU-15,[18] thus trade between these two regions would lead to an increase in the wage of low-skilled workers relative to the high-skilled workers in the CEECs by a surge in demand for low-skilled goods from foreign markets and the according change in relative prices. Therefore, we would expect trade to reduce wage inequality in CEECs.[19]

[18]This assumption is mostly taken as granted. However, one should not forget that CEECs generally have good human capital stocks (cf. Gutman, 2000: 26). If this human capital can be realized in the context of Western modes of production is another issue.

[19]Obviously, the contrary is predicted for the EU-15. However, as Krugman (1995a) pointed out,

3.5 Empirical Investigations

The small interest in the question of transition and trade, and especially its welfare dimension is reflected in the small number of empirical contributions in the field. While very real and serious negative social phenomena (cf. Kornai, 2006: 21ff)[20] led to a considerable amount of studies about welfare and income distribution (see e.g. Commander (1997), Coricelli (1997), Förster/Tóth (1997), Milanovic (1998), Aghion/Commander (1999), Ferreira (1999), Micklewright (1999), Milanovic (1999) and the associated note by Eastwood (2000), Grün/Klasen (2001), Milanovic/Ersado (2008) for general and Rutowski (1996), Garner/Terrell (1998), Castronova (2006), Newell/Socha (2007) for more specific studies). However, these investigations were barely linked with openness and trade, even though the latter played a significant role in the transition process but found relatively low empirical attention on their part. One branch in literature (such as CEPR, 1990: 2 - 7, Winiecki, 2002: ch. 2, and Zarek, 2006 for example) tried to derive expected trade patterns merely from the classical HO model disregarding any later advances in trade theory as well as considerable influences of transition. A more promising approach was led mainly by facts and investigated actual trade patterns of CEECs empirically (Rodrik (1994), Dulleck et al. (2005), Zaghini (2005), Benedictis/Tajoli (2008) for example). Finally, while literature of the first branch did barely link the traditional HO model with real world data, a relatively extensive literature empirically investigating the adequacy of intra-industry trade models (mainly based on Dixit/Norman (1980: ch. 9)) emerged in the late 1990s (e.g. Fidrmuc et al., 1997, 1998, 1999; Hoekman/Djankov, 1997; Atrupane et al., 1999; and Fidrmuc, 1999.

Existing empirical studies about the influence of EU-CEECs trade on wages have usually addressed the issue from the viewpoint of the EU-15 countries (Kunze, 2000; Belke/Hebler, 2002: ch. 4; Breuss, 2006; Zuckerstätter (2004) e.g.). The remainder of this section discusses the to my knowledge only studies focusing on the influence of trade on wages from the CEECs' perspective.

Onaran and Stockhammer (2006) use data on 14 sectors for five CEECs (CEEC-4 plus Slovenia) for the time period 2000 - 2004 from the Vienna Institute for International Economic Studies (WIIW) to estimate the effects of FDI and EU-trade on real wages in the pooled sample of these countries. FDI and trade variables are lagged to capture time lags in the wage response and to avoid endogeneity problems (p. 9). They explicitly ignore unit root problems for real wages, arguing that the problem is less severe in a panel setting and the work with the logarithmic level might mitigate the problem (2006: 12).[21] For the unemployment rate, exports, imports, and FDI they argue that these variables tend to be stationary, which again is a strong assumption for a transition economy. Period-specific fixed effects are used to reflect a time trend. The results are reproduced in table 3.3 and clearly show that FDI has a positive albeit economically small effect on wages (p. 13). Exports to and imports from the EU (measured relative to the output of the sector) are far from being statistically significant.

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the effect of CEEC trade for Western OECD countries is very small and thus the effect rather low (even though some sectors such as textiles and transport equipment could indeed be affected, cf. Forslid et al. (2002)), whereas EU-15 trade accounts for a large share of CEECs' GDP.

[20] Interestingly, Kornai (2006) attributes a significant part of these phenomena to "cognitive problems" (26ff) of the CEECs' population while relatively few attention is devoted to system-specific (32f) and transition (31f) problems.

[21] As can be seen from the results in chapter 6 this is a rather hazardous statement. Also the reference of Onaran/Stockhammer (2006) to Wooldridge (2002) is not traceable.

Dependent Variable: Log Real Wage		
specification	3	4
observations	350	325
Constant	6.501***	6.470***
Productivity	0.119***	0.119***
Unemployment	-1.141**	-0.958***
FDI inward stock/output (1 lag)	-	0.124**
Exports to EU/output (1 lag)	0.006	-0.001
Imports from EU/output (1 lag)	-0.020	-0.034
adjusted R-squared	0.994	0.994
prob(F-stat)	0.0	0.0

Source: Onaran/Stockhammer, 2006: Table 3 (Annex)

Table 3.3: Onaran/Stockhammer short term results

Finally, they also estimate a cross-section model they refer to as a "long term estimation" taking five-year averages (2000-2004) of all variables for all sectors in the countries (see table 3.4). The openness variables (imports, exports, FDI) are taken for the period 1999-2003 to reflect the lag structure. Long-term effects of trade with the EU-15 start to play a role in this specification, however, the influence of exports is negative and the influence of imports is positive. They classify this result as being the "opposite to what the traditional trade theory would expect" and conclude from the negative net effect of exports and imports,[22] "that increased exposure to foreign markets have raised the competitive pressure on labor in the bargaining process over the longer term" (p. 16). However, it is not the case that this specification measures any rise or fall since for every sector simply the long-run average (and not the average change of the variable) is used. Accordingly there is no long-run effect that is estimated. Besides from possible omitted variable problems using pooled OLS, the outcome might have a very simple explanation: It might merely reflect the fact that CEECs' exports are more concentrated in low skill products which realize a lower price and where wages are lower while sectors where CEECs have a high import penetration are expected by the HO model to be more skill intensive and thus wages are generally higher within these sectors. The Onaran/Stockhammer estimate simply says that sectors with higher export shares have on average lower wages and sectors with higher import penetration have on average higher wages. It is also obvious in this specification that FDI stocks are negatively correlated with wages since it can be assumed that FDIs flow into low skill, low wage sectors which obtains empirical support by Egger/Stehrer (2003: 68).

Breuss (2007) uses panel data on 14 EU countries and 10 CEECs[23] between 1992/95 and 2005 to estimate the influence of openness on the labor-income share using fixed country effects. The results are reproduced in table 3.5 and show, that as expected from theory the labor-income share in the EU decreases as a consequence of globalization in general. Contrary, in the CEEC the increase in global net trade had a positive influence on the labor income share but trade with the EU dampened the income share of labor.[24]

[22]The difference is borderline significant.

[23]Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia and Slovenia

[24]Note, that again the specification is likely to suffer from spurious regression and endogeneity problems and only estimates the effect in the short run. Furthermore, the dependent variable is the

Dependent Variable: Log Average Real Wage	
observations	65
Productivity, log average	0.342***
Unemployment	-3.7***
FDI inward stock/output (1 lag)	-0.967***
Exports to EU/output (1 lag)	-0.510***
Imports from EU/output (1 lag)	0.351**
adjusted R-squared	0.608
prob(F-stat)	0.0

Source: Onaran/Stockhammer, 2006: Table 5 (Annex)

Table 3.4: Onaran/Stockhammer "long term" results

Dependent Variable: Labor income share		
	EU	CEEC
constant	64.00***	68.86***
net trade	-0.28***	0.27***
trade with CEEC	-0.14***	-
trade with EU	-	-0.46***
FDI net	-0.08***	0.12**
observations	224	110

Source: Breuss, 2007: 18 (Table 2); net trade is total commodity export minus total imports in % of GDP
FDI net means FDI outflow minus inflow;
for CEEC only inflow

Table 3.5: Breuss' Estimation for determinants of the labor income share

Egger and Stehrer (2003) use data for 14 industries in the Czech Republic, Hungary and Poland between 1993 and 1999 and find a positive effect of intermediate goods exports and intermediate goods imports (with the EU) affecting the skilled-to-unskilled wage bill in favor of unskilled workers in the CEECs. Therefore, they conclude that intermediate goods trade with the EU as a measure of outsourcing of vertically integrated multinational corporations accounts for a considerable reduction in the predicted growth of the skilled-to-unskilled workers wage bill ratio in these countries.[25]

In a similar manner, **Esposito (2007)** finds a significantly negative impact of intermediate goods exports on the ratio of non-manual to manual workers for the Czech Republic, Hungary and Poland by updating the analysis of Egger and Stehrer (2003) until 2005 and excluding the early 1990s. He further finds that trade integration and outsourcing shaped the evolution of production and trade structures. While medium and high-skill intensive industries generally grew stronger, especially in Hungary, he also finds evidence that these countries specialized in the export of unskilled intensive intermediate goods driven by the export of parts and components.

labor income *share*, thus trade with the EU might have had positive influence on wages but even higher influence on capital income.

[25] A growth of the skilled-to-unskilled wage bill ratio was expected as a result of transition since CEECs inherited rather low wage differentials especially as regards skill requirements (Nesporova, 1999: 22; for the effects of changing skill demand see Rutowski (1996) and Commander/Kollo (2008) e.g.).

A study by **Newell and Socha (1998)**, mainly investigating the effects of privatization on wages, finds suggestive circumstantial evidence that the increase in trade with Western Europe, especially Germany, raised wages and employment in Polish manufacturing industries between 1992 and 1996 through a relative shift in labor demand.

The study of **Milanovic and Ersado (2008)** is a certain ray of hope in the field: For the fist time using panel data from household surveys they try to investigate reasons for the rapidly increased inequality in 26 CEECs and find that foreign trade liberalization appears to have an entirely neutral effect on income distribution. However, for the question examined in this thesis their findings should not be overrated since they did not use effective trade integration but rather policy variables as explanatory variable (p. 8).

Chapter 4

Considerations on the Model Structure

Chapter 1 has introduced the economic theory relating a change in a country's trade equilibrium to a change in factor prices, i.e. wages. In chapter 3 we have seen, that for the CEEC-4 under consideration there might have been many other forces at work influencing wages. The intention of this chapter is to discuss in which form theses influences might be reflected in an estimable model and to illustrate possible specification errors of the statistical model. Therefore, the first section discusses how the adjustment process between two equilibria might be shaped whereas the second section introduces thoughts on other variables than trade influencing wages (the corresponding observed data will be presented in section 5.3) and reviews the problem of spurious regressions, often ignored in empirical panel data investigations.

4.1 The Adjustment Process

Let y_t be either a measure for the wage level in the CEEC-4 or a measure for the equality of wage levels between CEEC-4 and the EU-15 (constructed in a way so that $y = 0$ indicates equality of wages and $y < 0$ if wages in the EU-15 are above CEEC-4 level) in time period t, let $x_{1,t}$ be a measure for the volume of trade at time period t, and let e be the unit vector.

From the economic theory presented in chapter 1 we would thus expect $\beta_1 > 0$ in the equation

$$y_t = \beta_0 e + \beta_1 x_{1,t} + \epsilon_t, \qquad \epsilon_t \sim NID(0, \sigma_\epsilon^2), \tag{4.1}$$

indicating either a positive correlation between the level of trade and wages in CEEC-4, or an equalizing effect of trade on wages in CEEC-4 and the EU-15. Considering trade to be the only variable influencing wages, two problems concerning the dynamics of the model arise: The speed and acceleration of adjustment.

Firstly, certain assumptions have to be made on the *lag structure*, i.e. the question how much time wages need to react to a change in foreign trade. It is obvious that in reality production factors are not perfectly mobile across industries in the short run and therefore an appropriate lag structure would give them time to adjust. How much time this takes is a rather empirical question (for the econometric theory see Johnston, 1984: 343ff).[1]

Secondly, certain questions about the acceleration of the process arise. Assume that the level of trade increases from the autarky equilibrium to the free trade equilibrium in a linear fashion. Will the equalization process of factor prices then also take

[1] Lagging the trade variable also takes care of possible endogeneity problems.

place linearly? If not, ϵ_t will not be independently distributed across time periods in equation 4.1 and thus a central assumption of the OLS model will be violated.

It is also possible that the adjustment process runs in logarithmic form, i.e. the faster the bigger the difference in wages is (and thus the further the trade level is away from equilibrium). This is mainly due to the fact that as trade is liberalized the price differences of the goods traded between both countries are higher in the first years after liberalization and are diminishing thereafter. On the other hand, if increasing returns to scale are assumed, the change in the marginal productivity of the process of labor reallocation towards the sectors with comparative advantages will be lower in the first years.
There are several approaches to modeling these propositions. One would be to use fixed time effects, i.e. setting a time dummy variable for each year similar to the sector specific dummies in the LSDV estimator (and to possibly interact them with the export share). This would allow at least for different intercepts in different years but will result in a decrease in d.o.f. and it is questionable whether it is the appropriate approach. Another possibility would be including a time trend, which could also be multiplied with the trade variable. Finally, a possibility would be to use the existing difference in wages as an explanatory variable and to possibly interact this variable with exports.[2]

If the free trade equilibrium and FPE is obtained and y_t is a measure for the equality of wage levels between CEEC-4 and the EU-15 constructed as above, $y_t \approx 0 = \beta_0 + \beta_1 x_{1,t} + \epsilon_t$ must hold and thus

$$\beta_0 = \beta_1 x_{1,t}.$$

If the model was correctly specified, $\epsilon \sim NID(0, \sigma_\epsilon^2)$ and OLS would be BLUE (cf. Appendix A).[3]

However, as discussed before, it is very likely that relevant variables are missing in this specification. If this was the case, the obtained OLS coefficients would be biased (referred to as "omitted variable bias"), OLS will no longer be BLUE and inference is undermined (cf. Johnston, 1984:260-261).

4.2 Misspecifications

4.2.1 Omitted Variables

Outside of the restrictive HO framework there might exist other variables influencing wages. Even if the problem is less severe in a panel data context (cf. Hsiao, 1990: 3f),

[2] Greene (2000: 326) gives a very intuitive example of such a specification modeling braking distance D with speed S and road wetness W by

$$D = \beta_1 + \beta_2 S + \beta_3 W + \beta_4 SW + \epsilon.$$

Since

$$\frac{\delta E(D)}{\delta S} = \beta_2 + \beta_4 W \text{ and}$$
$$\frac{\delta E(D)}{\delta W} = \beta_3 + \beta_4 S,$$

the marginal effect of higher speed on braking distance is increased when the road is wetter (if $\beta_4 > 0$).

[3] The error ϵ might then be interpreted as a certain error in data measurement, as a certain degree of randomness or simply existing because we were unable to obtain and include all variables relevant to the determination of wages. The differences in interpretation may be of interest for philosophy, however, note that from the econometric point of view all these three interpretations are equal (cf. Johnston, 1984: 14f).

if they were omitted, the parameter OLS estimate for the influence of trade would be biased and conventional inference procedures would be incorrect (cf. Johnston, 1984: 260f or Wooldridge, 2003: 87-92).

One important example is **unemployment** which is assumed to be non-existent in the HO framework. In reality, however, unemployment might have an important influence on wage levels by affecting the bargaining power of unions as well as individual workers.

In microeconomic theory also **productivity changes** would lead to changes in wages. In the strict HO framework productivity changes occur only due to reallocations of production factors due to trade liberalization, so that all productivity changes are captured in the trade variable. However, in reality it is likely that there are other sources of productivity change.

A further relevant variable to consider is **competition with imports**. In the classical HO framework each country will export only a certain class of goods according to their comparative advantages and thus intra-industrial trade does not occur. However, modern theory of international trade allows for this possibility of intra-industry trade due to product diversification and imperfect competition.

FDI would be another variable worth considering in this context, since it might likely affect the factor proportions and therefore wages. Samuelson (1948, 1949) explicitly excluded the possibility of factor movement since his question of interest was whether FPE would also occur in the absence of factor movement. Factor mobility has received little attention in trade literature (Wong, 1995: 3). Rybczynski (1955), however, showed that an increase in one factor of production "must lead to an absolute expansion in production of the commodity using relatively much of that factor" (p. 337) and to a "worsening in ... the relative price of the commodity using relatively much of that factor" (p. 340) and thus finally also influence real wages. Empirically, Wörz and Stehrer (2009: 108f) for example find evidence for a relative downward pressure of FDIs on wages for seven sectors in OECD and selected non-OECD countries, thereof four supplementary CEECs, between 1981 and 2000. On the other hand, Bedi and Cieślik (2002) find evidence that Polish workers in sectors with higher FDIs enjoy higher wages and higher wage increases.

Finally, the **profits** of the enterprises might be important. Again, the strict HO framework does not allow for profits since the zero-profit condition has to hold to determine equilibrium wages. In reality, however, there might be profits and they might influence wages in two ways: If a surplus is obtained, workers might appropriate part of it in the next year(s) through higher claims in the wage bargaining process. On the other hand, operating surplus can be seen as a proxy for market power of enterprises and if this is rising, it will be more difficult for workers to enforce wage claims.

4.2.2 Spurious Regressions

Another problem that is likely to arise if the examined data has a time series component is the spurious regression problem which is well known from the time series context through Granger and Newbold (1974).[4]. They simulated 100 different and

[4] A nutshell discussion is given in Granger, 1990.

unrelated non-drifting random walks[5] with a length of 50 time periods and showed that 78 % of the variation in any series can be explained by any two other series even though they are not at all related. In a panel setting, spurious regression problems are "usually ignored in applied economics" (Entorf, 1997: 291) but have "interesting properties" (Banerjee, 1999: 609): The LSDV estimator $\hat{\beta}$ is consistent for its true value (Kao, 1999: 5, Theorem 1; cf. Phillips, 1987 for the pure time series context), but its t-statistic, t_β, "diverges so that inferences about the regression coefficient, β, are wrong with the probability that goes to one asymptotically" (Kao, 199: 6) and the asymptotics of $\hat{\beta}$ are different from those of the spurious regression in pure time-series data (Kao, 1999: 2). Increasing N does not help the t-statistic to converge to a meaningful distribution and when T increases the rate of wrong rejection of $H_0 : \beta = 0$ increases significantly (cf. Kao, 1999: 14). Entorf (1997) finds that for $T \to \infty$ (but possibly even for small T) and finite N the spurious regression problem holds for FE panel models and t-statistics can be highly missleading. Contrary to pure time-series models, the R^2 remains low in a spurious panel setting (Kao, 1999: 14/15).

One modus operandi to avoid these nonsense regressions is using series that are stationary. Most economic series (besides from financial market data) can be made stationary by taking the first or second differences $\Delta x_t = x_t - x_{t-1}$, or $\Delta^2 x_t = \Delta x_t - \Delta x_{t-1}$ respectively. Such series are said to be *difference stationary* or *integrated* of order 1, or 2 respectively, denoted I(1) or I(2). A random walk (see footnote 5) is an example of a difference stationary series.
Another example of non-stationary series that can be made stationary by transformation are trend stationary series, generated by $x_t = \phi_1 + \phi_2 x_{t-1} + \phi_3 t + \epsilon_t$, where $\phi_2 < 1$. Then the detrended series $z_t = x_t - \phi_3 t$ is stationary.

The distinction between difference and trend stationary series is essential for the econometric analysis of the series (see below; for a discussion of the relevance of the two aspects of non-stationarity in applied economics see e.g. Nelson/Plosser, 1982 and Stock/Watson, 1988). Different unit root tests applied in section 5.5 allow to distinguish whether the series under consideration is a random walk with or without drift or a trend stationary process.

