2. Literature Overview

In this chapter, the topic of this research “Agglomerations and regional development in Hungary” shall be positioned in a theoretical and literature context. The appropriate analytical framework will be selected and suitable models will be identified in section 2.1. The new research contribution of this research will be shown against the background of previous empirical studies reviewed in section 2.2. The aim is to infer hypotheses for this research, more concretely on how integration with the EU has influenced industry structure and regional development in Hungary during the period 1992 to 2008 and whether there were direct effects measurable in Hungary’s agglomeration and regional specialization pattern. The hypotheses will be formulated in section 2.3. These will include questions like the following: How has agglomeration of manufacturing industries developed over the period? Which effects could be observed with respect to specialization for the regions in Hungary? And thirdly, where in space have manufacturing concentration processes and certain specialization pattern taken place?

Further, the Europe agreement - which was the main pre-accession policy of the EU and was in force for 12 years of the period encompassed by this research - shall be presented in its main elements in section 2.3, as the regulatory framework is deemed to have shaped economic relations between the EU and Hungary to a large extent. The hypotheses posed by this dissertation shall be formulated in detail towards the end of this chapter in section 2.4. Finally, the data available as a basis for this research shall be presented in section 2.5.

2.1 Theoretical background

In the choice of a stream of theory, it has been taken into consideration what this research is interested in, namely to explain to which extent regional industry structures in Hungary and the degree of agglomeration is influenced by economic integration with the EU. While liberalisation of trade and falling transport costs are certainly important factors playing a role in economic integration, free capital flows (FDI) and technological progress - expressed in advances such as higher productivity due to newer production facilities and fresh know-how in production processes9 - also play a role. As the Europe agreement had a concrete influence on

9 A number of empirical studies prove the benefits of FDI brought about directly or by spill-over effects on the efficiency of production and improvements in competitiveness.
trade volumes and on investors' location decisions with respect to FDI, theories on trade and location have been looked at as a basis.

This theoretical section is structured as follows: section 2.1.1 explains in an overview the choice of theory, while section 2.1.2 contains various models of the NEG. In that part, section 2.1.2.1 presents the basic Krugman (1991a) model, section 2.1.2.2 modifications to the Krugman model, including the one by Livas-Elizondo & Krugman (1996), section 2.1.2.3 the model by Ludema & Wooton (1997), and section 2.1.2.4 the models by Krugman & Venables (1996) and by Puga (1999).

2.1.1 Selection of a stream of theory

The subject of this section is to explain the choice of a stream of theory used as a theoretical framework for this research. To this end, the main theories taken into consideration have been summarized in form of a table. Table 1 gives an overview of theories involving trade and making a statement on the location of industry, generally speaking, or more concretely on industry agglomeration or regional specialization in the context of trade and economic integration.

The three steams of theory which have been examined are: Neo-classical theory, the New Trade Theory, and the NEG.

The distinguishing features of the three schools of theory are as follows:

(i) Neo-classical Theory

The neo-classical theory is based on Ricardo, Heckscher and Ohlin. It is characterised by homogeneous products and constant returns to scale. Location is determined exogenously, given spatial distributions of natural endowments, technologies and factors. Economic activity is spread or concentrated over space according to the spread or concentration of these underlying features. For basic literature, please see the overview in Table 1.

The dominating location pattern is inter-industry specialization: sectors settle in locations with a matching comparative advantage. In this framework, with the assumption of zero trade costs, the spatial distribution of demand affects the pattern of trade, but not the location of production. At prohibitively high trade costs, perfect dispersion of industries producing non-traded goods follows the geographical distribution of demand.

Thus, the neo-classical theory is not judged a suitable framework for this research due to the lack of statements on the regional distribution of industries within a
<table>
<thead>
<tr>
<th>Basic Literature</th>
<th>Neo-classical Theory</th>
<th>New Trade Theory</th>
<th>New Economic Geography</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ricardo, Heckscher, Ohlin</strong> (1933), Balassa (1964, 1985), Samuelson (1948, 1964)</td>
<td><strong>Constant economies to scale, homogenous products, full rents to factor owners, growth through capital accumulation, inter-industry trade</strong></td>
<td><strong>New: intra- and inter-industry trade (globalisation, integration areas); aggregate scale effects due to local spillovers; size of home market (exogenous)</strong></td>
<td><strong>New: existence of transport costs (transport, transaction and trade costs, including NTBs); internal economies of scale; product differentiation; backward-forward linkages</strong></td>
</tr>
<tr>
<td><strong>Market structure</strong></td>
<td>Perfect competition on all markets</td>
<td>Monopolistic competition</td>
<td>Monopolistic competition on industrial markets</td>
</tr>
<tr>
<td><strong>Other assumptions</strong></td>
<td><strong>Constant economies to scale, homogenous products, full rents to factor owners, growth through capital accumulation, inter-industry trade</strong></td>
<td><strong>Natural resource endowments, or factor endowments and intensities; technological differences</strong></td>
<td><strong>Degree of plant-level increasing returns; substitutability of differentiated goods</strong></td>
</tr>
<tr>
<td><strong>Determinants of location</strong></td>
<td><strong>Natural resource endowments, or factor endowments and intensities; technological differences</strong></td>
<td><strong>Degree of plant-level increasing returns; substitutability of differentiated goods</strong></td>
<td><strong>The level of transport costs; Pecuniary externalities (labour markets, input-output linkages, migration-induced demand linkages); strength of centripetal and centrifugal forces; technological externalities (in some models)</strong></td>
</tr>
<tr>
<td><strong>Welfare effects of trade liberalisation</strong></td>
<td><strong>Net welfare gain; all countries gain; owners of scarce factors lose</strong></td>
<td><strong>Net welfare gains; large countries benefit more than small ones; possibly all factor owners gain</strong></td>
<td><strong>Net welfare gains; “u-curve” b of real wage relation of two regions during falling transport costs; periphery versus core can lose at intermediate or advanced stages of integration</strong></td>
</tr>
<tr>
<td><strong>Whether suitable for this research</strong></td>
<td><strong>No: lack of statements on the regional distribution of industries within a country; “Balassa-Samuelson effect” is of certain interest for CEEC-EU context</strong></td>
<td><strong>No (only in part, not ideal): lack of explicit statements on regional location of agglomeration and on the degree of specialization over time</strong></td>
<td><strong>Yes: Formalisation of mechanisms by which even a priori very similar regions can end up with very different production structures; agglomeration and specialization explicitly dealt with; with factor mobility regional industry structures emerge endogenously (static total industry)</strong></td>
</tr>
</tbody>
</table>

Source: Own summary. Notes: a) For a discussion of Ohlin in the light of NEG, see Krugman’s essay “Was it all in Ohlin?” (Krugman 1999).

b) For an explanation of the u-curve, see the text at the end of section 2.1.2.1.
country. The so-called “Balassa-Samuelson effect” is nevertheless interesting for explaining certain broad developments in the CEEC-EU context (see in chapter 3, section 3.2.1).

(ii) New Trade Theory:

The models of the New Trade Theory take as exogenous only market size, while the other elements are no longer taken as exogenous. Market size is determined primarily by the size of the labour force in a country, and labour is immobile internationally. For industrial products, these models introduce imperfect competition, differentiated products and increasing returns to scale. The typical outcome is inter-industry specialization of countries, with sectors clustering near large product markets, as well as intra-industry specialization across firms producing a different variety of good each. As long as some firms are left in the smaller market, intra-industry trade will prevail. As trade costs fall towards zero, all increasing returns activity will tend to concentrate near the core market, and intra-industry trade between the core and the periphery vanishes.

*New Trade Theory* is not fully suitable as a framework for this research, as it lacks explicit statements on regional location of agglomeration and on the degree of specialization over time.

As the existence of increasing returns to scale plays a role in *New Trade Theory* as well as in the models of the NEG, an overview on these scale economies shall be given here, which is based on the survey by *Pratten (1988)* conducted in context with the Single Market programme. The author categorised different types of economies of scale. *Pratten* defined economies of scale as “reductions in average unit costs attributable to increases in the scale of output”. Based on estimations of the importance of scale economies in the EU by means of engineering estimates, he concluded that the apparently lower degree to which manufacturing firms in Europe seem to exploit economies of scale in comparison to their Japanese or US counterparts, when judging from their size, should be a cause for concern. The dimensions of economies and diseconomies of scale are summarized in Table 2.

(iii) New Economic Geography:

In the models of the *New Economic Geography (NEG)*, the location of industry becomes entirely endogenous. As production factors and firms are mobile, even market size is explained within the model. In a set-up with two or three regions over which labour and output of industry is uniformly distributed at the start, externalities, input-output linkages and other factors produce self-reinforcing agglomeration processes. The economy will tend towards new locational equilibria in the medium-term.
In NEG models there are many possible and locally stable equilibria, i.e. of the distributions of industry and workers over a given regional space which remain constant as such over a certain period. Which pattern is attained depends on the initial distribution of workers and industry, on various industry characteristics, and on the assumptions regarding the mobility of workers. The strength of centripetal and centrifugal forces - forces attracting workers and firms towards the centre, or in the latter case, inciting them to relocate in the periphery - will shape the form of the equilibrium attained.

Table 2: Overview of economies and diseconomies of scale

<table>
<thead>
<tr>
<th>Economies of scale exist in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Production:</td>
</tr>
<tr>
<td>• the total output of particular products over time,</td>
</tr>
<tr>
<td>• the duration of production runs,</td>
</tr>
<tr>
<td>• the rate of production of particular products per unit of time (incl. the size of batches),</td>
</tr>
<tr>
<td>• the extent of standardization of components and products,</td>
</tr>
<tr>
<td>• the capacity of units of production lines or of individual plants,</td>
</tr>
<tr>
<td>• the overall size of plants at one site, and</td>
</tr>
<tr>
<td>• the extent of vertical integration;</td>
</tr>
<tr>
<td>2) Selling and distribution costs:</td>
</tr>
<tr>
<td>• sales to each customer,</td>
</tr>
<tr>
<td>• the geographic concentration of customers, and</td>
</tr>
<tr>
<td>• the size of consignments to customers;</td>
</tr>
<tr>
<td>3) Overall dimensions of scale:</td>
</tr>
<tr>
<td>• the size of firms,</td>
</tr>
<tr>
<td>• the scale of an industry, and</td>
</tr>
<tr>
<td>• the scale of a national economy.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diseconomies of scale include</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) A fixed supply of a production factor, or increasing cost of a factor as demand rises:</td>
</tr>
<tr>
<td>• the labour supply in an area,</td>
</tr>
<tr>
<td>• the space available at one site for a factory,</td>
</tr>
<tr>
<td>• the supply of water which can be taken from a river for cooling a plant, and</td>
</tr>
<tr>
<td>• the size of a ship which can dock at a port;</td>
</tr>
<tr>
<td>2) The efficiency in the use of factors of production may decline with increases in scale due to:</td>
</tr>
<tr>
<td>• technical forces,</td>
</tr>
<tr>
<td>• management,</td>
</tr>
</tbody>
</table>

Source: Own summary based on Pratten (1988).
The level of trade costs or transport costs over time - in the course of integration processes - plays a decisive role. NEG models make certain predictions about the location of industry and the degree of regional specialization during economic integration processes. While trade costs were falling between countries due to the measures implied by a customs union and technological progress in the transport industry, they are also falling between regions within a country, not only due to the latter, but also due to infrastructure improvements such as those implied for beneficiaries of the European regional policy and the respective pre-accession instruments\textsuperscript{10}.

During European economic integration in particular, trade costs between member states in the form of tariffs and quotas had been eliminated by 1968 when the customs union formed among the six founding member states had been completed and subsequently widened to the member states acceding to the EU in various EU enlargements. Since then, trade costs in the form of non-tariff barriers (NTBs), border controls and customs formalities, as well as transport costs played the dominant role. NTBs comprise these national rules and regulations regarding safety and health standards, packaging and labelling requirements, national certifications, norms and standards, to name just a view. Where later in this research the word of declining "transport costs" is used to describe the process of economic integration, this is meant to comprise all of these aspects, i.e. it is used synonymous to the notion of "trade costs".

NTBs have played a prominent role as trade impediments during European integration between member states since 1968. In its jurisdiction, the European Court of Justice and the European Commission have tried to combat them based on rulings such as the famous "Cassis de Dijon" case.\textsuperscript{11} Furthermore, in an effort to enhance competition and further trade liberalisation with respect to these NTBs, the European Single Act of 1986 has explicitly attacked NTBs and national product market regulations as well as the mutual recognition of professional and university diploma with the Single Market programme.

NEG is chosen here as the suitable stream of theory. With factor mobility, regional industry structures are emerging endogenously, given a static total of industry. NEG contains the formalisation of mechanisms by which even a priori very similar regions can end up with very different production structures.

\textsuperscript{10} In the case of Hungary and the other CEECs, this was called ISPA.

