Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

Local Development and Policies of Protectionism

Author: **Bc. Aleš Bělohradský**

Supervisor: **Doc. Ing. Vladimír Benáček, CSc.**

Academic Year: **2014/2015**

Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

The author grants to Charles University permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, May 15, 2015

Signature

Acknowledgments

The author is grateful especially to Doc. Ing. Vladimír Benáček, CSc. for his kind supervision and then to Dr. Marc Schramm from Utrecht University for helpful tips and directions regarding the NEG modelling.

Abstract

Economic situation in the Central Europe is to a big extent influenced by the disparities between core regions (mostly the capitals) and the rest. If the gap between cores and peripheries is still widening, local governments of peripheral regions must come up with policies to protect their economies from the globalised world. This basic statement is examined in this work using two different methods: regionalised input-output analysis (for Czech regions) trying to discover structural differences between regions and its implications, and NEG equilibrium simulation method examining agglomeration forces in the Central Europe and evaluating possible outcomes of protective policies in terms of NTBs (limiting the openness). The results confirm the agglomeration tendencies and suggest mainly two ways of effective policies: regional specialisation and investments into infrastructure, which would lower the transaction costs within the peripheral regions. NEG simulation method has serious limits due to the problematic calibration.

JEL Classification	O11, O15, O18, R11, R12, R15
Keywords	regional development, policies, protection

Author's e-mail	ales.belohradsky@gmail.com
Supervisor's e-mail	benacekv@fsv.cuni.cz

Abstrakt

Ekonomická situace ve střední Evropě je do značné míry ovlivněna výraznými rozdíly mezi ekonomickými centry (zejména hlavními městy) a ostatními regiony. Pokud se navíc rozdíl mezi centry a periferiemi stále zvětšuje, znamená to pro lokální samosprávy, že musí hledat cesty, jak své ekonomiky v tomto globalizujícím se světě chránit. K rozpracování této základní teze tato práce používá dvě různé metody: zaprvé regionalizovanou input-output analýzu (pouze pro české regiony), skrze níž popisuje strukturální rozdíly mezi regiony a jejich implikace pro případné protekcionistické politiky, a poté simulaci rovnovážného modelu Nové Ekonomické Geografie (NEG), která prověřuje aglomerizační tendence ve střední Evropě a poukazuje na některé možnosti protekcionistických technik ve smyslu netarifních bariér (zvětšování transakčních nákladů). Výsledky prokazují pokračující aglomerizaci a navrhují dvě preferované politiky: regionální specializaci a investice do infrastruktury, které sníží

transakční náklady uvnitř periferního regionu. Metoda NEG simulace má nicméně značné limity vzhledem k problematické kalibraci.

Klasifikace JEL	O11, O15, O18, R11, R12, R15
Klíčová slova	regionální rozvoj, politiky rozvoje, ochrana

E-mail autora	ales.belohradsky@gmail.com
E-mail vedoucího práce	benacekv@fsv.cuni.cz

Contents

List of Tables

List of Figures

Acronyms

BL Backward Linkage

CE Central Europe

EEG Evolutionary Economic Geography

EE Employment Elasticity

EM Employment Multiplier

EU European Union

FDI Foreign Direct Investment

FE Fixed Effects

GDP Gross Domestic Product

GRIT Generation of Regional Input-Output Tables

GVA Gross Value Added

H-O Heckscher-Ohlin

IE Income Elasticity

IM Income Multiplier

I-O Input-Output

MRIOT Multi-Regional Input-Output Tables

NACE Nomenclature générale des Activités économiques dans les Communautés Européennes

NEG New Economic Geography

NTB Non-Tariff Barriers

NUTS Nomenclature of Units for Territorial Statistics

OE Output Elasticity

OLS Ordinary Least Squares

OM Output Multiplier

RIOT Regional Input-Output Tables

SLQ Simple Location Quotient

Master's Thesis Proposal

Author	Bc. Aleš Bělohradský
Supervisor	Doc. Ing. Vladimír Benáček, CSc.
Proposed topic	Local Development and Policies of Protectionism
Specialization	Economic Theory

Topic characteristics In the last decades we could identify two antithetic principles in development of the world market. Globalization on one side as the well-described process of widening the field for all economic players—and hence emerging the bigger and bigger players. On the opposite side there are regions which are making out that they need to protect their autonomy from those globalizing forces. Thus we can find such instruments in local policies like subsidies to local firms, marks of local origin, special local vouchers instead of premiums in cash and even the various types of local currencies. Simply said we can see the kind of "regional or local protectionism" in the contrary to the globalization, which also contains several economic dimensions.

The criticized mechanism of globalization lies on the fact that it widens the gap between regions, where the big firms have the quarters, and others, where they just sell their products. Money from those marginal regions flow out and thus they are locked in the poor performance.

This topic is examined mainly by environmental economists, lead by the British New Economic Foundation, who try to evaluate the self-reliance of economy using the regional money multiplier, but conclude that this approach has brought partial results only. In this work I will therefore try to widen its scope from mere monetary to real flows and include the effects of intra-regional trade using the methodology of regional input-output tables (as explained below).

The theoretical background which I want to base on is the most recent approach called Evolutionary Economic Geography (EEG), which has been

developed mainly by Dutch economists such as Ron Boschma, Ron Martin or Koen Frenken. This approach combines the spatial analysis with the theory of institutional change and the theory of social networks. This third element they consider as more influential on performance of economic regions than the spatial conditions as such.

The empirical validity of this approach is still being examined and enhanced. The problem is, similarly to the mentioned surveys of the environmental economics, in the lack of data on the level of firms.

Czech situation is geographically quite lucid thanks to one well-performing agglomeration in the center of the country and the surrounding regions performing more or less badly, though covering some 70% of the economy. This division between Prague agglomeration and peripheries has escaped the attention of economic analysts (in contrast to sociological studies). The regions are obviously dependent on the state transfers and the situation seems to be non-sustainable.

This work should describe the emerging techniques of protectionism from the perspective of economic regions (primarily focusing on Czech regions), draw up the policy recommendations and for this purpose examine the significance of 1) intra-regional trade, 2) financial flows from outside and 3) institutional structures and networks for the regional economic development.

Hypotheses

1. The effect of local trade. The regions with strong and balanced intra-regional trade are better performing, while flowing-out of money leads to the lock-in effects due to cyclical "macroeconomic" disequilibria.

2. The effect of FDI. There is no possibility to discover the financial flows from one region to another—the only way is to analyze the foreign investments, while they are statistically recorded. The hypothesis is that the region should prefer the policies supporting small local firms (subject to local financing) than big financial flows from outside (private or public).

3. The Czech regional trade based on inter-industrial specialization is not allowing some regions to catch up with the central Bohemian cluster based on exports of high-paid bureaucratic services (public and private) since its spillovers cannot be absorbed in peripheries.

Methodology

1. Regional Input-Output tables using the non-survey regionalization methodology, such as GRIT approach (Jensen *et al.* 1979), described in FoodIMA (2008) Deliverable 6.1 and applied for instance in Semerák *et al.* (2010). Comparison of outputs of I-O analysis and Money-multiplier surveys of environmental economists (Sacks 2002).

2. Regression analysis in favor of analyzing the share of investments from abroad (FDI) on the prosperity of the regions.

3. Reconstruction of the regional balance of payments (if possible due to the availability of data) and regional price-level indices.

Expected contribution In the first place there is a lack of works concerning with geographical issues in the Czech economic literature. This work should connect most recent attitudes of economic theory (such as evolutionary approach or theory of networks) with actual challenges of regional development in the Czech Republic.

Questions of protectionism in the favor of regional or rather generally local development (in current European space is even small country with fixed exchange rate to Euro becoming a sort of a region) are likely to emerge in the near future â€“ this work can put some perspective how to deal with them, offer policy recommendations on both regional and national level.

From the methodological point of view the main contribution could be in summarizing the possibilities of solving the problem of poor availability of regional data and hence making the analysis at the regional level using the transformations of instruments and data from the national level.

Outline

1. Literature review
    a. Regional literature, geographical aspects
    b. Recent topics in theory of protectionism
    c. Methodological background, FDI literature, Input-Output literature
2. Theoretical part
    a. Geographical view on economy, evolutionary economic geography and theory of networks

b. Forms of protectionism on the regional level in the Central-European conditions

c. Identification of Czech geographical specifics and challenges

3. Empirical part
   a. Reconstruction of available regional instruments, balance of payments, regional price-levels
   b. Input-Output analysis
   c. FDI analysis
4. Conclusions and policy recommendations

Core bibliography

1. Boschma, R. & K. Frenken (2006): "Why is economic geography not an evolutionary science? Towards an evolutionary economic geography." *Journal of Economic Geography* **6(3)**: pp. 273–302.
2. Boschma, R. & R. Martin (2010): *The handbook of evolutionary economic geography.* Cheltenham, GB: Edward Elgar.
3. Boschma, R. & A. T. Wal (2008): "Applying social network analysis in economic geography: framing some key analytic issues." *The Annals of Regional Science* **43(3)**: pp. 739–756.
4. FoodIMA Project, Deliverable 6.1: *A Theoretical Framework for the Construction of a Complete Regional I-O Model.* GR: Aristotle University of Thessaloniki.
5. Frenken, K. (ed.) (2007): *Applied evolutionary economics and economic geography.* Cheltenham, GB: Edward Elgar.
6. Jensen, R. C., T. D. Mandeville & N. D. Karunaratne (1979): *Regional Economic Planning: Generation of Regional Input-Output Analysis.* London: Croom Helm.
7. Martin, R. (2009): "Rethinking Regional Path Dependence: Beyond Lock-in to Evolution." *Papers of Evolutionary Economic Geography* **09.10**.
8. Sacks, J. (2002): *The Money Trail.* London, GB: New Economics Foundation and The Countryside Agency.
9. Semerák, V., K. Zigic, E. Loizou & A. Golemanova-Kuharova (2010): "Regional Input-Output Analysis: Application on Rural Regions in Germany, the Czech Republic and Greece." *Paper prepared for presentation at the 118th seminar of the EAAE.*
10. Vousden, N. (1990): *The economics of trade protection.* US: Cambridge University Press.

Author Supervisor

Chapter 1

Introduction

During the last months the question of inequality has become very popular among scholars, politicians and even the public: the book criticizing famous Kuznets curve became a bestseller of last year (Piketty 2014).[1] The old question, why certain places and countries in the world are persistently underperforming, is thus recently again very popular. The specific side of inequality research is a question of regional dependence: why the regions within a country tend to be relatively more or less rich—is it caused by structural difference, geographical or historical determinants? And most importantly does the convergence hypothesis of economic growth hold or is the gap still widening? Economic literature has been for a long time quite uniform in favour of the former idea but recently more and more voices turn to the latter.

Regions within countries are more or less self-governing units, their goal is to boost the economic growth, attract the investors and to diminish the unemployment. If it is true that the inequality is continuously rising, local governments of peripheral regions have serious problem. Can they face this tendency or are they inevitably locked in poor performance? What policies lead to desired goals? Is it better to specialize in certain production for example via attracting a rich investor, or rather to support diversity and self-sustainability? Is it better to act in favour of higher openness in trade for instance by investing to better infrastructure, or rather to support own small market? In our work we will consider these questions, with an encompassing question back in our minds: does local "protectionism" pay off?

[1] The book by Thomas Piketty, 2014, *Capital in the 21st century*, has caused huge debates over global inequality and according to some opinions, it has also redirected the prevalent academic view on the topic.

In the literature we can find articles demonstrating the effect of freeness[2] in trade towards widening the gap (Brakman *et al.* 2006), providing the evidence leading to rather pessimistic prospects about the possibilities of catching up (Redding & Venables 2004), and even quite clearly supporting the closing up of the regions against the rest of the world (Sacks 2002).

Obviously there is a huge difference between the regional inequality in developing countries and in well-developed high income countries. Naturally the research is focused more on the developing countries, especially on China, where the regional differences are huge. The objective of this thesis is to analyse the prospects of development of regions at the level of NUTS 2 in Central Europe and to evaluate the extent to what the protective policies can play a positive role, regarding the inequality and economic performance.

In order to shed some light on the outlined questions we use two different methods. Firstly we construct regional Input-Output tables for selected regions and do the simple impact analysis to see the underlying existing structures of regional economies in covered area. Next we run couple of simulations using the Krugman's New Economic Geography models to analyse the effect of certain protective policies and to get a notion of future potential dynamics. New Economic Geography offers an extensive theoretical background for analysing geographical effects in economy, but its use in empirical work is so far rather limited. Brakman *et al.* (2006) as nearly the only one existing empirical study at this field, use the simulation method for Western Europe. Our work will be probably first using this method for regions in Central Europe. It can therefore contribute also in detecting drawbacks and advantages of this geographical approach for empirical studies.

In Chapter 2 we present the core literature concerning all connected topics: the issues of inequality, protectionism and the geography. Chapter 3 covers the theoretical framework, especially the geographical element of the analysis, and the theory of protectionism. Chapter 4 gives the first image of characteristics of examined area, and describes the used methods and data. Chapter 5 brings the results and finally Chapter 6 summarizes our findings.

[2]The term "freeness" is becoming popular in recent international trade and economic geography literature, see for instance Brakman *et al.* (2006) or Borbély (2006).

Chapter 2

Literature review

This work links three different strands of literature. At the first place it draws on the regional income inequality literature mostly connected to the so called Williamson hypothesis, secondly it follows the literature studying the role of geography, spatial structures and its evolutionary aspects, as this is possible important driver of the evolution of spatial inequality. Finally it considers the recent understanding of protectionism with respect mainly to the regional perspective.

2.1 Regional inequality and development

Regional inequality and issue of inequality as such has been for a long time largely influenced by the work of Kuznets (1955), who came up with the well known inverse U-shaped relation between inequality and economic growth. First who elaborated Kuznets' theory from individual income to regional inequality was Williamson (1965). Williamson proved that for his sample of countries the level of inequality declined in period from 1950 to 1960, which was consistent with the convergence hypothesis and with the inverted-U relation. Similarly as in Kuznets' version is assumed that during industrialisation only few people benefit and inequality rises, in Williamson's regional version is assumed that at early stage the most profitable are regions with richer natural endowments. During 60's the issue of regional inequality became widely known as "North-South problem" according to the geographical conditions in United States, but dozens of articles spoke about "regional dualism", "pockets of poverty", and "growing centres". Surprisingly there is not many articles which have provided a decent empirical evidence for the existence of Kuznets

inverted-U-shaped curve. Among more frequently cited studies there is exactly one article (Fisch 1984), which is suspicious to Williamson's results and one (Amos Jr. 1988), which proves the inverted-U relation and expands it by an additional stage: countries in higher stage of development according to Amos tend to rise in inequality again, so the relation is more like inverted-horizontal-S. Subsequent articles examining this relationship are very recent, which shows that the question of relationship between spatial inequality and economic development is (1) not very frequently examined, but (2) is attractive until today. Massive panel analysis with 56 countries and 29 years was done by Lessmann (2014). With recent data he found evidence for both, the inverted-U-shaped hypothesis and Amos' hypothesis of re-increase in latter stage.