[5] A random walk is an example of a stochastic trend, i.e. the trend of the series is random. It is generated by the process $X_t = X_{t-1} + \epsilon_t$. Hence $X_1 = X_0 + \epsilon_1, X_2 = X_1 + \epsilon_2 = X_2 = X_0 + \epsilon_1 + \epsilon_2$ and further $X_t = X_0 + \epsilon_1 + \epsilon_2 + ... + \epsilon_t$. Since $\epsilon_t \sim i.i.d.(0, \sigma^2)$ it follows that $E(X_t) = E(X_0 + \epsilon_1 + \epsilon_2 + ... + \epsilon_t) = E(X_0)$, thus the proces has constant mean. However, since $Var(X_t) = Var(X_0) + Var(\epsilon_1) + ... + Var(\epsilon_t) = 0 + \sigma^2 + ... + \sigma^2 = t\sigma^2$ the variance is increasing with time and therefore the series is not stationary.

Chapter 5

Data Description and Statistics

For the econometric analysis examining the impact of trade with the EU-15 on the wages in the Czech Republic, Hungary, Poland, and Slovakia I use OECD data for 13 manufacturing industries over the period 1997-2005[1]. Despite being a relatively short period, it covers an interesting range of time that coincides with major trade liberalizations between the EU-15 and the CEEC-4, and where CEECs have become relatively stabilized after the transition shock (cf. ch. 3).

Data like these, which have a cross-sectional as well as a time series dimension are called panel (or longitudinal) data (cf. Wooldridge, 2003: 426 e.g.). In the present case the panel has N = 13 cross-sectional components (denoted i = 1, 2, ..., N) and T = 9 (denoted t = 1, 2, ..., T) time dimensions.

The fact that panel data has two dimensions usually leads to a larger number of data points. Thus, while a shortage of d.o.f. is often a problem in analyzing time series data, this problem is less severe in a panel setting since the two dimensions offer more information and degrees of freedom which helps to reduce the gap between the information requirements of the researcher and information provided by the data (Hsiao, 1990: 218). The many advantages[2] of panel data have encouraged a fruitful theoretic as well as applied literature in panel data econometrics (Baltagi, 2004, and 2006 give an overview of the theoretical contributions and empirical applications in the field).

The main data I am using throughout the subsequent econometric analysis comes from the OECD, mainly from the STAN database for Industrial Analysis which "includes annual measures of output, labor input, investment and international trade that allow to construct a wide range of indicators to focus on areas such as productivity growth, competitiveness and general structural change" (OECD, 2005: 1). It is based on the International Standard Industrial Classification, Revision 3 (ISIC Rev.3) and covers all activities (including services). For my purpose, however, internationally tradable goods, especially manufacturing goods, are of interest, because they are most likely to be affected by the integration to the EU (cf. Onaran/Stockhammer, 2006: 8). These 13 manufacturing industries are listed in table 5.1. The branches *Agriculture, Hunting, Forestry and Fishing* (ISIC Rev. 3: 01-05), *Mining and Quarrying* (10-14), and *Electricity, gas and water supply* (40-41) could have been included in the analysis too since they are tradable goods. However, these branches are subject

[1] In the case of the Czech Republic and Hungary the data is available from 1995 onwards, for Poland starting in 1996. However, to make the results comparable, the main focus is on the period 1997 to 2005.

[2] For a more detailed discussion, see Hsiao, 1990: 1-5.

to special considerations (material deposits, strategic political interests, protection in agricultural sector for example)[3] and have therefore not been considered. The same is true for sector 7 since its activity depends on natural resources and wages in these sectors are considered to be influenced by very specific factors. Therefore the sector is excluded from most parts of the analysis.

Industry	**ISIC Rev. 3**	**Code**	**skill**
Food Products, Beverages & Tobacco	15-16	3	L
Textiles, Textile products, leather & footwear	17-19	4	L
Wood and products of wood & cork	20	5	L
Pulp, paper, paper products, printing & publishing	21-22	6	L
(Coke, refined petroleum products & nuclear fuel	23	7	ML)
Chemicals & chemical products	24	8	MH
Rubber & plastics products	25	9	ML
Other non-metallic mineral products	26	10	ML
Basic metals & fabricated metal products	27-28	11	ML
Machinery & equipment, n.e.c.	29	12	MH
Electrical & optical equipment	30-33	13	H
Transport equipment	34-35	14	H
Manufacturing n.e.c.; recycling	36-37	15	L

Note: The classification of the skill intensity in the very right column follows OECD (2007: 220): L = low technology; ML = medium-low technology; MH = medium-high technology; H = high technology. Industries 13 and 14 have been assigned to high technology industry according to the subsections included in them.

Table 5.1: List and classification of industries

Bernard et al (2002: 13) argue that "in general, tests of relative factor price equality should employ the most disaggregate industry data available". It is generally expected that the true economic relationship is micro and therefore the most disaggregate data is the most desirable. However, if econometrics is understood as "systematic study of economic phenomena using observed data", as Spanos ([1986], 1993: 3) puts it, the word "observed" already implies that we sometimes don't have the data of our desired level of disaggregation. Since this is a frequent problem in econometric analysis[4] it is not surprising that a discussion of data aggregation (cf. Fisher, 1990 for a survey) emerged not more than a dozen of years after the foundation of the *Econometric Society*. In this regard econometrics can also be seen as "an attempt to compensate for the glaring weakness of the data base available" as Leontief (1971: 2) calls it and this weakness is especially obvious when dealing with CEECs. It should be noted, however, that examples exist, where the errors in econometric models were less after data aggregation and it is assumed that this is the case quite frequently in economics since micro data have undergone various transformation processes (Fisher, 1990: 37f).

[3] Furthermore another problem exists as far as availability of data is concerned, since employees' income is not available for *Mining and Quarrying* in France and Portugal.

[4] Cf. Spanos ([1986], 1993: 663): "The main problem in econometric modelling, however, is that what a theory suggests as important features to be observed and the available observed data can differ substantially."

5.1 Wages

Obviously the most essential variable in the data are wages. STAN offers an aggregation of labor compensation of employees at current prices in national currency (LABR) for each industry.[5] I divided those by the number of employees (EMPE) in every industry[6] to obtain the nominal average yearly sector-specific gross wages per worker:

$$nominalwage = w = \frac{LABR}{EMPE}. \tag{5.1}$$

It was not possible to calculate these for Ireland since it does not report appropriate EMPE data until 1998 and the sector *Coke, refined petroleum products and nuclear fuel* is neither reported in EMPN nor in EMPE (even after 1998). The problem, however, is negligible as will be clear after it is explained how EU-15 wages are calculated since the exports of all four CEECs to Ireland are marginal.

With those limitations in mind, wages were available for the period 1995 onwards, except for Poland (1996), and up to 2006/7 except for Denmark (EMPE until 2005), Sweden (EMPN until 2005), Poland, and Hungary (2005).

5.1.1 EU-15 Wages

At a first thought it might seem reasonable to sum up all LABR in EU countries and divide it by the sum of EMPE for every i and t to obtain the EU-15 wage. This would give the arithmetic (or population) mean of EU wages weighted by the number of employees. However, this does not necessarily make sense in the present context. To understand why, assume a CEEC with wage w_{NMS} and two (groups of) EU-15 countries with wages w_L and w_H, where $w_L < w_{NMS} < w_H$. Assume that workers in most EU-15 countries earn w_H so that average EU wage is higher than w_{NMS} but that the CEEC almost exclusively establishes trade relations to countries with w_L. Thus, if FPE holds, we would be mistaken assuming the CEEC wage to raise and converge to the population mean of the EU wage since it is more likely to fall close to the level of w_L.

Accordingly I calculated an average EU-15 wage specific to each of the four CEECs, which is weighted by the export share of the CEEC to the EU-15 member states (which is called EU reference wage in the further analysis) and which is given for each CEEC by

[5] Furthermore, STAN also offers the sum of wages and salaries (WAGE) for some countries. Supplementary to WAGE, LABR also includes supplements such as contributions to social security, private pensions, health insurance, life insurance etc. Since they can be regarded as part of the wage which is directly spent for financial security it is the more appropriate measure.

[6] This might lead to minor inadequacies since EMPE is not calculated in full-time equivalents. Full-time equivalents are only available for a couple of countries. As long as the development of part-time work has not differed systematically between countries and sectors during the time period under consideration, the inadequacies are negligible, however.
Another problem arises since Sweden does not report EMPE data but only data for total employment (EMPN) which also includes the self-employed and unpaid family workers. However this can be assumed as a proxy for EMPE. Denmark and Finland have been taken as a reference point to calculate the share of EMPE/EMPN in each industry. This can be justified since labor markets there and in Sweden can be assumed to be similar ("Scandinavian Model"; the case of Norway and Iceland may be different due to their high reliance on oil and fish; see Andersen et al., 2007: 13 for reference). It turned out that this ratio (combined for Denmark and Finland) in all manufacturing sectors was above 0.84 for all sectors and years. This ratio was multiplied with Swedish EMPN data to estimate Swedish EMPE:

$$\frac{(EMPE_{it}^{DK} + EMPE_{it}^{FIN})}{(EMPN_{it}^{DK} + EMPN_{it}^{FIN})} \cdot EMPN_{it}^{SWD} = \widehat{EMPE}_{it}^{SWD}$$

$$EUreferencewage = \sum_{j=1}^{M}(w_j \cdot \frac{X_j}{\sum_{j=1}^{M} X_j}) \quad \forall\, i,t \tag{5.2}$$

and where X_j are the exports of the CEEC to EU-15 country $j = 1, 2, ..., M = 13$[7] and w_j is the wage in EU-15 country j. [8]

Since Slovakia reports trade data beginning in 1997 only it becomes clear why the general analysis of this thesis is limited to the period 1997-2005.

5.1.2 Nominal, Real and PPP Wages

The SST and FPE theorem are formulated in real rather than in nominal wages.[9] Many studies consequently use real wages (while some others even use nominal wages, cf. Berger/Westermann, 2001). However, using purchasing power parities (PPPs) might be a meaningful alternative. PPPs "are currency conversion rates that both convert to a common currency and equalise the purchasing power of different currencies. In other words, they eliminate the differences in price levels between countries in the process of conversion" (OECD website).

Let PPP be $\frac{P^*}{P}$ where P^* is the price of a representative basket of goods abroad in foreign currency and P is the price of the same basket of goods at home in national currency. This means that $\frac{P^*}{P}$ units of the foreign currency buy the same amount of goods in foreign as one unit of national currency at home.

It should be noted that there exist PPPs for different aggregates. Instead of using the PPP for GDP which is taken in many cases, I took PPP for private consumption from the Eurostat website since this seems more appropriate to compare wages of different countries since their purchasing power usually does not directly depend on the level all prices in an economy but especially consumer prices.[10]

Hence, a possible way to compare wages across countries would be to use the measure

$$unitywage_{A/B} = \frac{w_a/PPP_A}{w_B/PPP_B}, \tag{5.3}$$

where A refers to the CEEC and w_B is the associated EU reference wage. Unfortunately, the stationarity characteristics of this variable do not allow for using it in the econometric analysis (see section 5.5) which is a loss since this measure has a number of advantages. It can be seen immediately that it does not matter which country is taken as reference for PPP in this case (cf. OECD, 2006: 125) and that the measure compares the purchasing power of wage earners in country A relative to the purchasing power of wage earners in country B (see Appendix A for a proof). Accordingly, if the purchasing power of wage earners in both counties is equal, $unitywage_{A/B} = 1$ must hold. This concept allows one to really compare "whether workers can afford bundles of goods which ... could be regarded as equivalent" (Raffer, 1987: 193; see

[7] Usually we would expect M to be 15, however, have in mind that Ireland is not included, as mentioned above. Furthermore the Bilateral Trade Database of the OECD treats Belgium and Luxembourg together. Accordingly, they were treated as if they were one country in the analysis. Therefore $M = 13$.

[8] Now it becomes clear, why the exclusion of Ireland would not make much difference: the CEECs' exports to Ireland are so marginal that this would not significantly influence EU-15 reference wages.

[9] To be more precise, inflation does not play any role.

[10] Since Belgium and Luxembourg are treated as one country, their PPP (as well as their CPI when real wages were considered) was calculated by their individual PPPs weighted by their shares in added value in manufacturing in year t.

193ff as well as Raffer, 2006 for a discussion).

Another advantage of this measure is, that it does not need to use exchange rates to make wages comparable across countries, as can be seen from above. This is a main advantage since exchange rates might be influenced by many aspects of currency markets and thus rapid movements in the exchange rate might not reflect changes in economic or living conditions, especially in the short run. This might not matter much in the present analysis since I use yearly averages. However, note that the CEEC-4 have applied different monetary policies (cf. Zuckerstädter, 2004) leading to different long-run developments in their exchange rate.

Turning a blind eye to the conceptual general problems of "testing" for FPE or the SST, there is a problem in using this measure in the HO framework. Thinking in common currency and keeping price levels in A and B fixed where $P_A \neq P_B$, we might observe $unitywage_{A/B}$ going to unity and thus an equalization of purchasing power of workers in countries A and B but from a general perspective, factor prices are not equalized. On the contrary in the context of trade liberalization, the HO framework predicts equalization of good prices and *through this* equalization of good prices, *also factor prices* equalize. However, it can be shown, that unitywage going to unity is a necessary (though not sufficient) condition for FPE (see Appendix A). Therefore, to start with testing for this proposition is quite accurate.[11]

5.1.3 Descriptive Wage Statistics

Table 5.2 gives an overview of the development of real wages and the unitywage in the CEEC-4 and the EU-15 between 1997 and 2005.[12] We can see that none of the four CEECs had reached more than 56.6 % of the living standard (i.e. unitywage) of their trading partners in the EU-15 in 1997. Poland, having the smallest gap in 1997, had the smallest increase throughout the following eight years (7.2 %) but still came closest to the level of EU-15 trading partners in 2005. The Czech Republic (+ 38.0 %) and Slovakia (+ 28.1 %) had the highest increases in living standards, with Hungary (+ 21.5 %) not lagging far behind. In 2005 thus, every country reached at least 48 % of the standard of their EU-15 trading partners.

When looking at the development of real wages (see table 5.2), we see a similar picture:[13] Especially the Czech Republic performed well with p.a. real wage increases

[11] If this proposition holds, the problem can be investigated in a supplementary way. In common currency the problem is easy to address by looking if prices or absolute (real) wages also equalize. Empirically, using price level indices (PLIs) is an appropriate way. PLIs are obtained by dividing PPPs by the exchange rate E, which expresses the amount of foreign money that has to be paid in order to obtain 1 unit of national money. PLI indicates the relation of the foreign price level to the price level at home in common currency. Note, that according to the introduction of the Euro and the fixed exchange rates $PLI = PPP$ for Euro countries starting as of 1999.

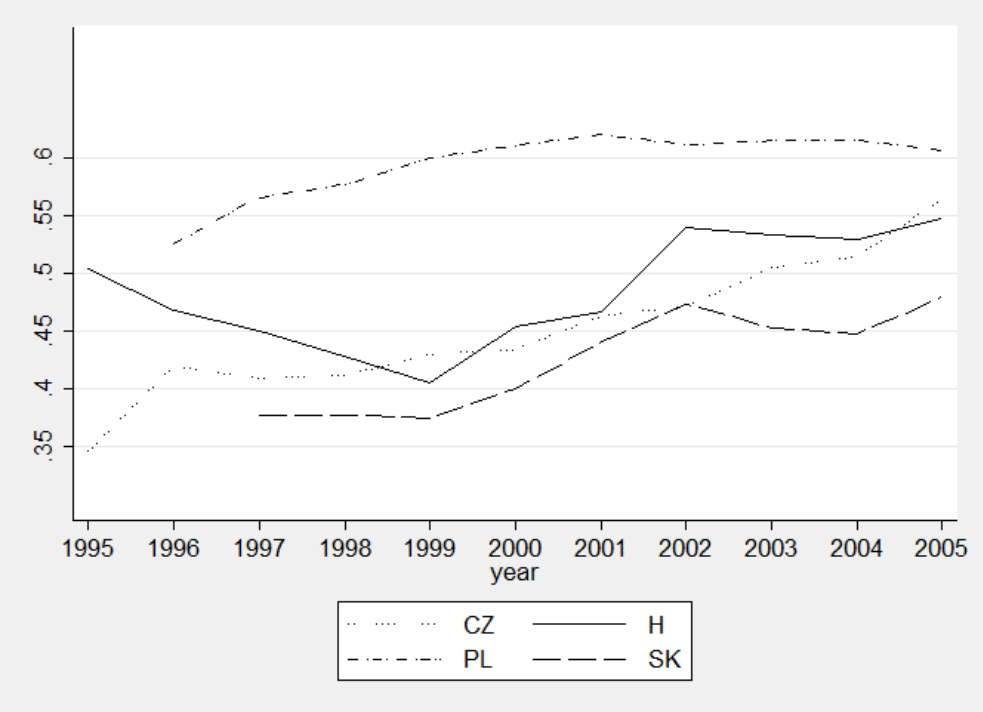
[12] No exchange rate was needed to calculate real wage changes. For the EU-15 national real wage changes were weighted by the number of employees. The unitywage of CEECs does not refer to the EU-15 as a whole but is relative to trading partners in the EU-15 using the concept introduced above. All wages are calculated as the average of wages in sectors i weighted by employment in sector i. Thus due to the level of data aggregation, there might be differences to the manufacturing wages officially provided by OECD STAN.

[13] This might not be surprising at a first thought. Have in mind, however, that the unitywage is weighted by the exports to the corresponding trading partner. Thus, if trade reallocation towards high-income EU-15 partners takes place between 1997 and 2005, high real wage changes might be outperformed by this shift in trade patterns. The opposite seems to be true for Slovakia, which had modest real wage changes but a high increase in the unitywage with respect to EU-15 trading partners.

	CZ	H	PL	SK	EU
avg. real wage growth p.a.	3.81 %	2.92 %	1.42 %	1.63 %	0.55 %
avg. real wage growth p.a. if employment structure fixed	3.49 %	2.39 %	1.22 %	1.77 %	0.21 %
1997 unitywage	0.409	0.450	0.566	0.374	1
2005 unitywage	0.565	0.547	0.606	0.480	1

Table 5.2: Development of manufacturing wages 1997-2005

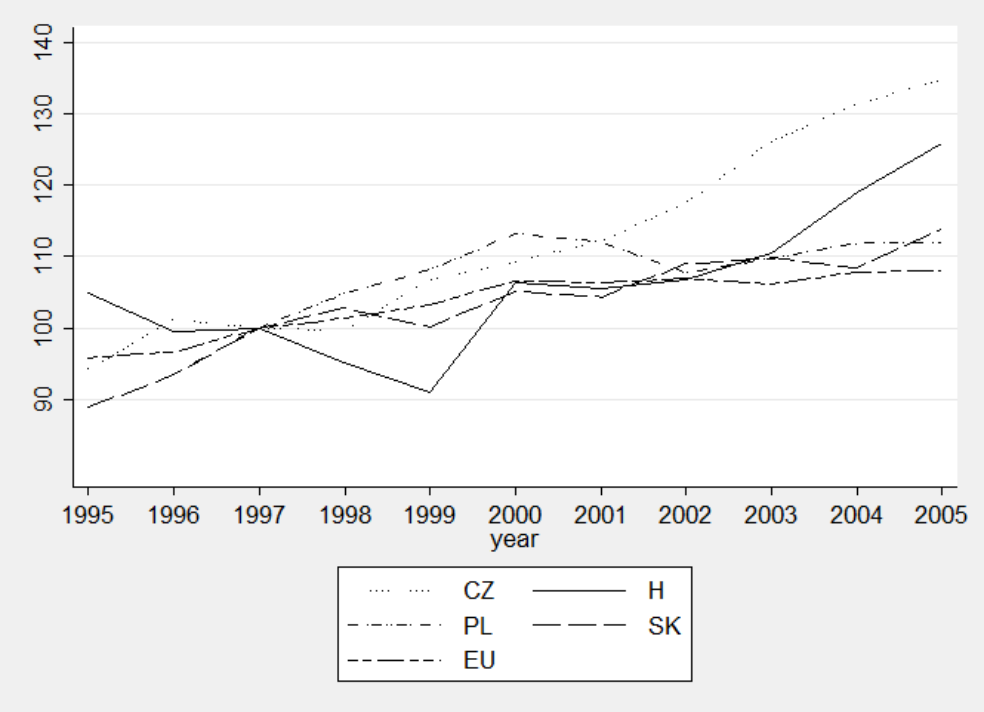
Figure 5.1: development of manufacturing unitywages



of 3.81 % on average, followed by Hungary (+ 2.92 % p.a.) and Slovakia (+ 1.77 % p.a.). Polands real wage increase was the lowest (+ 1.22 % p.a.) but was still twice as large as in the EU-15 (+ 0.55 % p.a.).