\textsuperscript{11} Official Journal of the European Communities, Series L 120/78 (Rewe/ Bundesmonopolverwaltung für Branntwein), Jurisdiction No. 1979. Subsequently, the European Commission sent the new interpretation of the articles 30-36 of the Treaty on the European Economic Community, which was based on this ruling, to all member states, and established a supervision by the Commission in this area.
Regional effects of economic integration can be deducted from the models, and the location of industry in space can be predicted over time. The processes of the formation of industry agglomerations and of the specialization of regions are explicitly dealt with in NEG.

### 2.1.2 NEG models

This section will now look at important models of NEG, and in particular at those models thought of potential relevance for explaining the actual development of industry agglomeration and regional specialization in Hungary in the context of European integration since 1992.

Economic integration processes are constructed in NEG models via transport costs falling over time. Transportation of goods is subject to “iceberg” transport costs as first modelled by Samuelson: rather than modelling a separate transportation sector, it is supposed that a fraction of a good shipped simply melts away or evaporates in transit (Fujita et al. 1999). For 1 unit from region 1 to reach its destination in region 2, $n = l + \tau$ units must be shipped, where $n > 1$. $\tau$ is meant to include trade barriers (tariffs, quotas and NTBs) as well as ordinary transportation costs. This is then manifested in higher prices for industrial goods imported from another region (or country) as compared to the locally produced industrial goods.

The basic Krugman (1991a) model is described in its main elements in section 2.1.2.1, as are some variants of that model, such as those extending to more than two regions (section 2.1.2.2), and in particular the model by Livas-Elizondo & Krugman (1996) which models the effects of trade liberalisation on the internal economic geography of a country. The model by Ludema & Wooton (1997) - see section 2.1.2.3 - which allows for partial agglomeration and partial inter-regional migration of workers - is described in more detail than the Krugman model, as that model is of particular interest for the empirical research on industry agglomeration in Hungary under the Europe agreement. Finally, the model by Puga (1999) is described in section 2.1.2.4 as it makes explicit statements on agglomeration and specialization during integration processes, as is the model by Krugman & Venables (1996) for that same reason.

### 2.1.2.1 The basic Krugman model

The model by Krugman (1991a) which was the starting point of the new wave of models and theoretical approaches called “New Economic Geography” set out in an effort to explain the relatively persisting shape of manufacturing in the U.S.A.
Krugman\textsuperscript{12} considered the formation of the US manufacturing belt during the industrial revolution and the continued relevance of that concentration of manufacturing industry, with the location of one third of the U.S. population today still in the original 13 states, as well as with the formation of a new industrial centre to the West in the Silicon Valley. He sees a long shadow cast by history coupled with what he calls “accident” over the location of production. The view by McCarty (1940) that “outside the manufacturing belt, cities exist to serve the farms; inside, farms exist to serve the cities”\textsuperscript{13} must have enticed Krugman to the stylized facts which his NEG model is based on.

In his model, Krugman (1991a and 1991b) considers an economy with two sectors, manufacturing and agriculture. The agricultural sector produces a single homogeneous good under perfect competition; the total quantity is $C_A$, whilst the manufacturing sector is characterized by monopolistic competition. A large number of potential firms can each produce one differentiated product; products are symmetric in the sense that consumers do not prefer one product to another; consumers have, however, preference for variety. The behavioural assumptions are as follows: consumers maximize their utility functions $U(C_A, C_M)$ given their budget constraints.\textsuperscript{14} There is free entry for firms; and firms maximize profits.

Further, it is assumed that the only production factor in the economy is labour, more concretely two types of labour: workers who produce the manufactured goods, and farmers who produce the agricultural good. The agricultural sector works with constant returns to scale, while each variety of manufacturing goods is produced with increasing returns to scale.

Geography enters in Krugman's basic model in the way that the economy consists of two distinct regions, East and West. The transportation of manufactured goods between regions is costly; exogenously given transport costs in the iceberg form are incurred, i.e. he assumes that a certain fraction of the goods does not reach its destination.\textsuperscript{15} Transport costs for agricultural goods are assumed to be non-existent. And the initial distribution of manufacturing firms is taken as given by some historic factors which are, however, difficult to grasp or explain logically.

\textsuperscript{12} Paul Krugman was granted the Nobel Prize in Economics for his work in 2008, including for the articles which started the stream of theory now referred to as “New Economic Geography”.


\textsuperscript{14} Consumers’ utility function is described more in detail in context of the Ludema & Wooton model in section 2.1.1.3.

\textsuperscript{15} Iceberg transport costs are explained more in detail in context of the Ludema & Wooton model in section 2.1.1.3.
With regards to the mobility of labour, *Krugman (1991a)* assumes that agricultural labour continues to be immobile, while manufacturing labour always moves to the region which offers the higher present real wage. More concretely, the population of manufacturing workers moves to the high wage location at a speed that is proportional to the present wage differential. In equilibrium, both regions must either offer the same manufacturing wage (symmetric situation), or the (complete) manufacturing population must be concentrated in the region offering the higher real wage. The latter is the case of (complete) industry agglomeration in one region. In Krugman’s model, *agglomeration becomes irreversible.* For such a constellation to be robust, no firm must have an incentive to build a plant in the periphery. For an illustration, please see Figure 1.

**Figure 1:** Centripetal and centrifugal forces acting on the firm in the centre-periphery equilibrium with agglomeration according to the *Krugman (1991a)* model

![Diagram showing centripetal and centrifugal forces](Source: Own graphical illustration based on *Krugman (1991a).*

**Figure 1** shows the centripetal and centrifugal forces working on the firm in the Krugman model for the equilibrium with agglomeration. The first *centripetal* force is that one acting on firms in the centre, i.e. in the agglomeration. A firm wanting to move to the periphery would need to induce manufacturing workers to move to the periphery. As they will have to import most consumption goods from the centre, the costs of living are higher in the periphery. As a result, the firm
would need to pay higher wages in the periphery, which drives up the output price.

The second centripetal force is the fact that the majority of the firm’s customers live in the centre. Serving them from the periphery would involve transportation costs making the product more expensive, thus another reason to stay in the centre.

The third is a centrifugal force, namely the agricultural population in the periphery could be served cheaper if the firm produces in the periphery. Basically, an agglomeration equilibrium in the Krugman (1991a) model - with complete agglomeration of manufacturing industry in one of the two regions - results when the last, centrifugal, effect is small relative to the first two, centripetal effects.

The Ludema & Wooton model, which is described in section 2.1.2.3, will add further assumptions to the location of firms and workers between centre and periphery during regional integration.

2.1.2.2 Modifications to the Krugman model

While the basic model by Krugman (1991a and 1991b) captures important aspects of regional patterns of location of industry and agriculture, it relies on a number of assumptions which have a high level of abstraction. More complex model variants change the results of this model only slightly, as the interactions between agglomerating forces and centrifugal forces remain valid, according to Fujita et al. (1999). The relation between transportation costs, scale economies and agglomeration patterns, and the role of history for the formation of agglomeration in a region will not be altered in their basic statements by model modifications. If some of these assumptions are relaxed, however, the modified model scenario may lead to additional insights on the spatial pattern. This section shall give an overview of some of these further developments.

The assumptions in the basic Krugman model which were relaxed in subsequent literature are:

(1) There are no negative externalities between firms, such as due to pollution or congestion;

Schmutzler (1999) pointed to a paper by Brakman et al. (1994) which modified the Krugman model by introducing negative technological externalities in a multi-region version, adding the assumption that the fixed and marginal costs associated with production of an industrial good depend positively on the number of firms in the location, thus capturing a congestion effect. Those negative congestion
externalities make production in the dominant manufacturing region excessively costly. This leads to an equilibrium where agglomeration is usually not complete, and where some firms will find it profitable to move to the less congested periphery.

(2) No market for housing and land; both regions offering identical wages;

Further, a modified version of a 3-region set-up is the more recent paper by Brülhart et al. (2004) produced in the perspective of further enlargement of the EU to the East. They use that model to stipulate that an Eastern enlargement of the EU by Croatia or other countries in the Balkans would benefit Greece economically. Livas-Elizondo & Krugman (1996) introduced urban land rents and commuting costs, which add a centrifugal force. This model is very interesting for this research, as it explicitly models the effect of trade liberalisation on the internal geography of a nation. It will be described more in detail under point (4). When farming and housing are space-consuming activities, agglomerations have to offer higher wages to compensate for commuting costs and land rents. This additional centrifugal effect will reduce both the likelihood of an agglomeration and its size.

(3) There are only two regions;

In the basic Krugman model, there are only two locations, East and West. As Schmutzler (1999) points out, however, the main insights generated in the two region framework about history, the relation between transportation costs, scale economies and agglomeration patterns are robust to the relaxation of this assumption. With many potential locations, however, agglomeration and decentralization are not the only possible equilibria. In particular, multiple agglomerations in different regions are conceivable as equilibria.

Krugman himself modified his basic model (in 1992, 1993, and 1994) to introduce more regions, namely 12 equidistant regions. Given various initial distributions of manufacturing in these regions and an appropriate generalisation of the process of adjustment to regional wage differentials, a great number of equilibrium constellations exist. The typical equilibrium in such a set-up involves agglomeration in more than one region, mostly either in two locations or sometimes in three. This is an interesting outcome which could be useful for explaining the shape of industry agglomerations in Hungary and its 20 regions during the research period. To give a slight hint already at this point of what is analysed in more detail in chapters 3, 4, 5, Hungary has developed two agglomeration centres during the later 1990s and early 2000s, namely in the centre of Hungary around Budapest, and in the West near the border with the EU-15.
Trade liberalisation between countries is not modelled, in particular the effects on the internal geography of a country;

A very interesting variant of the Krugman model is the multi-region model by Livas-Elizondo & Krugman (1996) aimed at modelling the effects of trade liberalization on the internal geography of a nation. They take a three-region model, where two regions can be regarded as different regions within the boundaries of one country integrating with each other, while the third region may be a different country, or the rest of the world. The assumption of relatively low transportation costs between the first two regions within the same country can then be interpreted as the absence of trade barriers. Labour is perfectly mobile between domestic regions, but not between domestic regions and the rest of the world. Transportation of goods is subject to “iceberg” transport costs, however of different size, one for transports within the country, the other - higher one - for imports. This second one includes trade barriers (tariffs, quotas and NTBs) as well as ordinary transportation costs. The fraction of manufacturing goods provided by the rest of the world is exogenous in the model. Regions are modelled to capture the centrifugal forces including due to land rents and commuting costs in agglomerations.

In such a framework, one can investigate how trade barriers affect the manufacturing pattern (within countries). Livas-Elizondo & Krugman (1996) aim at explaining the emergence of many of the world’s largest cities (metropolis) in Third World countries. As a possible explanation for this, they state that there is a negative relation between geographical concentration within a country and the degree of trade liberalization of this country. Namely, at very high international transportation costs, there will be no international trade. If an agglomeration exists within the two-region country, then it will be the only supplier of manufacturing goods for consumption in the country, and the local demand for the cheaper goods will be higher.

A significant reduction of trade barriers reduces the importance of these centripetal forces: as the economy becomes more dependent on international markets, local demand is less important. In the region with the agglomeration, land rents and commuting costs are high. Firms will be attracted to the other region because they can pay lower wages there. Numerical simulations of the authors showed that for very low international transportation costs, only the decentralized equilibrium will be sustainable, while for intermediate ranges, there are multiple stable equilibria: agglomerations in both regions and the decentralized equilibrium, where manufacturing is spread evenly across regions. Schmutzler (1999) points out that this outcome is not inconsistent with the basic Krugman model, as the reduction of transportation costs between two regions could lead to complete agglomeration in one region, whereas in this three region model, they are
considering transportation costs between the two regions and the rest of the world; so as the set-up is different, the resulting effect can well be different.

In the latter case, namely very low international transportation costs, Livas-Elizondo & Krugman (1996) show that trade liberalisation tends to break up geographical concentration within an economy, i.e. enabling agglomerations in both regions, or the decentralized equilibrium. This implies that with falling trade costs, regional specialization will first rise, then fall again as geographical concentration of industry is breaking up.

This could be an interesting idea for the context of industry agglomeration in Hungary during the trade liberalisation period of the Europe agreement. As a caveat, it shall be mentioned here that it is difficult to have data for the falling level of international transport costs. While some figures for international transport costs per se are shown in section 2.2.3 of this chapter, the EU keeps data on the level of tariffs and quotas between the EU and Hungary after the start of the Europe agreement confidential.\footnote{Those were not even made available to Commission internal authors, such as John Sheehy from DG Economics and Financial Affairs writing in 1993 and 1994. I have found data on the level of tariffs and quotas between the EU and Hungary only for the years 1989, 1990 and 1991, in: European Commission (1994).}

2.1.2.3 The model by Ludema & Wooton

The model by Ludema & Wooton (1997) differs from the basic model by Krugman (1991a), who assumes complete mobility of manufacturing workers, in that it takes additionally account of partial immobility of workers. Due to this assumption, the model is able to explain regional structures in which industry is spread unequally in space, yet not fully concentrated in only one region. These somewhat more realistic scenarios regarding agglomeration may be of interest for the interpretation of the empirical results on agglomeration of the manufacturing industry in the 20 regions in Hungary (see chapters 4 and 5). A large part of NEG-models based on the basic model by Krugman does not allow for such a spread of industry, but only for complete agglomeration of industry in one region or an equal spread over both regions, which diminishes the political relevance of those models. The model by Ludema & Wooton (1997) has been discussed by various authors before, such as Schmutzler (1999), and by Lammers & Stiller (2000) in the context of suitable regional policy goals for the EU.