Montouri & Rey (1999) examined the convergence theory in case of US states testing a wide variety of econometric methods. They found the strong spatial autocorrelation, which influences the channels of convergence mechanism: the economic development of region does not occur separately but in spatial clusters.

Sawers (2006) considers the tendencies in regional inequality in case of Lithuania as a representative of post-socialist transitional economies. His results are clearly in favour of rising inequality, while large cities are developing quickly as they are significant recipients of FDIs, whereas rural areas remain in behind.

In addition, there is a vast literature concerning various effects of globalisation on regional development. The advantage and the shortage of described discussion in one is that it describes relation between inequality and economic development as it was just an intra-national matter, dependent only on the level of national GDP, but of course it is highly connected to the global development. Lowering transport costs and rising openness of countries and regions brings another driver for regional disparities, as it is connected with moving of (especially high skilled) labour, clustering of production and other factors. Ezcurra & Rodríguez-Pose (2013) consider this mechanism and reveal a positive relationship between economic globalisation (as a level of integration of a country with the rest of the world) and increase of regional inequality within the country. This line of thinking leads to the importance of geography and the spatial economic structure, which opens the second strand of the literature we base on.

2.2 Geographical and evolutionary aspects

When determining roots and main drivers of different growth paths of countries across the world, researchers usually follow one of these three explanations: extent of trade, quality of institutions or geographical aspects. Although the determinants of growth of European regions certainly differ from, let's say, African countries, the conclusions at this field can be worthwhile even for regional analysis. The question is indeed the same: to what extent is the development of regions dependent on their trade, institutions or geography?

Overall and strong evaluation of these three drivers was provided by Rodrik *et al.* (2004), who concludes that conventional measures of geography and trade become insignificant or have very weak direct effect, when controlling for institutions (which in this case means the World Bank's Rule of law indicator). Geography turns out to have mainly indirect effect through influencing institutions. Also current research of World Bank goes in direction of geographical determinants (World Bank 2009; Gill *et al.* 2009). But still the tough struggle between proponents of institutions and geography in determining economic growth keeps going until nowadays (Diamond 2012; Acemoglu & Robinson 2012).

When speaking about geography in economics, it recently mostly refers to the approach of New Economy Geography (hereafter NEG) connected mainly to names of Paul Krugman and Michael Porter (Fujita *et al.* 1999; Brakman *et al.* 2009). NEG is based on neoclassical general equilibrium model, but it brings into analysis some new crucial aspects: most importantly the role of transport costs and the economies of scale, which all in all turns the models into imperfect competition, implies emergence of agglomerations and inevitably leads to persistent inequality in distribution of economic activity and development. This of course brings complications for too optimistic view about the convergence hypothesis of classical Solow model.

So far NEG literature is represented mainly by theoretical works, with relatively small empirical and policy relevance. In empirical work, two main branches can be identified: first applies the general equilibrium model and simulates the development of economy depending on various conditions. Brakman *et al.* (2006) do one of first attempts to enhance simple NEG two-region model and run a multi-region simulation for NUTS 2 regions in Western Europe and prove by this the link between freeness of trade and tendency of economy towards few big agglomerations. Second branch of NEG literature uses the key

NEG conditions (as economies of scale) to enrich econometric estimations of growth patterns or the trade, often based on classic gravity approach (Redding & Venables 2004). The importance of clusters is for US illustrated by Porter (1998) and Belleflamme *et al.* (2000) discuss Porter's results (and NEG results as such) by stating that economies of scale are just one side of agglomeration effect, but there are also certain costs connected to common location with competitors. The historical perspective for the role of agglomeration forces in the globalization process is stressed by Crafts & Venables (2003) showing the importance of analysing the dynamics of agglomerations even in today's research.

In the similar time as NEG, also other approach connecting economic analysis and geography emerged. This is called Evolutionary Economic Geography (hereafter EEG) and is rooted more in the geographical science than economics. The relation between these two approaches can be easily illustrated: although Krugman labelled his economic approach as New Economic Geography, the proponents of second approach reacted that it is "a case of mistaken identity: it is not that new, and it most certainly is not geography." (Martin 1999)

EEG is focused more on the role of institutions and networks, including the analysis of evolution, and criticizes NEG that it is far from reality (Boschma & Martin 2010). The role of clusters is obviously subject of research of both approaches, the latter institutional way of thinking nevertheless enhances the understanding of proximity from pure geographical to more complex view. Boschma (2005) distinguishes between five types of proximity: organizational, geographical, social, institutional and cognitive. They will be further explained in the theoretical part.

Both ways also involve the concept of path dependency, taking into account the power of historical determination. In NEG it is more in the form of historical accident: while one of possible multiple equilibria is chosen, it is very unlikely that it will evolutionarily disappear thanks to rising economies of scale. EEG accents the role of deeply rooted, rigid and just slowly evolving informal institutions and the path dependency emerging from this. All in all the common ground is the persistence of any current institutional-economic setting.

2.3 Recent topics in the theory of protectionism

The focus of this work is to discuss the potential policies of protectionism from perspective of regional development, which follows inherently from the question of growing regional disparities and from the rising "localisation, not globalisation" opinions.

So far, the idea of protectionism is obviously mostly connected to the level of national states (Bhagwati 1989; Baldwin & Evenett 2009), whereas European union is increasingly considered as one player. Similarly to the empirical studies, theoretical models are based mainly on analysis of imposing tariffs or quotas as the most common inter-national trade barrier (Vousden 1990; Feenstra 2004; Batabyal & Beladi 2009). Protective tendencies within the countries is a topic, which is studied surprisingly scarcely. An exception in this is China (Bai *et al.* 2004), which has nevertheless very different conditions from Europe. Moreover the theoretical works such as Vousden (1990) are in line with standard trade theories, where natural endowments and comparative advantages play the crucial, free trade gives the most efficient outcomes and the questions of inequality, spatial effectiveness and intra-industry trade are put aside. We introduce this line of thinking in Section 3.2, but it is clear that its value for our analysis will be limited.

On the other hand we can cite some studies such as Ward & Lewis (2002) or Sacks (2002) which examine the "dark side" of lowering the barriers among regions, especially considering the mechanisms of money outflows from the regions (quicker the money flows out, less wealth for region it brings). Their conclusions in fact encourage to invent the protectionist techniques to avoid these outflows. The actual topic for current environmental economists is measuring the regional money multiplier—how large is the total turnover of a sum of money for certain period of time. Sacks (2002) constructs the multiplier called LM3, which tries to trace the "money trail" and hence show, how much from the initial sum remain in the region and how much flow away. In Czech conditions this research was replicated by Kutáček (2007). Unfortunately this way hasn't brought very valuable results.

It is of course not usual to speak about protectionism in this context, but rather about seeking of sustainable development. Similarly in case of very few studies about community currencies: Longhurst & Seyfang (2013) divide community currencies to four types, service credits, mutual exchange, local currencies and barter markets. Their analysis nevertheless regards just how

these means fulfil the regional goals (and consider it as unsatisfactory), not on the effect to wider market. Collom (2011) studies just the motivations to implement community currencies, not the economic impacts.

Chapter 3

Theoretical part

> "In a global economy—which boasts rapid transportation, high-speed communications, accessible markets—one would expect location to diminish in importance. But the opposite is true. The enduring competitive advantages in a global economy are often heavily localized, arising from concentrations of highly specialized skill, knowledge, institutions, rivalry, related businesses, and sophisticated customers." (Porter 1998, pp. 90)

The opening quotation for this chapter reflects in a simple way an important discussion of economic theory: mainstream economics for a long time expected that the technological evolution, better infrastructure, lower transport costs, higher productivity, etc., would continuously push the world closer towards perfect markets, as assumed by the standard trade theory. We have seen from the existing literature, especially from that about regional inequalities, that the belief in automatic mechanisms of the world without frictions is still powerful. (Maybe not so much) surprisingly, reality goes in a different direction, inequality continuously rises and thus more and more attention is attracted by "new" trade theory, which involves the crucial assumption of increasing returns to scale and imperfect competition. Then there is just a small step to the approaches, which we are mostly interested, because they involve geography seriously into the analysis.

In this part we need to explain what we think by "taking geography seriously", and how it is connected to the main topic of regional protectionism. Protectionism itself needs to be as well theoretically elaborated before we start the analysis. Purpose of this chapter is thus to clearly state the research objectives and to offer some theoretical background.

First of all we assume that the economic activity in Central Europe tends to concentrate in few agglomeration centres, mainly in capital cities. The gap

between these "central" regions and the peripheries is still widening. This needs a geographical view: whether we can find clustering tendencies and speak about agglomerization of the economies. In addition to that we need to construct a measure of regional inequality.

Secondly we want to aim on the drivers of existing regional disparities. We expect, simply said, that regions with strong and balanced intra-regional trade are better performing. Weak intra-regional trade and higher dependence on outside region lead to the outlined mechanism of flowing-out of money, which causes the lock-in effects due to the cyclical "macroeconomic" disequilibria. Not only countries but also regions have their own "current account" and its deficit has similar implications. Every current account deficit must be financed from "abroad" as illustrated in a simple macroeconomic identity: $(S_p - I) + (T - G) = -I_f$, where we have private savings S_p, domestic and foreign investments I and I_f, taxes T and governmental spendings G. The problem of flowing-out of money is captured in this identity by too low private savings S_p in the region (if money flows out too quickly, fewer people in the region can profit from them and thus overall private savings become lower). Besides this, there are also other mechanisms, how the region can run into the deficits (i.e. too high investments and obviously the local government's budget deficit).

Regarding the question of regional specialisation towards certain economic sector, we assume that smaller sectoral diversity even strengthens the lock-in effect since the flag industries are often less connected to the regional economy then small local firms. This is often a reason for the critiques of large inward FDI projects (like the building of huge car-factory), as it absorbs a lot of labour force, gains mostly flow out, and it destroys to some extent the existing economic structure of the region, lowers the sectoral diversity and thus makes the region even more dependent on the outside trade.

Connecting these hypotheses together, it is likely that higher openness to trade and better access to market (better connection to the "central" region) also strengthen the lock-in effect since it increases the relative cost of localising the economic activity into the peripheral region. This idea can look a bit tricky, but it follows the Krugman's theory in the sense that lowering the transport costs encourages companies to move from peripheral regions to cores as they can easily manage their operations from distance and in central regions they can profit from higher returns to scale.

In the Table 3.1 we summarize all hypotheses described above. To make the orientation easier, we add in the second column also the potential protective

implications. What we mean by regional protective policies will be explained further on in Section 3.2, but at this place we find it valuable to outline the straight connection between the hypotheses and its implications.

Table 3.1: List of hypotheses

Hypothesis	**Protective implications**
Agglomerization: Economic activity in CE tends to concentrate in few agglomeration centres. The gap between central regions and peripheries is widening.	Depends on the driver of disparities, but if it is an inherent property of the overall economic development, some redistribution or "cohesion" policies on national or international level are needed.
Intra-regional intensity: Regions with strong and balanced intra-regional trade are better performing, while flowing-out of money leads to lock-in effects.	Any barriers to trade with outside regions could be worthwhile to intensify the local trade. Extreme version might be for instance imposing local currencies (see Subsection 3.2.1).
Intra-regional diversity: Smaller sectoral diversity strengthens the lock-in effect since the flag industries are often less connected to the regional economy.	Avoid big investments from outside, prefer the investments within the region. Avoid intense specialisation and rather support diversity (by local subsidies for instance).
Openness: Better access to market (better connection to the "central" region) strengthens the lock-in effect since it increases the relative cost of localising the economic activity into the peripheral region.	Aim on investments into the local infrastructure (making the interactions within the region easier) than on investments into the better connection with core regions.

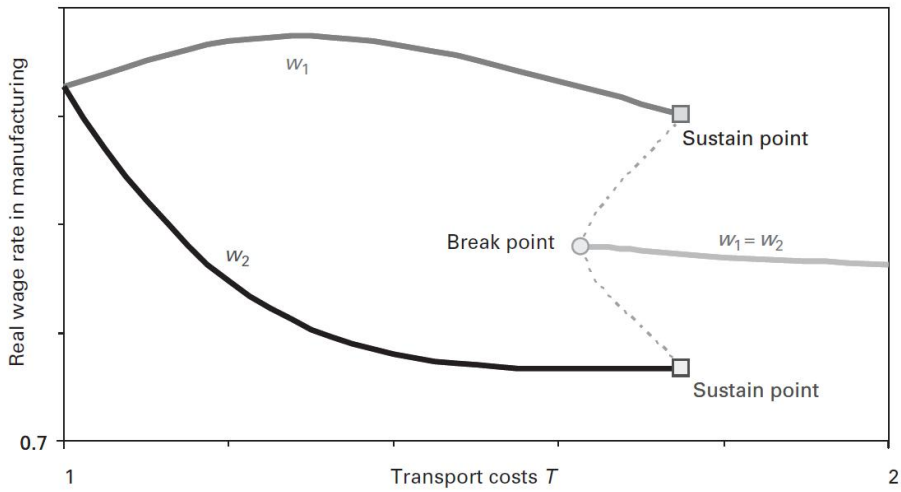
To underlay the hypotheses with some theoretical context, we firstly elaborate in a bit more detail how geography will be involved into our analysis, emphasizing the way how agglomerations shape the spatial economic structure, and then we lay down few notes about the theory of protectionism regarding the differences of standard and new trade theory.

3.1 Geographical view on economy

3.1.1 New Economic Geography

In most basics, the NEG model is built on the interaction of trade costs based on distance between actors and the economies of scale, which together shape the market. The role of trade costs is crucial: if they are high, the economic activity remains dispersed, but as they diminish, firms care less, how far they are from customers. From the assumption of economies of scale then follows that it is better to concentrate the production to fewer places. Historically this explains the emergence of big, rich and most dynamically evolving cities and the less industrialized, poor peripheries (Crafts & Venables 2003). This dynamics is illustrated in Figure 3.1. Starting with high transport costs $T = 2$ (transport costs are explained in Subsection 4.2.4), real wages of two regions remain same and thus the economic activity is spread between them. Pushing transport costs down, this equilibrium at a certain point becomes unsustainable, one of regions attracts more mobile workforce and the gap in real wages emerges.

Figure 3.1: History of the world



Source: Brakman *et al.* (2009, p. 160)

The immediate conclusion is that the economic activity tends to diverge across regions and countries and not to converge as would be stated from Solow model (overall convergence in this optics is an ideal state in case of zero transport costs). The spread of economic activity can be caused by historical accidence, but once it happens, it is persistent. This is the point, where NEG claims to involve the path dependency into the analysis. It also implies

that this view counts with multiple equilibria. (Fujita *et al.* 1999; Brakman *et al.* 2009)

Of course the situation of current developed world is far from such a level of transport costs, which would lead to equal economic dispersion. Agglomerations already exist and they seem to be persistent.