The increase of real wages for all countries is a process that consists of two components: First the level of wages in each sector may change. Secondly, there might be labor mobility between these sectors and workers may move from low wage sectors to higher wage sectors. Therefore it is of interest which of those two effects caused the wage increase. To find out I re-calculated the 2005 real wage for all countries but used the 1997 employment structure instead of the 2005 employment structure as weight. The results can be seen in the middle row of table 5.2 and show that keeping the employment structure fixed at 1997 level, the wage increases are still substantial and therefore wages must have risen mainly due to wage increases within each industry. Slovakia is the only case where wages with fixed employment structure have risen more than when compared to the actual employment structure, indicating that a slight move of laborers towards lower wage sectors has taken place. On the other hand, the difference in the development of wages with fixed employment structure compared to the actual development was quite dramatic for the EU-15 countries, indicating a redeployment of workers towards sectors with higher wages. From the data analyzed so far, we do not know, why this happened. Note, however, that the

Figure 5.2: DEVELOPMENT OF REAL MANUFACTURING WAGES, INDEX (1997 = 100)



HO framework predicts a higher labor demand in the high skill industries after trade liberalization with a "less advanced" region/country.

Regarding the distribution of employees among industries (see table B.3 in Appendix B), many employees in CEECs are concentrated in the sectors: *food products, beverages and tobacco* and *basic metals and fabricated metal products. Electrical and optical equipment* is another important sector, though less for Poland. *Machinery and equipment, n.e.c.* is important in the Czech Republic and in Slovakia, while the low tech sector *textiles, textile products, leather and footwear* are important in all countries with the exception of Czech Republic.

The situation in the EU-15 does not differ much from the CEECs in this regard with *basic metals*, *food*, *machinery and equipment*, as well as *electrical and optical equipment* being the most important sectors there.

The *textile* sector has dramatically lost importance in all countries. *Electrical and optical* as well as *transport equipment* were sectors in the Czech Republic, where employment highly increased. Hungary experienced a real surge in *electrical and optical equipment* employment which also grew in the Slovak Republic while employment decreased strongly in *machinery and equipment* in the latter.

Real wage increases (see table B.2 in Appendix B) have been relatively modestly distributed in the Czech Republic, where the sector *coke, refined petroleum products and nuclear fuel* made most gains (+ 5.8 % p.a.) while the increase was the less pronounced (but still quite high) in the sector of *wood and products of wood cork* (+ 2.2 % p.a.). Also in Poland gains were relatively equally distributed with the *chemicals* (+ 2.7 % p.a.) and *textile* (-0.5 % p.a.) sectors marking the extreme values. In Hungary the increase in the *machinery* sector (+ 7.0 % p.a.) was exceptionally high, whereas sectors *coke, refined petroleum products and nuclear fuel* and *manufacturing n.e.c.* suffered real wage losses of -1.0 % p.a. in average. In Slovakia the wage

surge in sector *coke, refined petroleum products and nuclear fuel* (+ 10.1 % p.a.) was outstanding while real wages in the *wood* sector decreased by an average of -0.7 % p.a..

5.2 Trade Data

Trade data is the second important set of data in the subsequent analysis. It has been taken from the STAN Bilateral Trade Database (BTD) which breaks down bilateral trade flows by OECD member (and some other) countries by economic activity.

Exports are measured in US-$. These were generally transformed to an export share which I calculated by dividing the exports towards the EU-15 by gross output transformed to US-$ with the corresponding exchange rate (taken from the OECD website).

5.2.1 Descriptive Trade Statistics

When looking at this data, we can see first of all, that all countries have relatively high export shares. In the case of Poland, which has the lowest share, manufacturing exports were 24.8 % of manufacturing gross output in 1997 and 42.9 % in 2005. Secondly, manufacturing exports increased significantly in all countries, the most in Poland (+ 73.0 %), the least in Hungary (+ 34.7 %). The EU-15 has been by far the most important trading partner for all four CEECs: Their exports to the EU-15 accounted for at least 47.2 % and 57.8 % (Slovakia) of all exports in 1997 and 2005 respectively. The highest share of manufacturing exports towards the EU-15 was achieved by Hungary in 1997 (72.2 %) and by the Czech Republik in 2005 (66.4 %). Interestingly, there seems to be convergence among the CEECs concerning the importance of exports towards the EU-15 in total exports: For the Czech Republic, Hungary and Poland, the share of EU-15 exports to total exports did not differ more than one percentage point from their mean of 65.5 % in 2005. In 1997 the mean was 65.1 % and thus not very different, but extreme values did scatter much more arround this value (Czech Republic: 59.8 %, Hungary: 72.2 %). For both years, only the Slovak Republic lay well below (47.2 % and 57.8 % respectively). Relative to the gross manufacturing production (cf. table 5.3), exports to the EU-15 have risen by 22.4 % in Hungary and by more than 60 % for the other countries and it seems that this percentage has settled down at a certain level after 2003, or even before for Hungary (1999). From 2004 to 2005 the percentage has even decreased for all four CEECs.

An interesting pattern of CEEC-4 exports towards the EU-15 is revealed by a look at figure 5.4 which depicts the percentage change of manufacturing exports to the EU-15 (as a percentage of manufacturing gross production) between 1997 and 2005 by skill intensity (according to the classification given in table 5.1): While HO theory would predict that low-skill intensive goods exports would increase as a result of trade liberalization, we can see that in fact the relevance of high-skill and medium-high-skill intensive exports has dramatically risen for all countries, especially the Czech Republic and Slovakia, while the significance of less skill intensive exports remained fairly unchanged (or even decreased in the case of Hungary).

The next important trading partners for the CEEC-4 are themselves. Here, Hungary and Poland can be distinguished from the others: While the share of exports towards CEEC-4 to total exports amounted to 9.0 % for the former countries in 2005, it was remarkably higher in Czech Republic (16.1 %) and especially Slovakia (25.6 %). Here old ties of the common country seem to prevail - the importance of intra-CEEC-

Figure 5.3: CEECs' manufacturing exports towards the EU-15 (as percentage of manufacturing output)

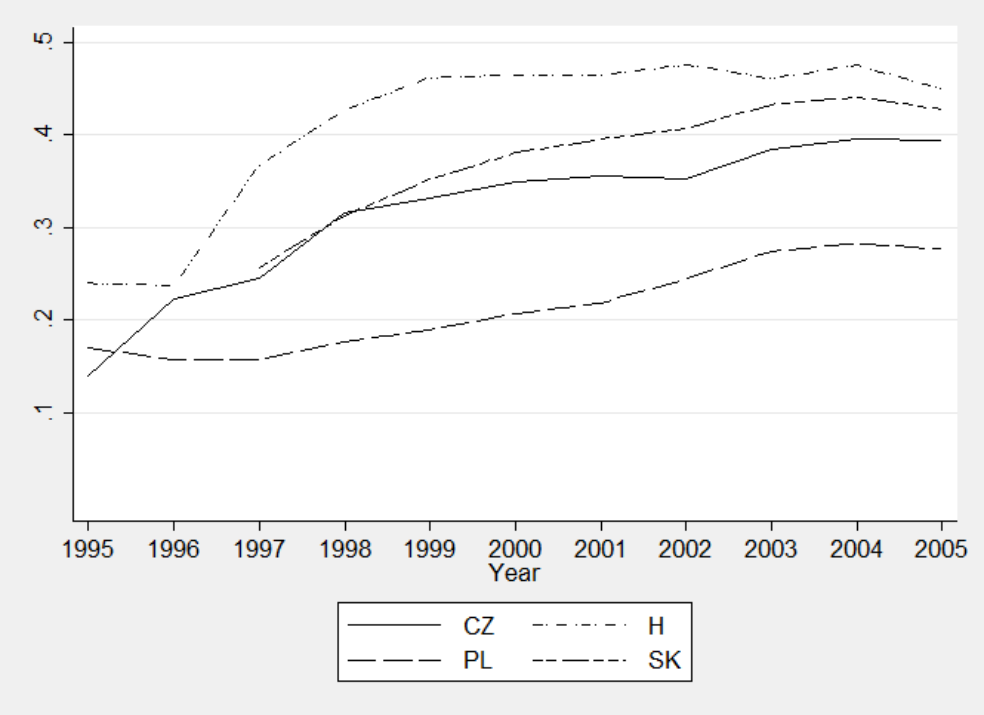
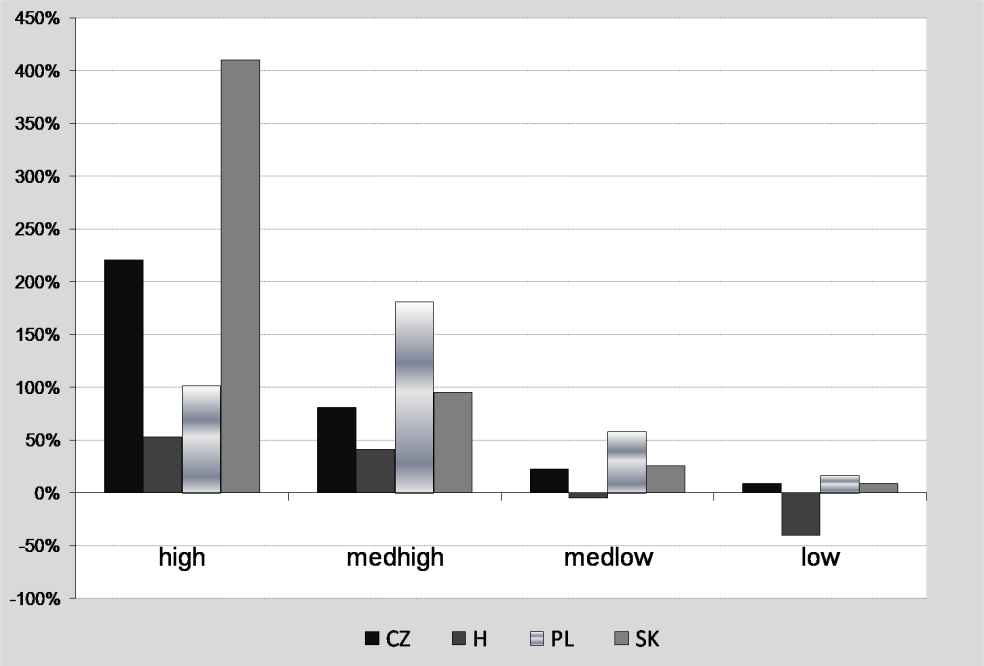


Figure 5.4: development of skill intensities in CEEC-4 exports towards the EU-15, 1997-2005



4 trade is decreasing in the latter, however, while it is dramatically increasing for the former. Relative to gross manufacturing production, only Slovakia experienced a slight decrease (- 0.7 %) of CEEC-4 exports.

Exports to the other eight NMS amounted to an average of 4.2 % of total exports and 2.6 % of gross manufacturing production in 2005 but was increasing in relevance for all countries, especially for Hungary and Poland. Decreasing, on the other hand, was the importance of Russia as an export destination: for all countries even the percentage relative to gross manufacturing production decreased, especially for Hungary. Russia is the most important for Poland: 4.6 % of all Polish manufacturing exports went to Russia in 2005. For the other three countries this percentage was less than 2 %.

More than 11.3 % of exports of the CEEC-4 went to other countries in the world, the share is highest for Poland (17.7 %) and its share develops differently across countries (but is increasing in relation to gross manufacturing production for all countries).

5.3 Other Variables

Following the considerations in subsection 4.2.1, there are other variables which will be used in the subsequent analysis.

Unemployment rates have been taken from the OECD website where they are provided as harmonized unemployment rate including persons above a specific age, who were without work, currently available for work and seeking work, in relation to the civilian labor force. Obviously, this measure is not sector specific.
The data divides the CEEC-4 into two parts (cf. table 5.5): Hungary and the Czech Republic had a relatively low unemployment rate, being below the level in the Euro area for most years. However, while the unemployment rate decreased from 9.0 % to 7.2 % in Hungary between 1997 and 2005, it increased dramatically from 4.8 % to 7.9 % in the Czech Republic. Poland and Slovakia on the other hand had unemployment rates that were well above the Euro area average throughout all years under consideration. In both countries the unemployment rate increased: from 10.9 % to 17.8 % in Poland and from 11.9 % to 16.3 % in Slovakia.

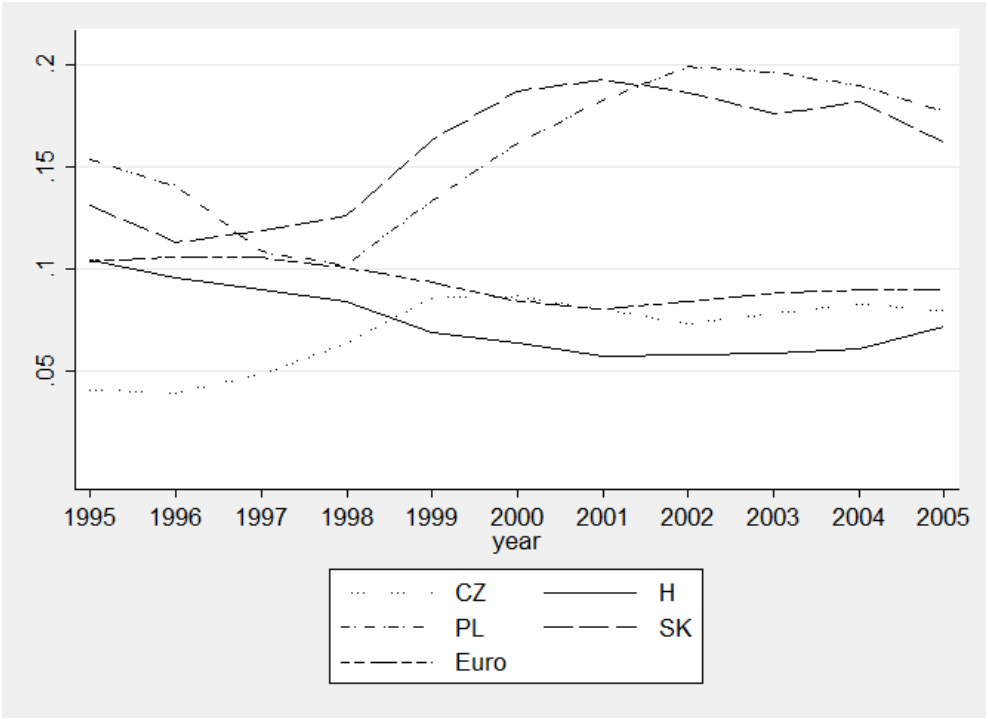
Foreign competition, i.e. **import penetration**, is calculated as the proportion of imports from the BTD relative to gross output plus net imports:

$$MPEN = \frac{IMPO}{PROD + IMPO - EXPO}.$$

This measure is sector specific.

As mentioned in subsection 4.2.1, productivity changes might result from changed trade patterns but also for other reasons. In reality, however, it is hard to distinguish the sources of any productivity gain. Thus, only including overall productivity changes will result in a biased estimator for the effect of trade, if trade and productivity are correlated. Furthermore, usual productivity measures are not sector specific. Egger and Stehrer (2003: 66) use lagged real goods production to account for sector specific non-neutral technical progress. This, however, does not overcome the problem of biasing the trade coefficient. Thus, I suggest using **Research & Development**

Figure 5.5: Unemployment Rates 1995 - 2005



expenses of enterprises as an instrument for productivity since they might affect productivity but are uncorrelated with trade. Another advantage is the fact, that R & D expenses are provided at the industry level. On the other side, spillover effects for R & D might occur, meaning that R & D expenses in one industry might also affect the productivity of another industry. This problem (which is subject to current research efforts in panel data econometrics, cf. Kapedanios et al., 2006 or Pesaran et al., 2007 e.g.) is less severe in the present context since the consistency of the estimator for the influence of R & D on wages is of little interest.

Data on **foreign direct investments** unfortunately was not available on a level of industry aggregation compatible with my data.

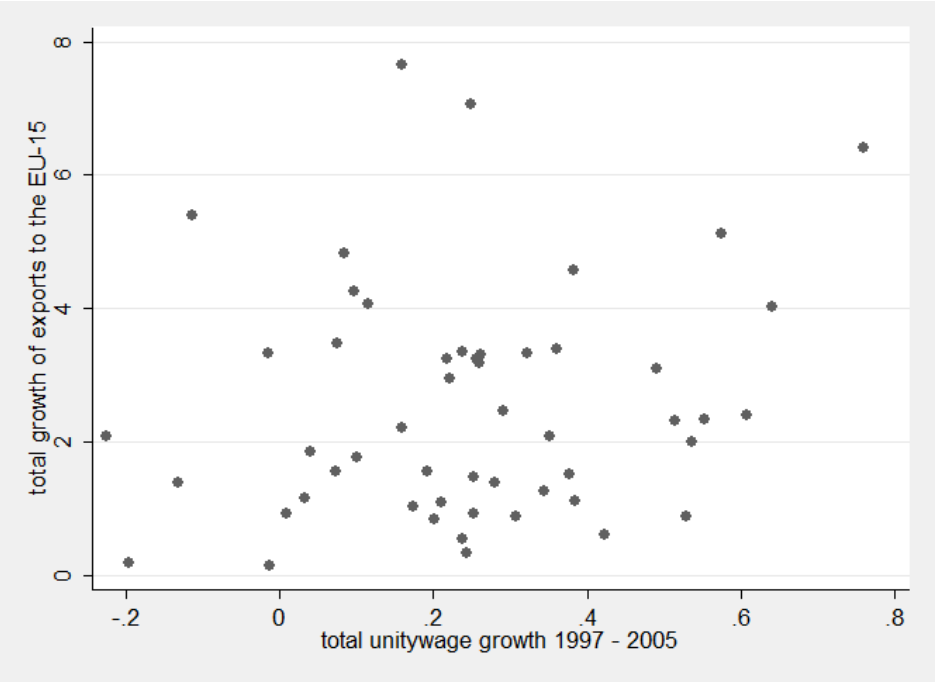
5.4 Preliminary Analysis

So far, we have seen that wages have risen more substantially in the CEEC-4 than in the EU-15 but we do not know what has driven these wage changes. Before providing a more elaborate econometric framework I present some scatter graphs and simple regressions concerning the overall development of the variables between 1997 and 2005. Figure 5.6 shows the development of unitywages between 1997 and 2005 on one axis and the development of the export quote of the corresponding industry on the other axis. Figure 5.7 does the same but uses real wage development rather than unitywages.