In the following, the Ludema & Wooton model shall be described more in detail with a view to an interpretation of the empirical results obtained for industry
agglomeration and regional development in Hungary under the Europe agreement in this research. The model starts out with the following assumptions:

- There are two homogenous regions, North and South.
- There are two production sectors:
  - the agricultural sector production homogenous agricultural goods, at constant economies of scale, and
  - the industrial sector producing differentiated industrial products, with increasing economies of scale.
- All individuals have preferences for product diversity, according to their utility function:

\[
U = C_M^\mu * C_A^{1-\mu}
\]

where \( C_A \) is the consumption of the agricultural goods, \( C_M \) the consumption of an aggregate of industrial goods, and \( \mu \) the share of spending on industrial goods. With \( c_i \) as consumption of the product variant \( i \), the aggregate of industrial goods \( C_M \) is defined as:

\[
C_M = \left[ \sum_{i=1}^{k} c_i \right]^{\frac{\sigma}{\left(\sigma - 1\right)}}
\]

with \( \sigma > 1 \)

where \( k \) is the number of potentially producible industrial goods and \( \sigma \) is the elasticity of substitution between industrial goods, which are close but not perfect substitutes.

The next set of assumptions concerns the production factors:

- full employment of the production factors prevails at all times;
- agricultural workers are producing the agricultural goods, and industrial workers producing the industrial goods;
- agricultural workers cannot become industrial workers and not vice versa either;
- the number of industrial workers and agricultural workers is given exogenously;
- agricultural workers are completely immobile and equally distributed over both regions;
- industrial workers, however, are mobile to a differentiated extent due to regional preferences: It is assumed that workers prefer either of the regions as a personal preference, independently of the income level, as their place of work and living. \textit{Ludema} \& \textit{Wooton} take account of the different individual extent of those regional preferences by introducing a "discount
factor” applied to the income of the other region, which enters into the decision making of the industrial workers.\textsuperscript{17}

The assumptions made regarding transport costs are:

- the transport of agricultural goods between the two regions is assumed to be free of cost. Therefore, the price of the agricultural goods and the income of agricultural workers are equal in both regions.
- the transport of industrial goods between the two regions, however, is subject to transport costs in the “iceberg form” described by Samuelson: rather than modelling a separate transportation sector, it is supposed that a fraction of a good shipped simply melts away or evaporates in transit (\textit{Fujita et al. 1999}). In order for consumers in the target region to receive \( I \) unit of industrial goods, \( T > 1 \) units have to be shipped. This is manifested in higher prices for the imported industrial goods as compared to the locally produced industrial goods.

Assumptions regarding industrial firms and the regional distribution of industrial goods:

- all industrial goods are produced with increasing returns to scale;
- in equilibrium, production costs equal sales revenue due to the assumption of free market entry (i.e. zero profits);
- each firm produces one product variant, each firm a different one. The number of product varieties is therefore equal to the number of firms;
- each product variant is either produced in region North or in region South;
- the number of firms in a region is proportional to the number of workers in a region:
- consumers always want to buy all product variants, such that they must be transported between the regions.

Thus in the \textit{Ludema & Wooton} model, there are 3 exogenous influences on the equal distribution of industrial goods producers (industrial workers and firms):

1. the size of transport costs - \( \tau \),
2. the part of expenditure spent on industrial goods in the utility function - \( \mu \), and
3. the elasticity of substitution between industrial goods - \( \sigma \).

\textsuperscript{17} The higher the regional attachment of the industrial worker, the higher the discount factor, and thus the lower is the interregional mobility of industrial workers (\textit{Ludema & Wooton 1997}).
Endogenous to the model is the determination of the distribution of workers and firms between the two regions North and South, as are the regional wages (nominal and real wages). Those in turn are determined by the decisions of firms and industrial workers, which depend on the strength of agglomerating and centrifugal forces:

- A centripetal force is the aim of firms to locate near the largest market, i.e. in the region with more workers (as agricultural workers are equally distributed). For industrial workers, it is advantageous to live also in that region, as their real income is higher there due to the larger choice of product variants available locally. These two forces both reinforce a process of geographic agglomeration.

- The centrifugal force is the following: in the region with less industrial workers, called the "periphery", the demand for industrial goods by the immobile agricultural workers and the (small) number of industrial workers is an interesting location for firms seeking less intensity in competition, as less firms are located in this region. Thus for firms, there is a trade-off between being close to the larger market in the agglomeration and benefiting of less intense competition in the periphery (also according to Krugman 1991b).

The regional real wages, resulting from a combination of regional price index and nominal wages, differ in a situation of unequal regional division of industrial workers and firms for 3 reasons:

- due to the **home-market effect**: nominal wages are *ceteris paribus* the higher, the larger the local market;

- due to the **price index effect**: the price index is lower in the region with the larger market, this is due to the transport costs for imported goods as the greater number of (cheaper) local product variants is available there;

- due to the **competition effect**: in the smaller market, the intensity of competition is weaker and the profit maximizing price under certain conditions higher; the firms in the region with less industry will then pay higher nominal wages due to the zero profit assumption for firms.

The home-market effect and the price index effect tend to work as centripetal forces reinforcing agglomeration, while the lower competition in the smaller market tends to work as a centrifugal force. Which effect of these three is dominant in the Ludema & Wooton model, depends on the level of transport costs (thus the price difference between imported and locally produced industrial goods) and on the strength of regional preferences of workers.
**Ludema & Wooton (1997)** distinguished the following transport costs:

- Relatively high $\tau$: the real wage is higher in the region with fewer industrial firms;
- Medium $\tau$: the real wage is higher or lower in the region with fewer industrial firms;
- Relatively low $\tau$: the real wage is higher in the region with more industrial firms (in the agglomeration);
- Very low $\tau$: the real wage is higher in the region with more industrial firms (in the agglomeration).

Long-term *equilibrium* is characterized by the non-existence of incentives to migrate. As industrial workers do have a regional preference, real wage differentials may exist even in equilibrium in the *Ludema & Wooton* model. The inter-regional difference in real wages, which will trigger the decision to migrate of the industrial worker, depends on the strength of the individual’s regional preference.

**Table 3: Possible equilibria depending on the level of mobility of industrial workers and on the level of transport costs**

<table>
<thead>
<tr>
<th>Low mobility of industrial workers (= strong regional preference)</th>
<th>High mobility of industrial workers (= low regional preference)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relatively high or medium transport costs</strong></td>
<td><strong>Case 1</strong></td>
</tr>
<tr>
<td>Symmetric equilibrium; no regional income differentials</td>
<td>Symmetric equilibrium; no regional income differentials</td>
</tr>
<tr>
<td><strong>Relatively low transport costs</strong></td>
<td><strong>Case 2</strong></td>
</tr>
<tr>
<td>Symmetric equilibrium; no regional income differentials</td>
<td>Asymmetrical equilibrium; regional income differences prevail; “u-shaped” relationship between transport costs and the relation of real wages</td>
</tr>
<tr>
<td><strong>Very low transport costs</strong></td>
<td><strong>Case 3</strong></td>
</tr>
<tr>
<td>Symmetric equilibrium; no regional income differentials</td>
<td>Symmetric equilibrium; no regional income differentials</td>
</tr>
</tbody>
</table>

Source: Summary based on *Ludema & Wooton (1997)* and *Lammers & Stiller (2000)*.

Depending on the level of transport costs and the preference to migrate, different equilibria can form in the *Ludema & Wooton* model. A symmetric equilibrium is defined as an equal distribution of industry over both regions. In five cases, a
symmetric equilibrium will come about in which no regional income differentials prevail. This is namely the case for relatively high or medium level transport costs, and for very low transport costs, both no matter the strength of regional preference of industrial workers; it is also the case for relatively low transport costs combined with low mobility of industrial workers.

Table 3 gives an overview of these 6 cases, where a small change in transport costs in the course of proceeding integration may have a decisive influence on the regional equilibrium and the distribution of economic activity (industrial firms and industrial workers). Falling transport costs from medium to relatively low levels will initially strengthen agglomerating forces, and when falling even further, will weaken them, reversing into a centrifugal force (due to external diseconomies\(^{18}\)).

The interesting case of this model is case 5, the \textit{Symmetric equilibrium} which will come about when relatively low transport costs are combined with a high mobility of industrial workers. In this asymmetric equilibrium, both regions have some industry, however to a different extent. In the larger region, higher real wages prevail; some workers, however, will never migrate to the larger region due to their regional preference for the other region. Thus, a complete agglomeration of industry in one region, leaving the other region void of industry - as in the Krugman (1991a) model where the agglomeration is even irreversible - will never come about in the Ludema & Wooton model.

Reading Table 3 column-wise from top to bottom and staying in the right column, thus with a high mobility of industrial workers, economic integration associated with falling transport costs will start by an equal spread of industry over both regions, then at relatively low transport costs, pass through an equilibrium with agglomeration of most industry in one of the regions (\textit{case 5}); at this stage, regional specialization will be highest. And finally, with still falling transport costs to very low levels, set about a re-location of firms and industrial workers from the centre back into the periphery. In this latter process, real wages in the periphery will rise and attract industrial workers and firms until a symmetric equilibrium with equal distribution of industry and no differences in real wages has come about. This will entail a falling degree of regional specialization.

This process just discussed in the proceeding paragraph is of interest in analysing the empirical findings for industrial agglomeration and regional development (per capita income) in Hungary during the period of this research. Namely, it will be interesting to view industry agglomeration, the inter-regional migration of

\(^{18}\) For concrete examples of external diseconomies, see my overview of Pratten (1988) on the subject of scale economies, in section 2.2.1.
workers, the development of industrial wages and the degree of regional specialization in the light of predictions on equilibria cases 4, 5 and 6 of the Ludema & Wooton model. This would take as a premise that the inter-regional mobility in Hungary was that of industrial workers and could be categorized as “relatively high” (for empirical data on the inter-regional mobility in Hungary, see chapter 3 section 3.5).

2.1.2.4 The models by Krugman & Venables and by Puga

For the sake of completeness of this overview of relevant NEG models, the article by Venables (1996) shall be mentioned first. Venables introduced backward-forward linkages in an international trade context into the set-up of an NEG model in order to deal with the effects of decreasing trade costs on economic geography. Notably, he considered two monopolistically competitive industries (instead of one as in the Krugman model) which are in an upstream-downstream relationship. He assumed that labour is immobile. Nevertheless, concentration of the sales of manufacturing industry in one of the two initially identical regions may result: upstream firms benefit from being in locations with many downstream firms since they can serve customers more cheaply; and downstream firms benefit from being in a location with many upstream firms because this decreases their input costs. The region with the concentration of manufacturing industry sales becomes specialised in that respect.

In that setting by Venables, the effects of integration on the likelihood of agglomeration are non-monotone. As trade costs decrease from very high to medium level, clustering forces come to dominate, and industrial agglomeration is likely to form, giving rise to regional wage differentials. At very low trade costs, however, such wage differentials are not sustainable: industry relocates in response to wage differences, so that a dispersed pattern of production re-emerges as the equilibrium.

In a more recent paper, Overman et al. (2008) build on the assumption of backward-forward linkages and combine the framework of the NEG models with some aspects of the urban systems literature. They aim to explain why the impact of a positive shock is in some sense shared between regions when they are in a complementary relationship with each other, but when they are in a competitive relationship instead, the positive shock to one region has a negative impact elsewhere. Their explanations depend on what they call three relationships: the earnings-employment relationship which captures the supply side of the economy (increasing or decreasing returns to expanding employment in a region); the “cost-of-living” relationship capturing the effects of the employment level on prices of goods and assets; and third the “migration” relationship linking population
movements between regions. They produce a specific diagrammatic framework to explain the different potential outcomes for those regional set-ups based on the strength of forces in the three relationships, which is, however, not directly applicable in the context of this research.

*Krugman & Venables (1996)* ask the question whether increasing integration will make countries more or less similar in their industry structure, i.e. on the degree of specialization. This model is interesting, as this research will deal with the question of specialization of regions in Hungary in chapter 5. Their model is a variant of the *Venables (1996)* model, in that two monopolistically competitive industries are no longer in a clear upstream-downstream relationship, but instead, the product of each industry can be used either for consumption or as an input. Each industry uses inputs from the other sector as well from its own. Crucially, such intra-industry linkages are assumed to be more important than inter-industry linkages. Labour is assumed to be internationally immobile, but can move between different sectors as a response to the sector offering the higher present real wage.