3.1.2 Proximity

In NEG, the transport costs are usually dependent exclusively on locations and mutual geographical distances. This can be very limiting when taking a look on the interdependencies across the countries, disregarding the other than geographical barriers between the different countries or different regions, in literature called "border effects" (Brakman *et al.* 2006). We therefore use the work of Boschma (2005), although he belongs to EEG, so to the opposite camp of economic geography, and he certainly would not be willing to serve for enriching the NEG model. He distinguishes five types of proximity: organizational, geographical, social, institutional and cognitive.[1]

The most intuitive is the geographical proximity. In Boschma's meaning, spatial closeness helps people to share the tacit knowledge, or in other words it brings the knowledge externalities. Besides this effect (which is in our case more incorporated into the production function through increasing economies of scale), it also and primarily means, that bigger distance leads to higher transporting costs of distributing goods.

Organizational proximity means that the organizations of the same sphere of business tend to know about the others, to cooperate and even to share knowledge (at least through the employees who change the working place)—this is called tacit knowledge. Therefore we assume that similarly specialised regions have "closer" to each other. Typically this is influential between the large cities (mostly capitals), where the knowledge-based sectors are concentrated and hence the mobility of labour between these regions is a bit higher.

Social proximity means the level of trust based on social relations. Of course the quality of relations and mutual communication is very hard to evaluate, nev-

[1]Evolutionary perspective at first place does not look for any equilibria, but instead it says there is no equilibrium in the real world. Involving its propositions into equilibrium-seeking modelling is thus clearly not in line with the approach. Moreover it should be mentioned that Boschma's intention in the article was different from ours: i.e. to explain what are the drivers for inventive dynamics in various regions (or we can say for increasing returns and economies of scales); whereas we are looking for drivers of spatial movement of labour.

ertheless there are some strong proxies like the common language—especially when we need to include the differences among countries.

Similarly institutional proximity is the trust based on common institutions. We could include all from the legal background to culture, shared values and norms, and other "informal institutions." Nevertheless we could protest that even language is a sort of institution. So in this case we consider just formal institutions and most importantly, of course, the belonging to the same country.

And the last is cognitive proximity, which is about the manners of communication, variability of ideas and notions etc. Very tight cognitive proximity can easily lead to immobility and routines. Boschma (2005) states, that routines are not good for the economy, because communicational and cognitive diversity leads to the innovations, but we are interested more in the conditions, which make certain regions cognitively closer than to others. We expect that it might be a case when the regions share some mutual characteristic conditions, which shape all: the forms of production, of communication, transport mechanisms, etc. For instance this can be caused by sharing the same coast of sea or the same (important) river. It can also be shaped by common historical roots (path dependence again: this could be the case of for example Sudetenland with its lack of common memory).

Enriching the understanding of distance between regions might be a possible way how to deal with border effects, which are still a bit problematic in the NEG approach. (Brakman *et al.* 2006)

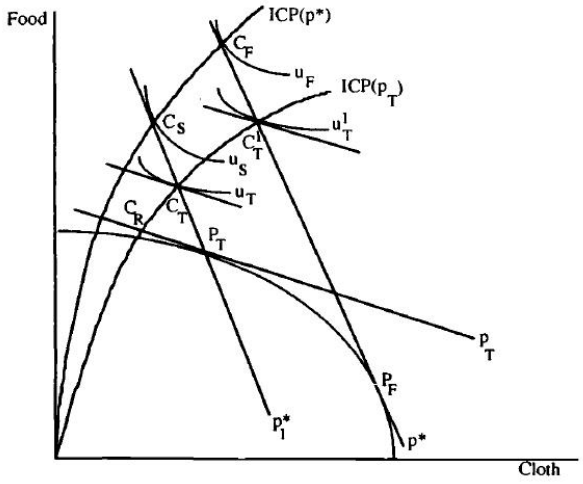
3.2 Protectionism

The issue of protectionism was elaborated mainly in terms of standard trade theory. Let's see what are its implications and what would it mean in perspective of new trade theory and NEG.

Vousden (1990) uses the standard Heckscher-Ohlin model for international trade (Figure 3.2), where a country has certain production frontier based on two factors capital and labour, and showing the relative productivity of economy in labour-intensive (Cloth) and capital-intensive sector (Food). Domestic autarkic prices are determined by the slope of production function at the point of tangency with the highest utility indiference curve (this point is not depicted in the graph). Nevertheless using the world market (and world prices p^*), the economy can by exporting cloth and importing food get on much higher utility

curve (consumption point is marked as C_F, while production as P_F). So far it is basic mechanism of H-O model of international trade.

Figure 3.2: H-O model with protectionist decisions



Source: Vousden (1990, p. 26)

What is new in Figure 3.2, however, is an introduction of tariff. Suppose that there is a tariff for imported food. It immediately (in perfect competitive world) leads to change of domestic prices (from p^* to p_T) and shift of production point (to P_T). But trading with the rest of the world is still at world prices (hence the curve p_1^*), while domestic consumers face the tariff-distorted price ratio. It determines a new point of consumption to C_T.

The result for the economy is apparently negative in terms of total welfare: feasible consumption was pushed downwards. In terms of production it is twofold, producers of food are probably better off, while they produce significantly more, but the cloth production on the other hand declines.

In case of regions we cannot speak about tariffs, but instead we have to think about non-tariff barriers (NTBs) such as subsidies which also distort the relative prices. Although imposing a tariff is not a feasible policy for regional governments, the effect of any other protective policy, which changes the relative prices would be in this theory identical (the forms of protectionism in case of Central-European regions are outlined it the next subsection).

Regarding this basic outlook, we can make two remarks:

1. The Stolper-Samuelson theorem states, that "a rise in relative price of a commodity leads to a rise in the real return to the factor used intensively in producing that commodity and to a fall in the real return to the other

factor" (Vousden 1990, p. 11), so it implies fall in real wages (real return to labour) in our case. On the other side, there is a limitation of this model, while it assumes a full use of the factors, and thus it does not show any effect on unemployment, which could be easily a reason for such a protective decision.

2. The problem of standard trade theory is, that it is based on endowment-world and hence on the assumption of different autarkic relative prices. Nevertheless the real world shows the big extent of trade even between countries, which are almost identical regarding endowments and economic structures. This can be explained only by involving increasing returns to scale as it is in NEG.

The first point would mean, that there is a trade-off between higher equality and higher total wealth, which takes us back to our fourth hypothesis.

3.2.1 Forms of protectionism on the regional level in the Central-European conditions

In Subsection 3.1.1 we have described the tendency of economy to create agglomerations concentrating economic activity. In Chapter 4 we will describe, to what extent this is the case of Central Europe. Before that we need to fill in the missing piece in theory: what are we talking about when speaking about regional protective policies?

For the purposes of this text, we need to look at the protective mechanisms resulting from decision-making at the micro level: on the level of business units and regional political authorities. From this point of view, we can roughly distinguish three areas of protectionism.

Firstly there are direct tools, such as subsidies, special payments, everything under the labels like "support of local business". It has the only reason, to diminish the potential gains of moving the business to agglomerations in other regions, to motivate the people to stay in the region. Next is the indirect method like giving the marks of local origin, motivating customers to prefer the local products. The last form of the protectionism is closely related to this, because it comprises all mechanisms, which help to keep money inside the region. It mostly means generally the support of local supply-demand structures . But in extreme cases we can see for example the local currencies, which are trying to substitute the national currency—in our area it is for example

German Cheimgauer in Bavaria, which is also one of few successfully established alternative currencies. In most cases it does not come accepted (in the Czech Republic until now in all cases). Local currencies have obviously also the anti-inflation meaning, which may be often more important motivation.

The attempts to measure the inter and intra-regional money flows through constructing money multipliers are limited by the lack of data (Sacks 2002). We thus look for another way how to describe this phenomenon. The method which takes place in standard international economics for measuring the intersectoral linkages in economy including its connection to the foreign markets, is the input-output analysis. For our needs it must be regionally-adjusted.

Chapter 4

Data description and methodology

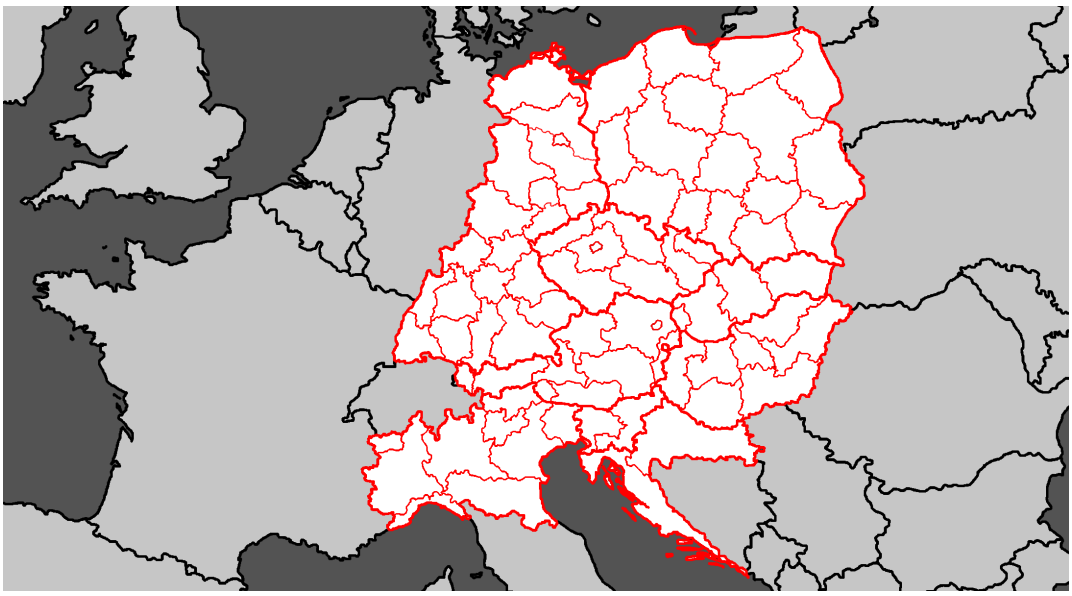
In our analysis we use two different methodological approaches with the side intention to evaluate the possibility of its interconnection. The first is input-output impact analysis, using the regionalisation method to obtain regional I-O tables. The second is economic simulation using the NEG model and evaluating the impacts and effectivity of various changes emerging from protective decisions. It should be noted that the covered region differs for both methods. As it will be explained in Subsection 4.2.3, regionalisation of national I-O tables needs very detailed structural data of national economies, which are not freely distributed because of confidentiality issues. We have obtained the necessary data for Czech regions from Czech statistical office, but not from other statistical offices from other countries. The I-O analysis will be therefore limited to the regions within the Czech Republic. Subsequent NEG part will afterwards generalise some issues for the whole region. Preceding to the description of the two methods, we introduce the covered region including some simple static analysis.

4.1 Description of the covered region and preliminary descriptive statistics

For our purposes we use the area of the European Commission's Central Europe 2020 Cooperation Programme covering the 77 NUTS 2 regions from 9 EU countries (Germany, Poland, Czech Republic, Austria, Italy, Slovakia, Hungary, Slovenia and Croatia), as shown at the Figure 4.1. The whole area is used in Nomenclature of Units for Territorial Statistics simulation, while through the I-O impact analysis we take a look just on the Czech Republic. Most of our

data is from year 2009, mainly because of limited availability of newer detailed regional data.

Figure 4.1: Map of covered regions



Source: author's graphics

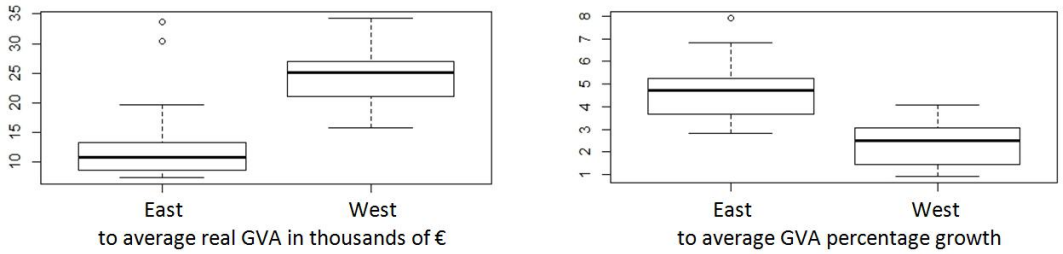
The area is highly geographically and economically diversified, with a persistently significant division to the west and east part, where the former consists from Germany, Austria and Italy and the latter from others. First difference is in terms of overall production, second is in distribution of economic activity. Figure 4.2[1] shows the division between East and West in gross value added (GVA) per capita, both value and in growth. We can easily see the huge difference. On the one side, Germany, Austria and Italy have much higher real GVA per capita: the third quartile of East (around EUR 14,000) is still lower than the lowest value of West. On the other side the average rate of growth is approximately 5 % in median in eastern countries and 3 % in western, thus we can speak about the general convergence of eastern regions.

In eastern part the economic activity is much more concentrated to the capital cities, while in West it is more spread throughout the space, though even there are significant economic clusters (of actually higher production in absolute terms than in the eastern part). (Gill *et al.* 2009)

We firstly deal with three issues regarding the economic conditions in Cen-

[1]The boxplots show differences in distribution for East and West, where the bold line represents a median level, edges of the boxes show first and third quantiles. Values on y-axes are either level of GVA or its growth as described under each graph.

Figure 4.2: Boxplots of the east-west division



Source: Author's analysis.

tral Europe: tendencies towards economic clustering, regional specialisation and the flexibility of labour force.

4.1.1 Clustering tendencies

Regarding our first hypothesis we need to focus on clustering and agglomeration tendencies. Clusters in economic literature describe usually industrial localization (emerging due to lower transaction costs). This is the case mainly of the United States, where the geographically dependent industrial specialization is demonstrable (Porter 1998). Situation of European Union, which is still composed from (to some extent) individual countries, is different, nevertheless the principle is the same: we can see clustering of economic activity around agglomerations.

The Czech Republic offers a clear example: in 2011 Prague, located in the centre of the state, governed 25 % of total Czech production, assuring the level of GDP per capita at EUR 31.200 per year (125 % of EU average level), while regions at peripheries were around EUR 12.500 (approximately 50 % of EU average).

We can evaluate a simple measure of a "weight of agglomeration" by taking a ratio of capital's GDP per capita (level per inhabitant allows a better comparison) to the country average (for all regions in the country).

Clustering effects in the Central European conditions were examined for example by Tondl & Vuksic (2008). They focused on the ability of regions in the post-socialist East-European countries to catch up with the Western regions, thus they based their analysis on the dataset from the post-transforming period (1995-2000) and the East-European countries and found the clear evidence for the significance of the clusters around large cities.

Another measure of level of concentration of economic activity we can use, is the normalized Theil index of regional inequality, computed as follows:

$$TI = \frac{100}{R \ln R} \sum_{j=1}^{R} \left(\frac{Y_j}{\bar{Y}} \ln \frac{Y_j}{\bar{Y}} \right) \tag{4.1}$$

where Y in our case is GDP per capita, j is a region and $\bar{Y}$ is an average GDP for all R regions in a country. This index gives value from 0 (absolute equality in economic level) to 100 (all income is produced by one region). As we know about huge differences between countries, we do this separately for (bigger) countries, east-west division and for the whole region. The results for both, Theil index and the weight of agglomerations described above are shown in Table 4.1.