In table 5.3 the results of a regression of the changes of the variables mentioned above on changes of the export share are presented: $y_t = \alpha + \beta x_t + \epsilon_t$, where y_t measures the overall change in either unitywage or real wage while x_t measures the overall change in the export share and t is an index for the industries.

Since the constant α captures a large fraction of the variation in the data, I ran all regressions as a homogeneous model also (i.e. under the restriction $\alpha =$

Figure 5.6: DEVELOPMENT OF UNITYWAGES AND EXPORTS



0). Economically we would expect this restriction to hold if the change in wages is exclusively due to the change in the export share which is a rather unrealistic assumption.

Without forcing the regression line to go through the origin, Hungary is the only country where the change in exports towards the EU-15 had a significant effect on the development of (real) wages, and this relationship is positive. Interestingly, if all countries are pooled, there is a positive relationship that is significant at the 5 % level for real wages, though not for the unitywage. Generally, real wages seem to react more significantly to trade. In the homogenous regression, all coefficients are statistically different from zero and > 0 on the 10 % level. On a first view thus, there seems to be some evidence that there is a positive correlation between the change in CEECs' wages and the change in their exports to the EU-15.

It might also be interesting to check whether low wages increased more than higher wages during the time period under consideration. If this would have been the case this indicates a compression of the income distribution (unless it is outweighed by changes in the employment structure). Therefore I ran a simple regression of the (real) wage change between 1997 and 2005 on the level of real wages in 1997: $y_t = \alpha + \beta x_t + \epsilon_t$, where y_t measures the overall change in the real wage and x_t is the 1997 level of real wages (and t again is an index for the industries).

We can see from figure 5.8 that the relationship is not very strong. By running a regression of the two variables (see table 5.4), however, we obtain significant positive estimates (except for the case of Hungary and the pooled regression) indicating a positive relationship between the level of the real wage in 1997 and its development in the eight years thereafter. Since sectors with higher wages have experienced higher growth rates, we would expect wage inequality to have risen. We can also observe

Figure 5.7: DEVELOPMENT OF REAL WAGES AND EXPORTS

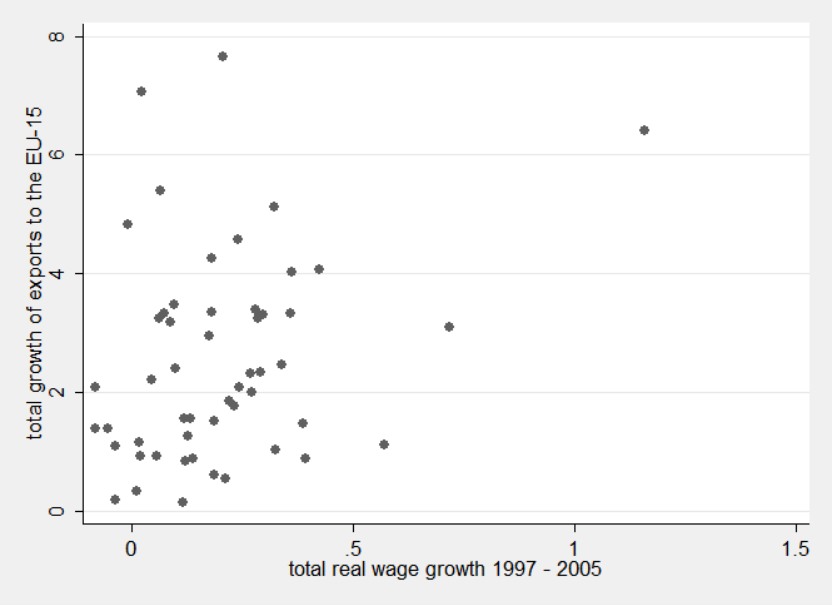
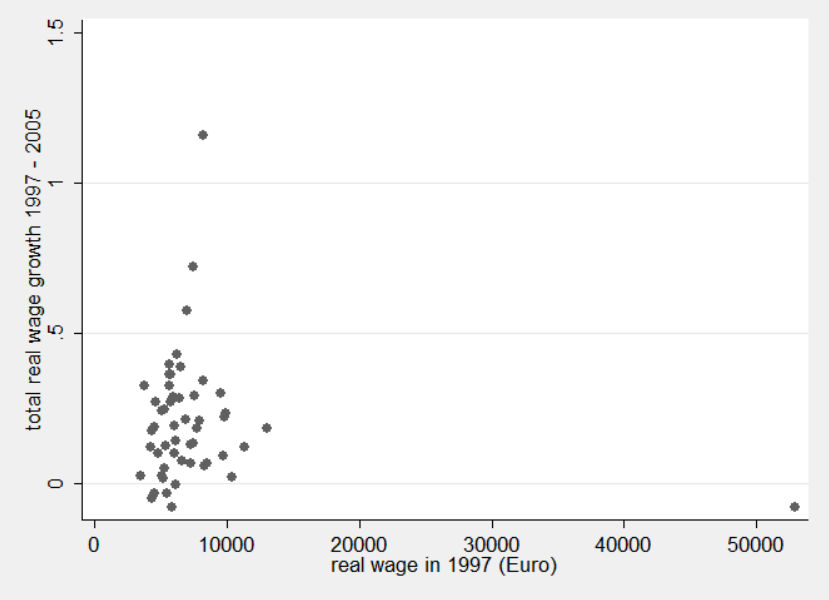


Figure 5.8: REAL WAGES IN 1997 AND THEIR INCREASE UNTIL 2005



country	α	β	β (if $\alpha = 0$)
CZ	0.375***	-0.003	0.118***
unitywage	(0.085)	(0.032)	(0.025)
CZ	0.338***	-0.003	0.106***
real wage	(0.058)	(0.021)	(0.020)
H	0.001	0.093	0.093**
unitywage	(0.117)	(0.062)	(0.030)
H	-0.039	0.130**	0.112***
realwage	(0.097)	(0.051)	(0.025)
PL	0.117	0.000	0.028*
unitywage	(0.081)	(0.023)	(0.013)
PL	0.044	0.20	0.030***
realwage	(0.040)	(0.011)	(0.006)
SK	0.265**	0.024	0.083***
unitywage	(0.110)	(0.029)	(0.019)
SK	-0.011	0.066	0.063***
realwage	(0.149)	(0.40)	(0.020)
pooled	0.192***	0.021	0.073***
unitywage	(0.052)	(0.017)	(0.011)
pooled	0.113**	0.035**	0.065***
realwage	(0.050)	(0.016)	(0.010)

Table 5.3: Simple regression between changes in wage and export share, 1997-2005

from the figure that there is an outlier, which represents the 1997 real wage of the sector *Coke, refined petroleum products & nuclear fuel* in Hungary being equal to 52.940 Euro. Excluding this sector from the pooled regression does not change the outcome significantly; only the constant in the equation becomes insignificant at the 10 % level, all of the other main results remain qualitatively the same. However these results might be interpreted, it is important to stress that we do not know the impact of trade in this relationship.

country	α	β	β (if $\alpha = 0$)
CZ	-0.038	1.84e-06**	1.65e-06***
	(0.148)	(7.25e-07)	(1.06e-07)
H	0.236**	-2.66e-08	1.93e-08
	(0.080)	(2.28e-08)	(2.14e-08)
PL	-0.100	7.06e-06***	3.83e-06***
	(0.066)	(2.22e-06)	(6.29e-07)
SK	-0.866**	5.12e-06***	1.12e-06***
	(0.301)	(1.42e-06)	(3.62e-07)
pooled	0.235***	-4.44e-06	0.0000131***
(1997 wage in Euro)	(0.044)	(4.39e-06)	(3.60e-06)

Table 5.4: Simple regression between wage change and 1997 wage level

To hopefully obtain more meaningful results about the relationship between trade and wages as well as their distribution I move on to a more elaborate econometric analysis.

5.5 Stationarity and Non-Stationarity

First, to avoid the spurious regression problem discussed in the previous chapter I investigate the stationarity characteristics of the series.

Definition 1 *A series* $y_t = y_1, y_2, ..., y_T$ *is said to be (covariance or weakly)*[14] ***stationary*** *if*

$$E(y_t) = 0,$$
$$Var(y_t = \sigma^2,$$

and

$$Cov(y_t, y_s) = 0 \; \forall t \neq s$$

holds (cf. Greene, 2000: 528).

A stationary series thus is characterized by constant mean and variance.

To test for stationarity, different unit root tests in the time series context have emerged. However, in a panel data setting, unit root tests have not been developed until the 1990s.[15] Levin and Lin (1993, published as Levin et al., 2002, further referred to as LLC) did pioneering work in this area and their contribution "contained almost all the key elements which continue to preoccupy the later discussion in the literature" (Banerjee, 1999: 614). Their null hypothesis states, that each cross-sectional/individual time series is integrated while under the alternative none of them have a unit root, i.e. all of them are stationary. While the null hypothesis of the LCC test makes sense under some circumstances, the alternative is very strong (see Maddala/Wu, 1999: 635). The test proposed by Im et al. (2003, further IPS) therefore formulates a "heterogeneous alternative" that allows some (but not all) of the individual series to have a unit root under the alternative. Thus, rejection of H_0 does not necessarily imply that the unit root null is rejected for all i but that H_0 is rejected for $N_0 < N$ members of the group (Im et al., 2003: 73). The central statistic of the test is the $\tilde{t}$*-bar statistic* which is computed as

$$\tilde{t}\text{-}bar_{NT} = \frac{1}{N} \sum_{i=1}^{N} \tilde{t}_{iT}, \tag{5.4}$$

where $\tilde{t}_{iT}$ is a simplified version of the DF statistic for group i (cf. Im et al., 2003: 57). The test therefore "is a way of combining the evidence on the unit root hypothesis from the N unit root tests performed on the N cross-section units" (Maddala/Wu, 1999: 635).

Both the LLC and IPS test are based on the ADF test and therefore also suffer from its lack of power in distinguishing the unit root from a borderline stationary alternative even though this problem becomes less severe in a panel setting (cf. Baltagi, 2002: 362 and Maddala/Wu, 1999: 631). Furthermore they require a balanced panel, i.e. $t = T \; \forall i$.

Due to these limitations Maddala and Wu (1999) proposed a test based on a classic book of Sir Ronald Aylmer Fisher from 1932[16] which is more powerful in distinguishing the null and the alternative hypothesis (see Maddala/Wu, 1999: 645):

[14] The concept of strong stationarity assuming that the distribution is not changing over time is neither needed nor meaningful in the present context.

[15] For example, Kao and Chiang (2000: 180) state that "not much attention has been paid to testing the unit roots in panel data". However, Banerjee (1999: 607) mentions that panel unit root and cointegration have been a "fruitful area of study in recent years."

[16] A similar test has been proposed by Choi (2001).

Let π_i denote the p-value of any unit root test[17] for cross-section/individual i. The test statistic then is

$$\overline{\pi} = -2 \sum_{i=1}^{N} log(\pi_i)$$

where $\overline{\pi}$ is χ^2 distributed with 2N d.o.f.[18] The test needs no balanced panel and can be used for different lag lengths in the individual regressions (Maddala/Wu, 1999: 636). The Fisher test is thus an exact test based on combining the significance levels while the IPS test is an asymptotic test which combines the test statistics.

All three tests discussed are thus a combination of independent unit root tests within the N cross-sections. Maddala/Wu (1999: 650) consider this generalization of tests used in univariate data to panel data as a "major problem". This independence also implies that all three tests are based on the assumption that the error terms ϵ in the test equations are not cross-related among the sectors/individuals i.

Without cross-section correlation in the errors, IPS performs slightly better than the Fisher and the LLC test but in the presence of this correlation Maddala/Wu (1999: 644/5) found Monte Carlo evidence suggesting that the problem is less severe with a Fisher test, especially when T is large and N relatively small. They therefore conclude "that the Fisher test is better than the IPS and LL[C] test" (645, see also 650).

IPS (1995/2003) allows for a limited cross-section correlation through the inclusion of common time effects (i.e. a term $\theta_t > 0$ is added to the test equation and can be eliminated by subtracting out the mean $\overline{y}$ from y_{it} before performing the unit root test; cf. also Breitung/Pesaran, 2005: 18f) but it is unlikely that cross-section correlation takes on this simple form in real-world applications (see Maddala/Wu, 1999: 645). The IPS test, however, has been widely implemented in empirical research (cf. Drine/Rault, 2006: 315).

Generally, the technique of demeaning cannot work when pair-wise cross-section covariances of the error terms differ across the individual series (Pesaran, 2007: 265). Different procedures (which were called "second generation" panel unit root tests drawing a distinction to the "first generation" tests mentioned above) to solve for this problem have been developed (see Breitung/Pesaran, 2008 for an overview). Pesaran (2007) e.g. proposed a CADF test where the ADF is extended with the cross-section averages of lagged levels and first differences of the individual series. In formal notation, the problem and test structure is explained as follows: Suppose a panel time series $y_{it} = y_{i0}, ..., y_{iT}$ of the cross sections i = 1, 2, ..., N is generated by a stochastic, first order autoregressive (AR(1)) process

$$y_{it} = (1 - \phi_i)\mu_i + \phi_i y_{i,t-1} + u_{it}$$

for each i, where y_{i0} are given and u_{it} has the single-factor structure $u_{it} = \gamma_i f_t + \epsilon_{it}$ with f_t being the unobserved common effect that is serially uncorrelated with $E(f_t) = 0$, $E(f_t^2) = \sigma_f^2 < \infty$ and $E(f_t^4) < \infty$ and set to unity without loss of generality and all ϵ_{it} are i.i.d. across i and t with $E(\epsilon_{it}) = 0$, $E(\epsilon_{it}^2) = \sigma_i^2 < \infty$, $E(\epsilon_{it}^4) < \infty$ and finally ϵ_{it}, f_t, and γ_i are independently distributed $\forall i$. Taking the first difference $\Delta y_{it} = y_{it} - y_{i,t-1}$ leads

$$\begin{aligned} \Delta y_{it} &= (1 - \phi_i)\mu_i + \phi_i y_{i,t-1} - y_{i,t-1} + u_{it} \\ &= (1 - \phi_i)\mu_i + (\phi_i - 1) y_{i,t-1} + \gamma_i f_t + \epsilon_{it} \\ &= \alpha_i + \beta_i y_{i,t-1} + \gamma_i f_t + \epsilon_{it} \end{aligned} \tag{5.5}$$

[17] The test can even be performed for unit root tests where the null hypothesis is stationarity.

[18] Thus, the test is also called the inverse Chi-squared (or P-)test (cf. Pesaran, 2007: 266).

with $\alpha_i = (1 - \phi_i)\mu_i$ and $\beta_i = (\phi_i - 1)$.

Since if $\phi_i = 1$, i.e. $\beta_i = 0$, the series y_{it} is said to have a **unit root**, the test hypotheses of interest is

$$H_0 : \beta_1 = \beta_2 = ... = \beta_N = 0 \tag{5.6}$$

with the heterogeneous alternative

$$H_1 : \beta_1 < 0, \beta_2 < 0, ..., \beta_{N_1} < 0; \beta_{N+1} = \beta_{N+2} = \beta_N = 0 \tag{5.7}$$

with $N_1/N = \delta$ and $0 < \delta \leq N$ as $N \to \infty$.

If $\overline{\gamma} = N^{-1} \sum_{j=1}^{N} \gamma_j$ with $\overline{\gamma} \neq 0$, then f_t can be proxied by the cross section mean of y_{it}, $\overline{y}_t = N^{-1} \sum_{j=1}^{N} y_{jt}$ and its lagged value(s) $\overline{y}_{t-1}, \overline{y}_{t-2}, ...$ for sufficiently large N (see Pesaran (2006a) for explanation). We can thus estimate equation 5.5 in the CADF form

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + c_i \overline{y}_{t-1} + d_i \Delta \overline{y}_t + e_{it} \tag{5.8}$$

by OLS to obtain a t-ratio (see Pesaran, 2007: 269ff) in a similar way as in equation 5.4, whose critical values are derived and tabulated by Pesaran (2007: 274ff). This can be interpreted as t-bar statistic of the IPS test with mean deviations (see Pesaran, 2007: 276f).

The CADF is valid for panels where N and T are of the same orders of magnitudes and has satisfactory power even for relatively small values of N and T but is based on a one factor residual model, which is restrictive in some settings (Pesaran, 2007: 267). A truncated version of the test performs slightly better with small T, but its power is still low for $T < 50$, especially if $N < 20$ (cf. Pesaran, 2007: 288). A further problem is that since the CADF test removes common factors, it will eventually indicate stationary series even where the series are actually non-stationary due to a common stochastic trend (Breitung/Pesaran, 2005: 24). Interestingly, however, even if the test was not designed for weak cross section dependence, it tends "to be the most robust to spatial type dependence" (Breitung/Pesaran, 2005: 25).

To investigate the stationarity characteristics of the series, I decided to conduct a CADF test using the STATA module written by Piotr Lewandowski[19] and two types of Fisher tests written by Scott Merryman[20], one based on the DF statistic and another one based on a test statistic proposed by Phillips and Perron (1988). The results are presented in table 5.5 and show, that we are unable to clearly reject the null hypothesis of a unit root for the unitywage, real wage, real wage gaps, and the export share variables for levels as well as logarithms of the series. The logarithm of the Slovak unitywage and the Hungarian real wage gap are the only wage series that allow for a relative robust rejection of H_0.[21] Regarding the export share, the Hungarian one is the only one where we can clearly reject the null (in levels and logarithms).[22]

[19] Warsaw School of Economics, Institute for Structural Research, Poland

[20] Risk Management Agency, US Department of Agriculture

[21] This result holds if a deterministic trend is assumed for Slovakia and not assumed for Hungary.

[22] Since the time series is relatively short (T = 8) we run relatively short of d.o.f. This explains why no second lag was used (since I reject H_0, this will not change the outcome anyways) and why no time trend was included in the CADF statistic. The conventional IPS statistic requires $T > 5$ and if a trend is included $T > 6$ (cf. Im et al., 2003: 59). CADF further decreases the d.o.f. since supplementary lagged values of the cross-section means $\overline{y}$ and differences of their actual values are used in the regression. Therefore it is no further surprising that the p-value of the CADF statistic for wage variables is always 1 if a trend is included (and mostly 1 for the export quota, p-values therefore have not been reported in the table).