The outcome with respect to agglomeration is the following: at high levels of transport costs, there is never agglomeration. There is a range of transport costs - medium level - for which agglomeration may, but need not occur. And at sufficiently low transport costs, only agglomerated equilibria are stable. Therefore, economic integration in this model first makes agglomeration possible, and then, if transport costs become low enough, makes it necessary. This outcome is subject to the condition that input-output links and the consequent cost and demand linkages are stronger within each of the industries than between them. If that condition is reversed, however, each location will always have some of each industry, as firms then derive more benefit from proximity to firms in the other industry than their own.

With respect to (country) specialization, *Krugman & Venables (1996)* predict that in the process of proceeding economic integration and declining transport costs, each country will develop agglomerated industrial districts. Specialization will take place in the way that each country will lose its presence in one of the industries. This will initially cause adjustment problems, as workers of that industry will suffer a loss of real wages. In the end result of this process, however, real incomes will rise, and in addition to the usual benefits from integration, cost savings will be realized from the benefits of agglomeration.

In a different model by *Puga (1999)*, the effects of regional integration and regional differences in production structures and income levels are analysed with respect to agglomeration and regional specialization. This model is of particular
interest for this research, as it describes the process of industry concentration during integration when depicted graphically as an Ω-shaped relationship. To give a hint at this point, this is very close to the actual findings of manufacturing industry concentration in Hungary during European integration, as will be analysed in detail in chapter 4.

Figure 2: The „u-curve“ for industry shares in two regions’ economic integration processes

![Graphical illustration of the relationship between the level of transport costs and industry shares in two regions.](image)

Source: Graphical illustration based on the *Ludema & Wooton (1997)* model and on *Lammers & Stiller (2000)*.

Before going into detail, the notion of the so-called “u-curve” of NEG models shall be explained here. The “u-curve”19 has been formalised in a three-country setting with regional integration by *Puga & Venables (1997)*.20 The graphic illustration of the relationship between the level of transport costs during

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19 A different “u-curve“ exists in models of business administration. That u-curve by *Michael Porter (1990)* describes the relationship between a firm’s profitability and market share: high profitability for the specialised firms with small market shares and also for the generalists with large market shares, low profitability for those “stuck in the middle”.

20 Their model allows for input-output linkages and for factor price changes in response to complete specialization in the production of the increasing-returns to scale industry. Countries are identical in endowments and size, but at a critical threshold of regional integration, agglomeration forces endogenously trigger a discrete formation of a core-periphery division among participating regions of the country (as production factors are internationally immobile). Further integration leads to a gradual re-dispersion of the increasing returns-to-scale activity within the integrating area.
integration and the relation of real wages in the two integrating regions takes the shape of a "u" and is therefore called the "u-curve". This is shown in Figure 2.

In addition, *Puga & Venables (1997)* showed that locational changes of industry along a "u-curve" can have considerable welfare implications, since welfare gains accrue disproportionately to the core or centre, while the periphery can suffer absolute declines in welfare in an intermediate interval of trade costs. The "u-curve" hypothesis has been used in the *Ludema & Wooton (1997)* model and by *Puga (1999)*. The latter considers it of empirical relevance based on the findings by *Hanson (1998)* in the context of US-Mexican integration in the NAFTA setting, and by *Brülhart & Torstensson (1998)* in the EU context (for details of that empirical work, see section 2.2.3).

Now turning towards the details of the model by *Puga (1999)*, he assumed that the world is populated by L workers, consists of two regions, region 1 and region 2, which are endowed with K_1 and K_2 units of arable land. Each region can produce both agricultural and industrial output. Land is used only by the agricultural sector. The industrial sector produces differentiated products under increasing returns to scale. Labour is used by both sectors and is assumed to be perfectly mobile between sectors within each region, and immobile between regions. Agglomeration without labour migration across regions takes each region's labour endowment as fixed. The requirement that in equilibrium real wages must be equalised across regions is dropped.

For agglomeration without inter-regional migration, as a first stage with high trade costs, when firms concentrate in a region, they must draw workers solely from the agricultural sector in the same region, and this drives up local wages. Higher wage costs tend to discourage firms from clustering together. Yet the agglomeration of industry can still be an equilibrium if firms more than make up for higher wages by being close to other firms, thus avoiding trade costs on purchases of intermediates and sales to other firms. Secondly, at intermediate trade costs, agglomeration forms, which is a partial agglomeration in Puga's model. One region attracts more industry due to demand and cost linkages than the other. Regional specialization is rising to its highest level then.

At trade costs still falling to very low levels, starting from the equilibrium with (partial) agglomeration, industry will spread out across regions again. Concentration will decrease, and so will regional specialization. This is because then the cost saving of firms from being able to buy intermediates locally instead of having

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21 In an appendix, *Puga (1999)* also derives some of the main results for any number of regions; however, that generalisation adds little to the two region case as long as trade costs change symmetrically.
to import them falls with trade costs, but the wage gap between regions remains. At some point, a firm finds it worthwhile to re-locate to the de-industrialised region, and combine imported intermediates with cheaper local labour. In this case, relocation to the de-industrialised region will continue until symmetry between regions is re-established. This is associated with the lowest regional specialization levels.

Depicted graphically, the above process results in what Puga calls "an Ω-shaped relationship" between the concentration of industry and falling trade costs. This is illustrated in Figure 3.

**Figure 3:** Industry shares in the two regions during a gradual process of integration without inter-regional migration: Ω-shaped relationship

The graph in Figure 3 shows the Ω-shaped relationship for industry concentration or agglomeration to happen in one region and falling trade costs as described by the Puga (1999) model. At high trade costs, firms want to be where final demand is, so they split between the regions (symmetric equilibrium). As trade costs fall below some critical level at which the symmetric equilibrium becomes unstable, the share of industry in one of the two regions rises gradually until it absorbs all firms (complete agglomeration). Thus at intermediate levels of trade costs, firms cluster in one region to exploit cost and demand linkages. Without

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22 Puga (1999) describes this Ω-shaped relationship for a gradual process of integration. He adds, however, that whether there is discontinuous or gradual change in trade costs, the relationship between regional integration and agglomeration is the same.
inter-regional labour mobility, however, agglomeration opens up wage differences. Further integration and even lower levels of trade costs lead to a gradual fall in this region’s share of industry, until symmetry between regions is re-established. This is so as at low levels of trade costs, firms want to be where immobile factors are cheaper, so they spread across regions again.

With respect to regional specialization, Puga (1999) states that regional specialization is increasing to its highest point at medium levels of trade costs. This is the situation where agglomeration of industry has formed in only one of the two regions. With trade costs further falling to low levels, specialization of the regions is decreasing again.

With the actual empirical findings for agglomeration and concentration in Hungary in mind (see chapters 4 and 5), I would like to make the following summary statement regarding the appropriateness of two of these theoretical models: If the actual level of inter-regional migration23 in Hungary can be judged “high”, then the use of the Ludema & Wooton model - the right column of Table 3 - seems appropriate as the theoretical interpretation. If, however, the inter-regional migration levels in Hungary would be judged to be “low”, then rather the use of the Puga (1999) model with the Ω-shaped development of industry concentration in the course of European integration seems appropriate (low inter-regional migration is then approached by the assumption of no migration).

This concludes the overview of a suitable theoretical framework for my research. The next section 2.2 will deal with previous empirical work in related areas and of potential interest for the subject of this research.

2.2 Previous empirical studies

In this second part of chapter 2, an overview shall be given with respect to previous empirical studies in fields of interest for the topic of this research, which is on industry agglomeration and regional development in Hungary under the Europe agreement.

The word “agglomeration” will be understood in this context in the narrow sense meaning industry agglomeration, not in the sense denoting mere urban areas of high population density. The focus shall further be on empirical work on Europe, although some studies on the US and Japan are also mentioned. Most studies on

23 The inter-regional migration in Hungary is analysed in detail in Chapter 3, sections 3.5.1, 3.5.2, and 3.5.3.
related topics existed for the EU-15 or selected member states, yet very rarely on
the EU-25 or even EU-27\textsuperscript{24} due to the short time span passed since the Eastern
enlargement. Relevant studies on the CEECs where they include Hungary will
also be reviewed. Previous empirical work on certain economic or regional
aspects in Hungary with relevance for this research will also be described.
Where studies touch on various topics, they are described in all relevant aspects
under the heading which covers most of the contents. Empirical studies on
regional development, including the most recent cohesion report and reviews by
the European Commission, will be dealt with in chapter 7, as they are the basis for
any economic policy discussion involving the regions.

The remainder of this overview of previous empirical studies is organised as
follows: section 2.2.1 reviews empirical research on industry agglomeration and
concentration. Section 2.2.2 looks at empirical work on industry specialization of
countries or - where rarely available - of regions. Section 2.2.3 summarizes where
previous empirical papers found results regarding the effects of trade on industry
location and also quotes estimates on the magnitude of trade costs in the
manufacturing sector. Section 2.2.4 will look at relevant studies of the influences
of FDI and of local labour markets on industry location. The final section of this
part - section 2.2.5 - will discuss studies on various CEECs and on Hungary
regarding industrial developments during the transition period and in the years
around the Eastern enlargement of the EU.

2.2.1 Industry agglomeration and concentration

Industry agglomeration and concentration are both expressions for the same
phenomenon. They describe how concentrated or dispersed an industry is over the
space looked at, for example a country or the EU. Industry agglomeration further
describes areas of high density of industries, often coupled with a high share of
industry employment in local employment. These areas are characterized by
various spill-over effects, economies of scale play a role, and sometimes dis-
economies are also starting to skew the balance of benefits and disadvantages of
such agglomeration centres.

In a report on the location of European industry commissioned by European Com-
mission, \textit{Midelfart-Knarvik et al. (2000)} analysed production data for 13 EU
countries and 36 industries from 1970 to 1997 using OECD data. They found that
the industrial production structures of countries grew in their difference from each
other over that period. Using Gini coefficients as concentration measure, they
observed a slight decrease in average industry concentration from 1970 to 1985,

\textsuperscript{24} The Eastern enlargement of the EU has come to a halt in 2007 with the accession of
Bulgaria and Romania as 26th and 27th member state on 1st of January 2007.
followed by a slight increase to the early 1990s and a reverse thereafter. Among industries initially concentrated and dispersing over time were beverages and tobacco, machinery & equipment. Dispersed industries concentrating over the period were textiles, wearing apparel, leather and fur products, furniture, and transport equipment.

As a complement to traditional concentration indices, the authors proposed an index of spatial separation giving a production-weighted sum of all bilateral distances between countries. They found this to first rise for manufacturing as a whole, then falling from 1991 onwards. Interestingly, the high-technology industries were the least separated throughout the entire period. This included drugs and medicines, office and computing, radio, television and communication, electrical apparatus, and professional instruments.

The authors also looked at country specialization using the Krugman specialization index for the period 1970 to 1997. They found that average specialization was lowest for the period 1980 to 1983 and then rose up to 1997. Grouping countries by their date of EU accession, they found that the 1973 and 1981 entrants exhibit an increase from the early 1980s, whilst the 1986 entrants show increasing Krugman specialization from around 1992 onwards.25

In an analysis of manufacturing industries with respect to the Single Market, Brüllhart (2001a) looked at 32 manufacturing sectors of an OECD data base for 13 EU-15 countries over the period 1972 to 1996, using locational Gini indices based on employment data.26 He found that concentration increased continuously over the period in employment terms, while remaining roughly unchanged in export terms. On average, increases in concentration were stronger in the period up to the launch of the Single Market programme than afterwards. The sectors most sensitive to the Single Market, however, showed an acceleration in concentration after 1986. He also found evidence that low-tech industries were the most strongly concentrated. This is the contrary of the results by Midelfart-Knarvik et al. (2000) based on their spatial separation index. Finally, Brüllhart concluded that centre-periphery gradients across countries were losing importance for industrial location in the EU-15 over that period.

Brüllhart & Traeger (2003) described the distribution of 7 broad economic sectors across 17 West European countries and regions over the period 1975 to 2000.

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25 EU-accessions: 1973 UK, Ireland, Denmark; 1981 Greece; 1986 Spain, Portugal. The study from 2000 does not examine the effects on the 1995 entrants Austria, Sweden, and Finland.

26 Brüllhart (2001a) also analysed country level specialization using the same data base, see summary in section 2.2.2.
Based on a Cambridge Econometric data base of employment at a country and Nuts-3 regional level, they applied entropy indices as measure of concentration and associated bootstrap tests for de-composing geographic concentration into within-country and between-country components. With regards to manufacturing industry, they found that manufacturing has become gradually more concentrated. Further, the accession of a country to the EU during the period was associated with an increasing tendency for manufacturing activity to locate in countries’ peripheral regions. It will be interesting to see which tendency prevailed in Hungary during the period analysed in this research which spans until 5 years after EU accession.