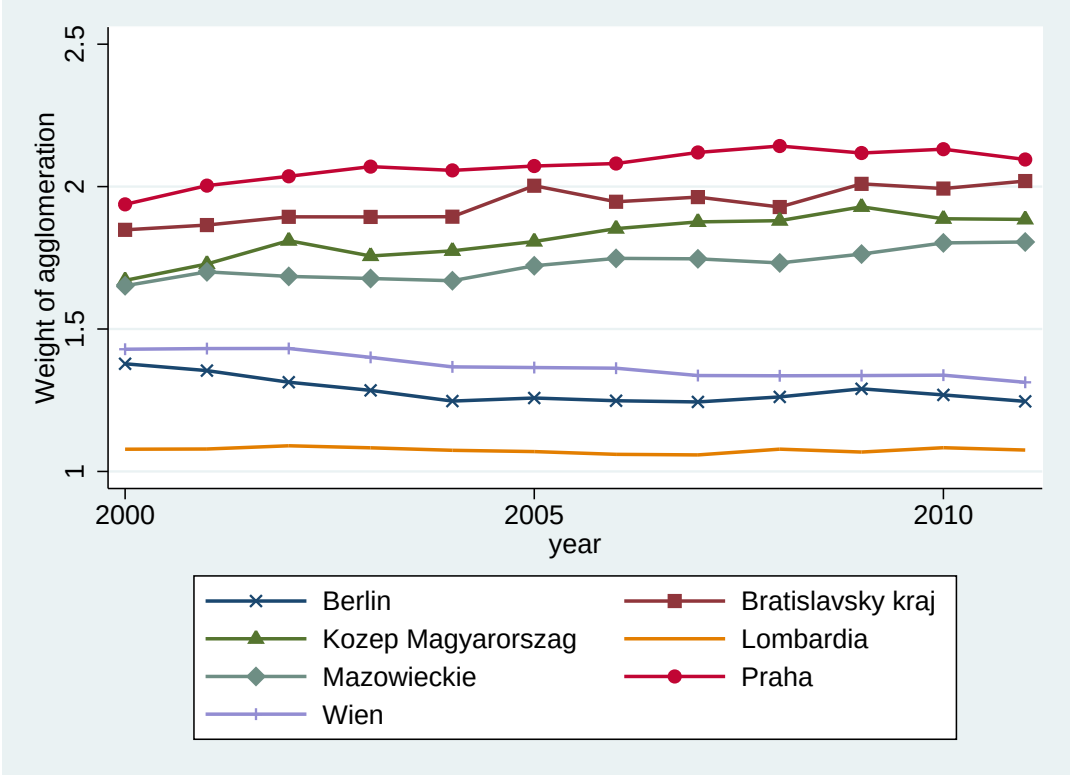
Table 4.1: Regional inequalities: Theil index based on GDP per capita, 2009, and the Weight of agglomerations

Area	Theil index	Weight of agg.
Germany	0.69	1.27
Czech Republic	3.44	2.10
Italy	0.20	1.08
Slovakia	10.88	2.02
Hungary	3.52	1.88
Austria	0.78	1.31
Poland	0.95	1.81
East	3.01	1.69
West	0.51	1.23
Total area	3.85	1.41

Source: author's computations.

Apparently there are big differences in levels of dispersion between Eastern and Western countries. Slovakia, although it has only 4 regions, shows immense level of regional inequality in compare to others. In terms of weight of agglomeration, Czech and Slovak republics have GDP per capita in capitals twice as big as the average in the rest of the regions, while for instance in Italy there is almost no difference. From Figure 4.3 we can also conclude that the difference is even in evolution over time: the weight of capital of Eastern countries is rising, whereas the weight of Western capitals is rather declining.

Figure 4.3: Evolution of the weight of agglomeration (regions with capital cities



Source: author's analysis

4.1.2 Effect of specialisation and economic diversity

As mentioned earlier, clusters in US environment have primarily industrial connotations (it is not just about information technologies in Silicon Valley, casinos in Las Vegas and financial services at Wall Street, as are the most common examples, but the specialisation covers the whole continent, as shown in Porter (1998, p. 82)). Essletzbichler (2007) evaluates the interrelations between diversity, stability and economic growth on the period from 1975 to 2002 and reveals the negative relationship between economic growth and diversity (since the first is connected to lower stability of economy whereas the latter leads to higher stability).

We have evaluated economic diversity for each region by Herfindahl index (Essletzbichler 2007):

$$HI_j = \sum_i s_{ij}^2 \tag{4.2}$$

and

$$s_{ij} = \frac{E_{ij}}{\sum_j E_{ij}} \tag{4.3}$$

where E_{ij} is the employment in a sector i and a region j. We use the NACE, rev. 2 division of economic activities. Because we want to examine the relative specialisation, we do not use the absolute values of employment, but the ratios of employment rates to total share of the sector in economy. Thanks to that we can identify the most specialised regions in the Central Europe: the most relatively specialised regions are those with huge coal mining sector (primarily Polish Ślaskie with 10 % of its economic activity in coal mining, Łódźkie together with electricity supply, then Dolnoślaskie and Czech Severozápad), then Berlin in administrative, professional, scientific and real estate activities (similarly as other capitals), Brandenburg in wholesale at automotive sector, Bolzano and Tirol due to the tourist industry (accommodation and services).

However, regional specialisation is a complicated issue, as the main theoretical background goes back to the Heckscher-Ohlin model (outlined in Section 3.2), whereas in real world there is an intra-industry trade recently increasing in importance, which is not explained by the standard theory. Borbély (2006) is still able to find specialisation towards labour intensive production in Poland, or high technology in Hungary (among CE countries), but the results are rather weak and national economic structures rather similar. In terms of regions there can be specialisation in certain industry more visible, but that is something what usually is not examined.

4.1.3 Labour mobility and a Division of labour

Important assumption of NEG model is the mobility of labour force across regions. Even in the Central Europe we can see certain patterns in labour mobility (mostly towards capitals and from East to West), but the actual patterns are not important for our future analysis.

What we need for our modelling of labour mobility is to distinguish between mobile and immobile labour force. The immobile sectors are in the model characterized by constant returns to scale and mobile sectors by increasing returns to scale. In basic NEG as described in Brakman *et al.* (2009) there is used a simple division to agriculture as immobile and manufactures as mobile sector. We nevertheless use the NACE, rev. 2 classification to construct the ratios, distinguishing according to the theory high returns to scale sectors as the mobile

ones and low returns to scale sectors as immobile ones. These characteristics can be found in World Bank (2009, p. 130). Within mobile sectors we thus count part of manufactures (machinery, motor vehicles, pharmaceuticals, tobacco), financial services, professional, scientific and technical activities and arts, entertainment and recreation. The only exception, which belongs to high returns to scale sectors, but we classify it as constant returns to scale, are coal and petroleum production, gas and electricity services, which are nevertheless undoubtedly immobile regarding the dependence on natural endowments. These numbers are needed for setting the initial populations of flexible labour force in the model (see parameters γ, λ_r and ϕ_r in equation (4.12)), but the model is not very sensitive to the differences, so it is not necessary to seek for precise numbers. Resulting shares in our case for selected regions are listed in Table 4.2.

Table 4.2: Ratios of mobile labour force to total (selected regions), 2009

Region	Mobile LF
Prague	0.21
Moravskoslezsko	0.10
Berlin	0.21
Oberpfaltz	0.13
Dresden	0.17
Východné Slovensko	0.10
Tirol	0.13
Veneto	0.16

Source: Eurostat, author's computations.

4.1.4 Summary of the descriptive part

We have taken into consideration the area of 77 NUTS 2 regions in the Central Europe. This area is economically significantly heterogeneous: mean gross value added (GVA) of the regions is EUR 17.1 thousand per capita yearly with standard deviation almost 8 thousand, differing from Hungarian average at 10.73 to Italian at 26.2. Apparently, the country specific effects remain the crucial determinant of the regional performance. We have shown that there is still very significant division to western and eastern part, which roughly reflects the historical division by the Iron Curtain (we have included the former Eastern

Germany to the west, but it could be included as well on the other side, as the average GVA of its regions is 17.15 comparing to 26.65 of the regions formerly belonging to the Western Germany).

Besides the country specifics we have mentioned the clustering tendencies of economy mainly to the capital cities.

In comparison to US economy, where the clusters are often connected to considerable industrial specialisation, the Central-European economy seems to be rather diversified, although there are some exceptions (most importantly in case of knowledge-based services, located often in capital cities).

Agglomerations were shown to play an important role and even to increase in importance in case of Eastern part of our area. Specialisation patterns are more tricky and will be of the main interest in our following analysis.

4.2 Methodological issues

4.2.1 Input-Output analysis

Input-Output (I-O) analysis is the method pioneered in the second half of 20th century by Wassily Leontief, firstly exploring the inter-industry relations in the US economy. For our purposes it offers interesting insights: we want to analyse on one hand the structure of the inter-regional trade, on the other hand the inter-sectoral linkages within the region and hence even to evaluate the importance of particular sectors for the regional economy.

Complete method is described for instance in Miller & Blair (2009). Its strength is in showing the inter-sectoral linkages in both directions: the rows of I-O table represent the distribution of output for each sector throughout the economy, while rows describe the composition of inputs required by each sector to produce its products. Besides this intermediate production, I-O tables show also final demand in the additional columns, including consumption, investments and exports, and the additional rows account for other inputs to production such as employee compensation or imports.

As mentioned in literature review in Section 2.3, environmental economists such as Sacks (2002) try to evaluate a money multiplier to depict the extent to which money flows out from the region. I-O analysis offers a non-survey alternative for these multipliers, which can be even more detailed because it distinguishes different impact of various industries on output, employment and

household income (and possibly other factors: popular extension in recent days is to add the effect on environment).

If we denote the square matrix of intermediate production as $\mathbf{Z}$ and the vector of final demand as $\mathbf{y}$, we can write $\mathbf{x} = \mathbf{Z} \cdot \mathbf{I} + \mathbf{y}$, where $\mathbf{x}$ is total output. Then we can compute the matrix of technical coefficients (or direct requirement matrix) $\mathbf{A} = \mathbf{Z}\hat{\mathbf{x}}^{-\mathbf{1}}$, where $\hat{\mathbf{x}}$ is a diagonal matrix of $\mathbf{x}$. The core matrix in I-O analysis is $(\mathbf{I} - \mathbf{A})^{-1}$, which is called Leontief inverse matrix and has some useful properties, such as $\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y}$.

Now we can define the multipliers and measures of elasticity derived from I-O analysis. Here we are following the research of FoodIMA (2008). The simplest backward linkage coefficient is computed for each sector in economy as a column sum of direct requirement matrix $\mathbf{A}$:

$$\underset{1\times n}{\mathbf{BL}} = \underset{1\times n}{\mathbf{i}} \cdot \underset{n\times n}{\mathbf{A}} \tag{4.4}$$

where $\mathbf{i}$ is a unit row vector and n is number of sectors. As the result for $\mathbf{BL}$ is a sum of direct requirements, it measures only direct effects, i.e. what is a direct effect through inter-sectoral linkages if production in a sector increases by a unit (it needs more inputs).

To measure also additional effects of such an increase following from increased spendings (indirect effects) we can use Leontief inverse matrix instead of simple direct requirement matrix. The output multiplier than has the following form:

$$\underset{1\times n}{\mathbf{OM}} = \underset{1\times n}{\mathbf{i}} \cdot \underset{n\times n}{(\mathbf{I} - \mathbf{A})^{-1}} \tag{4.5}$$

This coefficient measures how big an increase of output must be to meet the final demand increased by an extra unit of output in a specified sector. The next one, income multiplier shows how the overall household income changes if there is a unit change in income in a particular sector:

$$\underset{1\times n}{\mathbf{IM}} = \left(\underset{1\times n}{\mathbf{H}} ./ (\underset{n\times 1}{\mathbf{x}})^T\right) \underset{n\times n}{(\mathbf{I} - \mathbf{A})^{-1}} ./ \left(\underset{1\times n}{\mathbf{H}} ./ (\underset{n\times 1}{\mathbf{x}})^T\right) \tag{4.6}$$

Vector $\mathbf{H}$ represents the household compensation (wages, salaries). Right array division (denoted by operator ./ representing a division of element by element) by sectoral total output $\mathbf{x}$ describes the direct income effect of a sector.

The last, employment multiplier, can be obtained equivalently, and it indi-

cates the overall change in employment if there is a change in employment in a sector:

$$\underset{1\times n}{\mathbf{EM}} = \left(\underset{1\times n}{\mathbf{E}} ./ (\underset{n\times 1}{\mathbf{x}})^T\right) \underset{n\times n}{(\mathbf{I}-\mathbf{A})^{-1}} ./ \left(\underset{1\times n}{\mathbf{E}} ./ (\underset{n\times 1}{\mathbf{x}})^T\right) \tag{4.7}$$

where $\mathbf{E}$ is a vector of employment. There are unfortunately no data available on regional employment broken down by two-character NACE, rev. 2 classification. We therefore use combination of national data, regional employment in one-character NACE, rev. 2 division and detailed information on value added to compute the detailed regional employment data., using the location quotient, equation (4.11), and the results seem sufficiently reliable.

There is a problem with multipliers that they do not account for relative importance of sectors in the economy regarding the effect on final demand. This problem can be nevertheless diminished by using elasticities. Thus we also compute output, income and employment elasticities:

$$OE_j = OM_j(FD_j/X) \tag{4.8}$$

respectively

$$IE_j = IM_j(FD_j/X) \tag{4.9}$$

respectively

$$EE_j = EM_j(FD_j/X) \tag{4.10}$$

where FD_j is final demand in sector j and $X = \sum_{i=1}^{n} X_i$ is total gross output of the economy. Elasticities show in percentage the change of sectoral outcome, household income or employment due to a percent change in regional demand of the particular sector.

With described coefficients we can do an impact analysis, which reveals what impact on overall economic performance (or employment) is caused by a change in a specific sector. By this mean it is possible to evaluate different local policies or, let's say, protective strategies.

4.2.2 Regionalisation of I-O tables

The problem for our analysis is that the statistical offices offer the I-O tables just on the level of countries, not on the level of regions, and gathering the data

from firms through own surveys would be prohibitively costly. Nevertheless there are possibilities how to reliably regionalise the national tables.

Firstly there are non-survey methods how to get the regional input-output tables (RIOT) through various regionalisation adjustments of the national input-output tables. They usually use the location quotients based on the structural characteristics of the regions. Simple location quotient is computed as follows[2]:

$$SLQ_i = \frac{Y_i^R}{\sum_{i=1}^{n} Y_i^R} \cdot \frac{\sum_{i=1}^{n} Y_i^N}{Y_i^N} \tag{4.11}$$

where Y_i^R and Y_i^N are the total gross output of the sector i in the region, respectively the country, and the sums represent the sums over the n sectors. For computing SLQ, Y can be substituted by data for employment or gross value added.