	CADF (1lag)	Fisher ADF (1 lag)		Fisher PP (1lag)	
series	no trend	no trend	trend	no trend	trend
CZ unitywage	0.632	1.0	0.3027	1.0	0.0061
H unitywage	0.053	0.5405	0.9805	0.3885	0.8877
PL unitywage	0.974	0.0009	0.0707	0.0004	0.0008
SK unitywage	0.056	0.1540	0.0	0.9317	0.2423
log CZ unitywage	0.857	1.0	0.0699	1.0	0.0
log H unitywage	0.002	0.5535	0.9742	0.4421	0.9151
log PL unitywage	0.683	0.0002	0.0288	0.0001	0.0001
log SK unitywage	0.009	0.0350	0.0	0.7240	0.0915
CZ real wage	0.647	1.0	0.0	1.0	0.0
H real wage	0.012	0.7980	0.9903	0.7197	0.9713
PL real wage	1.0	0.0030	0.0	0.0	0.0227
SK real wage	0.528	0.0	0.0	0.0	0.0
log CZ real wage	0.196	1.0	0.0	1.0	0.0
log H real wage	0.306	0.7855	0.9799	0.7112	0.7112
log PL real wage	1.0	0.0007	0.0	0.0	0.0126
log SK real wage	0.174	0.0	0.0	0.0	0.0
CZ real wage gap	0.992	0.0200	0.0	0.0312	0.0020
H real wage gap	0.042	0.0	0.5049	0.0	0.4166
PL real wage gap	0.929	0.0154	0.0115	0.1195	0.4359
SK real wage gap	0.956	0.0	0.0023	0.0206	0.9864
log CZ real wage gap	0.921	0.0180	0.0001	0.0178	0.0019
log H real wage gap	0.073	0.0	0.3301	0.0	0.0444
log PL real wage gap	0.505	0.0083	0.0093	0.0729	0.3783
log SK real wage gap	0.998	0.0	0.0027	0.0120	0.9790
CZ ExpQ	0.226	0.6530	0.9435	0.2015	0.2526
H ExpQ	0.001	0.0	0.0	0.0	0.0
PL ExpQ	0.879	0.8315	0.0411	0.9964	0.9809
SK ExpQ	0.728	0.5366	0.0	0.4891	0.2174
log CZ ExpSh	0.385	0.0821	0.6414	0.0008	0.0745
log H ExpSh	0.004	0.0	0.0	0.0	0.0
log PL ExpSh	0.910	0.8213	0.8890	0.9379	0.9650
log SK ExpSh	0.802	0.0025	0.0	0.0010	0.2670

Note: Reported values are p-values. Tests conducted for the period 1997-2005.

Table 5.5: Unit Root Test

When turning to first differences (see table 5.6), we see that interestingly H_0 can still not be rejected for unitywage in the case of Hungary and also the CADF does not allow rejecting the null for Slovakian unitywage.[23] Also, the results for the first difference of the real wage gap do not allow a clear rejection for all countries under consideration. Following a conservative strategy, the use of the first difference of the real wage is probably the only appropriate way for serious regression analysis: Any test statistic applied allows rejection of H_0 on the 10 % level at least (and on the 5 % level in the case of the CADF statistic).

[23] In the case of Slovakia note, that we further run short of d.o.f. since the first lag (for the period 1996-97) does not exist.

	CADF (1lag)	Fisher ADF (1 lag)		Fisher PP (1lag)	
series	no trend	no trend	trend	no trend	trend
d(CZ unitywage)	0.003	0.0	0.0	0.0	0.0
d(H unitywage)	0.305	0.4411	0.6930	0.0	0.0001
d(PL unitywage)	0.008	0.0	0.0	0.0	0.0
d(SK unitywage)	1.0	0.0	0.0	0.0	0.0573
d(CZ real wage)	0.0	0.0	0.0	0.0	0.0
d(H real wage)	0.011	0.0705	0.0	0.0	0.0
d(PL real wage)	0.0	0.0	0.0382	0.0	0.0
d(SK real wage)	0.019	0.0	0.0	0.0	0.0
d(CZ real wage gap)	0.081	0.0004	0.0006	0.0	0.0
d(H real wage gap)	0.250	0.6213	0.0	0.0	0.0
d(PL real wage gap)	0.271	0.0024	0.6711	0.0	0.0188
d(SK real wage gap)	1.0	0.0	0.0	0.3362	0.0144
d(CZ ExpSh)	0.125	0.0078	0.0	0.0	0.0
d(H ExpSh)	0.047	0.0	0.1226	0.0	0.0
d(PL ExpSh)	0.859	0.0019	0.1124	0.0	0.0
d(SK ExpSh)	1.0	0.0	0.0	0.0	0.0

Note: Reported values are p-values. Tests conducted for the period 1997-2005.

Table 5.6: Unit Root Test for First Differences

Chapter 6

The Influence of Trade on Wages

6.1 Cointegration Analysis

Considering real wages to be the only wage series being integrated of order one (I(1)) the next step is to check whether the variables that are assumed to influence real wage are cointegrated with real wage. Generally, two I(1) series y and x are said to be cointegrated if the error term ϵ of the regression $y = \alpha + \beta x + \epsilon$ is stationary. This can economically be interpreted as a stable relationship between the two variables. More formally:

Definition 2 *Consider the n_i time series variables $z_{it} = (z_{i1t}, z_{i2t}, ..., z_{in_it})'$ as being different variables observed within the i^{th} cross section unit in period $t = 1, 2, ..., n_i$. Let z_{ijt} $I(1), j = 1, 2, ..., n_i$ for each i. If there are linear combinations of z_{ijt}'s for $j = 1, 2, ..., n_i$ that are I(0), i.e. if there exists an $n_i \times r_i$ matrix ($r_i \geq 1$) β_i such that*

$$\underset{r_i \times n_i}{\beta_i'} \quad \underset{n_i \times 1}{z_{it}} \quad = \quad \underset{r_i \times 1}{\xi_{it}} \quad I(0)$$

*then z_{it} is said to form one or more **cointegrating relations** (cf. Breitung/Pesaran, 2005: 25).*

Compared to the normal time series case, in a panel context "the analysis of cointegration is further complicated by heterogeneity, unbalanced panels, cross section dependence, cross unit cointegration and the N and T asymptotics" (Breitung/Pesaran, 2005: 26). Again, the problem of cross section dependence arises but has been ignored in the first wave of contributions to this topic. Recent contributions (cf. Pesaran (2006b) and Westerlund (2007) e.g.) have paid attention to this dependence which could arise in presence of common stationary or non-stationary components (see Breitung/Pesaran, 2005: 29ff for a survey).

A further difference to the time series context is that testing for the stationarity of the residuals of the estimated structural equation can't be applied if x is endogenous (cf. Pedroni, 1999: 654) at least in the long run. In the present case this is quite likely since wages in a sector are likely to be positively correlated with prices, which are themselves negatively correlated with demand, i.e. exports. Under these conditions the OLS estimator would be consistent but inefficient (cf. Breitung/Pesaran, 2005: 33) and other estimators such as FMOLS (put forward by Phillips and Hansen, 1990; cf. Phillips, 1995: 1025) or the probably "more promising" (Kao/Chiang, 2000: 216) DOLS estimator (suggested by Saikkonen, 1991) are more efficient to estimate the cointegration relationship.

Before estimating the possible cointegration relationship one, however, has to test whether cointegration is the case. Different test statistics have been developed, e.g.

the ones by Kao (1999) or Pedroni (1999, 2004; generalized by Banerjee and Carrion-i-Silvestre, 2004). Fairly recently, Westerlund (2007) proposed four test statistics of the null hypothesis of no cointegration, of which two test for the alternative that the panel is cointegrated as a whole, while the others test for at least one cointegrated individual/cross-section as alternative. More precisely, they test "whether the error correction term in a conditional error correction model is equal to zero. If the null hypothesis of no error correction is rejected, then the null hypothesis of no cointegration is also rejected" (Westerlund, 2007: 710). "Each test is able to accommodate individual-specific short-run dynamics, including serially correlated error terms, non-strictly exogenous regressors, individual-specific intercept and trend terms, and individual-specific slope parameters" (ibid.).

The setup is as follows: The series y_{it} is modeled as having a deterministic term $(\phi_{1i} + \phi_{2i}t)$ and a stochastic error (z_{it}) and x_{it} is a pure random walk. The basic idea (cf. Westerlund, 2007: 711ff) is that in the conditional error correction model

$$\alpha_i(L)\Delta y_{it} = \delta_{1i} + \delta_{2i}t + \alpha_i(y_{it-1} - \beta_i' x_{it-1}) + \epsilon_{it},$$

where $\alpha_i(L) = 1 - \sum_{j=1}^{p_i} \alpha_{ij} L^j$ with L being the lag operator, all variables have to be stable so that the whole model is stable. Then β_i defines a long-run equilibrium relationship between x_{it} and y_{it}. If the error correction parameter $\alpha_i < 0$, then there is error correction implying that y_{it} and x_{it} are cointegrated. If $\alpha_i = 0$, there is no error correction and hence no cointegration. Accordingly $H_0 : \alpha_i = 0$ vs. $H_1 : \alpha_i < 0$ is tested by a least square estimate of α_i and test statistics are derived, where G_τ and G_α are group mean statistics and P_τ and P_α are panel statistics.

series	G_τ	G_α	P_τ	P_α
CZ: ExpSh	0.860	0.997	0.661	0.781
H: ExpSh	0.887	0.994	0.662	0.743
PL: ExpSh	1.0	0.998	0.971	0.913
SK: ExpSh	1.0	0.999	0.994	0.942

Notes: Reported values are p-values.
Test conducted for one lag without constant
or deterministic trend for years after 1996.

Table 6.1: Westerlund's cointegration test in levels

The results reported in table 6.1 (and derived through the STATA module by Persyn/Westerlund, 2008) don't allow to reject the null hypothesis of no cointegration on a reasonable level of significance. The same is true if logarithms of the series are used instead of levels.[1] Thus, the only cautious strategy modeling the influence of trade on wages is using first differences of real wages as the dependent variable and to accordingly use explanatory variables in first differences too. One should be aware, however, that this only allows investigating the short run relationship and destroys information contained in the series (cf. Granger, 1990, 247; Greene, 2000: 781).

[1] Again, in this testing procedure we run short of d.o.f. since $T = 8$ is a very short period of observation. Accordingly we cannot even include a constant and trend in the testing equation. Tests for the whole period 1995-2005 for the Czech Republic, Hungary, and Poland (in levels), which increases the d.o.f. show that we can reject H_0 for all three countries for the G_τ statistic on the 1 % level and for the Czech Republic for the P_τ statistic on the 5 % level if a trend and a constant are included. Note that the α statistics are generally more appropriate than the τ statistics if T is substantially larger than N (Westerlund, 2007: 722) which is not the case here.

6.2 Modeling Strategy

In setting up the potential model, a central question of the analysis is not only, if the data (or: the *econometric* model) fits an *economic* model, but also if it fits a *statistical* model (cf. chapter 2). For example, consider the simple model

$$y_{it} = \beta_0 + \beta_1 x_{it} + u_{it}, \tag{6.1}$$

where y stands for wages, x stands for exports and u is the error term. Leaving besides any *statistical* considerations about the lag structure, fixed unobserved industry effects and the spurious regression problem this *estimable* model can be seen as generally corresponding to the *economic* model of the HO-Samuelson framework. However, as mentioned before, we will also have other variables heavily influencing wages and omitting these will bias the OLS estimator even though trade indeed were a relevant true explanatory variable and furthermore conventional inference procedures will be incorrect since also the variance of the error term cannot be correctly estimated (cf. Johnston, 1984: 260f). Thus the *statistical* model would be inappropriate.
Fortunately we do have other variables at hand and even though some of them might be irrelevant for wages, their inclusion will lead to unbiased coefficient estimates of the true parameters of the relevant variables in the X matrix and the residual variance will also be an unbiased estimate of σ^2 (cf. Johnston, 1984: 261f). Nevertheless adding (relevant or irrelevant) extra variables lowers the precision of estimation of the relevant coefficient(s) (cf. Johnston, 1984: 245ff, 262f).

I thus consider every model $M_r : M_0 \subseteq M_r \subseteq M_{all} \cap M_r \succeq M_{all}$, where M_0 only includes the first lag of the EU-15 export variable (and a constant) as an explanatory variable (i.e. this variable is *protected*) and M_{all} includes the full set of variables (see Appendix C), as a *potential candidate model*. As a selection criterion (cf. Leeb/Pötscher, 2008: Section 1.2.2 for an overview) for the preference order $\succeq$, two general approaches arise: a consistent or a conservative strategy. In the further one the probabilities of over- and underparameterizing the model converge to zero as the observations tend to infinity. The latter is given if the possibility of selecting a model that does not nest the minimal true model tends to zero asymptotically. Among the most commonly known selection criteria are Akaike's AIC and Schwarz' BIC, where BIC is a consistent selection criterion "punishing" supplementary explanatory variables generally more than AIC which is a conservative criterion. By choosing AIC I follow a conservative strategy that asymptotically selects only correct models but possibly overparameterized ones (cf. Leeb/Pötscher, 2005: 23/46, Note 6, and 35ff). I use a *backward selection* approach, i.e. I start with the full model and eliminate one variable respectively.[2] Out of these eleven submodels anyone that has a lower AIC is considered as a potential candidate model. Out of these, again one variable is eliminated respectively and the procedure is repeated until no further decrease in AIC is possible. From all remaining models the one with the lowest AIC is chosen.

6.2.1 POLS vs. FE

In a very first step another decision has to be made, namely which estimator should be used. If the original model in levels is

$$y_{i,t} = \varpi + \alpha t + \beta x_{i,t} + u_{i,t} \tag{6.2}$$

[2] If a lagged variable is excluded, any higher lag of the same variable is excluded too.

with $u_{i,t} = v_i + \nu_{i,t}$, i.e. v_i is a sector specific unobserved effect and $\nu_{i,t} \sim NID(0, \sigma_\nu^2)$, taking the first difference of equation 6.2 will eliminate this unobserved effect:

$$\begin{aligned} y_{i,t} - y_{i,t-1} &= \varpi + \alpha t + \beta x_{i,t} + v_i + \nu_{i,t} - \varpi - \alpha t - 1 - \beta x_{i,t-1} - v_i - \nu_{i,t-1} \\ \Delta y_{i,t} &= \alpha(t - [t-1]) + \beta(x_{i,t} - x_{i,t-1}) + \nu_{i,t} - \nu_{i,t-1} \\ &= \alpha \times 1 + \beta \Delta x_{i,t} + \nu_{i,t} - \nu_{i,t-1} \\ &= \alpha + \beta \Delta x_{i,t} + \epsilon_{i,t} \end{aligned} \tag{6.3}$$

where $\epsilon_{i,t} = \nu_{i,t} - \nu_{i,t-1} \sim NID(0, \sigma_\epsilon^2)$. Furthermore, we lose N observations since we now have T-1 time periods for each i and while the original intercept ϖ (as well as all potential variables that are not time varying) vanishes, the original trend now becomes the intercept in the first difference model. First differencing a structural equation with unobserved effects produces asymptotically valid inference (Wooldridge, 2002: 281) and is a "powerful method" of policy analysis (Wooldridge, 2002: 283). Under the above assumptions, application of OLS (called POLS) leads to a consistent and (under the strict exogeneity assumption)[3] unbiased "first difference" estimator $\hat{\beta}_{FD}$(Wooldridge, 2002: 280). Generally, under the assumption $E(\nu_i \nu_i' | x_i, v_i) = \sigma_\nu^2 I_T$, the FE estimator of the original series is more efficient than the FD estimator. But we have seen that this assumption is not fulfilled since the variance of the error term ν_i is not assumed to be stable over time. Instead for the FD POLS estimator we assume $E(\epsilon_i \epsilon_i' | x_{i1}, ..., x_{iT}, v_i) = \sigma_\epsilon^2 I_{T-1}$. ν_{it} being a random walk will thus lead to no serial correlation in ϵ_{it} (cf. Wooldridge, 2002: 281).

If one assumes that the time trend αt in equation 6.2 is sector specific, α in equation 6.3 will become sector specific (and thus α_i). The assumption of sector specific time trends is not unlikely since (especially skill specific) wage differentials were very low under CPEs and thus wages in industries with higher skill intensities are expected to rise faster than others for example. Empirically, the normality of ϵ in 6.3 is an essential criterion to discriminate between the FD POLS and the FD FE estimator. If the errors of POLS estimation are normally distributed, POLS will be consistent and efficient. However, the results presented in table 6.2 indicate that this is not the case. Using POLS and FE for the full model, a Jarque-Bera test shows that we can easily reject the null hypothesis that the residuals are drawn from a normal distribution for POLS on the 1 % level for all countries. On the other hand, when using a FE estimator we cannot reject the null on a 10 % level for Hungary and Poland, and on a 1 % level for the Czech Republic and Slovakia. Also both model selection criteria AIC and BIC prefer FE over POLS in each case. Thus, any further FD estimation is based on the FE assumption.

6.3 Model Estimation

As we can see from table 6.3, the full model does not lead to significant results for the influence of exports towards the EU-15 on CEEC-4's wages. Only for Hungary the parameter estimate for the influence of exports on wages is significantly smaller than zero on the 5 % level whereas the influence of the third lag is significantly positive

[3]This strict exogeneity assumption is a rather strong assumption in the present context. If the correlation between exports to the EU-15 and CEEC wages is positive, as expected, there will be no such problem but if it is negative, there might be severe endogeneity problems since wages are a key determinant of goods prices on which demand (and thus also export) hinges. By lagging the trade variable by one period this problem can be overcome. This also makes sense to a certain degree as far as the model specification is concerned since we would not expect markets to immediately adopt to the new conditions.

	POLS			FE		
	Jarque-Bera	AIC	BIC	Jarque-Bera	AIC	BIC
Czech Republic	0.0031	1713	1745	0.0349	1703	1734
Hungary	0.0000	2266	2298	0.6083	2247	2278
Poland	0.0082	843	868	0.1344	819	843
Slovakia	0.0000	1288	1315	0.0180	1280	1307

Note: Reported values of the Jarque-Bera normality test are p-values.
Sector 7 excluded from estimation.

Table 6.2: Criteria for selection of POLS vs. FE

(on the 10 % level). Generally, the results leave a lot to be desired since only few variables are significant. Also in the best AIC models presented in table 6.4 hardly any general statement about the influence of trade on wages can be drawn. The qualitative apects of the estimates for Hungary remain as in the full model (even though the third lag is now significant on the 5 % level) and the third lag of the export variable is now significantly positive at the 1 % level for Poland. Note, that all parameter estimates for the export share towards the EU-15 (besides from the first lag in Hungary) are positive, even though they are not statistically different from zero on the 10 % level of significance in most cases. A further interesting aspect is that besides from the Czech Republic all three lags of the export share remain in the best AIC model. Unemployment remains in the model as an explanatory variable only in the case of Czech Republic and the influence is significantly negative there, as expected from economic theory. Interestingly, for all other countries than the Czech Republic the influence of the real wage gap is significant at least on the 10 % level in the best AIC model: If the real wage gap between these CEECs and its EU-15 trading partners was higher (i.e. the variable value lower, as discussed in section 4.1), the subsequent increase in real wages tended to be stronger in the corresponding industry. This is a slight evidence of convergence but is not necessarily related to trade. No definitive statement can be made about import penetration but it does not seem to be an appropriate variable explaining wages since it is eliminated in all best AIC models except for Hunary where the first lag remains in the best AIC model and is significantly positive on the 5 % level. This might be surprising since higher import penetration might be interpreted as increased competition by foreign markets (cf. Stockhammer/Onaran, 2006) which might entail downward pressures on wages. But if the increased import penetration is due to intra-industrial trade, then it might allow specialization and upgrading patterns that can result in wage increases.[4] In the Czech Republic, the lagged level of operating surplus remains in the best AIC model and is significantly negative (on the 10 % level) which might be counterintuitive due to economic theory. However, have in mind that restrictions to wage increases were in profitable enterprises were implemented in transition economies (cf. p. 20 and Nesporova, 1999: 23).