Ellison & Glaeser (1997) introduced a new kind of concentration index to measure industry concentration at the plant level, while controlling for the size of geographic areas for which data are available. Their index is intended to also capture the co-agglomeration of related industries, i.e. the additional agglomeration caused by localized industry-specific spill-overs and natural advantages. In their further research, Ellison & Glaeser (1999) applied their index to US 2-digit industry data in order to answer the question whether natural advantage can explain agglomeration. Their empirical results explain about 20% of the observed geographic concentration by a small set of such advantages.

Giacinto & Pagnini (2008) analysed agglomeration within and between regions in Italy using Italian census data for 103 manufacturing and service industries for the year 1996. Their idea was to find out whether agglomeration forces stop at regional administrative boundaries or not. The authors chose a firm-level concentration index and use Monte Carlo simulation techniques. They concluded from their analysis that between-regions spill-overs existed in Italy. They found, however, that Ellison-Glaeser type indices, which require firm-level data, are not sufficient to measure the intensity of spatial clustering forces when such between regions-linkages exist.

In an analysis of structural developments in the manufacturing sector of ten CEECs, Hildebrandt & Wörz (2004) examined industrial concentration for the years 1993 to 2000. This was done with country-level data on output and

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27 The within-country concentration of agriculture and construction were not affected by accession to the EU. Market services relocated increasingly towards central regions in context with EU accession.

28 In their formula defining the probability of a “crucial spill-over” between each pair of plants, Ellison & Glaeser (1999) interestingly also built in the Herfindahl index in the nominator and denominator, but applied to the plants’ shares of industry employment. In my research (see Chapter 4, Section 4.5), the Herfindahl index is applied to an industry sector per region and the share in manufacturing employment. Plant level data were not available for Hungary, making it impossible for me to use an Ellison-Glaeser index.
employment for 13 industries using a database of their research institute, the wiiw. In terms of the one indicator chosen, the authors observed an increase in concentration of industrial activity both in output and employment terms, to higher levels and by a higher percentage than in the EU during the “pre-Single market period”.

Using panel estimation techniques, the authors further found output concentration to be strongly influenced by differences in technology, differences in FDI levels, and the location of domestic demand, while concentration of the labour force was strongly related to productivity differentials only. In their model, the variables designed to capture explicitly NEG explanations - scale economies, trade costs, and input-output linkages - remained insignificant. The variable for export orientation to the EU was significant or highly significant for 3 of 6 industries with high increases in concentration between 1993 and 2000, while the variable for imports from the EU was relevant for only two industries. This hints towards inter-industry trade with inputs sourced from different countries than those where output is sold to. For those three industries - wood, pulp and paper, and electronics-, the authors conclude that export re-orientation of the CEECs towards the EU-15 had an impact on increasing concentration and industrial re-structuring in CEECs. For Hungary, however, the concentration trend in the electronics industry was, according to the authors, certainly policy driven to a great extent. Hildebrandt & Wörz called for further research of concentration and specialization patterns in CEECs and for the EU-25 as a whole, as the concentration levels in the EU-15 were falling during the period 1993 to 2000 due to the Single Market programme, while those in the 10 CEECs were rising during the pre-accession period. This research is one contribution in that field.

In an article on the Single market and geographic concentration in Europe, Aiginger & Pfaffermayr (2004) analysed the development of industry concentration for 99 Eurostat 3-digit industries for the years 1985, 1992 and 1998. Their analysis of three concentration measures is based on value added data for the country-level of 14 EU member states. They found a highly significant difference in concentration trends in the pre- and post-Single market period. While concentration was rising before 1986, a decline was observed after the start of the Single Market programme. Interestingly, the authors acknowledged that while this is an important political and economic result, countries are not the ideal unit for studying regional concentration of industries. This seems to confirm the need to perform such an analysis based on regional level data - as is realised for Hungary in this research.
Stirböck (2001) looked at possible agglomeration tendencies of capital in seven EU-15 countries. She was interested in relative concentration of capital in industry from 1985 to 1994. She applied standardised Gini coefficients and Lorenz-Münzner coefficients to data on direct investment and gross fixed capital formation for 11 industries at the Nuts-2 regional level (instead of employment, production or value added data which are used by most other studies on agglomeration). Concentration was found to have increased in Belgium by 18%, Denmark (by 21%) and Ireland, while the UK had decreasing concentration (by 8%). On the national level, absolute concentration was calculated also for employment data; this resulted in a level of concentration lower than for capital. Stirböck concluded that employment is more uniformly allocated than capital, possibly due to the lower mobility of employment. This is an interesting statement, which allows the inference that the empirical results on industry concentration and regional specialization in Hungary of chapters 4 and 5 of this research - which are obtained based on employment data - can be judged as “more conservative” than they would have been with capital data.

Brülhart et al. (2008) looked at the influence of tax differentials on agglomeration. Drawing on a firm-level dataset for Switzerland and employing fixed-effects estimation techniques, they found that firm births on average react negatively to corporate tax burdens, but that the deterrent effect of taxes was weaker in sectors that were more spatially concentrated. Those findings – according to the authors – support the validity of recent theoretical results, suggesting that agglomeration economies can reduce the importance of tax differentials for firms’ location choices and thereby lessen the intensity of corporate tax competition, even if technological and administrative barriers to capital mobility are low.

Finally, in a study on concentration in the services sector, Stierle-von Schütz & Stierle (2004) looked at concentration in the services sector for 14 EU member states and the 10 CEEC candidate countries from 1995 to 2000. They calculated three of the measures used by Hallet (2000) for 11 NACE services sectors with Eurostat data of gross value added per region. They found that concentration of financial intermediation slightly increased for the 25 countries over the period, with a high in 1997, while that of public administration hardly changed at all. They also found that hotels and restaurants were more likely to be found in peripheral regions, while financial intermediation and real estate businesses tended to concentrate in the centre. Overall, they admit that the period analysed - 1995 to 2000 - was comparatively short for finding general results.

29 These seven countries were: B, DK, F, Irl, I, Lux, and the UK.
30 For a summary and details of Hallet (2000), please see in section 2.2.2.
2.2.2 Industrial specialization of countries or regions

Related to the topic of agglomeration of industries is the notion of specialization of countries or regions. Specialization looks at a geographic area and determines - by means of a selected measure - whether that area is specialised in certain industries, or whether it is well diversified, or whether the industrial structure is just equal to the average of a greater space. This section summarizes relevant findings on this topic in fields related to the subject of this research.

In a working paper on the competitiveness of European industry done for DG Enterprise of the European Commission (European Commission 1999), a group of authors analysed industrial specialization of 14 EU countries with regard to exports and production at the country level. They found that export specialization - as measured by the Balassa index for revealed comparative advantage - declined for 3-digit NACE industries during 1988 to 1998, and that specialization in production increased weakly from 1985 to 1998.

Amiti (1999) analysed country specialization for 65 manufacturing industries in 5 EU-15 countries for selected years from 1976 to 1989 using - despite certain disadvantages - the Gini index. She found increasing specialization from 1980 to 1989 both in the richer “core” EU countries France and Germany as well as in the poorer “peripheral” EU countries Spain and Portugal.

In an analysis of specialization trends in 32 manufacturing industries across 13 EU-15 countries, Brülhart (2001b) analysed country-level specialization using OECD employment data with locational Gini indices for 1972 to 1996. He found an increase of specialization and of the dissimilarity of industrial structures in the sample countries. Specialization was found to be most pronounced in resource- and labour-intensive sectors. Increasing clustering was found in technology-intensive industries since the mid-1980s. Specialization of exports, whilst decreasing on average, was stronger than specialization of employment.

Hallet (2000) used Eurostat data of gross value added for 17 Nace manufacturing branches for 119 regions in order to examine regional specialization and concentration in the EU from 1980 to 1995. On average, he found a very moderate decline in regional specialization over the period. 33 34 regions had become more

31 The authors measure specialization at the country level based on output for which they take value added at factor costs calculated with the Herfindahl index.
32 See discussion in Chapter 5, Section 5.1 for details.
33 Regional specialization by Hallet (2000) is measured as the coefficient of variation of sectoral GVA composition in a region in % of the coefficient of variation of sectoral composition of total GVA of EU-15.
specialised, while 85 regions had become less specialised. In 1995, Southern periph-
eral regions tended to be higher specialised due to their smaller economic base. Seve-
ral core regions along the “blue banana” also tended to be highly specialised.

In looking at concentration in the EU-15, Hallet (2000) used four measures, a con-
centration measure based on a coefficient of variation, a clustering measure based on a gravity model summing up distance-weighted production of all pairs of regions, a centrality measure expressing whether production is located in the centre or the periphery of the EU, and an income measure capturing the GDP per capita of the regions. For the year 1995, he found that only transport equipment, paper and printing products were spatially highly concentrated. By means of the clustering measure for data of 1995, he found that for metal products, transport equipment, and chemical products the values indicated that production took place in regions close to each other. Tested for the centrality measure in 1995, most branches followed the centre-periphery pattern of GDP, except for banking and insurance services on the high end and textiles on the low side. The income measure showed in 1995 that the more traditional labour-intensive branches - food, beverages and tobacco, mineral products, and textiles and clothing - tended to be located in peripheral regions with lower income.

In a paper on industrial activity in accession countries, Traistaru et al. (2002) analyzed relative employment specialization in selected accession countries for the period 1990 to 1999. Using data collected in a private data base and relative concentration at Nuts-2 or Nuts-3 level, they stated that Hungary had no region with high specialization and 5 regions with low specialization. Overall, they suggested that industries in accession countries tend to locate where production factors are abundant, e.g. labour intensive industries in regions where labour is abundant, and research-oriented industries in regions with higher shares of researchers in employment. And larger regions tended to have larger shares of manufacturing activity than smaller regions.

Finally, in their empirical research on the existence and importance of economic geography effects, Davis & Weinstein (1999) investigated production structure for a sample of regions in Japan in the year 1985. They included factors such as absolute market size, backward-forward linkages and “real-world” geography in their model. They found that for 8 of 19 manufacturing sectors, among them transport equipment, electrical machinery, and chemicals, these factors did play a role in determining the structure of production.
2.2.3 The effects of trade and the magnitude of trade costs

As the Europe agreement with Hungary as a legal framework for economic integration consisted to an important extent of trade provisions, and this research is interested in seeing whether there was an influence of bilateral trade and integration on agglomerations and regional development in Hungary, this section will review previous research on trade in its effects on industry location. As trade costs play an important role in the models of NEG dealing with economic integration, studies with empirical estimates on the magnitude of trade costs will also be included.

A report commissioned by the European Commission (1994) analysed the economic interpenetration in foreign trade between the EU-12 and Eastern Europe. For the period 1988 to 1993, the authors found that Hungary's export strength to the EU tended to be in labour-intensive products requiring medium-skill level labour input. The progress of more R&D as well as skill-intensive industries in the early 1990s showed that the dominance of rather simple labour intensive exports may have been characterizing the pre-transition and early transition phase only. The authors also calculated an index measuring the change of trade pattern with the EU. With respect to exports and imports, that index was lowest for Hungary among the 5 CEECs which were part of that study during the five-year period 1988 to 1993. This means that Hungary's trade pattern with the EU countries had changed much less than that of the other CEECs during that re-orientation phase. This could be explained by the fact that in 1988, Hungary was the most market-oriented CEEC by some distance, having already started down the path of reform some time before. 34

The authors of European Commission (1994) also looked at trade barriers at the NACE 3-digit industry facing Hungarian exports into the European Community level during 1988 to 1992. Almost all sectors were subject to a most-favoured nation rate of duty not equal to zero, of on average 7.1%, ranging from about 1% up to 18% in 1988. About a quarter of all import sectors was subject to quota regimes, encompassing in some cases almost 100% of the EU imports of the product from Hungary, equal to 26.8% on average over all sectors. Further, about one fifth of imports from Hungary were subject to other non-tariff barriers; this encompassed on average 14.2% of the EU imports from Hungary in 1988. 35 The 30 most protected EU sectors were also listed in that publication. These sectors encompassing a cumulated export share of 51.4%, among them many food

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34 More details on economic reforms in Hungary will be given in chapter 3, section 3.1, section 3.2.3, and section 3.8.

35 This figure is certainly at the low side, the actual figure must be much higher in my view, given the multiple potential obstacles on the NTB side.
and textiles products, steel tubes and radio and television equipment. Those findings were broadly confirmed in the “Trade Policy Review” of Hungary by the World Trade Organization (1998).

In studies by Landesmann & Stehrer (2002 and 2008) on several CEECs, the authors analysed the evolution of competitiveness, industry and trade specialization. While one set of countries remained locked into a rather traditional pattern of trade and industry specialization (in low-skill, labour-intensive branches), others - among them Hungary - showed a much more dynamic pattern of integration into the European division of labour. Different countries in the region had succeeded to different degrees in the qualitative nature of their structural transformation and in developing their position in cross-European trade structures. This differentiation was likely to have, according to the authors, a bearing on how they would cope with the additional adjustments required by the accession process itself and on what footing they would be able to participate in the integrated structures of the enlarged European economy. This also has implications for the instruments required to deal with the problems of cohesion once they are members of the EU (on this latter aspect, see the policy conclusions of this research in chapter 7, section 7.2).