The approach which we apply in this work is based on the method called GRIT methodology (Generation of Regional Input-Output Tables), firstly described by Jensen *et al.* (1979)[3]. It allows the researcher to insert in the non-survey regionalised tables also some empirical characteristics (we will not do that at an initial stage, it might, however, turn out to be worthwhile later on). It would be reasonable mainly in cases of regionally important sectors. In this work we follow the research of Semerák *et al.* (2010), respectively the research project FoodIMA (2008).

Of course, what is changing when constructing I-O tables for smaller regions is not only the economic structure, but also the extent to which the region is dependent on trade with other regions. As Miller & Blair (2009, p. 69) point out, one "worldwide region" has no imports and exports, whereas an urban area is crucially dependent on trade with outside area.[4] Decent regionalisation methods are able to divide the matrix of national I-O table to a block matrix, where each block represents a single region and together it is tied into the complete national I-O table. Then it shows exact linkages between industries in separate regions, but constructing such a table would be very problematic

[2]See Semerák *et al.* (2010) or Miller & Blair (2009, p. 349).

[3]A good overview of this method is again in Miller & Blair (2009, p. 374)

[4]Regarding the potential protective decision making, it makes sense to take into account regions with certain political autonomy (nations, provinces, municipalities). Regions on the level of NUTS 2 seem to make most of the sense when following Alesina & Spolaore (2003), who argue that in the connected single market area such as European Union, countries are becoming needless for regions and we may witness in future growing separating tendencies similar to those in Catalonia or Scotland.

as we do not have any information about exact trade between regions. This approach is called MRIOT (Multi-Regional Input-Output Tables) and is in a way successfully used for example in Andrew & Peters (2013).

Another idea is to disaggregate the value added in the national I-O table according to the regions (using the share of each sector in the region to the total region's value added) under the assumption of identical technologies. Each region would therefore have its own additional group of rows for its value added (under the matrix of intermediate consumption). Then there is an option to disaggregate also the final consumption and by the means of matrix algebra to evaluate how the consumption in one region influences for instance the employment in others.

We will primarily use the GRIT method of regionalisation, but we will check the results even for this easier method. The exact methodology which we employ is described in Appendix A including the explanation of handling the issue of imports and exports.

4.2.3 Data limitation in I-O analysis

As explained in Appendix A, regionalisation process requires a detailed structural data on either employment distribution or value added for each region. This both is under the restrictions of confidentiality and thus the data of this type are either not even gathered (usually for employment) or at least are not freely available. We have obtained the data about regional value added broken down by all industries in two-character NACE Rev. 2 classification from Czech Statistical Office only for Czech NUTS 2 regions. Therefore we restrict the I-O analysis just for Czech regions.

4.2.4 NEG simulation

The second method used in our analysis is an NEG spatial equilibrium simulation. We use the multi-region version of the core model of geographical economics, as described in Brakman *et al.* (2009, pp. 81-133). The setting of the model is quite extensive, so we describe just the main points, referring for the deeper explanation to the source literature.

Production is a function of labour, for region r is given by

$$Y_r = \lambda_r W_r \gamma L + \phi_r \left(1 - \gamma\right) L \tag{4.12}$$

where Y_r is regional production, L is total labour, γ is fraction of total labour employed in mobile sector, λ_r and ϕ_r are the regional shares of the total mobile and immobile labour and W_r is a nominal wage in the mobile sector, while the wage in immobile sector is set to be numeraire.

Regional price level is given by

$$I_r = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\epsilon}\right)^{1/(1-\epsilon)}\left[\sum_{s=1}^{R}\lambda_s W_s^{1-\epsilon}T_{rs}^{1-\epsilon}\right]^{1/(1-\epsilon)} \tag{4.13}$$

For this equation is important the expression inside the square brackets, which gives that the price level I in region r is dependent on nominal wages W of R weighted by transport costs T between the regions (the own region has transport cost $T = 1$ so the biggest effect). It means that being closer to regions with high wages makes prices higher. The rest are more or less technical parameters, characterizing increasing returns of scale in production function (α and β) or consumer's "love of variety"[5] ($\epsilon = 1/(1-\rho)$ as the elasticity of substitution for manufactured goods), because each firm in the model is supposed to produce a different product.

Nominal wage is given similarly by

$$W_r = \rho\beta^{-\rho}\left(\frac{\delta}{(\epsilon-1)\alpha}\right)^{1/\epsilon}\left[\sum_{s=1}^{R}Y_s I_s^{\epsilon-1}T_{sr}^{1-\epsilon}\right]^{1/\epsilon} \tag{4.14}$$

Again the core of this expression is that inside the square brackets, which represents "market access", showing that the nominal wage of region r depends on the size of surrounding markets (in terms of output Y). Parameter δ indicates the preferences of consumers between product from mobile and immobile sectors.

The equations (4.12)-(4.14) give together a short-run equilibrium. For long-run equilibrium we need one more equation for real wages, while long-run equilibrium emerges just in situation when real wages are equal and thus there is no incentive to relocate (or all mobile labour force is already concentrated in one sector). Real wages are thus computed as

$$w_r = W_r I_r^{-\delta} \tag{4.15}$$

For running the model we need information about:

[5]This term refers to Krugman's first monopolistic competition models (Krugman 1979).

1. locations and the mutual distances,
2. size of locations in terms of labour,
3. rate of distribution of mobile and immobile labour for each location.

Firstly about locations and mutual distances. The crucial parameter for this model is the transport cost T. It is usually called iceberg cost, since it expresses how much of a product is necessary to send to be sure that 1 unit arrives to the destination. If $T = 1.3$, it means that 0.3 from each unit "melts" during the way. The size of transport cost of course depends on distance. Usual form involved to NEG model is as follows:

$$T_{rs} = T^{D_{rs}} \tag{4.16}$$

where D is a measure of distance between regions r and s. The equation implies that transport costs are equal to the value of T when $D_{rs} = 1$. We follow the usual setting (Brakman *et al.* 2009) that this is true for distance of 100 km (we count D = distance/100). There are also different functional forms how to shape the relation between transport costs and distance (Brakman *et al.* (2006) for example use different form), but in our case this works best.

We use a matrix of direct line distances between cities in neighbouring regions (or within a region). Distances between non-neighbouring regions are computed via Dijkstra's algorithm, which is usually used for this purpose.

As explained in Subsection 3.1.2, the final geographical distances between cities are adjusted by other mutual characteristics, defined in table Table 4.3.

Table 4.3: Definition of mutual distances

Proximity	Used characteristics
Geographical	Distance on straight line computed using geo-coordinates
Organisational	Similarity in regional specialisation based on regionalized statistics using location quotient, eq. (4.11), and Herfindahl index, eq. (4.2)
Social	Identical language (Czech and Slovak considered as identical)
Institutional	Identical country
Cognitive	Share of Mediterranean coast, Donau connection or the Alps

Source: Eurostat, author's computations.

Geographical distance is measured in km, other proximities have qualitative character and can be weighted. We set the weight initially on 50 (subtracted in

case of organisational and cognitive proximity, added in case of social and institutional difference). It says that for example having different language makes the regions "more distant" like they were 50 km further from each other. This is really a cosmetic adjustment, but it makes a possibility for better calibration of the model further on (to make it fitting to the real world) and it also allows some interesting experiments during the simulations (considering among others the importance of border effects).

Second type of needed data concerns the population and labour data. We gather the population data for one largest city in each region, which is involved into the model. For 4 regions we chose two cities, as both were significantly big (i. e. Venecia and Padova, Katowice and Czechostowa, Gdynia and Gdańsk, Halle and Magdeburg), thus finally we have 81 cities involved in the model. It is necessary to run model with cities, not with regions, because cities are mutually comparable and really constitute agglomeration units, whereas regions are differently big and the model would lead to absurd outcomes.

Finally, the division of labour was constructed, as explained already in Subsection 4.1.3. Since we do not have labour statistics at the level of cities, we assume the similar structure for city as it is for the whole region, which is definitely a strong assumption. The division as such is at the same time one of the main shortcomings of the model, because it assumes in fact just two economic sectors (manufacturing and agriculture in the core model), though each firm in the model produces differentiated product. Any specialisation of a region on certain production is not possible in this model. We will come back to this later when evaluating the linkages between this approach and preceding I-O impact analysis.[6]

Simulation itself is then running in two steps: firstly the model finds the short-run equilibrium, given the population of each location, share of mobile workers (and firms), mutual distances and possibly also initial distribution of production (but it does not influence the results). Then the program (in Stata in our case) computes the equations (4.12)-(4.14) several times until the moment, when the differences in nominal wages between two iterations are below a certain stopping criterion. Then the real wage is computed according to the equation (4.15) and the flexible labour moves according to a logistic

[6]There are different versions of NEG and one takes into account intermediate production, which could be interesting for our analysis, but at the other hand, it does not allow the labour force to move between regions, so we could not consider overall agglomeration forces (Brakman *et al.* 2009, pp. 151-161).

function[7] and then the all process starts again, until the long-run equilibrium, i. e. real wages are equal or all mobile workforce is already in one region (which is typical output of this kind of model). The process until the computing of real wage we call one iteration.

It should be clearly stated that the purpose of this kind of simulation is not to predict actual spatial and economic evolution, but to allow to compare the effects of different strategies. So it makes sense just in relation to the outputs from the model for different settings. As such it is a powerful instrument to evaluate the relative size and direction of different policies and strategies.

Table 4.4 offers the summary of parameters for our baseline model. The core parameters (δ and ϵ) are taken from Brakman *et al.* (2006), where it is evaluated for NUTS 2 regions in Western Europe, which is very similar to our model, so we consider it as a best estimation.

Table 4.4: Configuration of parameters for baseline model

Par.	Label	Value
δ	Consumption share of goods produced by the mobile sector	0.30
ϵ	Elasticity of substitution among different products of mobile sector	2.98
α	Fixed returns to scale part of production function	3.00
β	Increasing returns to scale part of production function	1.00

Source: (Brakman *et al.* 2006)

4.2.5 Empirical assessment of the NEG wage equation

As a first part of the NEG analysis, we try to evaluate empirical validity of the wage equation (4.14) in the Central European conditions. For Western Europe the similar verification was done by Brakman *et al.* (2006). Firstly we need to log-linearise the wage equation to get the equation (4.17), which is possible to estimate through econometric methods.

[7]The function distributing labour across regions only determines a shape of the evolution, not the value of the long-term equilibrium. So its exact form is not crucial for the outcome. Brakman *et al.* (2009) describe $\dot{\lambda}_r = \eta(w_r - \bar{w})$ with a parameter η, we use $\dot{\lambda}_r = (1 + \eta_A\eta_B^{-1})/(1 + \eta_A\eta_B^{-w_r/\bar{w}})$ with two parameters η_A and η_B.

$$\ln W_i = cons + \frac{1}{\epsilon} \ln \mathrm{MA}_i + \sum \gamma \mathrm{Z}_i + \mu_i \tag{4.17}$$

Intercept in this case involves all the parameters before the core sum in wage equation (4.14) and market access MA is a label for the sum in the square brackets, shown again in (4.18). Finally Z is a vector of optional control variables.

$$\mathrm{MA}_s = \sum_{s=1}^{R} Y_s I_s^{\epsilon-1} T_{sr}^{1-\epsilon} \tag{4.18}$$

A simplified way to construct the market access is to use the contiguity matrix **B** instead of exact distances between all regions. A simplified approach for the output and price level is to use GDP measured in purchasing power standard. The more decent way to involve transport costs is to use all mutual distances according to the equation (4.16). Problematic in this "more decent" way is that we need to estimate transport costs T and elasticity of substitution ϵ to be able to evaluate the market access according to expression (4.18). This is the reason why we firstly want to employ the simplified version of MA using the contiguity matrix, estimate ϵ and then to try this more complicated way and compare the results. Nevertheless T must be set manually, we have chosen $T = 1.3$ as this level is usually used as a low level of transport costs and should work rather neutrally (Brakman *et al.* 2006; 2009).

4.2.6 NEG experiments

Subsequently we want to run the model and reveal the spatial equilibrium for Central Europe. We can then compare the current level of inequality with the predicted level in equilibrium. After that we can change some parameters to do the experiments, which can indicate some characteristics of the regional dynamics for case of certain protectionist policies.

We can do three simple experiments:

1. Changing overall transport costs. This is usual NEG method showing the different dynamics for different level of freeness of trade. First reason is that we cannot evaluate transport costs on any proper empirical base, so it shows the possible range. In our case it can also be interpreted as a possible result of any region-protective decision from European Commission.

2. Changing elasticity of substitution among variety of goods. Higher elasticity would lead to more intensive consumption of local goods (consumers do not look for variety and prefer local goods, which is cheaper due to lower transport costs). And for firms is thus profitable to stay closer to costumers. This illustrates the efforts of shaping people's preferences towards local goods.

3. And finally the experiment of changing transport costs for certain peripheral regions, which hypothetically impose protective policies.

Chapter 5

Results

5.1 I-O analysis: structural differences between regions

First part of our analysis focuses on structural differences between regions, which are crucial for regional development potential mainly from standard trade theory perspective (as outlined in Section 3.2) In Subsection 4.1.2 we have shown that from simple descriptive view the role of sectoral specialisation in Central Europe is not of such an importance like in United States. Nevertheless this needs to be analysed more properly. We use for this purpose Input-Output methodology described in Subsection 4.2.1 with specially derived regionalised I-O tables for the NUTS 2 regions of the Czech Republic (exact methodology of regionalisation of I-O tables is described in Appendix A).

5.1.1 Regional I-O impact analysis

In Table 5.1 we highlight the most important sectors for Czech regions in terms of output elasticities (for the definition see Subsection 4.2.1). For each region there are chosen sectors with highest output elasticity (OE)[1], which measures the overall percentage change in the regional output caused by a percent change in final demand of a sector. The shift in final demand can be caused for instance by pushing up exports: it is therefore important indicator for regional governments and their decision-making towards subsidies, or other support of exports of one particular sector. The table clearly shows that the most of the

[1]The only exception is Central Bohemia, where the third is skipped. This is Real estate activities having similar characteristics as in Prague.

regions have one or two sectors with significantly higher output elasticities. These are the sectors, which, we can say, the regions are specialised in.