Besides from Slovakia all models produce a F-statistic that allows to reject the null hypothesis that the complete set of explanatory variables have no significant influence on wages on the 1 % significance level (cf. Johnston, 1984: 186f). Furthermore, the Jarque-Bera statistics allows rejection of the normality assumption only for the Czech Republic and Slovakia on the 5 % level (but not on the 1 % level).

[4]For example, deeper integration in the global division of labor might lead to a split-up of the production processes ("global value chains"). If therefore a reallocation of labor from intermediate goods to higher value-added final goods production takes place, wages might increase and since required intermediate goods are imported, import penetration might raise too. However, the question about the causes raising import penetration are beyond the scope of this thesis.

	dependent variable: **d.(real wage)**				
	CZ	H	PL	SK	all
d.expquot	7,829	-1,148,858**	3,489	-26,448	-1,650**
(1 lag)	(39,128)	(487,104)	(18,645)	(61,961)	(719.8)
d.expquot	7,499	23,969	-13,220	-46,625	-712.2
(2 lags)	(40,368)	(337,318)	(16,518)	(79,421)	(599.3)
d.expquot	-9,322	568,228*	14,877	19,421	588.8
(3 lags)	(16,305)	(326,264)	(13,776)	(26,129)	(573.8)
d.unempl	-127,561	-545,245	54,461	132,753	-9,949***
(1 lag)	(89,781)	(4,495,944)	(37,016)	(142,947)	(3,370)
real wage gap	0.5132	-63.1***	-0.8384**	-3.34	-0.2593***
(1 lag)	(0.9510)	(23.0)	(0.3783)	(2.67)	(0.0371)
d.mpen	1,305	36,728*	-1,187.887	35,957	23.06
(1 lag)	(40,032)	(18,676)	(17,502)	(50,121)	(33.22)
d.mpen	-13,759	7,637	12,241	42,352	5.24
(2 lags)	(41,752)	(11,598.28)	(13,906)	(57,844)	(29.73)
d.ops	3.34e-07	-0.000259	3.67e-08	-1.16e-07	7.12e-08
(1 lag)	(8.98e-06)	(0.000269)	(1.78e-06)	(0.0000306)	(2.20e-06)
ops	-0.0000149	0.0000575	2.68e-07	0.0000183	2.54e-06
(1 lag)	(0.0000102)	(0.0001673)	(1.56e-06)	(0.0000307)	(1.86e-06)
d.R&D	-2.20	-27.9	-0.1904943	-6.97	2.50
(1 lag)	(4.32)	(17.6)	(7.497906)	(21.82)	(6.16)
d.R&D	3.26	-24.76	-16.1	19.6	-3.99
(2 lags)	(3.30)	(20.41)	(11.12)	(20.83)	(6.98)
d.R&D	-8.31**	-4.84	-17.04	-3.93	-10.47*
(3 lags)	(3.60)	(19.32)	(10.26)	(16.20)	(6.06)
constant	32,144	-1,818,200***	-26,065**	-105,111	-7,613***
	(29,986.65)	(661,762.8)	(11,422)	(83,775)	(1,120)
Prob F-stat	0.1225	0.0064	0.0655	0.7936	0.0
within R^2	0.2400	0.3468	0.5057	0.1759	0.3582
AIC	1,703	2,247	819	1,280	3,990
Obs	84	84	48	60	264

1997-2005 (98 for SK), Sector 7 excluded. Standard Errors in parentheses
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table 6.3: FD FE ESTIMATION RESULTS (FULL MODEL)

	dependent variable: **d.(real wage)**				
	CZ	H	PL	SK	all
d.expquot	7,492	-1,122,453**	8,485	16,330	-1,355***
(1 lag)	(17,588)	(454,739)	(6,905)	(21,129)	(492.7)
d.expquot	X	190,731	4,305	6,745	-737.0
(2 lags)	X	(212,489)	(8,155)	(25,167)	(486.1)
d.expquot	X	597,576**	31,651***	25,586	573.2
(3 lags)	X	(242,615)	(10,410)	(22,135)	(549.3)
d.unempl	-145,691**	X	X	X	-11,007***
(1 lag)	(72,563)	X	X	X	(3,310)
real wage gap	X	-67.67***	-0.3793*	-3.97*	-0.2649***
(1 lag)	X	(19.82)	(0.1910)	(2.12)	(0.0363)
d.mpen	X	35,481**	X	X	X
(1 lag)	X	(17,326)	X	X	X
d.ops	X	X	6.25e-07	X	-2.59e-07
(1 lag)	X	X	(1.00e-06)	X	(2.12e-06)
ops	-0.000013**	X	X	X	3.38e-06*
(1 lag)	(5.64e-06)	X	X	X	(1.78e-06)
d.R&D	-1.71	-17.78	X	X	X
(1 lag)	(3.92)	(13.72)	X	X	X
d.R&D	3.49	X	X	X	X
(2 lags)	(3.01)	X	X	X	X
d.R&D	-7.96**	X	X	X	X
(3 lags)	(3.29)	X	X	X	X
constant	15,793***	-1,959,282***	-12,207**	-121,745*	-7,811***
	(2,806)	(587,919)	(5,546)	(66,310)	(1,094)
Prob F-stat	0.0075	0.0003	0.0092	0.3637	0.0
within R^2	0.2275	0.3148	0.3761	0.0917	0.3426
AIC	1,692	2,239	816.3	1,269	3,987
JB	0.0215	0.7430	0.7228	0.0304	0.0208
Obs	84	84	48	60	264

1997-2005 (1998-2005 for SK), Sector 7 excluded. Standard Errors in parentheses
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level
Jarque-Bera reports p-values for normality test of residuals.

Table 6.4: FD FE ESTIMATION RESULTS (BEST AIC MODELS)

6.4 Distributional Effects

In a next step I examined whether the impact of trade on wages was statistically different across sectors with different skill intensities.[5] By statistically different I mean that each parameter estimate for a subsample lies outside of the 90 % confidence intervall of the other estimate. If we assume that CEECs are abundant in low-skilled labor and that the demand for goods intensively using this factor of production will increase due to trade liberalization, also demand for low-skilled labor will increase and so will their wages. The full as well as the best AIC models are estimated with the subsamples of different skill intensities. The results are presented in tables B.4 to B.13 in Appendix B and summed up in table 6.5. As can be seen there, the results are inconclusive and none of the results is statistically significant.

	Δ low vs. med-high skill		Δ low-med vs. med-high skill	
country	full model	best model	full model	best model
CZ	-	-	+	-
H	+	+	+	-
PL	+	-	+	-
SK	+	-	-	-
all	+	-	-	-

Notes: + indicates that the impact of the export share on real wages was more positive (or less negative) for the less skilled industries; - indicates the opposite.

Table 6.5: DISTRIBUTIONAL EFFECTS

6.5 Pooling All Countries

If all countries are pooled (and thus the number of observations is dramatically increased), we obtain results that are somewhat more meaningful and significant (see the rightmost columns of tables 6.3 and 6.4). Here, the first lag of the export share has a significantly negative impact on wages (on the 5 % level in the full and on the 10 % level in the best AIC model). The second lag is also negative but not significant (in both specifications) while the third lag turns positive but is also insignificant (in both specifications). Note that despite being insignificant, conservative backward model selection maintains all three lags of the export share in the best model. The presented findings might indicate that trade liberalization has a strong negative effect on real wages in the short-run whereas the long-run effect is rather insignificant but tends to be positive. The only single-country finding that necessarily contradicts this view is the Czech one, where all parameter estimates are insignificant but the first lag is positive while the third one is negative.

Besides from the trade parameters, unemployment has a significant negative impact on real wages in both specifications (on the 10 % level) as is expected from economic theory. The same is true for the real wage gap, indicating a process of convergence in real wages between the CEEC-4 and the EU-15 (cf. the statement about the individual countries on p. 59). The effect of import penetration is positive but statistically insignificant and is eliminated in the backward selection process for the

[5] The subsample of low-skilled industries comprises the *food*, *textiles*, *wood*, *pulp and paper* sectors as well as *recycling* and *manufacturing* that is *n.e.c.* The low-med skill subsample supplementary includes sectors *rubber and plastic products*, *basic metals*, and *non-metallic mineral products*. Finally the med-high skill subsample consists of sectors *machinery and equipment n.e.c.*, *electrical and optical equipment*, *transport equipment*, and *chemicals and chemical products*. Cf. table 5.1 on p. 36.

best AIC model. The influence of the lagged level of operating surplus is positive and turns significant (at the 10 % level) in the best AIC model. This might indicate that workers can acquire a certain share of last year's profit in the bargaining process for example. The overall F-test for both pooled models clearly indicates significance of the complete regression, however, inference might be missleading since the hypothesis that the residuals are drawn from a normal distribution is rejected on the 5 % level (but not on the 1 % level) of significance.

6.5.1 Distributional Effects

Concerning the distributional effects of exports in the pooled model, we again observe no statistically significant difference across subsamples. The results comparing low and med-high skill intensive sectors are inconclusive since full and best (AIC) model arrive at different conclusions. When looking at the different impact in low-med and high-med skill intensive sectors, both models indicate that real wages in med-low skill intensive sectors where more negatively affected by growing exports towards the EU-15 than real wages in med-high skill intensive sectors which is contrary to the expectations drawn from economic theory. In the best AIC model the sum of the parameter estimates for all three lags of the export share of med-high skilled sectors (-599) lies even above the summed upper borders of the 90 % confidence intervall for the med-low sectors (-1,212); but on the other hand, the sum of parameter estimates for med-low sectors (-4,739) is not below the lower bound of the 90 % confidence intervall of the med-high skilled sectors (-5,730) so that the difference cannot be classified as being statistically significant. As can be derived from tables B.12 and B.13 in Appendix B, the more negative impact of exports on wages in med-low skill intensive sectors comes particularly from the fact that after a negative first and second lag, the impact turns positive in the third lag for med-high skill intensive sectors while it remains negative for med-low skill intensive sectors. I suggest that this pattern might arise from a higher mobility of higher-skilled workers which may be able to adapt to changing foreign demand and domestic production structures more quickly. This assumption is likely to be influenced by a geographical agglomeration of skill-intensive industries in certain areas, while less skill-intensive industries are geographically more scattered and concentrated as a legacy from the communist past (cf. p. 19). However, the highly aggregated data used in this investigation does not allow to check for strong empirical support of this hypothesis.

6.6 Estimating the Long-run Correlation

In a final step I took up the idea of Onaran/Stockhammer (2006, cf. p. 27 of this thesis) to estimate a long-run relationship. Contrary to them, however, I do not use averages of the variable but long-run differences. Thus, the dependent variable is the percentage increase of either real or unitywages from 1998-2005. The explanatory variables are the percentage change in the export share (towards the EU-15), in the unemployment rate,[6] and in import penetration. These changes are calculated over the period 1997-2004 to allow for a lag structure of at least one year. The real wage gap between the CEEC-4 and the EU-15 enters the equation in 1997 levels since sectors where the wage was especially low in 1997 are expected to experience higher wage increases within the following years. We can see from table 6.6 that this expectation is fulfilled since the parameter estimate of this variable is < 0 (and significant at the 10 % level at least for Poland, Slovakia and the combination of all

[6] The change in the unemployment rate is only included in the pool of all countries since it is not sector-specific. Therefore it would simply act as a constant on the country level.

countries). Also operating surpluses and R & D expenses enter the equation not in long-run differences but in averages over the period 1997-2004 since they are assumed to have a persistent influences on wages.

dependent variable: Δ_{98-05}**real wage**					
	CZ	H	PL	SK	all
Δ_{97-04} expquote	-0.0137203	0.3047	0.0559114**	-0.0265299	-0.0430825
	(0.0487254)	(0.2509)	(0.013508)	(0.0671819)	(0.0535559)
Δ_{97-04} unempl	X	X	X	X	-0.0619558
	X	X	X	X	(0.0600708)
real wage gap	-2.28e-06	-0.0000154	-9.62e-06*	-0.0000142**	-7.80e-06*
	(2.80e-06)	(0.0000118)	(4.01e-06)	(4.83e-06)	(4.57e-06)
Δ_{97-04} MPEN	-0.0129384	0.4924	-0.1095	0.2733	0.1345
	(0.1157)	(0.5100)	(0.0494)	(0.1916)	(0.1611)
$\overline{OPS}^{97-04}$	-0.0178824	-4.40*	-0.7938*	-0.8868	-0.9514
(% of gross prod.)	(0.4178781)	(2.01)	(0.2810)	(0.7545)	(0.7007)
$\overline{R\&D}^{97-04}$	2.47	13.22	-2.51	-118,238	10.28*
(% of gross prod.)	(3.35)	(12.30)	(14.13)	(83,228)	(5.65)
constant	0.2584**	0.1456	-0.1377	-0.2384	0.0703555
	(0.0797)	(0.3836)	(0.0996)	(0.1745)	(0.1617761)
observations	12	12	9	12	45
R^2	0.4973	0.7005	0.9657	0.6325	0.2872
prob F-stat	0.4137	0.1206	0.0209	0.2015	0.0356
AIC	-41.5152	-4.412561	-39.19999	-21.67237	-31.12484
JB	0.0	0.0139	0.0461	0.0	0.0

OLS estimation, excluding sector 7
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table 6.6: LONG-RUN CORRELATION (FULL MODELS)

The results for the influence of the variables on the real wage in the full model is presented in table 6.6. As can be seen there, the long-run influence of exports towards the EU-15 are only significant in Poland (at the 5 % level and positive). Thus, in Poland sectors that got more export-oriented towards the EU-15 during the period 1997-2004 had higher significantly higher increases in real wages between 1998 and 2005. A positive relationship is also suggested for Hungary but is not statistically significant (at the 10 % level) there. Negative, but also insignificant, relationships are suggested for the Czech Republic and Slovakia.

When turning to unitywages as the dependent variable (see table 6.7) we see that the export share is now only significant (at the 10 % level) for Slovakia and switches to a positive influence there while generally all other variables become insignificant. In the case of Slovakia though we cannot conclude that exports towards the EU-15 led to a convergence of living standard with the EU-15. Rather, an adjustment of export markets to domestic living standards took place since a shift of Slovakian EU-15 exports towards countris with lower wage levels has occured which automatically leads to an increase in unitywage (see footnoe 13 on page 39).

Backward model selection (cf. section 6.2) leads to the models presented in table 6.8 when real wage change is the dependent variable. For Slovakia no submodel obtained a better AIC and therefore the full model is equal to the best AIC model. Again, we can see a positive relationship between exports towards the EU-15 and real wages in Hungary and Poland that is only significant in Poland (at the 5 % level). In the Czech Republic the relationship is negative but far from being significant. The same is true if all countries are pooled together. In this specification the impact of unemployment on real wages is significantly negative (at the 10 % level) and also sectors of the CEEC-4 which lagged further behind the wage level of the EU-15 had

dependent variable: Δ_{98-05}**unitywage**					
	CZ	H	PL	SK	all
Δ_{97-04} expquote	-0.0751545	0.1373	0.1115	0.2077*	-0.0117081
	(0.2209716)	(0.3433)	(0.0964)	(0.1061)	(0.0747248)
Δ_{97-04} unempl	X	X	X	X	-0.021469
	X	X	X	X	(0.0838149)
real wage gap	-0.0000106	-0.0000187	-9.62e-06	-0.0000109	-8.83e-06
	(0.0000127)	(0.0000162)	(0.0000286)	(7.64e-06)	(6.37e-06)
Δ_{97-04} MPEN	-0.1293	0.2003	0.3386	-0.0080716	0.1928
	(0.5246)	(0.6978)	(0.3528)	(0.3027563)	(0.2248)
$\overline{OPS}^{97-04}$	-0.6304	-3.75	1.82	1.34	0.4929
(% of gross prod.)	(1.90)	(2.75)	(2.01)	(1.19)	(0.9777)
$\overline{R\&D}^{97-04}$	-29.53	4.08	-29.84	-243,544	-6.28
(% of gross prod.)	(15.17)	(16.83)	(100.8)	(131,499)	(7.88)
constant	0.3431	0.085623	-0.6164	-0.2634	-0.0943162
	(0.3615)	(0.524859)	(0.7109)	(0.2757)	(0.2257211)
observations	12	12	9	12	45
R^2	0.4964	0.4456	0.5536	0.5819	0.0659
prob F-stat	0.4152	0.5055	0.6404	0.2742	0.8426
AIC	-5.2312	3.112694	-3.824643	-10.69433	-1.146998
JB	0.8803	0.4727	0.7104	0.0	0.7539

OLS estimation, excluding sector 7
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table 6.7: LONG-RUN CORRELATION (FULL MODELS)

dependent variable: Δ_{98-05}**real wage**						
	CZ	H	PL	all	all(2)	all(3)
Δ_{97-04} expquote	-0.0124933	0.3890	0.0520576**	-0.008981	X	X
	(0.025732)	(0.2302)	(0.0173286)	(0.0463253)	X	X
Δ_{97-04} unempl	X	X	X	-0.1069*	X	X
	X	X	X	(0.0573317)	X	X
real wage gap	X	-0.0000206*	-9.07e-06***	-0.0000115***	-8.32e-06**	-8.51e-06***
	X	(9.44e-06)	(2.28e-06)	(3.92e-06)	(3.29e-06)	(2.65e-06)
Δ_{97-04} MPEN	X	X	-0.1328*	X	0.0757959	X
	X	X	(0.0689)	X	(0.1149141)	X
$\overline{OPS}^{97-04}$	X	-2.82*	-0.6197	X	-0.9742*	-0.8250*
(% of gross prod.)	X	(1.50)	(0.4075)	X	(0.4985)	(0.4564)
$\overline{R\&D}^{97-04}$	4.34**	X	X	X	1.34	
(% of gross prod.)	(1.66)	X	X	X	(4.31)	
constant	0.3115***	-0.0262775	-0.1368	-0.0979964	-0.0438819	-0.0574905
	(0.0159)	(0.2510)	(0.0930239)	(0.1130082)	(0.1313139)	(0.1068122)
CZ	X	X	X	X	0.2627*	0.2660***
(dummy)	X	X	X	X	(0.0704994)	(0.0654068)
H	X	X	X	X	0.0905609	0.1028*
(dummy)	X	X	X	X	(0.065151)	(0.059471)
PL	X	X	X	X	-0.0806327	-0.0581152
(dummy)	X	X	X	X	(0.0769566)	(0.0658328)
expshare	X	X	X	X	-0.0942253	-0.0672449
(CZ)	X	X	X	X	(0.0981182)	(0.0883706)
expshare	X	X	X	X	0.4731218***	0.4880513***
(H)	X	X	X	X	(0.1445702)	(0.1366209)
expshare	X	X	X	X	0.0349513	0.0315527
(PL)	X	X	X	X	(0.0508951)	(0.0446638)
expshare	X	X	X	X	-0.0145322	0.0005896
(SK)	X	X	X	X	(0.0659978)	(0.0597317)
observations	12	12	12	48	45	48
R^2	0.4369	0.6191	0.8284	0.2075	0.7030	0.7044
prob F-stat	0.0754	0.0431	0.0082	0.0158	0.0	0.0
AIC	-46.15499	-5.528724	-41.26866	-35.4272	-60.5143	-70.77059
JB	0.0	0.0988	0.0199	0.1592	0.0	0.0

OLS estimation, excluding sector 7
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table 6.8: LONG-RUN CORRELATION (BEST AIC MODELS)

significantly higer increases in real wages.