Brülhart & Torstensson (1998) analysed the role of intra-industry trade during European integration on the location of European industry. They used Eurostat data on the country level for 12 EU-15 countries. They were interested in the role of scale economies and the level of intra-industry trade during increasing European integration. The authors also included in their analysis the role of NTBs for the sample of 98 industries for 6 selected years between 1961 and 1990. They found that intra-industry trade (IIT) was highest for industries with low scale economies and low NTBs, lower for high scale economies and high NTBs, and lowest for high scale economies, low NTBs. Over the time span from 1961 to 1990, IIT had risen for all of these categories. From 1977 and 1990, the level of IIT remained more or less the same. Whether NTBs were high or low only mattered for industries with high scale economies in producing different levels of IIT, and not noticeably for industries with low scale economies.

In a paper on trade-induced adjustments in industry, Azhar & Elliott (2003) applied a so-called S-index\textsuperscript{36} to industry level data in the United Kingdom (UK). Their aim was to identify increases in inter-industry trade, which mean that import and export changes were unmatched and thus induced a re-allocation of resources from industries contracting to those expanding. Those adjustments follow the rule: the greater are the factor requirement differences between

\textsuperscript{36} The S-index is a modified measure for adjustment costs, belonging to the family of marginal indices measuring intra-industry trade.
industries and the more geographically dispersed is the production, the more severe are the adjustment implications. If increases in trade are intra-industry in nature, however, the smooth adjustment hypothesis should hold, i.e. the adjustment costs will be less because resource transfers as a result of sectorally matched increases in imports and exports can be contained within individual industries or possibly firms.

Applying the S-index to 80 SIC 3-digit manufacturing industries’ trade of the UK with the rest of the world from 1979 to 1991, Azhar & Elliott found differentiated results. The textiles industry experienced the most severe contraction due to trade induced adjustment pressures, as did the extraction and manufacture of minerals. The largest adjustment costs associated with expanding sectors were found in mechanical engineering, food processing, manufacture of motor vehicles, and the manufacture of office machinery. The application of that S-index is judged not to be appropriate for this research’ analysis of industry agglomeration and regional development in Hungary, as it describes intra-industry trade at the country-level between countries only and makes no predictions for the regional level.

The phenomenon of outward processing trade (OPT) which played a role for most CEECs in the 1990s was analysed by Tajoli (2003). Looking at EU-CEEC trade structures during the transition period, the author calculated shares of outward processing trade (OPT) in total trade for the years 1989 to 2000. For Hungary, the OPT had its main importance in the early years of that period; its influence declined rapidly from 1997 onwards. In 1989, the share of OPT in total trade was at 16.3%, in 1992 and 1993 both above 20%, 1994 still high at 17.5%; then the gradual decline started with 13% in the following two years, 10% in 1997, and down to a mere 4% by the year 2000. In comparison with other large CEECs, Hungary had the second highest share of OPT in total trade, second only after Romania. Poland, the Czech Republic and Slovakia experienced a similar relative decline over time as Hungary did. Only for the Baltic countries, OPT played an increasing role during the later 1990s, however declining from 1998 onwards as well. The reason behind the end of this phenomenon of OPT in Europe is that processes in the textiles industry were subject to globalisation. While labour costs in CEECs had been gradually increasing, international trade costs were falling and quality standards were improving slowly in China, it became economically more attractive for the textiles sector to shift production completely to countries in the Far East, such as India and the largest share to China.

The next set of empirical studies deals with the magnitude and importance of trade costs. With respect to borders and international trade, the World Bank (2008a) states that the number of international borders has increased from 100 to more than 600 since 1900. What matters for economic growth is the “thickness”
of economic borders, which depends on the restrictions on the flow of goods, capital, people, and ideas. That report stated that borders between the member states of the EU were only about one-forth as thick as those in Western Africa. Further, while stating that prosperity demands mobile people\(^\text{37}\), the role of falling transport costs is recognised explicitly. Falling transport costs encourage specialization and trade between economies at similar stages of development. Intra-industry trade is now half of global trade, up from about a quarter in the 1960s. Because this trade is especially sensitive to transport costs, East Asia, North America, and Western Europe account for much of it.

In an analysis of the magnitude and causes of market fragmentation in the EU-15, Head & Mayer (2000) applied a monopolistic competition model of trade to estimate border effects for 120 NACE 3-digit industries for the period 1975 to 1987, including also Eurostat Comext trade data and information on NTBs\(^\text{38}\). They found on average smaller border effects in Europe than those estimated for the Canada-US border. For the average industry in 1985, Europeans purchased 14 times more from domestic producers than from equally distant foreign ones. The tariff equivalent of the border was 36% for 1984-1986, as indicated by the most conservative estimation method. Where countries had a common language, however, the border impediment effect was only around 5%. Brenton et al. (2001) pointed out the importance of NTBs for accession countries, in context with their integration into the European Common market and their taking over the Acquis Communautaire in the field.

Head & Mayer (2000) further decomposed border effects into a part due to government actions impeding trade, i.e. NTBs, and into consumer preferences for domestically-made products, i.e. home bias. While the impact of borders has declined over time during the process of European integration, the reductions began at least a decade before the launch of the Single Market programme. Their results provide indirect evidence for a consumer bias as explanation of border effects.

Niebuhr & Schlitte (2008) based themselves on estimates by Bröcker (1998) and other authors and used travel time equivalents instead to measure the impediment effect of a border. This means that for them, travel time between the CEECs and EU-15 countries includes waiting times at border crossings, which are added as a

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\(^{37}\) The USA, the world’s largest economy, is also among the most mobile, with about 35 million people changing their places of residence every year (World Bank 2008a). This corresponds to 12.0% of the population. The figure is not inter-state mobility, but counts any internal mobility.

\(^{38}\) See also a study of the European Commission by Buigues et al. (1990) on NTBs in the EU.
time penalty to raw travel times. Proceeding economic integration is then modelled by reducing the time penalties. The authors assumed that the accession of the CEECs to the EU corresponds to a decline of this time penalty from the start level of 60 minutes - when crossing from a CEEC to an EU-15 country - and 100 minutes in the case of crossing from one CEEC to another CEEC. By these estimates, they generated data for the purpose of evaluating improvements in market access due to Eastern enlargement of the EU, based on GVA and consumption data.

In a discussion paper on the economic geography of trade, Overman et al. (2001) looked at transport costs estimates in literature. They stated that there exists a wide dispersion of transport costs (here in the narrow sense, i.e. not including NTBs) across commodities and across countries. For the US in 1994, freight expenditure was only 3.8% of the value of imports according to customs data, while the equivalent numbers for Brazil and land-locked Paraguay were 7.3% and 13.3% respectively. These data incorporate the fact that most trade is with countries that are close, and in goods with low transport costs. Looking at transport costs unweighted by trade volumes gives much higher numbers. The median cif/fob ratio, across all country pairs for which data was available, was 1.28 - implying 28% transport and insurance costs. Sharing a common border substantially reduces transport costs. Finally, overland distance is around 7 times more expensive than sea distance: being landlocked increases transport costs by approximately 50%.

A further empirical study on trade costs is that by Hummels (2001) who estimated the cost of time in transit and also looked specifically at manufactured goods. He used data on some 25 million observations of shipments into the US, some by air and some by sea. The cost of an extra day’s travel is around 0.3% of the value shipped. For manufacturing sectors, the number goes up to 0.5%. Remarkably, these costs are around 30 times larger than the interest charge on the value of goods. The share of US imports going by air freight rose from 0 to 30% between 1959 and 1998.

Estimates by Hummels also indicate that each additional day spent in transport reduces the probability that the US will source from that country by 1 - 1.5%. For manufactured goods, each day saved in shipping time is worth 0.8% ad-valorem. The advent of fast transport (air shipping, containerization and faster ocean vessels) is equivalent to reducing tariffs on manufactured goods from 32% to 9%.

39 Looking across commodities, an unweighted average of freight rates is typically 2 to 3 times higher than the trade weighted average rate, according to Overman et al. (2001).
40 Whilst being landlocked is the case for Hungary, the value should probably be lower than 50%, as Hungary uses the Danube waterway advantageously for shipment of goods.
between 1950 and 1998. That gives a reduction in average shipping times of 26 days over 50 years, equivalent to a shipping cost reduction worth 12 - 13% of the value of goods traded. This analysis shows that even without the effects of economic integration, trade costs have fallen over time due to technological progress and probably also due to the simplification of customs formalities.

### 2.2.4 Foreign Direct Investment (FDI) and local labour markets

Foreign direct investment (FDI) can also play a role in directing industry location and the formation of agglomerations. Local labour markets bear an influence on the location or relocation decision of firms or industries as well. The findings of empirical studies on Hungary relevant for this research shall be summarized in this section.

In a paper on the labour market in Hungary during the transition period 1993 to 2000, the Hungarian author Fazekas (2003) analysed the effects of foreign direct investment and other influences on the performance of local labour markets. He described that during the first phases of the transition to a market economy, more than 1.5 million jobs disappeared in Hungary; new jobs were created elsewhere, namely in developed urban agglomerations. He saw the observed polarisation of local labour markets in Hungary as mainly driven by employment changes as a consequence of agglomeration forces in transition economies. Fazekas further found that unit labour costs were lower in regions with low unemployment due to higher productivity prevailing there. He called the internal migration flows observed in the years 1996 and 2001 “quite modest”, yet acknowledged that they did react to economic incentives to some extent. By means of regression analysis, the author found that the industrial past of the regions, the proximity to Western borders, and the education level of the local labour force had a positive impact on attracting foreign direct investment to a region. Finally, an increasing density of firms with FDI was found to have a significant positive effect on the productivity of domestic firms. According to the author, this could be one of the explanations of the increasing regional productivity gap between firms settled in good and bad regions.

Csengodi et al. (2003) did research on foreign takeovers and wages in Hungary during the period 1992 to 2001. Using private firm level data from Hungary, they found that wage levels for FDI-target firms tended to be about 9% higher than those of indigenous firms, and this already prior to the ownership change - which they saw as confirmation towards the “picking the winner” hypothesis.

Békés (2005) analysed Hungarian FDI data from a firm level data base for the period 1993 to 2002. His question was whether there existed agglomeration
effects strong enough to explain the co-location of firms. He analysed two-digit sectors by means of a model including input-output linkages, wage level data for labour costs, but disregarding market structure and competition, one of the main weaknesses of that model. He found it difficult to disentangle various agglomeration forces within an industry. He concluded that most of the industries do have a strong tendency to settle where other similar firms have already settled, and that subsidies tended to attract large firms. He suggests that improving the relationships between suppliers and multinationals would probably foster more investment.

In a study on agglomeration economies and location choice for FDI, Boudier-Bensebaa (2005) developed a panel model of the location determinants of FDI. She estimated this based on FDI stocks for the 7 Nuts-2 regions in Hungary from 1990 to 2000. The author concluded that countries with higher labour availability, greater industrial demand and higher manufacturing density attract more FDI. Surprisingly, higher unit labour costs were found to attract FDI - as in the research by Csengodi et al. (2003). The causation should rather be vice-versa in my view: That firms with FDI tend to pay a wage premium. In addition, inter-industrial agglomeration economies and infrastructure availability were found to be important in that article.

### 2.2.5 Studies on the CEECs and on Hungary

This section looks at studies comprising several CEECs or Hungary directly during the transition period and the pre-accession phase, where such studies looked at regional development during integration or at some aspects of industry location. Literature since the EU accession of Hungary is hardly available so far due to lack of recent data.

In an analysis of regional development in Poland, Hungary and the Czech Republic, Dreyhaupt-von Speicher (2002) investigated the influence of various factors on regional welfare and growth. That study comprised data for 77 regions in the 3 countries for the years 1996 and 1999. Factors included were the unemployment rate, the activity rate, employees in industry, gross wages in industry, gross production investment, and some welfare indicators like doctors and the availability of certain services. Using cluster analysis, four types of regions were identified with respect to their per-capita-GDP and welfare. For Hungary, the relative position of Central Hungary had advanced from the third to the most dynamic group between 1996 and 1999. No catching-up of the economically weaker regions in Hungary was noticeable from 1996 to 1999.
In a regression analysis of influences on regional development, Dreyhaupt-von Speicher found a positive correlation of housing conditions and the availability of passenger cars with regional per-capita-income. The state of the transformation process to a market economy, infrastructure endowments, human capital disposition, and geographical factors such as the distance to the national capital or to economic centres of the EU were also found relevant. As a policy strategy for EU regional policy, the author recommended to grant transition countries more national autonomy in the allocation of funds, such that they could foster growth regions and put more means into the improvement of national labour mobility and the housing infrastructure.