Table 5.1: Output multipliers and elasticities for top sectors in Czech regions, 2009

Region		1	2	3
Czech Rep.		Manufac. of motor vehicles	Real estate activities	Construction of buildings
	OE	0.103 (1)	0.069 (2)	0.057 (3)
	OM	1.829 (11)	1.731 (26)	2.212 (3)
Prague		Financial services	Wholesale & Retail, exc. motor v.	Air transport
	OE	0.114 (1)	0.097 (2)	0.055 (3)
	OM	1.328 (70)	1.486 (48)	1.237 (74)
Central Bohemia		Manufac. of motor vehicles	Manufac. of coke & refined petrol prod.	Manufac. of tobacco products
	OE	**0.534** (1)	0.053 (2)	0.041 (4)
	OM	1.398 (65)	1.087 (77)	1.096 (76)
South-West		Manufac. of machinery	Manufac. of motor vehicles	Manufac. of beverages
	OE	0.107 (1)	0.065 (2)	0.061 (3)
	OM	1.394 (60)	1.829 (12)	1.337 (69)
North-West		Manufac. of coke & refined petrol prod.	Mining of coal and lignite	Electricity, gas, steam supply
	OE	0.232 (1)	0.134 (2)	0.088 (3)
	OM	1.133 (77)	1.114 (78)	1.413 (35)
North-East		Manufac. of computers	Manufac. of motor vehicles	Manufac. of textiles
	OE	0.205 (1)	0.200 (2)	0.059 (3)
	OM	1.441 (62)	1.608 (40)	1.264 (76)
South-East		Extraction of crude petroleum & gas	Manufac. of computers	Construction of buildings
	OE	0.133 (1)	0.077 (2)	0.057 (3)
	OM	1.006 (81)	1.512 (60)	2.121 (2)
Central Moravia		Manufac. of rubber & plastic pr.	Manufac. of computers & electronics	Manufac. of food products
	OE	**0.385** (1)	0.071 (2)	0.058 (3)
	OM	1.246 (75)	1.504 (47)	1.567 (40)
Moravia-Silesia		Manufac. of basic metals	Mining of coal and lignite	Manufac. of motor vehicles
	OE	0.275 (1)	0.095 (2)	0.082 (3)
	OM	1.287 (73)	1.121 (78)	1.666 (35)

Source: author's computations. Numbers in brackets indicate rank within a region.

The values show the amount of impact of hypothetical one percent shift in final demand (in case of elasticity) or one unit change in the amount of output

(in case of multiplier), therefore we speak about impact analysis. Comparing Czech regions, the most significant effect in terms of output elasticity is found for Manufacture of motor vehicles in Central Bohemia, which shows that a percent increase in final demand of these products leads to 0.534% change of total output, which is an extraordinary influence. The next one is Manufacture of rubber and plastic products in Central Moravia (0.385%). At first sight we can notice that majority of Czech regions is significantly specialised (comparing the differences in first three sectors in terms of output elasticities).

The table allows an interesting and important comparison with output multiplier (OM), measuring the interrelation with the rest of the regional economy. The number exactly means what value of output is needed by the total regional economy in order to cover a monetary unit increase in the final demand of a particular sector. In compare to the output elasticity, this value overlooks the relative importance (size) of the sector in economy and thus it is a more clear indicator of sectoral interdependence.

The resulting OM shown in Table 5.1 are quite staggering. At first sight there is a huge difference in ranks of output multipliers and elasticities (ranks are in brackets). For instance already highlighted motor vehicles manufacturing sector in Central Bohemia is 65th in the region in terms of interdependence (i.e. output multiplier) as shown in Table 5.1. But still in absolute value 1 CZK increase of this sector's production leads to 1.394 CZK increase for the total regional economy. The other regions show the similar pattern: rubber and plastic manufacturing in Central Moravia is 75th in terms of interdependence, Silesian metal industry 73rd etc. All in all these results show that the most important sectors tend to be less connected to the regional economy, which is in accordance with the critique of environmental economists (Sacks 2002).

Highest numbers for output multipliers (exceeding in most cases value of 2) are in all sectors connected to constructions, advertising and travel industry.

Similarly we can measure also the effect on household income and employment. In terms of elasticities (i. e. percentage change of household income or employment due to a percent change in final demand of particular sector) there are not significant differences compared to the presented results for output. The most visible difference is in case of Real estate activities: for all regions it belongs among the most important sectors. Otherwise it corresponds more or less to the structure of output elasticity and some results even strengthen the outlined implications: for instance employment elasticity for Manufacture of rubber and plastic products in Central Moravia is 0.6, which is highly above

the levels of other regions; it means that if Central Moravia supports export of this product for one percent, it would lead to 0.6% increase of overall regional employment. Differences of results between output elasticities (OE), household income elasticities (IE) and employment elasticities (EE) are demonstrated in Table 5.2. (In brackets there are always the ranks within the region.)

Table 5.2: Comparison of Output, Household Income and Employment elasticities

Region		Agriculture	Manuf. of food prod.	Manuf. of machinery	Constr. of buildings	Real estate
Prague	OE	-0.00 (80)	0.01 (36)	0.00 (45)	0.02 (15)	0.05 (5)
	IE	-0.00 (79)	0.01 (35)	0.00 (45)	0.02 (16)	0.11 (1)
	EE	-0.00 (79)	0.01 (36)	0.00 (45)	0.02 (17)	0.11 (3)
South-	OE	0.03 (13)	0.04 (10)	0.11 (1)	0.04 (8)	0.04 (11)
West	IE	0.03 (14)	0.05 (7)	0.11 (1)	0.04 (9)	0.09 (2)
	EE	0.03 (14)	0.05 (9)	0.14 (1)	0.05 (8)	0.13 (3)
South-	OE	0.03 (11)	0.04 (6)	0.06 (4)	0.06 (3)	0.05 (5)
East	IE	0.03 (12)	0.05 (6)	0.06 (5)	0.06 (4)	0.12 (2)
	EE	0.03 (11)	0.06 (7)	0.07 (6)	0.07 (4)	0.32 (1)
Moravia	OE	0.00 (59)	0.02 (18)	0.03 (9)	0.03 (10)	0.02 (14)
-Silesia	IE	0.00 (60)	0.02 (15)	0.03 (11)	0.03 (9)	0.05 (5)
	EE	0.00 (60)	0.02 (14)	0.03 (11)	0.04 (10)	0.06 (6)

Source: author's computations.

Regarding the multipliers, interpretation is much more tricky. Especially employment multipliers are very high, but it would be very suspicious to conclude that for example hiring one extra worker in Activities of head offices and management consultancy will bring to the economy increase of employment for 4 additional people, although the interrelation there certainly is. The thing is, that there is no consequent succession like this. Rather it says that if the sector should need one more worker, it must be accompanied by another 4 employees in other sectors altogether. It is thus also a measure of interconnection, but its interpretation is not so straightforward.

The next thing we can do is to compute the weighted averages of these multipliers for every region, where the weights will be given by shares of sectoral value added to the regional total. The results shown in Table 5.3 reveal some information about intra-regional sectoral interdependence.

In terms of output multiplier there are not big differences in the levels of diversity between the regions, but still it is interesting that Prague is the least

Table 5.3: Weighted averages of sectoral multipliers

Region	OM	IM	EM
Prague	1.50	1.21	-0.66
Central Bohemia	1.57	1.77	2.83
South-West	1.58	1.54	1.39
North-West	1.55	1.68	2.17
North-East	1.61	1.93	2.55
South-East	1.64	3.91	4.17
Central Moravia	1.53	2.16	2.64
Moravia-Silesia	1.57	1.85	2.94

Source: author's computations.

intra-connected one, similarly as in case of income and employment. Employment multiplier for Prague even shows that hiring three extra workers to a certain sector in average needs a loss of jobs of 2 employees from other sectors. At the other side, South-East has extraordinary income and employment multipliers showing that the intra-connection in this region is the relatively highest among all Czech regions.

5.1.2 Experiment: towards protectionism

In order to illustrate the effect of local government's decision to support certain industry we introduce a hypothetical situation, which is characterized by sort of redistribution of final demand. In previous chapter we analysed percentage changes based on specific final demand shock, which did not influence final demand of other products. In this setting we assume protective policy favouring one industry and other industries not only benefit through inter-sectoral linkages, but also carry certain cost in terms of reduced final demand. The total amount of redistribution is in each region 1% of total final demand. Cost is distributed uniformly across sectors.[2]

For each region we chose one sector from category of "mobile industries" with the highest elasticity of output (as it offers the highest reward for supportive effort). We skipped industries clearly dependent on natural endowments (such as mining) or another very rigid structures (such as electricity produc-

[2]In this section we do not elaborate what kind of political decision can lead to such a distribution. It has more illustrative purpose. But we can imagine for instance a corruptly targeted public contract: in such a case other firms face various "costs", from lower demand due to missing money on regional account, to lack of trust of potential investors due to corrupted environment.

ing). Table 5.4 shows the effects of 1% shift in final demand on regional output, total household income and employment.

Table 5.4: Effect of 1% redistribution in final demand (in %).

Region	Targeted sector	Output	HH In.	Empl.
Prague	Financial services	0.07	0.40	0.51
Central Bohemia	Manufacture of motor veh.	0.37	4.20	3.15
South-West	Manufacture of machinery	0.06	0.41	0.18
North-West	Manufacture of chemicals	0.04	0.39	0.15
North-East	Manufacture of computers	0.13	1.37	0.63
South-East	Manufacture of computers	0.04	0.54	0.20
Central Moravia	Man. of rubber & plastic pr.	0.27	2.34	1.51
Moravia-Silesia	Manufacture of basic metals	0.20	1.74	1.04

Source: author's computations.

Table 5.4 indicates that all regions can be better off if focusing on their key industrial sector. Note that this hypothetical case does not create any additional needed resources; extra demand in key sector is outweighed by decrease of demand in others. This experiment moreover reveals the regions with highest protectionist potential: especially in case of Manufacture of motor vehicles in Central Bohemia and Manufacture of rubber and plastic products[3] in Central Moravia. Moreover the results show that the most significant impact is expected in overall household income—this goes in accordance with our assumption about rising inequality as an effect of specialisation.

Because the I-O analysis is static in time and does not take into account geographical evolution, we have involved also dynamic NEG approach. The following sections bring the results.

5.2 Empirical results for the NEG wage equation

Firstly we show the results for equation (4.17) using the contiguity matrix method for the evaluation of market access. We also involve a measure of distance to agglomeration (country-specific, i. e. to the capitals, with exception of western part of Germany, for which we have used agglomerating centre in München, as Berlin is senselessly far). The reason for involving this variable

[3]This industry is tightly connected to manufacturing of motor vehicles: according to national I-O table, 23% of production goes as an intermediate input to car manufacturing, so these two regions can enforce their politics in one line.

is mostly to distinguish the specific effect of closeness of agglomeration from the contiguity effect, which can be henceforth more about effects over national borders etc.

Results are shown in Table 5.5. At the first sight the geographical aspects are highly significant for distribution of wage, which gives some credibility to NEG premises. As we expected contiguity effect is positive, it means that the level of wage is influenced by the level of economic activity in neighbouring regions. The effect of closeness to agglomeration centre is also significant (for the centres themselves we have used their radius): farther from centre, smaller average wage. Clearly most significant effect is nevertheless the country effect: comparing columns (2) and (4) which have the same specification, just (4) has added country dummies, is striking: differing in explanatory power from 18% to 90%, which is difference of 72 percentage points. 27 from that can be assigned to the historical root of Iron curtain division (regarding the third column), but still there is 42 percentage points for country-specific effects.

Table 5.5: Results for NEG wage equation using the contiguity matrix

$\ln W_{it}$	(1)	(2)	(3)	(4)	(5)
$\ln \mathbf{By}$	1.21 ***	1.01 ***	0.72 ***	0.24 ***	0.19 ***
$\ln D$		-0.42 ***	-0.31 ***	-0.13 ***	
Iron curtain			-0.67 ***		
const.	-4.95	-0.63	2.82	7.86	7.79
Country	no	no	no	yes	yes
Year	yes	yes	yes	yes	yes
method	FE	RE	RE	RE	RE
R^2	0.98	0.18	0.45	0.90	0.90

Source: author's analysis.

In column (5) we estimate the model only with market access variable, controlling for country effects. The coefficient 0.19 is according to the specification of the model inverted value of elasticity of substitution between the variety of manufacturing goods, hence we can compute $\epsilon = 1/0.19 = 5.24$. This is quite high level, which would imply rather imperfect competition (regarding the Dixit-Stiglitz model which is employed in NEG), nevertheless it is still reasonable number. Comparison wit the result of Brakman *et al.* (2006) for

regions in Western Europe, who found $\epsilon = 2.98$, reveals that the CE region is relatively farther from ideal perfect competition.

We use this level of elasticity of substitution to compute market access using the original expression (4.18). In Table 5.6 we show the same results as in the previous case, just using this different computation of market access (it is not limited to neighbouring regions but it weights production of all regions in our area).

Table 5.6: Results for NEG wage equation using the market access

$\ln W_{it}$	(1)	(2)	(3)	(4)	(5)
ln MA	1.71 ***	1.09 ***	0.54 ***	0.21 ***	0.22 ***
ln D		-0.06	-0.07	-0.07 ***	
Iron curtain			-1.03 ***		
const.	-9.34	-2.28	4.39	8.00	7.79
Country	no	no	no	yes	yes
Year	yes	yes	yes	yes	yes
method	FE	RE	RE	RE	RE
R^2	0.98	0.13	0.66	0.93	0.93

Source: author's analysis.

The results are very similar which supports the usefulness of the contiguity matrix approach. In this setting the distance to agglomeration centre does not play such a role, which makes sense as the distance is already included to the market access variable. Apparent shortcoming of this approach is that parameter ϵ is used for the computation of market access and at the same time evaluated by the equation. Hence we would need to do some iterations to obtain the equilibrium value, but it is not meaningful for our analysis (but it would be lower than from the previous method).

The main importance of our results is that it proves the NEG hypothesis about the spatial distribution of wage in CE conditions.

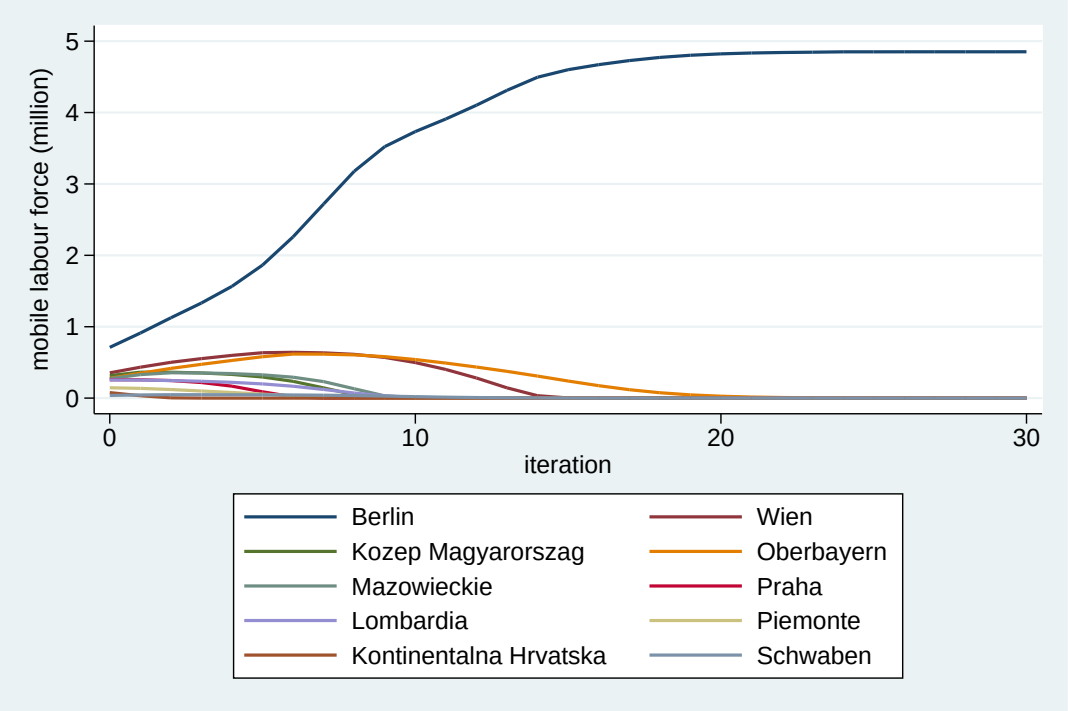
5.3 NEG simulations: geographical aspects of regional development

Now we turn to the sequential iteration method for finding the short-term and long-term equilibria of core NEG model, as described by the set of equations (4.12)-(4.15).