Since it might be a strong assumption that the constant (i.e. the linear time trend of the wage variable that is not explained by the variables in the model) as well as the parameter of the influence of the export share on real wages are equal across all countries I included dummy variables for the countries in the full pooled model (model 'all(2)' in table 6.8) and furthermore interacted them with the share of exports towards the EU-15.[7] The obtained results are similar to the results from table 6.6: The share of exports towards the EU-15 has a negative impact on real wages in the Czech Republic and Slovakia, while the influence is positive in Hungary and Poland. Now, Hungary is the only country where this influence is statistically significant (at the 1 % level). Furthermore, the initial gap between the CEECs and the EU-15 in real wage and operating surpluses have a significant influence on real wages. When the best AIC submodel is selected (column 'all(3)' in table 6.8), the impact of exports on real wages in the Slovak Republic turns positive but remains highly insignificant. All other results remain qualitatively unchanged.

To sum up these results, no clear long-run relationship between the share of exports towards the EU-15 and the development of real wages could be found in the CEEC-4. However, the results suggest that this relationship may seriously vary between countries.

[7]It should be clear that three country dummy variables account for all four countries and then also the unemployment rate becomes obsolete as an explanatory variable. Since all four country dummies are interacted with the export share also the overall export share is no longer needed.

Chapter 7

Conclusions and Implications

Using the OECD database for structural analysis, I have illustrated that real wages increased stronger in the CEEC-4 than in the EU-15 in the period 1997-2005. This led to a convergence in living standards of workers but it is very weak: None of the four countries obtained a living standard (unitywage) of more than 60.6 % of their EU-15 trading partners by 2005 (subsection 5.1.3).

The role of trade in this process of weak convergence is not clearly determined. Even though a major trade liberalization between the EU-15 and the CEEC-4 took place (manufacturing exports of CEEC-4 towards the EU-15 as a percentage of manufacturing gross output have approximately doubled in the period under investigation, see subsection 5.2.1), no clear implications of welfare effects can be derived from this export surge.

The results obtained from a rather conservative econometric analysis indicate that the increase in export shares towards the EU-15 and the increase of real wages do not move in a stable long-run relationship (section 6.1). There is evidence that the import of exports towards the EU-15 have a negative short-run impact but turn to a positive impact in the long-run (sections 6.3, 6.5). The former does not necessarily contradict the conclusions derived by Stolper and Samuelson (1941, 1948, 1949), since of course nobody "ever denied that the workers employed in the particular industry which loses a tariff could be hurt in the short-run, but according to the classical theory, in the long-run there would be an increased demand for those commodities in which the country had a comparative advantage" (Stolper/Samuelson, 1941: 59). Interestingly, while CEEC-4 are expected to have this comparative advantage rather in low-skilled industry; it seems that the impact of exports towards the EU-15 was more positive (or less negative) in sectors that have a higher skill intensity. This might be due to higher labor mobility in the latter sectors (sections 6.4, 6.5).

A further finding of interest is the fact that the major surge in exports of CEEC-4 towards the EU-15 has taken place in the sectors with higher skill intensity (see table 5.4 on p. 43). This clearly contradicts the expectations of the simple HO model about the trade patterns and production adjustment entailed by a trade transition from an autarky to a free trade equilibrium. This therefore suggests that the Stolper-Samuelson and the FPE frameworks are not adequately describing the forces influencing factor prices of labor in the present context.

The results presented in section 6.6 suggest that the long-run impact of exports towards the EU-15 differed systematically between countries: While the impact is more likely to be positive in Hungary and Poland, the results are negative but highly

insignificant for Czech Republic and Slovakia. Thus, it is possible that not trade liberalization per se has an unambiguous effect on wages but that it especially matters in which institutional environment trade liberalization takes place. To determine these possible influences is beyond the scope of this thesis and requires more detailed data. It should be noted though that the textbook distinction between the big bang and a gradual approach to transition does not seem to be an accurate explanation since Poland as well as the Czech Republic adopted a big bang strategy while Hungary is a textbook example of a gradualist strategy (see subsection 3.1.3). But Czech Republic and Slovakia undoubtedly share a joint past of policy in a common country shaped by a rigid system of central economic planning after the reform ambitions in the late 1960s failed. On the other hand, decentralization and liberalization processes took place in Hungary at that time and also Poland experienced certain market-oriented reforms in 1981 (even though they were foiled by the introduction of martial law by the government to some extent). These reforms might have strengthened the geographical agglomeration of manufacturing production which is highly concentrated in the Polish Silesian Voivodeship, while the Eastern parts of Poland are rather dominated by the primary sector and the West Pomeranian as well as the Western part of the Masovian Voivodeship and the Eastern part of the Lower Silesian Voivodeship are centers of tertiary economic activity. In Hungary, manufacturing production is also highly concentrated, namely in Central and Western Transdanubia. This geographical concentration of manufacturing production might increase mobility of workers across sectors (since workers do not have to move in order to change job) while the regional dispersion of manufacturing production all over the country in Slovakia and the Czech Republic might disable workers in stagnating and declining sectors to find work in industries that are expanding due to increasing foreign demand.

Such a tendency would mean that the theoretical shift towards institutions and economic geography in economic theory might be appropriate to account for the differences of the impact of trade on wages in different regions of Central and Eastern Europe. Furthermore, this suggests for lobbies and associations of workers, especially trade unions, that their major issue of concern should not be whether or not a country liberalizes trade, but under which environment and which conditions. Measures to increase the mobility of workers, such as infrastructure and a sufficient social protection (to allow for labor market transitions without a dramatic decrease in living conditions during this transition period), seem especially adequate to allow workers to reallocate if changing foreign demand leads to a change in production patterns.

How far aspects, such as labor mobility across sectors and institutional environment, can be made responsible for different impacts of trade on wages lies beyond the scope of this thesis and requires more detailed data. Collection of more detailed data in the last years, also as a result from the EU accession, might enable future research to investigate the trade-income relationship more satisfactory. Since the major trade liberalization took place already (see subsection 5.2.1) it is questionable to what extent this research will be fruitful.

Finally, one might argue that the CEECs are not good examples to investigate the trade-income relationship due to the many different forces at work in the transition context. This argument seems reliable to some extent, but especially the CEEC-4 were relatively stabilized in the mid and late 1990s. On the contrary, one might argue that there rarely has been such a good example of trade liberalization as the integration of the NMS to the common European market. Another issue to keep in mind in this process is the fact that this integration had not only narrow economic aspects but

also was shaped by institutional directives from the EU-15 and regional as well as structural subsidies for the NMS possibly influenced the trade-income relationship.

Appendix A

Theorems and Proofs

Gauss-Markov theorem

The following assumptions hold: $E(u) = 0$
$E(uu') = \sigma^2 I$
$rank(X) = k$ and
X is non-random
when no a priori information about the true value of β is given, meaning that any $\beta \in \mathbb{R}^k$ is a possible true value.

Then, the GMT shows proof that in the true model $Y_{n\times 1} = X_{n\times k}\beta_{k\times 1} + u_{n\times 1}$ the ordinary least squares (OLS) estimator $\widehat{\beta} = (X'X)^{-1}X'Y$ is the "best" estimator within the class of linear unbiased estimators ($\widehat{\beta}$ is BLUE) in the sense that $VC(\widetilde{\beta}) \geq VC(\widehat{\beta}) \forall \widetilde{\beta} : \widetilde{\beta} = DY$ for any non-stochastik $D_{k\times n} \wedge E(\widetilde{\beta}) = \beta$.

unitywage measures purchasing power

Let P' be the price level of any optional country of reference. Then:

Proof.

$$\begin{aligned} unitywage_{A/B} &= \frac{w_A/PPP_A}{w_B/PPP_B} = \frac{\frac{w_A}{P_A/P'}}{\frac{w_B}{P_B/P'}} \\ &= \frac{\frac{w_A \times P'}{P_A}}{\frac{w_B \times P'}{P_B}} \\ &= \frac{w_A \times P_B \times P'}{w_B \times P_A \times P'} = \frac{w_A \times P_B}{w_B \times P_A} \times 1 \\ &= \frac{w_A \times P_B \times P'}{w_B \times P_A \times P'} = \frac{w_A \times P_B}{w_B \times P_A} \\ &= \frac{w_A/P_A}{w_B/P_B} \end{aligned}$$

■

Thus, the price level of the reference country is eliminated, i.e. unitywage does not depend on which country is chosen for reference. Furthermore, it can be seen that unitywage compares the purchasing power of wage earners in two countries.

FPE implies unitywage = 1

Let E be the exchange rate between country A and B. For FPE then the following must hold: **Proof.**

$$\begin{aligned} \frac{w_A}{E} &= w_B \\ \frac{w_A}{PPP} &= w_B \\ \frac{w_A}{P_A/P_B} &= w_B \\ \frac{w_A \times P_B}{P_A} &= w_B \\ \frac{w_A}{P_A} &= \frac{w_B}{P_B} \end{aligned}$$

■

Since numerator and denumerator of the term $unitywage_{A/B} = \frac{w_A/P_A}{w_B/P_B}$ will then be equal, it is implied that $unitywage_{A/B} = 1$.

On the other hand in autarcy there might be an equilibrium, where prices between both countries differ and wages differ in the same proportion such that $\frac{w_A}{P_A} = \frac{w_B}{P_B}$ but FPE does not hold.

Appendix B

Tables

	CZ	H	PL	SK
1986	-	96.8	102.7	-
1987	-	100.7	104.5	98.3
1988	-	102.4	107.5	100.1
1989	-	102.4	106.7	101.9
1990	100	100	100	100
1991	88.3	89.4	98.2	82.7
1992	87.3	89.6	100.2	78.4
1993	88.1	94.6	104.0	75.7
1994	89.4	93.3	108.3	79.5
1995	92.7	94.5	115.2	82.9
1996	96.3	95.1	121.7	86.8
1997	96.6	99.1	129.4	89.8
1998	95.8	103.1	135.1	93.9
1999	97.9	107.3	140.8	96.4
2000	100.9	112.8	146.0	97.9
2001	103.4	118.5	148.0	100.9
2002	105.1	124.1	150.4	105.8
2003	108.5	129.0	156.3	110.5
2004	111.9	135.2	164.6	114.4

Source: own calculations based on Heston/Summers/Aten (2006); constant prices calculated using Laspeyres Price Index

Table B.1: Real GDP p.c., Index (1990 = 100)

sector	1997	2005	growth p.a.
Czech Republic			
Food Products, Beverages & Tobacco	189,291	235,601	2.8 %
Textiles, Textile products, leather & footwear	134,419	178,058	3.6 %
Wood and products of wood & cork	162,825	193,131	2.2 %
Pulp, paper, paper products, printing & publishing	231,984	297,077	3.1 %
Coke, refined petroleum products & nuclear fuel	251,388	395,205	5.8 %
Chemicals & chemical products	235,051	326,069	4.2 %
Rubber & plastics products	213,245	273,987	3.2 %
Other non-metallic mineral products	202,828	282,477	4.2 %
Basic metals & fabricated metal products	206,213	262,144	3.0 %
Machinery & equipment, n.e.c.	207,444	282,193	3.9 %
Electrical & optical equipment	202,074	267,406	3.6 %
Transport equipment	223,606	318,796	4.5 %
Manufacturing n.e.c.; recycling	166,109	210,789	3.0 %
Hungary			
Food Products, Beverages & Tobacco	1,451,822	1,759,399	2.4 %
Textiles, Textile products, leather & footwear	899,654	1,005,317	1.4 %
Wood and products of wood & cork	1,092,036	1,107,051	0.2 %
Pulp, paper, paper products, printing & publishing	2,402,105	2,688,554	1.4 %
Coke, refined petroleum products & nuclear fuel	11,200,000	10,300,000	-1.0 %
Chemicals & chemical products	2,067,280	2,522,259	2.5 %
Rubber & plastics products	1,729,617	2,318,809	3.7 %
Other non-metallic mineral products	2,201,804	2,242,078	0.2 %
Basic metals & fabricated metal products	1,754,745	1,853,540	0.7 %
Machinery & equipment, n.e.c.	1,570,701	2,698,824	7.0 %
Electrical & optical equipment	1,598,518	2,063,368	3.2 %
Transport equipment	2,006,815	2,603,808	3.3 %
Manufacturing n.e.c.; recycling	1,234,179	1,135,289	-1.0 %
Poland			
Food Products, Beverages & Tobacco	24,389	26,213	0.9 %
Textiles, Textile products, leather & footwear	16,835	16,215	-0.5 %
Wood and products of wood & cork	20,261	19,546	-0.4 %
Pulp, paper, paper products, printing & publishing	35,926	39,144	1.1 %
Coke, refined petroleum products & nuclear fuel	48,475	57,272	2.1 %
Chemicals & chemical products	36,787	45,375	2.7 %
Rubber & plastics products	26,839	28,609	0.8 %
Other non-metallic mineral products	26,942	30,366	1.5 %
Basic metals & fabricated metal products	27,818	31,514	1.6 %
Machinery & equipment, n.e.c.	28,612	33,834	2.1 %
Electrical & optical equipment	31,460	33,474	0.8 %
Transport equipment	29,374	35,422	2.4 %
Manufacturing n.e.c.; recycling	19,479	20,403	0.6 %
Slovakia			
Food Products, Beverages & Tobacco	182,835	200,626	1.2 %
Textiles, Textile products, leather & footwear	133,156	136,056	0.3 %
Wood and products of wood & cork	165,935	157,156	-0.7 %
Pulp, paper, paper products, printing & publishing	230,770	253,785	1.2 %
Coke, refined petroleum products & nuclear fuel	312,689	674,869	10.1 %
Chemicals & chemical products	234,633	267,356	1.6 %
Rubber & plastics products	235,185	233,590	-0.1 %
Other non-metallic mineral products	205,935	231,193	1.5 %
Basic metals & fabricated metal products	230,901	274,347	2.2 %
Machinery & equipment, n.e.c.	194,231	241,135	2.7 %
Electrical & optical equipment	194,559	199,288	0.3 %
Transport equipment	215,254	293,070	3.9 %
Manufacturing n.e.c.; recycling	165,484	194,457	2.0 %
EU-15			
Food Products, Beverages & Tobacco	27,978	29,251	1.2 %
Textiles, Textile products, leather & footwear	20,126	21,174	0.3 %
Wood and products of wood & cork	24,121	24,936	-0.7 %
Pulp, paper, paper products, printing & publishing	33,790	34,495	1.2 %
Coke, refined petroleum products & nuclear fuel	60,085	70,670	10.1 %
Chemicals & chemical products	48,204	54,326	1.6 %
Rubber & plastics products	31,472	33,127	-0.1 %
Other non-metallic mineral products	31,580	32,785	1.5 %
Basic metals & fabricated metal products	32,401	33,860	2.2 %
Machinery & equipment, n.e.c.	36,566	39,531	2.7 %
Electrical & optical equipment	37,375	41,861	0.3 %
Transport equipment	41,567	45,491	3.9 %
Manufacturing n.e.c.; recycling	24,502	24,994	2.0 %

All amounts in national currencies, Euro for the EU-15.

Table B.2: Development of Real Wages

sector	1997	2005	growth p.a.
Czech Republic			
Food Products, Beverages & Tobacco	167,464	135,506	-2.6 %
Textiles, Textile products, leather & footwear	167,825	90,116	-7.5 %
Wood and products of wood & cork	52,899	47,022	-1.5 %
Pulp, paper, paper products, printing & publishing	59,092	56,478	-0.6 %
Coke, refined petroleum products & nuclear fuel	5,923	3,209	-7.4 %
Chemicals & chemical products	49,943	42,660	-2.0 %
Rubber & plastics products	51,289	71,471	4.2 %
Other non-metallic mineral products	88,249	72,467	-2.4 %
Basic metals & fabricated metal products	243,956	200,443	-2.4 %
Machinery & equipment, n.e.c.	178,520	148,284	-2.3 %
Electrical & optical equipment	136,706	166,832	2.5 %
Transport equipment	97,972	125,022	3.1 %
Manufacturing n.e.c.; recycling	80,604	65,702	-2.5 %
Hungary			
Food Products, Beverages & Tobacco	146,130	131,683	-1.3 %
Textiles, Textile products, leather & footwear	146,297	89,641	-5.9 %
Wood and products of wood & cork	30,496	32,054	0.6 %
Pulp, paper, paper products, printing & publishing	34,942	40,628	1.9 %
Coke, refined petroleum products & nuclear fuel	4,781	5,366	1.5 %
Chemicals & chemical products	52,289	46,256	-1.5 %
Rubber & plastics products	29,217	36,660	2.9 %
Other non-metallic mineral products	26,046	28,171	1.0 %
Basic metals & fabricated metal products	79,479	94,559	2.2 %
Machinery & equipment, n.e.c.	68,600	53,004	-3.2 %
Electrical & optical equipment	89,357	154,758	7.1 %
Transport equipment	35,142	57,807	6.4 %
Manufacturing n.e.c.; recycling	24,941	36,304	4.8 %
Poland			
Food Products, Beverages & Tobacco	531,309	443,900	-2.2 %
Textiles, Textile products, leather & footwear	516,395	274,600	-7.6 %
Wood and products of wood & cork	120,946	118,600	-0.2 %
Pulp, paper, paper products, printing & publishing	119,356	123,900	0.5 %
Coke, refined petroleum products & nuclear fuel	22,510	15,700	-4.4 %
Chemicals & chemical products	137,866	100,500	-3.9 %
Rubber & plastics products	105,858	131,400	2.7 %
Other non-metallic mineral products	169,500	126,700	-3.6 %
Basic metals & fabricated metal products	339,658	281,700	-2.3 %
Machinery & equipment, n.e.c.	284,332	181,600	-5.5 %
Electrical & optical equipment	188,875	165,600	-1.6 %
Transport equipment	209,722	174,000	-2.3 %
Manufacturing n.e.c.; recycling	184,573	194,200	0.6 %
Slovakia			
Food Products, Beverages & Tobacco	69,741	46,727	-4.9 %
Textiles, Textile products, leather & footwear	90,091	67,934	-3.5 %
Wood and products of wood & cork	26,707	26,093	-0.3 %
Pulp, paper, paper products, printing & publishing	31,161	20,967	-4.8 %
Coke, refined petroleum products & nuclear fuel	6,106	3,583	-6.4 %
Chemicals & chemical products	28,370	12,838	-9.4 %
Rubber & plastics products	16,798	20,730	2.7 %
Other non-metallic mineral products	30,070	24,182	-2.7 %
Basic metals & fabricated metal products	81,059	70,802	-1.7 %
Machinery & equipment, n.e.c.	77,846	46,712	-6.2 %
Electrical & optical equipment	52,588	71,852	4.0 %
Transport equipment	26,635	31,706	2.2 %
Manufacturing n.e.c.; recycling	24,924	23,121	-0.9 %
EU-15			
Food Products, Beverages & Tobacco	3,263,448	3,262,961	0.0 %
Textiles, Textile products, leather & footwear	2,676,811	1,847,406	-4.5 %
Wood and products of wood & cork	771,262	722,411	-0.8 %
Pulp, paper, paper products, printing & publishing	2,409,475	2,134,046	-1.5 %
Coke, refined petroleum products & nuclear fuel	151,815	131,049	-1.8 %
Chemicals & chemical products	1,575,509	1,451,884	-1.0 %
Rubber & plastics products	1,304,224	1,308,686	0.0 %
Other non-metallic mineral products	1,257,417	1,186,411	-0.7 %
Basic metals & fabricated metal products	3,839,024	3,817,672	-0.1 %
Machinery & equipment, n.e.c.	2,949,302	2,910,509	-0.2 %
Electrical & optical equipment	3,026,978	2,690,276	-1.5 %
Transport equipment	2,503,429	2,555,164	0.3 %
Manufacturing n.e.c.; recycling	1,532,817	1,451,224	-0.7 %