In a study on the emerging economic geography in EU accession countries, Traistaru et al. (editors, 2003) gave an overview of the economic situation in 5 CEECs in the 1990s in view of their expected EU accession. The research used a private data base comprising the years 1990 to 1999, for Slovenia only from 1994 onwards. The authors stated that border regions with the EU-15 countries benefited most in terms of growth of per-capita-income, employment rates and FDI, while regions bordering external countries proceeded with their decline. The study found declining wages in more peripheral regions as compared to the capital region for all countries. A catching-up had started only towards the end of the decade, but could not be directly related to trade integration with the EU according to the data base of these authors.

Regarding geographic concentration of manufacturing, the study found that this had not changed significantly in Estonia, Hungary, Slovenia and Romania during the 1990s. Higher regional specialization tended to be associated with inferior economic performance, while regions with lower specialization performed better than the national average. This finding was not confirmed, by the results drawn from the Hungary chapter, however, where the Western regions were found to be more specialised than the rest of the country and economically better off also.

In a publication called “Change of course”, the Hungarian Central Statistical Office (2005) provided an overview of developments in the broad sectors of Hungary’s economy based on the statistics of HCSO. This broad summary allowed to analyse the effects of the transition phase on the situation of the economy and of the population. To give an example, while GDP declined in real terms from 1989 to 1998 when it reached again its pre-transition level, real income per capita declined with a lag of about 3 years and only reached its 1989 level in the year 2001. Other figures from that publication will be referred to in chapter 3 to put my own findings into context.

41 The five CEECs were Bulgaria, Estonia, Hungary (that chapter was written by Mafioli 2003), Romania, and Slovenia.
Rechnitzer (2000) analysed Hungary’s regions during the transition period. Based on 11 indicators, he identified similarities between Nuts-2 regions and showed how the regional system in Hungary had changed from 1991, at the start of the transition, to 1995, which he called near the end of it. Whilst in the first year, he noticed seven clearly separated groups, by 1995, more homogenous blocks with similar growth courses had formed, linked by apparent routes of development.

In his contribution to a book by Petrakos et al. (2000), Nemes-Nagy (2000) looked at the new regional structure in Hungary after the transition to a market economy. For the year 1996, he stated that around 40% of Hungary’s population of about 10 million was living in different types of settlements part of “winner” regions, 19.3% in so-called “starting-up” (the catching-up) regions, 17.8% in stagnating regions, and 22.8% in “loser” regions. Based on micro-regions, he further identified two areas of economic potential, one broadly around the capital, the other near the Western border with the EU.

In a chapter contained in the book edited by Hajdú (1999) on regional processes and spatial structures in Hungary in the 1990s, Faragó (1999) analysed regional economic development in a historical perspective. He described territorial development axes in Hungary in the 1990s. He pointed out that the development watershed of the socialist era had been an axis reaching from the North-East of Hungary - with heavy industry and mining - to the South-West, crossing through Budapest. In the later 1990s, the new development shed was between a prospering Western part and a declining Eastern part, notably a North-South axis starting at the Northern border of Central Hungary and passing through Budapest to the Southern border. According to this line, 13 regions are in the Western part and 7 of the 20 Nuts-3 planning-statistical regions make up the Eastern part of Hungary. Faragó further identified winner and loser regions based on 1996-data. He called the former industrial centres as well as the Eastern-most region Szabolcs-Szatmár-Bereg “the main losers” in the 1990s, for those regions have not been capable of coping with the structural transformations.

42 According to Fazekas (1999), in the Roman age the river Danube separated the civilization of the Roman Empire from the “barbaric territories”. Under Turkish rule, the Great Plain lost a significant part of its population. Urbanisation, the development of the bourgeois middle class was a significantly faster process in the North (mainly in the areas that today belong to Slovakia) and in the Western part of the country, where conditions were also more favourable for industrialisation.

43 In terms of Nuts-2 regions, the socialist era development axis would reach from Northern Hungary to Southern Transdanubia, and passing through Central Hungary.

44 That axis starts in the North-Centre, passing along Pest and Budapest regions, Bács-Kiskun and in the South along Csongrád region’s border.
Hantke (1995) analysed trade relations of Hungary with the countries of the EU at the start of the Europe agreement and immediately prior to it. After an overview of the main trade provisions of the Europe agreement, the reorientation of Hungary’s foreign trade flows which took place from 1988 to 1994 is looked into by means of trade statistics. Trade frictions which occurred in sensitive sectors in the first years of application of the Europe agreement were investigated from a political economy point of view, and actual developments were evaluated in the light of the predictions made by gravity models and discussed in view of EU trade and pre-accession policies. The results showed that Hungary’s exports to the EU increased by over 40% from 1988 to the end of 1992, the first year of being in force of the Europe agreement, and the share of the EU countries in total exports had increased from 23% in 1988 to 50% by 1992. The commodity composition started to change by 1993, from primarily agricultural towards manufactured products due to the scope of the trade provisions of the Europe agreement. Furthermore, Hantke (1995) assessed Hungary as being not yet well prepared to cope with the full impact of EU membership on its economy and predicted that this would be the case between 2000 and 2005. This has been a realistic prediction with hindsight, given that the actual EU accession date of Hungary was 1\textsuperscript{st} of May 2004.

De Sousa & Disdier (2002) looked at the importance of the legal framework as a trade barrier in 3 CEECs, using data for 17 ISIC sectors during the 4-year period 1995 to 1998. With respect to Hungary, they found that legal trade barriers did play a significant role in reducing international trade. The trade impediments worked both on the importers as well as on the exporters. In order of magnitude, border effects were found to be highest for food, beverages and tobacco, for wood, paper, printing and publishing, which they explained partly by national preferences. Weaker border effects were found in machinery and electrical equipment as well as textiles. These findings - though somewhat vague due to the shortness of the observation period - correspond broadly to those of other studies such as Head & Mayer (2000).

Szanyi (2005) looked at the electrical and optical equipment sector in Hungary from 1993 to 2004. Many former state-owned firms in that sector went bankrupt during 1993 to 1995. Up to the year 2000, FDI flows were characterized almost exclusively by inward investment flows. The largest foreign investors in the industry were companies like Siemens, IBM, Ericson and Nokia. After 1998 to 2000, re-locations started to play a role, such as re-location cases from Hungary to China or to Ukraine. Most relocations from Hungary were labour intensive activities in light industries or screwdriver-type activities in electronics. Still, far

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45 Hantke is the maiden name of Cordula Wandel.
46 See summary on the magnitude of trade costs in section 2.2.3, in the latter part.
more expansions and new establishments were carried out than relocations, measured both by the number of cases and by the potential impact on employment. Not only were existing activities expanded, but in many cases new activities were picked up, or other types of corporate functions including R&D were moved to Hungary.

Finally, in its first evaluation of the economic effects of Eastern enlargement, the European Commission (2006a) compared expectations towards the enlargement with first data after its realisation. That paper gave a policy-sided view on the economic geography of Europe which emerged since the EU accession of Hungary and 9 other countries. Chapter 7 will discuss more in detail potential policy relevant inferences from the results of the current research. The enlargement on 1 May 2004 has increased the GDP by 5% of EU-25 GDP, or 9% in terms of purchasing power, yet population increased by 20%. The economic fields covered by that evaluation included macroeconomic growth, the labour and financial markets, trade integration, FDI, migration, and agriculture.47

That analysis of economic effects of Eastern enlargement (European Commission 2006a) further stated that the CEECs were net beneficiaries of the EU budget. Migratory flows from the new member states (CEECs) into the EU-15 countries remained small in general, even towards those member states which have allowed unrestricted movement of workers. Previous fears of re-location were not justified, according to the data on which the authors based their evaluation. Whilst agricultural markets in the EU-25 were quite heterogeneous, increased trade integration, an inflow of FDI and direct income payments by the EU had contributed to a modernisation of agriculture by 2006. Ample room still remains for further rationalisation and increases in productivity in the agricultural sector of the new member states. The study concluded that the economic changes induced by the Eastern enlargement have been absorbed quite smoothly overall, and that there was no evidence of disruptive impacts on the product or labour markets. While they saw optimism in order, they warned not to underestimate the remaining challenges such as the ageing population and related budgetary strains, the wide gap in living standards and per-capita income, and the steps to take towards a growth-oriented knowledge based society.

What can be concluded from this overview of previous empirical research in section 2.2? The few existing studies on industry agglomeration or regional specialization in Eastern Europe have three main shortcomings: (i) That the time period was too short, mostly from 1995 until 2000, or 1992 until 1999. The

47 That paper was more policy-driven than empirically motivated, however, as a view to the group of authors shows: the “Bureau for European Policy Advisers” and the “Directorate General Economic and Financial Affairs”, both services of the European Commission.
present research will more than double that time span by the data base used here, namely from 1992 until 2008, spanning even the first five years since the EU accession of Hungary. (ii) Where the degree of concentration of industries was analysed regarding Eastern Europe, this has been done so at the country level, or with insufficient details about the regional level. This is the second speciality of this work in this respect, that it will analyse manufacturing agglomeration in Hungary based on data of the regional level. (iii) Finally, the subject of regional specialization in CEECs has hardly been dealt with in literature. This will be done in chapter 5 for the 20 regions of Hungary, an internationally open country, in the context of increasing European integration.

This concludes section 2.2 of this chapter which reviewed previous empirical research relevant for the topic dealt with in this research.

### 2.3 The Europe agreement with Hungary

This section deals with the institution of the Europe agreement\(^48\) which provided the legal framework governing the economic integration of Hungary with the EU during the pre-accession period. The aim is to set out the parameters which could have been relevant for shaping the integration process and which will be taken up in the regression models in chapter 6. As the Europe agreement was in force approximately for 12 years of the time span for which data were available, namely from March 1992\(^49\) \(^50\) up to the end of April 2004, this context for industry agglomeration and specialization of regions in Hungary cannot be ignored.

Apart from the Europe agreement, the importance of the so-called Copenhagen conditions of 1993 being fulfilled by Hungary as a prerequisite for EU accession shall be mentioned. The European Council formulated them as being a functioning market economy, a state governed by the rule of law, and a pluralistic democracy, as well as having transposed most of the Acquis Communautaire\(^51\) into national law. Eger (2003) pointed out the role which such conditionality can play for the ability of the government of an accession country to impose a “hard

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\(^{49}\) This was the date of entering into force of the Interim Trade Agreement which enabled the trade provisions to be applied in advance of the double ratification in all EU institutions and all EU member states and Hungary, which took 2 years longer.


\(^{51}\) This refers to the legislation passed by and in force in the current EU.
budget constraint” on the enterprise sector. The results of an empirical test of the relation between declining employment and output for 21 transformation countries - among them 10 accession countries including Hungary - have verified the proposition that the perspective of full EU membership can bring about this more efficient outcome.

This section now deals with the main contents of the Europe agreement, more concretely with its economic and trade provisions of the institutional arrangement in force in parallel to Hungary’s request and negotiations of full membership, the request for which had been deposited in 1994. When in 1990 and 1991, the European Commission negotiated a new type of association agreements with Hungary, Poland and Czechoslovakia in parallel, they were both a response to fundamental changes in the political situations as well as to serious economic problems in the wake of the fall of the Berlin wall, the break-down of trade relations within the Council for Mutual Economic Assistance (CMEA) and the strive to make a transition to a market economy and a pluralist democracy governed by the rule of law. The preamble reflected this large political step, stating that the contracting parties intend to “establish close and lasting relations of a new quality”.

The Europe agreement contained three broad types of provisions:

(i) Provisions regarding the free movement of goods, thus trade provisions;
(ii) Provisions setting up a level playing field with the EU, including such on competition policy, state aid rules, movement of workers, establishment of firms, and supply of services;\(^{52}\) and
(iii) Political provisions, providing for an institutionalised political dialogue on economic matters, financial cooperation, and cultural cooperation.

The trade provisions shall be described here. For the remainder of this research, it can be assumed as given that the free transfer of capital in convertible currency - an important condition for FDI - and other preconditions of a free market economy such as private property, legal forms of enterprises, a taxation regime similar to those of the EU countries, a modern banking system, and a functioning court system governed by the rule of law were existing in Hungary during the period of this research.

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52 Such rules are included in the European Treaties to govern economic relations in the European Single Market when the jurisdictions of several member states are concerned; they were included in the Europe agreement in an appropriate form to guarantee a level playing field, and probably in preparation for a future full membership of Hungary in the EU.
The creation of a free-trade area between the EU and Hungary within the time span of approximately 10 years\textsuperscript{53} was the principal objective of the Europe agreement. Trade liberalisation was done by the EU first, which eliminated tariffs and quantitative restrictions on industrial products on the date of entry into force of the agreement, while Hungary opened up its markets more gradually. The trade-weighted average tariff (MFN) was to fall from 7.5\% in 1992 to 1.9\% in 1994, 1.2\% in 1995 and 0.0\% in 1997 onwards, according to the European Commission (1994).