5.3.1 Baseline model

In the baseline model we compare two levels of transport costs: $T = 1.3$ as low transport costs and $T = 2$ as high level of transport costs.

Figure 5.1: NEG simulation: migration of labour force, $T = 1.3$



Source: author's analysis

Figure 5.1 shows a relatively fast complete agglomeration in Berlin, which is unexceptional outcome of NEG model, but should be explained. The model takes into account just economic profitability: if trade costs are low enough, it is economically advantageous to create clusters and benefit from economies of scale. This holds just for mobile sectors: the immobile sectors (which are much bigger then mobile in our setting) stay in their home city and face much lower real wages. The important message of the model is that this highly unequal equilibrium tends to be at the same time highly persistent and there are no big

chances for peripheries (in this case rest of Central Europe except Berlin) to catch up.

In spite of these notes, in our case complete agglomeration in Berlin does not make a lot of sense. We can highlight some conspicuous drawbacks of the model, which are revealed in this first result:

1. The model does not incorporate urban costs known from urban economics (Glaecer 2008). The cost of living, renting office etc. is necessarily increasing with rising agglomeration.

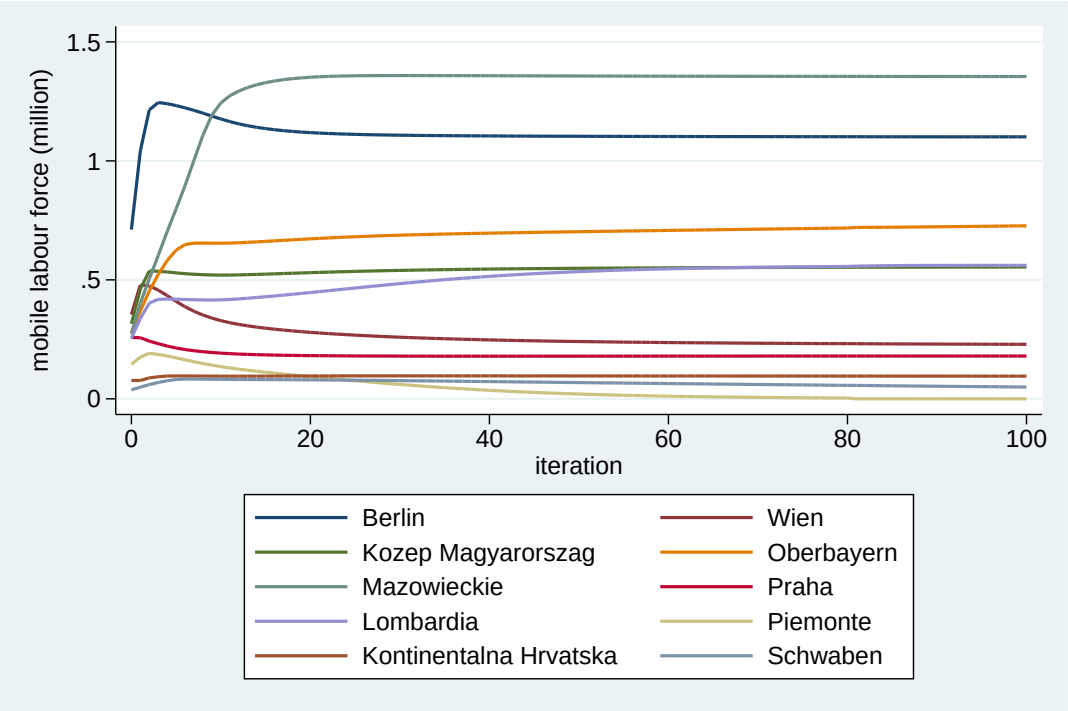
2. There are also other barriers and reasons why people are often fixed to their place (city, country), such as social and family ties, patriotism, language barriers etc. We tried to include the other than just geographical distance through simple fixed distance penalties, characterized in Table 4.3, but it does not overrule the agglomeration force of Berlin in this case.

3. The selection of area is crucial for outcomes of the model. If we take the model separately for national states, the results are obviously towards agglomerations in each capital (we have run the model for NUTS 3 regions for the Czech Republic). On the other hand by using the area of the European Commission's Central Europe 2020 Cooperation Programme we put away significant part of Western Germany, Central and South Italy, and of course the rest of European countries (and the rest of World).[4] For each setting the model can bring slightly different results and must be interpreted taking this limitation into account.

4. And finally it is impossible to interpret the results in time perspective. Iterations do not tell anything about real time. We thus can see the tendency, but have no idea, if it should happen in 10 or 500 years.

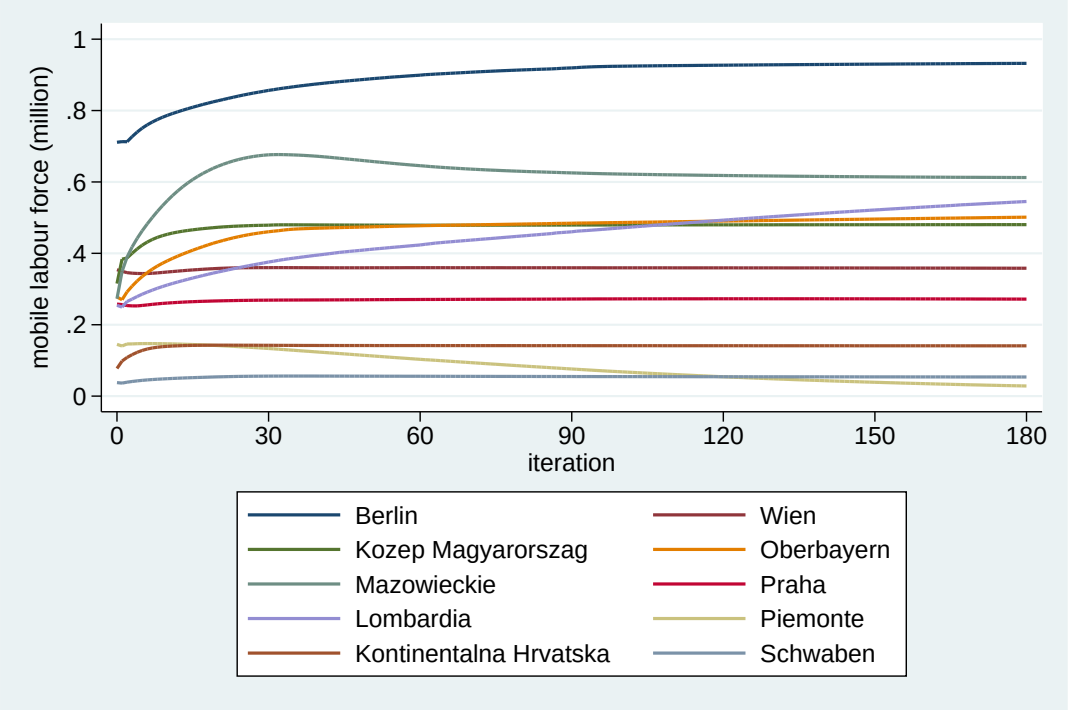
[4]This problem can be overcome by including large cities from the rest of Europe with fixed production to the regional demand function and subsequently to the wage function (4.14): $W_r = \zeta \left[\sum_{s=1}^{R} Y_s I_s^{\epsilon-1} T_{sr}^{1-\epsilon} + \sum_{v=1}^{V} Y_v^* T_{rv}^{1-\epsilon} \right]^{1/\epsilon}$, where v are the cities around our region and Y_v^* is their fixed GDP. Using this adjustment including 23 large cities from London to Kiev the results show clear gradient from west to east in terms of real wages, flexible labour force completely moves to Karlsruhe as the most western region. This geographical structure is much closer to the real distribution (with correlation to real data of 39%), but not very valuable for our purposes of analysing dynamics within the Central Europe. We thus keep the simple model although there remains this shortcoming.

Figure 5.2: NEG simulation: migration of labour force, $T = 2$



Source: author's analysis

Figure 5.3: NEG simulation: migration of labour force, $T = 1.3$, $\epsilon = 9$



Source: author's analysis

Figure 5.2 brings the results for high transport costs $T = 2$. It nicely proves the theoretical outline of the effect of transport costs, showed in Figure 3.1. We have stopped the iterations after 100 iterations, while the tendency towards multiple equilibria is already nice visible. For the baseline setting we finally run the simulation for low transport cost $T = 1.3$ but high elasticity of substitution between varieties of goods (people consume more local goods), $\epsilon = 9$.[5] The result is shown in Figure 5.3.

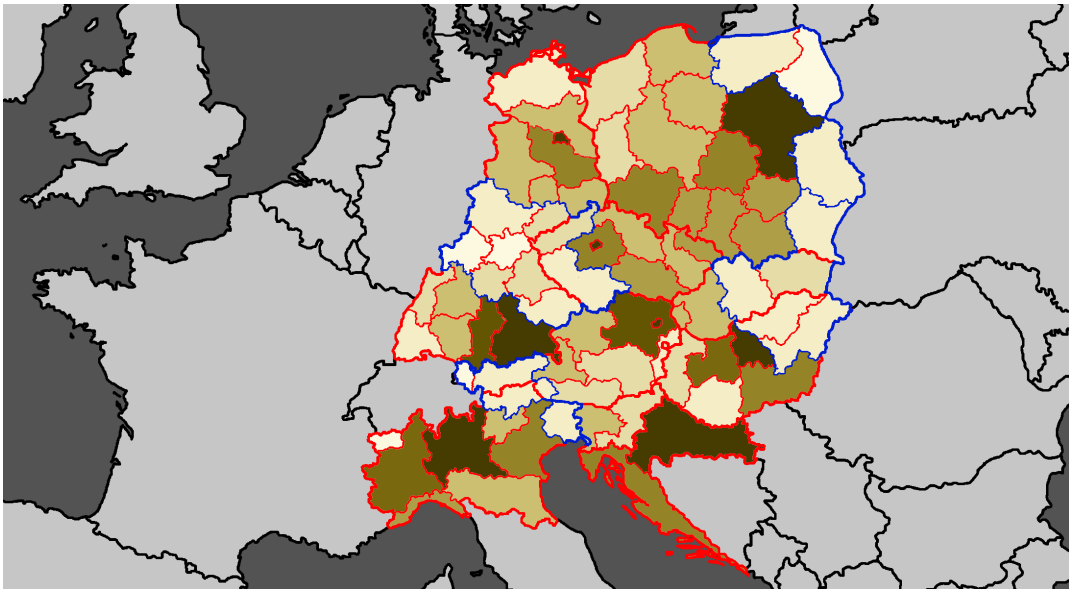
There are certain differences in the two restricting settings, such as surprisingly strong agglomeration force in case of Mazowieckie region (Warsaw), which can be explained by relatively high share if immobile sector in surrounding regions and hence a strong home-market effect, but in altogether it shows very similar agglomeration distribution in Central Europe (note that other regions mostly get rid off the mobile work force in first 30 iterations).

It is positive that the model detects as agglomerations the cities which actually play the role in the real world. Obviously it is caused by the initial distribution, but some of them, like Kontinentalna Hrvatska with Zagreb, or Schwaben, which profits from very close location to München, are of average size, similar to other non-detected cities such as Bratislava or Ljubljana. The wider geographical view is interesting as well: we can see that large cities in the centre of our area, such as Prague or Wien tend to attract less mobile workforce (they decline comparing to the actual level), although they still keep the agglomeration position. This also has background in economic geography theory, which tells that the economic activity tends to be spread into the most distant locations (see the idea of racetrack economy in Brakman *et al.* (2009, pp. 171-175)).

The geographical aspect is better visible from the distribution of levels of real wages, as shown in Figure 5.4. From the map, the distribution of agglomeration centres in space is visible at the firs sight, and moreover we can see clear spillover effect: regions neighbouring to agglomeration centres tend to have higher level of real wages than the peripheries.

[5]This level for high elasticity of substitution is not chosen arbitrarily, but it follows Brakman *et al.* (2006). We have also run the model for $\epsilon = 5.24$, which resulted in Section 5.2 from our wage equation regression, but the outcome is pretty similar to the baseline setting, just the evolution is slower.

Figure 5.4: Inequality in real wages in equilibrium, $T = 1.3$, $\epsilon = 9$



Source: author's graphics

5.3.2 NEG Experiment: towards protectionism again

In the map in Figure 5.4 are also identified the peripheral areas, for which we will run experiments outlined in Subsection 4.2.6. Particularly we take four areas covering 21 out of 77 NUTS 2 regions, bordered in the map by blue lines. Hereafter we label them as Western periphery, Eastern periphery, the Alps and Far Poland (the north-eastern periphery).

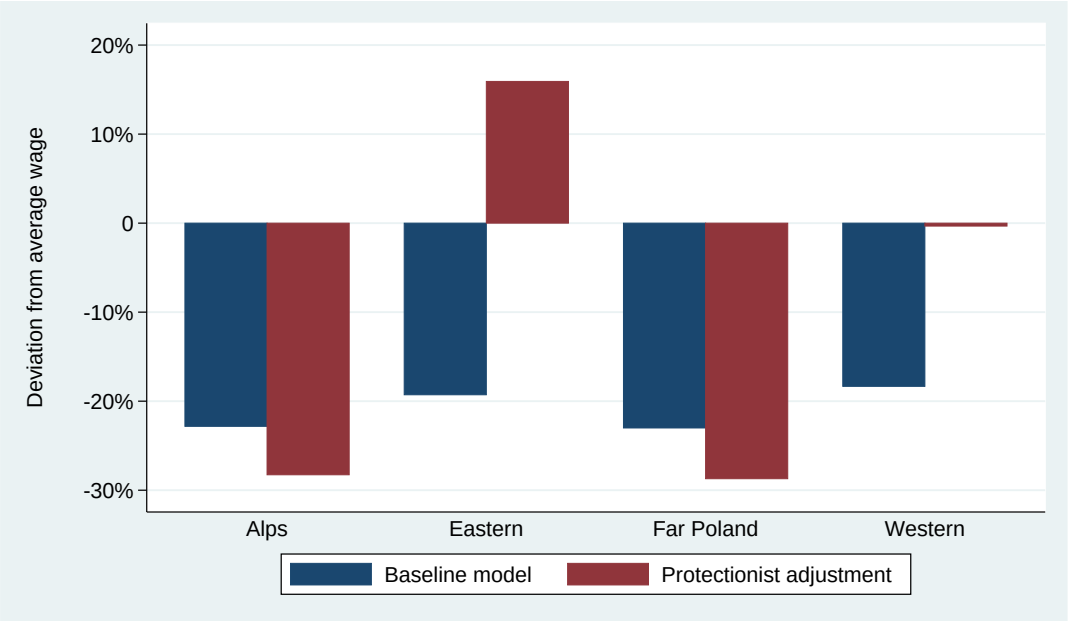
It is more powerful to connect more regions, because the introduction of protective policies can be twofold: causing higher trade costs against the rest of Europe and more importantly decreasing trade costs within the region. The second direction is what is more likely to happen from local governments (investments into infrastructure within the region, instead of improving connection to the agglomeration centre, etc.) and it could not be measured if we consider the effects for single regions (this depends on the level of detail to which is the area geographically broken down, we have relatively big regions on the level of NUTS 2, but the same principle would hold for smaller regions as well).