Table B.3: Development of Employees

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	4,302 (94,494)	(-159,557; 168,161)	16,445 (69,130)	(-106,765; 139,656)	35,294 (62,061)	(-69,484; 140,072)
d.ExpSh (2 lags)	41,233 (90,635)	(-115,934; 198,400)	9,014 (84,582)	(-141,736; 159,763)	71,200 (59,361)	(-29,019; 171,418)
d.ExpSh (3 lags)	-8,078 (29,943)	(-60,002; 43,845)	40,094 (35,759)	(-23,639; 103,827)	-17,844 (20,625)	(-52,665; 16,976)
d.unempl (1 lag)	-139,864 (188,352)		-162,536 (225,444)		-212,598* (118,648)	
real wage gap (1 lag)	-0.3404 (1.6481)		5.87* (2.97)		0.7270 (1.31)	
d.MPEN (1 lag)	20,386 (91,030)	(-137,466; 178,238)	3,879 (73,714)	(-127,500; 135,258)	-27,481 (63,055)	(-133,936; 78,976)
d.MPEN (2 lags)	-40,999 (83,652)	(-186,057; 104,059)	-14,036 (87,675)	(-170,298; 142,225)	-58,130 (58,406)	(-156,737; 40,476)
d.OPS (1 lag)	0.000017 (0.0000144)		-0.0000476* (0.0000239)		0.0000118 (0.0000106)	
OPS (1 lag)	-0.0000185 (0.0000159)		0.0000575 (0.0000341)		-0.0000262 (0.0000116)	
d.R&D (1 lag)	15.38 (33.03)		1.61 (6.75)		7.16 (8.59)	
d.R&D (2 lags)	-12.57 (34.19)		9.64 (5.401635)		14.52501 (9.842607)	
d.R&D (3 lags)	-9.62 (25.69)		-2.92 (5.55)		-13.19 (8.44)	
constant	6,739 (41,136)		208,813* (106,310)		38,525 (36,116)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.4: DISTRIBUTIONAL EFFECTS CZECH REPUBLIC (FULL MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	581.8 (29,935)	(-50,634; 51,797)	19,436 (30,602)	(-33,630; 72,502)	-2,653.513 (24,143)	(-43,261; 37,954)
d.unempl (1 lag)	-54,520 (111,398)		-188,211 (161,624)		-138,754 (88,799)	
OPS (1 lag)	-8.40e-06 (0.0000106)		-0.0000128* (0.0000114)		-0.0000138 (6.93e-06)	
d.R&D (1 lag)	4.57 (24.53)		-2.67 (6.25)		4.43 (7.32)	
d.R&D (2 lags)	-24.79 (23.64)		2.59 (4.34)		10.70 (8.83)	
d.R&D (3 lags)	-13.17 (22.50)		-7.19 (5.2)		-11.67 (7.78)	
constant	11,118** (4,580)		18,778** (6,701)		14,585*** (3,201)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.5: DISTRIBUTIONAL EFFECTS CZECH REPUBLIC (BEST AIC MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	-660,110 (577,798)	(-1,662,048; 341,828)	82,626 (2,419,273)	(-4,229,214; 4,394,466)	-366,606 (623,581)	(-1,419,396; 686,184)
d.ExpSh (2 lags)	-103,414 (623,193)	(-1,184,070; 977,242)	-2,796,517 (2,211,688)	(-6,738,382; 1,145,348)	-374,241 (646,902)	(-1,466,404; 717,922)
d.ExpSh (3 lags)	307,448 (905,113)	(-1,262,075; 1,876,971)	2,789 (626,303)	(-1,113,462; 1,119,039)	-285,704 (942,991)	(-1,877,754; 1,306,346)
d.unempl (1 lag)	-1,929,296 (6,060,027)		-1.22e+07 (1.31e+07)		-2,323,855 (5,557,185)	
real wage gap (1 lag)	-65.39** (30.67)		6.18 (65.43)		-80.03*** (26.43)	
d.MPEN (1 lag)	17,349 (25,258)	(-26,451; 61,148)	-857,691 (2,146,579)	(-4,683,512; 2,968,130)	1,726 (26,168)	(-42,453; 45,905)
d.MPEN (2 lags)	6,784 (18,046)	(-24,510; 38,077)	3,695,247 (3,019,478)	(-1,686,332; 9,076,826)	-701.7 (20,596)	(-35,474; 34,070)
d.OPS (1 lag)	-0.0001549 (0.0003369)		-0.0000237 (0.000702)		-0.0003813 (0.0003552)	
OPS (1 lag)	0.0002801 (0.0003037)		0.000221 (0.0004112)		0.0005468* (0.0003028)	
d.R&D (1 lag)	-115.2 (364.6)		2.47 (35.05)		-37.02 (88.18)	
d.R&D (2 lags)	-605.0 (498.9)		-18.86 (32.12)		-55.56 (99.47)	
d.R&D (3 lags)	-42.83 (346.3)		16.02 (31.53)		-96.39 (124.9)	
constant	-1,600,680** (724,630)		146,163 (2,330,899)		-2,144,940*** (655,515)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.6: DISTRIBUTIONAL EFFECTS HUNGARY (FULL MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	-562,815 (543,976)	(-1,493,493; 367,864)	-1,473,514 (1,431,319)	(-3,955,513; 1,008,485)	-279,961 (604,493)	(-1,296,688; 736,767)
d.ExpSh (2 lags)	-99,547 (427,918)	(-831,665; 632,570)	171,269 (375,947)	(-480,648; 823,185)	-461,531 (437,829)	(-1,197,938; 274,877)
d.ExpSh (3 lags)	145,079 (578,450)	(-844,581; 1,134,739)	761,905* (379,064)	(104,583; 1,419,226)	-374,337 (589,918)	(-1,366,552; 617,878)
real wage gap (1 lag)	-71.26** (27.24)		-59.65 (39.25)		-79.26*** (23.70)	
d.MPEN (1 lag)	11,575 (22,703)	(-27,267; 50,418)	-159,356 (1,364,024)	(-2,524,660; 2,205,949)	-2,460 (24,526)	(-43,712; 38,791)
d.R&D (1 lag)	241.3 (198.0)		-17.56 (18.35)		-8.93 (72.71)	
constant	-1,670,236** (644,423)		-2,160,539 (1,501,979)		-1,968,918*** (599,141)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.7: DISTRIBUTIONAL EFFECTS HUNGARY (BEST AIC MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	11,642 (23,452)	(-28,807; 52,090)	-25,917 (22,772)	(-66,026; 14,192)	25,855 (17,989)	(-4,474; 56,184)
d.ExpSh (2 lags)	-17,494 (21,472)	(-54,526; 19,539)	-16,124 (17,176)	(-46,377; 14,128)	-22,020 (16,290)	(-49,484; 5,444)
d.ExpSh (3 lags)	-19,046 (16,442)	(-47,404; 9,312)	11,559 (9,942)	(-5,953; 29,071)	-10,033 (12,265)	(-30,712; 1,0645)
d.unempl (1 lag)	-39,058 (23,848)		70,181* (34,313)		-23,474 (16,977)	
real wage gap (1 lag)	0.2759 (0.4867)		-0.6560** (0.2822)		0.0171 (0.3470)	
d.MPEN (1 lag)	865.3 (24,966)	(-42,195; 43,925)	24,374 (20,851)	(-12,350; 61,099)	-14,578 (18,457)	(-45,696; 16,540)
d.MPEN (2 lags)	17,478 (24,581)	(-24,917; 59,873)	22,018 (16,151)	(-6,428; 50,465)	14,248 (18,569)	(-17,058; 45,554)
d.R&D (1 lag)	-4.73 (22.46)		9.28 (7.62)		-2.88 (15.18)	
d.R&D (2 lags)	25.64 (26.68)		7.30 (6.53)		15.74 (16.03)	
d.R&D (3 lags)	17.46 (24.12)		3.72 (7.12)		10.26 (14.91)	
constant	7,085 (11,760)		-24,640** (10,428)		773.7 (8,929)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level
OPS had to be excluded since it was not available for all years and thus estimation of med-high subsample was not possible.

Table B.8: DISTRIBUTIONAL EFFECTS POLAND (FULL MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	14,068 (10,186)	(-4,395; 32,530)	5,813 (13,950)	(-20,616; 32,243)	15,446* (8,577)	(615.8; 30,276)
d.ExpSh (2 lags)	2,287 (12,999)	(-21,273; 25,846)	11,846 (15,777)	(-18,044; 41,736)	2,862 (10,139)	(-14,670; 20,394)
d.ExpSh (3 lags)	-5,090 (16,196)	(-34,444; 24,264)	37,535* (19,755)	(106.3; 74,963)	-7,775 (12,956)	(-30,178; 14,627)
real wage gap (1 lag)	-0.2861 (0.3162)		-0.2586 (0.3265)		-0.2149 (0.2384)	
d.OPS (1 lag)	2.98e-07 (1.60e-06)		3.61e-06 (3.30e-06)		-4.23e-07 (7.77e-07)	
constant	-7,265 (7,640)		-12,154 (11,716)		-5,661 (6,118)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.9: DISTRIBUTIONAL EFFECTS POLAND (BEST AIC MODEL)

	low skill		**med-high skill**		**med-low skill**	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	4,486 (166,057)	(-304,305; 313,277)	125,392 (187,291)	(-273,883; 524,667)	-89,837 (101,611)	(-265,087; 85,414)
d.ExpSh (2 lags)	-83,008 (294,403)	(-630,464; 464,448)	-117,689 (181,835)	(-505,333; 269,954)	-114,850 (145,557)	(-365,894; 136,195)
d.ExpSh (3 lags)	1,966 (62,644)	(-114,523; 118,455)	-87,500 (73,337)	(-24,3843; 68,843)	9,834 (38,006)	(-55,716; 75,384)
d.unempl (1 lag)	391,957 (578,356)		304,599 (389,007)		17,0895 (234,119)	
real wage gap (1 lag)	4.87 (25.83)		-1.97 (5.26)		-7.22 (6.03)	
d.MPEN (1 lag)	-45,048 (166,808)	(-355,235; 265,139)	-56,174 (90,264)	(-248,601; 136,254)	74,228 (88,984)	(-79,244; 227,700)
d.MPEN (2 lags)	44,112 (249,234)	(-419,351; 507,575)	19,161 (105,355)	(-205,440; 243,761)	84,579 (117,017)	(-117,242; 286,400)
d.OPS (1 lag)	0.0000971 (0.0001614)		2.55e-06 (0.0000735)		0.000013 (0.0000438)	
OPS (1 lag)	0.0000156 (0.0001918)		-0.0001007 (0.0001405)		9.56e-06 (0.0000405)	
d.R&D (1 lag)	-1,758 (2,936)		-7.05 (37.49)		36.03 (57.09)	
d.R&D (2 lags)	740.0 (5,175)		14.97 (28.86)		62.68 (61.13)	
d.R&D (3 lags)	1,965 (4,658)		-21.90 (24.69)		28.15 (37.41)	
constant	121,659 (660,398)		-56,090 (205,730)		-19,4235 (161,238)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.10: DISTRIBUTIONAL EFFECTS SLOVAKIA (FULL MODEL)

	low skill		**med-high skill**		**med-low skill**	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	-11,261 (38,908)	(-79,189; 56,667)	76,803* (38,741)	(7,755; 145,852)	-1,530 (31,521)	(-55,152; 52,093)
d.ExpSh (2 lags)	1,528 (48,120)	(-82,485; 85,540)	-1,505 (31,291)	(-57,274; 54,264)	-1,556 (38,426)	(-66,922; 63,811)
d.ExpSh (3 lags)	22,137 (38,748)	(-45,513; 89,788)	-14,674 (40,278)	(-86,460; 57,112)	19,780 (31,573)	(-33,930; 73,489)
real wage gap (1 lag)	-5.126684 (7.462152)		-2.656307 (2.176272)		-6.51 (4.92366)	
constant	-126,833 (186,392)		-102,117 (87,712)		-172,723 (131,794)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.11: DISTRIBUTIONAL EFFECTS SLOVAKIA (BEST AIC MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	-1,726** (805.8)	(-3,068; -384.9)	-3,300 (2,882)	(-8,115; 1,514)	-1,917** (856.2)	(-3,336; -499.2)
d.ExpSh (2 lags)	-1,286 (895.9)	(-2,777; 205.4)	-2,794 (1,792)	(-5,787; 200.2)	-1,700* (916.4)	(-3,218; -181.7)
d.ExpSh (3 lags)	-691.9 (865.1)	(-2,132; 748.1)	1,591* (858.7)	(156.9; 3,026)	-1,285 (903.6)	(-2,782; 211.3)
d.unempl (1 lag)	-7,889* (4,273)		-9,264 (7,283)		-9,888** (3,778)	
real wage gap (1 lag)	-0.2134*** (0.0606)		-0.2321*** (0.0632)		-0.2902*** (0.0499)	
d.MPEN (1 lag)	10.98 (31.23)	(-41.0; 62.96)	1,770 (2,249)	(-1,987; 5,527	11.10 (34.29)	(-45.69; 67.89)
d.MPEN (2 lags)	-5.72 (31.76)	(-58.59; 47.1)	3,160 (1,929)	(-62.51; 6,382)	-4.30 (34.51)	(-61.46; 52.87)
d.OPS (1 lag)	9.58e-06*** (2.96e-06)		-4.72e-06 (6.23e-06)		1.50e-06 (2.36e-06)	
OPS (1 lag)	-9.45e-06** (3.84e-06)		6.74e-06 (4.56e-06)		8.19e-07 (1.98e-06)	
d.R&D (1 lag)	15.56 (20.25)		1.71 (8.23)		10.92 (17.23)	
d.R&D (2 lags)	0.7902 (23.37)		-5.79 (9.81)		13.69 (17.88)	
d.R&D (3 lags)	-6.09 (22.76)		-7.32 (8.11)		-5.77 (16.04)	
constant	-4,619*** (1,495)		-8,771*** (2,449)		-7,287*** (1,287)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.12: DISTRIBUTIONAL EFFECTS ALL COUNTRIES (FULL MODEL)

	low skill		med-high skill		med-low skill	
	dependent variable: d.real wage					
	esti-mator	90 % intervall	esti-mator	90 % intervall	esti-mator	90 % intervall
d.ExpSh (1 lag)	-1,473*** (511.5)	(-2,324; -622.1)	-2,037 (1,410)	(-4,390; 315.5)	-1,707*** (560.5)	(-2,636; -779.3)
d.ExpSh (2 lags)	-1,359** (659.9)	(-2,456; -260.9)	-165.6 (842.3)	(-1,571; 1,240)	-1,802** (699.4)	(-2,960; -643.7)
d.ExpSh (3 lags)	-576.7 (824.7)	(-1,949; 795.1)	1,604* (823.0)	(231.1; 2,978)	-1,230 (870.4)	(-2,671; 211.4)
d.unempl (1 lag)	-8,292** (3,963)		-12,360* (6,954)	)	-9,684*** (3,631)	
real wage gap (1 lag)	-0.2169*** (0.0578)		-0.2569*** (0.0598)		-0.2866*** (0.0486)	
d.OPS (1 lag)	9.52e-06*** (2.62e-06)		-3.19e-06 (5.32e-06)		1.50e-06 (2.22e-06)	
OPS (1 lag)	-8.74e-06** (3.65e-06)		7.06e-06* (4.02e-06)		1.08e-06 (1.94e-06)	
constant	-4,730*** (1,428)		-9,741*** (2,314)	)	-7,205*** (1,253)	

FE FD estimation, 1997-2005. Standard Errors in parentheses.
Significance: * = 0.1 level, ** = 0.05 level, *** = 0.01 level

Table B.13: DISTRIBUTIONAL EFFECTS ALL COUNTRIES (BEST AIC MODEL)

Appendix C

List of Variables

Abbreviation	Full Name	Explanation	Source
ExpSh	Export Share	share of exports towards the EU-15 relative to gross output of the industry	OECD BTD
MPEN	Import Penetration	$\frac{imports}{grossoutput+imports-exports}$	OECD STAN
OPS	Operating Surplus	gross operating surplus for Hungary (= net OPS + depreciation of fixed capital), net operating surplus for other countries. National currencies.	OECD STAN
R & D	Research and Development	R & D expenses by main activity (by industry served for PL)	OECD website
real wage	real wage	wage p.c. at 1997 price level	OECD STAN CPIs from OECD website
unempl	unemployment rate		OECD website
unitywage	unitywage	see subsection 5.1.2	OECD STAN

In country specific analysis all variables were used in national currencies. In pooled analysis variables were converted to Euros.

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Zusammenfassung

Ich verwende die STAN-Datenbank der OECD sowie verschiedene ökonometrische Verfahren, um in dieser Diplomarbeit die Auswirkungen der Exporte in die Länder der EU-15 auf Löhne in den Visegrád Staaten (Polen, Slowakei, Tschechien und Ungarn) zu untersuchen.

Die Ergebnisse lassen keine klaren Schlussfolgerungen über diesen Zusammenhang zu. Während letzterer über einen kurzen Zeitraum durchaus negativ sein kann, scheint er zumindest in Polen und Ungarn langfristig positiv zu sein.

Klar ersichtlich ist hingegen, dass die Entwicklung der Exporte der untersuchten zentral- und osteuropäischen Staaten nicht den Vorhersagen des Heckscher-Ohlin Modells folgt und somit die darauf aufbauenden Theoreme von Stolper und Samuelson (1941) und bezüglich des internationalen Ausgleichs von Faktorpreisen die zugrundeliegenden Faktoren des Einflusses von Handel auf Faktorpreise nicht hinlänglich beschreiben.

Schlagwörter: Paneldaten, EU-Erweiterung, Handel, Löhne, Faktorpreise, Einkommensverteilung, Zentral- und Osteuropa, Visegrád Staaten

JEL Klassifikation: C23, F14, F15, F16

Abstract

For this thesis, I used the STAN database of the OECD and different econometric methods to investigate the effects of exports towards the EU-15 on wages in the Visegrad countries (Czech Republic, Hungary, Poland, and Slovakia).

The results do not allow to draw any definite statements about this effect. While the impact of exports towards the EU-15 on wages in the countries investigated is likely to be negative in the short run, it seems to be positive in the long run, at least for Hungary and Poland.

Nevertheless, it is clear that the pattern of CEEC-4 exports towards the EU-15 does not correspond with the predictions of the Heckscher-Ohlin model. Therefore, also the theorems of Stolper and Samuelson (1941) and concerning the equalization of factor prices, which are based on the Heckscher-Ohlin model, do not seem accurate to describe the underlying forces linking trade with factor prices.

Keywords: panel data, EU enlargement, trade, wages, factor prices, income distribution, Central and Eastern Europe, Visegrad Countries

JEL Classification: C23, F14, F15, F16