This trade liberalisation under the Europe agreement encompassed mainly trade in manufactured goods. According to the European Commission (1994), 49.5\% of Hungary's total exports entered into the EU duty-free in 1992, and some 75\% of industrial exports from Hungary would enter the EU free of tariffs and quantitative restrictions by the end of 1994. A later publication of the EU Commission (2006) stated that this free-trade zone covered 85\% of bilateral trade. As a matter of fact, mainly the agricultural goods and processed products thereof remained outside the scope of the Europe agreement, or - as in the case of certain industrial goods considered sensitive by EU member states - were allowed free trade much later than the general provisions foresaw.

What can be taken as given, however, is that the Europe agreement did liberalise most trade in manufactured goods. As the analysis of industry agglomeration and specialization undertaken by this research is based on data for manufacturing industries in Hungary, the Europe agreement and post-accession process can be considered as relevant frameworks under which the European integration of Hungary unfolded its economic effects.

\section*{2.4 The hypotheses}

The theoretical models of the NEG - which have been chosen as the theoretical framework for this research - make general predictions about the location of industry and regional specialization in the course of economic integration. Proceeding economic integration is modelled through falling trade costs. While these are falling between countries due to the measures implied by a customs union and technological progress in the transport industry, they are also falling between regions within a country, not only due to the latter, but also due to infrastructure improvements such as those implied for beneficiaries of the European regional policy and the respective pre-accession instruments\textsuperscript{54}. At

\textsuperscript{53} This period was later accelerated for most sectors, except for certain ones considered sensitive.

\textsuperscript{54} In the case of Hungary and the other CEECs, this was called ISPA.
initially relatively high trade costs, dispersion of industry will prevail (symmetry in two region models), firms will locate close to consumers; at medium-level trade costs, centripetal forces will reinforce agglomeration, centre-periphery structures will prevail, regional specialization will be highest; at relatively low trade costs, firms and workers will disperse again, a lower degree of regional specialization will be entailed.

The models by Ludema & Wooton (1997) - assuming inter-regional but not full migration of workers - and the model by Puga (1999) assuming no inter-regional migration could be used as theoretical framework. Which of these seems appropriate depends on the actual levels of inter-regional migration in Hungary (high or low). The models by Krugman & Venables (1996) and by Livas-Elizondo & Krugman (1996) are also suitable for the international context involving regional implications in a country with more than one region.

Table 4: Formulation of the hypotheses

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration with the EU under the Europe agreement reinforced industry agglomeration in the manufacturing sector.</td>
</tr>
<tr>
<td>This integration also led to an increase in regional specialization of the 20 regions at an inter-mediate stage.</td>
</tr>
<tr>
<td>With proceeding integration, dispersion tendencies set in and regional specialization decreased.</td>
</tr>
<tr>
<td>This turning point was reached prior to full EU-membership of Hungary.</td>
</tr>
<tr>
<td>Integration with the EU determined to a certain extent where in space the concentration of manufacturing industries took place.</td>
</tr>
</tbody>
</table>

Source: Own formulation.

Questions which are posed by this empirical research are: Which influences did European integration have on regional development in Hungary? The location of industry and changes in the degree of industry agglomerations, were they shaped by the influence of European integration, or by domestic economic policies, or by other factors such as local labour markets, other locational advantages, or the role of history? Which development did agglomeration of manufacturing industries undergo during increasing integration with the EU? Did integration and trade reinforce industry agglomeration in the manufacturing sector? Did agglomeration

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55 The inter-regional migration in Hungary is analysed in detail in chapter 3, sections 3.5.1, 3.5.2, and 3.5.3.
decrease? Were there perhaps phases of both? How did this affect the specialization of regions in Hungary? And where in space did the concentration of manufacturing industries take place? Was there perhaps a direct influence of the trade provisions of the Europe agreement on manufacturing concentration or regional specialization in Hungary? In light of these questions, the hypotheses shown in Table 4 are formulated.

Most previous empirical research on industry agglomeration in CEECs only remained at the country level, such as Hildebrandt & Wörz (2004), or - where it went to the regional level - such as that by Traistaru et al. (2003) - used data series which were too short or even contradictory. Hence, there is a need for in depth empirical research on the industry and regional level for individual countries in Central and Eastern Europe such as Hungary. The relatively long time period from 1992 to 2008 will be one of the advantages of the research results of this research.

A unique contribution of this research in measuring industry agglomeration in Hungary is that it applies six different concentration indices to the same set of data, thus allowing for a comparison of them. All of these indices were applied to Hungarian employment data by manufacturing subsector by region. The relatively long time series is the longest available and reliable at the time of writing using the Hungarian regional sectoral employment data series of the HCSO, namely 1992 to 2008. Regional specialization is measured also by means of calculating appropriate index figures.

The hypothesis of this research will be approached as follows by the remaining chapters of this research: Chapter 3 will evaluate the hypothesis by means of empirical descriptive analysis of main economic and regional indicators for Hungary. Chapter 4 will analyse industry concentration in Hungary by means of empirical calculations of 6 different concentration indices. Chapter 5 will present empirical results on the development of regional specialization in Hungary over the period. Chapter 6 will proceed with regression analysis on industry concentration and regional specialization. Finally, chapter 7 concludes this research with a view to policy recommendations regarding European regional policy and a perspective on future developments. Before proceeding with the remainder of this research, an overview of the data used as a basis shall be given in section 2.5.

2.5 Data used for this research

For the purpose of analysing industry agglomeration and regional development in Hungary in the context of European integration, I have chosen to use Hungarian
data provided by the Hungarian Central Statistical Office (HCSO). This was decided in order to obtain data on the longest possible time period for my research, and also the most recent ones at the end. This time period was 1992 to 2008 for the most important data series. According to the opinion of Hungarian researchers which I interviewed on this subject, data from 1992 onwards are largely trustworthy by international standards. Therefore, that year has been chosen as a starting point. The main series used were the “Regional Statistical Yearbook of Hungary”, the “Statistical Yearbook of Hungary”, and the “Yearbook of External Trade”. The data for the years 1992 until 1998 had to be typed into the computer manually from the printed format, as electronic versions started to be available only from 1999 onwards. For 2006 until 2008, the data were available from a special database of the HCSO. As the methodology had changed slightly, the data for the latter three years were adapted for consistency.

As this research deals with Hungary at the regional and industry level on the one hand and the EU on the other hand, there was no need to use data from Eurostat which would make several countries internationally comparable. More importantly, data on foreign trade provided by the HCSO also include exports from the so-called „customs-free zones” while Eurostat data do not. „Customs-free zones” were an important economic factor for Hungarian industry during the research period, as they contributed a share of 43% of Hungarian exports in 1999.

With regards to the industry level, the manufacturing sectors have been chosen as the level of detail, as the Europe agreement, the institutional framework of pre-accession integration and trade, covered mostly manufacturing products. For the entire period 1992 to 2008, the HCSO provides data for 8 sectors (more sectors would have been available only from 1999 on). These are shown in Table 5.

56 Harmonisation and verification of national data by Eurostat typically takes around two years at least before Eurostat publishes them.
57 The data for 2008 for that series have been released on the HCSO website on 20th of February 2009.
58 Where different sources are used in this research, such as Eurostat, the European Commission, or some by the Hungarian government, this is explicitly mentioned.
59 The difference was that from the electronic platform, only data for the manufacturing subsectors per region for enterprises with more than 4 employees and also institutions of central and local government, social security and non-profit institutions were included. This makes a difference mainly for the capital of Budapest. Hungary is a rather centralised country by its administrative tradition. To abstract from the latter three categories for the data of Budapest, the difference of the employment for the overlapping years of the two data series (2003, 2004, 2005) was taken as a %, and then this divergence was averaged and used as a corrector on the raw figures for Budapest for the years 2006 to 2008.
60 For more details on these customs-free zones, see the summary of the article by Vadász (2000) in section 3.2.4.
Table 5: The 8 manufacturing sectors used in this research

<table>
<thead>
<tr>
<th>Sector</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>food, beverages, and tobacco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DA*</td>
<td></td>
<td>15,16**</td>
</tr>
<tr>
<td>15,16**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>textiles, wearing apparel, leather and fur products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DB, DC</td>
<td></td>
<td>17-19</td>
</tr>
<tr>
<td>wood, paper and printing, publishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DD, DE</td>
<td></td>
<td>20-22</td>
</tr>
<tr>
<td>chemicals and chemical products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DF, DG, DH</td>
<td></td>
<td>23-25</td>
</tr>
<tr>
<td>other non-metallic mineral products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DI</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>basic metals and fabricated metal products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DJ</td>
<td></td>
<td>27-28</td>
</tr>
<tr>
<td>machinery and equipment (n.e.c., electrical and optical equipment; transport equipment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DK-DM,</td>
<td></td>
<td>29-35</td>
</tr>
<tr>
<td>other manufacturing industries, recycling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN</td>
<td></td>
<td>36-37</td>
</tr>
</tbody>
</table>

Notes: *DA-DN: Hungarian TEÁOR-classification
** 15-37: Corresponding NACE 2-digit classification.


Where data on external trade are used, these were published according to the SITC classification. These also had to be entered manually into the computer for the years 1992 to 1998. In order to make these categories compatible, which by far exceeded the 8 sector classification in Table 5, and also suitable for common empirical and regression analysis, I have converted the SITC data into the 8 manufacturing industries used in my research according to the official product category descriptions of both classifications.

As one of the main new elements of this research is that it looks at the regional level when analysing industry concentration and specialization, the regional level of detail shall be explained here. It was chosen to use the 20 Nuts-3 regions in Hungary as the relevant level. Hungary consists only of 7 Nuts-2 regions; using those would have made the data base too small. Further, the Nuts-2 regions in Hungary are merely “planning-statistical regions” with no political structure behind, whereas the Nuts-3 regions correspond broadly to municipal district administrations. These 20 regions will be presented in their geography and main economic characteristics in chapter 3, section 3.3.

Furthermore, for the purpose of deepening the analysis with respect to border regions and the importance of closeness to EU markets, the 20 Nuts-3 regions were categorized into four groups of regions according to the actual length of their
dominating border. 7 internal regions (INT), and among the 13 border regions 2 regions bordering the EU-15 (BEU), 6 regions bordering CEECs (BCE), and 5 regions bordering external countries (BEX).

For the purpose of analysing industry concentration and regional specialization, I have used data on manufacturing employment per region in the 8 sectors. To give an illustration, this produced a data sheet for each region, say Budapest, with the 8 industries as rows and the 17 years 1992 to 2008 in the columns, with 20 such data sheets for the 20 Nuts-2 regions as a data base for the empirical calculations. My idea to use output/production data in addition to these employment data proved to be unrealisable, as production data are not published at the regional level for the 8 subsectors by the HCSO.

At this point, it shall be pointed out that one of the specialities of my research is that it is based on regional sectoral manufacturing employment data as a basis for calculating industry concentration in Hungary, and not at sectoral country-wide data for a group of countries such as EU-15 or a set of CEECs, as most previous empirical studies in the field.

Data on the actual level of tariffs and quotas which prevailed during the period, for which the Europe agreement between Hungary and the EU was in force, are not publicly available. Even authors working within the European Commission, but in DGs other than the Customs DG or DG Trade, could not get access to such data (not even aggregates from the detailed customs code level). The data which I have found have been summarized in section 2.3. Those, however, are not suitable in any way for a chronological analysis over the entire period covered by this research.

I would have liked to also include into my analysis data on NTBs, as in my view this multitude of potential obstacles to trade in the norms, standards, packaging and safety rules areas are at least as important in the economic reality of internationally trading firms as tariffs and quotas. In a series of reports on the effects of the Single market done for the European Commission (1998), the importance of NTBs and other regulations on different manufacturing sectors such as the pharmaceuticals industry, the motor vehicles sector, food, drink and tobacco, and telecommunications equipment are examined in a descriptive way and data based on firm level inquiries for selected years. Whilst some researchers

61 The km length of the 20 regional borders with neighbouring countries was provided by the Hungarian expert for Schengen implementation in Hungary, Prof. Dr. habil Janos Sallai, Colonel, Budapest. His information is gratefully acknowledged.

62 This was verified by using the series “Yearbook of Industry and Construction”, and by a correspondence with a competent data official from HCSO.
also make reference to NTBs\textsuperscript{63}, there exists no set of consistent data on NTBs, however, for each year of the time period of this research. NTBs could not be used, therefore, as a variable in the regression analysis of chapter 6. In the theoretical framework of NEG models, they are assumed to be included in “transport costs” which comprise transport and other trade costs.

This concludes the overview of the relevant theoretical framework given in chapter 2, as well as of previous empirical work in the field, of the provisions of the Europe agreement, the formulation of the hypotheses, and of the data used for this research. Chapter 3 will now approach the subject “industry agglomerations and regional development in Hungary” by means of descriptive empirical analysis of economic data for the manufacturing industries and the regions in Hungary.

\textsuperscript{63} For example \textit{European Commission (1994), Brülhart \& Torstensson (1998), as summarized in section 2.2.3., Buïgues \& Ilzkovitz (1988), and Sapir (1996).}