In our experiment we reduce the transport costs within the peripheral regions on half and double the transport costs to the rest. The idea is to attract labour force to the area or in other words prevent fast flow-out of the mobile firms.

The overall output after this experiment is almost the same as in the baseline model, shown in Figure 5.1-Figure 5.2. Under high freeness of trade, all

labour force is attracted by Berlin (it just takes little bit longer), with high elasticity of substitution all protected regions are slightly better off, but the final distribution is almost the same. The biggest change emerges under high transport costs: Košice in Východné Slovensko becomes the another agglomeration. A conclusion, that the protectionist experiment was successful, nonetheless should not be done too easily. In Figure 5.5 we can compare the relative changes of deviation of the peripheral areas from average real wage.

Figure 5.5: Deviation from average real wage of peripheral regions: before and after protectionist adjustment



Source: author's analysis

For Eastern periphery, where new agglomeration emerged, and Western periphery, which is thanks to that able to catch up, was the protectionist decision worthwhile. The other two peripheries are actually even deeper in problems. It seems that the results of such a protectionist policy are highly dependent on geographical conditions. Agglomerations cannot emerge too close next to each other: Košice showed to be the exact place, where new agglomeration can emerge under certain conditions.

Another interesting result is that the change of average real wage for whole Central Europe is positive, which is little bit counter-intuitive: it means, that the introduced policies have in sum created higher freeness in trade, e. g. the improvement of the infrastructure within the regions trumped the higher barriers from these regions to the rest.

Chapter 6

Conclusion

In this work we have done a kind of methodological excursion looking for methods, which would be helpful for local governments in decision making connected to the inter-regional trade and questions of openness versus protection.

The most noticeable result is that regions (at least in the Czech Republic) tend to be relatively specialised, as they all turned out to have a certain "flag industry" (or two) with much higher output elasticity than the average. It means that increasing final demand in this industry leads to bigger overall changes for regional output than in any other industry. On the other hand these industries are surprisingly weakly connected to the rest of the regional economy, as we can see from the output multipliers (a unit change of output in the industry does not cause a big change of output in other industries).

Regarding our hypothesis about intensity: from results shown in Table 5.3, we can conclude that among Czech regions there are not significant differences in terms of intra-regional connections influencing level of output, but there are differences in terms of household income and employment multipliers. Nevertheless there is no evidence that higher intensity of intra-regional trade has significant positive effect on regional performance: Prague, which is in recent years undoubtedly the most progressive region in the Czech Republic, has the lowest multipliers, while Brno, as the second largest municipality, has the highest ones. This goes against the propositions of environmental economists such as Sacks (2002), that the intra-regional intensity is crucial for region's performance.

More important factor is probably the specialisation. The experiment showed that the policies leading to redistribution of demand structures towards higher specialisation (i.e. in favour of the region's flag industry) have a

positive welfare effect (regarding output, household income and employment). Specialisation itself, we can conclude, is thus desirable for regions. One would say that it could be different if the specialisation is caused by a big investment from outside and hence if it leads to weakening of intra-regional economic linkages (Ward & Lewis 2002). However, the results shown in Table 5.4 suggest that even if the connections within the regions are weak (as they are in the case of Central Bohemia) the effect of further specialisation can be high.

From the I-O analysis we can therefore conclude that our two hypotheses about intensity and diversity were not proven, but yet it might be valuable for the local governments to grasp such a detailed insight about the roles and weights of different industries as illustrated in Table 5.1 to shape the regional policies regarding the regional specifics. We believe that the GRIT approach can be useful for various issues in local decision making and that this work can be a little step towards that.

What should be discussed first, regarding the NEG part, are the apparent shortcomings of that analysis. First of all, we have not been successful in calibrating the model for CE conditions. It would be much more credible if we were able to model the recent distribution of GDP per capita and wages and to get roughly the actual levels of Theil indices. Nevertheless, this is not the case, although we have tried several extensions of the model to make it more realistic (the proximity adjustments, inclusion of surrounding regions—see the footnote on page 46, estimation of elasticity of substitution, various recalibrations of all parameters, etc.) The problem of TI in equilibria is that in this setting regions without mobile labour force produce constant production according to the number of inhabitants, GDP per capita is therefore everywhere equal to 1.

A possible way to deal with these problems may be to implement more complicated NEG model, such as the one in Puga (1999), who allows the labour force to move even between the two sectors, while agricultural sector is characterised not by constant but decreasing returns to scale. The only successful empirical study verifying the multi-regional NEG model (Brakman *et al.* 2006) also uses this type of the model (a bit further extended).

In spite of these limitations we still can come up with some conclusions regarding our hypotheses. Especially Section 5.2 brought persuasive evidence in favour of spatial wage distribution in Central Europe. This means that the agglomeration forces suggested by NEG have an important influence in this area, which proves a part of our first hypothesis (that there is a tendency to cluster around agglomerations). That could also imply that we indeed face widen-

ing the gaps between cores and peripheries. To certain degree likely equilibria are illustrated in Figure 5.2 and Figure 5.3. This is nevertheless only theoretical implication: as already admitted, empirical verification of this theory for CE failed on the calibration problems. Nevertheless it is also in line with our preliminary descriptive findings from 4.3, which moreover distinguishes the dynamics of Western (constant or downwards) and Eastern (upwards) regions.

The results for our fourth hypothesis (about openness) are from the same reasons rather illustrative. In the experiment in Subsection 5.3.2 we tried to limit the openness of the peripheral regions towards centres and instead to strengthen the connections within the peripheries. The results shown in Figure 5.5 are ambiguous, which clearly reveals that the effect of such a protective policy depends highly on the specific regional geographical characteristics (most importantly on its location relative to the central regions and then on the number and size of big cities, which together assures an "agglomeration potential"). Again, the main outcome of this analysis might be that regions should be aware of their preconditions before making such policy decisions.

To conclude in a bit more concrete way: what is clearly needed is a "cohesion" policy from above, which would fight against inherent tendencies of agglomerization and rising disparities. These policies should aim on improving infrastructure inside the peripheral regions (not primarily connecting them to the cores) and on better specialisation. Our results do not support the localisation tendencies in sense of assuring "self-sufficiency", as it is often presented, but rather in sense of specialisation and better connection to the global supply-chains. From this perspective also big investments from outside (for instance in form of FDIs) can be profitable in terms of regional welfare, although it is at the cost of weaker intra-regional connections. Of course, the local policies should follow the same directions, but they should also reflect the regional specifics, especially the structural differences revealed by regionalised I-O tables.

In future research it would be worth especially improving the NEG model as its implications can be much more valuable if it fits properly on the actual distribution. Nevertheless it is still very new theoretical approach and its empirical validity in general is still in question.

Bibliography

Acemoglu, D. & J. A. Robinson (2012): "'Why Nations Fail'." *The New York Review of Books* **59(13)**.

Alesina, A. & E. Spolaore (2003): *The size of nations*. Mit Press Cambridge, MA.

Amos Jr., O. M. (1988): "Unbalanced regional growth and regional income inequality in the latter stages of development." *Regional Science and Urban Economics* **18(4)**: pp. 549–566.

Andrew, R. M. & G. P. Peters (2013): "A Multi-Region Input-Output Table Based on the Global Trade Analysis Project Database (GTAP-MRIO)." *Economic Systems Research* **25(1)**: pp. 99–121.

Bai, C.-E., Y. Du, Z. Tao, & S. Y. Tong (2004): "Local protectionism and regional specialization: evidence from China's industries." *Journal of International Economics* **63(2)**: pp. 397–417.

Baldwin, R. & S. Evenett (editors) (2009): *The collapse of global trade, murky protectionism, and the crisis: Recommendations for the G20*. London, UK: Centre for Economic Policy Research.

Batabyal, A. A. & H. Beladi (2009): "Trade, the damage from alien species, and the effects of protectionism under alternate market structures." *Journal of Economic Behavior & Organization* **70(1-2)**: pp. 389–401.

Belleflamme, P., P. Picard, & J.-F. Thisse (2000): "An Economic Theory of Regional Clusters." *Journal of Urban Economics* **48(1)**: pp. 158–184.

Bhagwati, J. (1989): *Protectionism*. Cambrdige, Massachusetts, US: MIT Press.

Borbély, D. (2006): *Trade specialization in the enlarged European Union.* Springer Science & Business Media.

Boschma, R. (2005): "Proximity and Innovation." *Regional Studies* **39(1)**: pp. 61–74.

Boschma, R. & R. Martin (editors) (2010): *The Handbook of Evolutionary Economic Geography.* Cheltenham, UK: Edward Elgar.

Brakman, S., H. Garretsen, & C. van Marrewijk (2009): *The New Introduction to Geographical Economics.* New York, US: Cambridge University Press.

Brakman, S., H. Garretsen, & M. Schramm (2006): "Putting new economic geography to the test: Free-ness of trade and agglomeration in the EU regions." *Regional Science and Urban Economics* **36(5)**: pp. 613–635.

Collom, E. (2011): "Motivations and Differential Participation in a Community Currency System: The Dynamics Within a Local Social Movement Organization." *Sociological Forum* **26(1)**: pp. 144–168.

Crafts, N. & A. J. Venables (2003): "Globalization in History. A Geographical Perspective." In M. D. Bordo, A. M. Taylor, & J. G. Williamson (editors), "Globalization in Historical Perspective," Chicago, US: University of Chicago Press.

Diamond, J. (2012): "What Makes Countries Rich or Poor?" *The New York Review of Books* **59(10)**.

Essletzbichler, J. (2007): "'Diversity, stability and regional growth in the United States, 1975-2002." In K. Frenken (editor), "Applied evolutionary economics and economic geography," Cheltenham, UK: Edward Elgar.

Ezcurra, R. & A. Rodríguez-Pose (2013): "Does Economic Globalization affect Regional Inequality? A Cross-country Analysis." *World Development* **52**: pp. 92–103.

Feenstra, R. C. (2004): "How Costly is Protectionism?" *The Journal of Economic Perspectives* **6(3)**: pp. 159–178.

Fisch, O. (1984): "Regional Income Inequality and Economic Development." *Regional Science and Urban Economics* **14(1)**: pp. 89–111.

Flegg, A. T. & T. Tohmo (2014): "Estimating Regional Input Coefficients and Multipliers: The Use of FLQ is Not a Gamble." *Regional Studies* .

Flegg, A. T., C. D. Weber, & M. V. Elliot (1995): "On the appropriate use of location quotients in generating regional input-output tables." *Regional Studies* **29**: pp. 547–561.

FoodIMA (2008): "A Theoretical Framework for the Construction of a Complete Regional I-O Model." *Technical Report 6.1*, Aristotle University of Thessaloniki.

Fujita, M., P. R. Krugman, & A. J. Venables (1999): *The Spatial Economy, Cities, Region and International Trade.* Cambridge, Massachusetts, US: MIT Press.

Gill, I., C. ching Goh, & M. Roberts (2009): "Reshaping Economic Geography: Implications for New EU Member States." *World Bank Other Operational Studies* **10256**.

Glaecer, E. L. (2008): "The Economic Approach to Cities." *Harward Institute of Economic Research* **Working Paper N. 2149**.

Jensen, R. C., T. D. Mandeville, & N. D. Karunaratne (1979): *Regional Economic Planning: Generation of Regional Input-Output Analysis.* London, UK: Croom Helm.

Krugman, P. R. (1979): "Increasing returns, monopolistic competition, and international trade." *Journal of international Economics* **9(4)**: pp. 469–479.

Kutáček, S. (editor) (2007): *Penězům na stopě.* Brno, CZ: Trast pro ekonomiku a společnost.

Kuznets, S. (1955): "Economic Growth and Income Inequality." *American Economic Review* **45(1)**: pp. 1–28.

Lehtonen, O. & M. Tykkyläinen (2014): "Estimating Regional Input Coefficients and Multipliers: Is the Choice of a Non-Survey Technique a Gamble?" *Regional Studies* **48(2)**: pp. 382–399.

Lessmann, C. (2014): "Spatial inequality and development â€" Is there an inverted-U relationship?" *Journal of Development Economics* **106(1)**: pp. 35–51.

Longhurst, N. & G. Seyfang (2013): "Growing green money? Mapping community currencies for sustainable development." *Ecological Economics* **86**: pp. 65–77.

Martin, R. (1999): "The new 'geographical turn' in economics: some critical reflections." *Cambridge Journal of Economics* **23(1)**: pp. 65–91.

Miller, R. E. & P. D. Blair (2009): *Input-output analysis: foundations and extensions*. Cambridge University Press.

Montouri, B. D. & S. J. Rey (1999): "US Regional Income Convergence: A Spatial Economic Perspective." *Regional Studies* **33(2)**: pp. 143–156.

Piketty, T. (2014): *Capital in the Twenty-first Century*. Cambridge, Massachusetts, US: The Belknap Press of Harvard University Press.

Porter, M. E. (1998): "Clusters and the New Economics of Competition." *Harvard Business Review* pp. 77–90.

Puga, D. (1999): "The rise and fall of regional inequalities." *European economic review* **43(2)**: pp. 303–334.

Redding, S. & A. J. Venables (2004): "Economic geography and international inequality." *Journal of International Economics* **62(1)**: pp. 53–82.

Rodrik, D., A. Subramanian, & F. Trebbi (2004): "Institutions rule: The primacy of institutions over geography and integration in economic development." *Journal of Economic Growth* **9**: pp. 131–165.

Sacks, J. (2002): *The Money Trail*. New Economics Foundation and The Countryside Agency.

Sawers, L. (2006): "Inequality and the Transition: Regional Development in Lithuania." *Baltic Journal of Economics* **6(1)**: pp. 37–51.

Semerák, V., K. Zigic, E. Loizou, & A. Golemanova-Kuharova (2010): "Regional Input-Output Analysis: Application on Rural Regions in Germany, the Czech Republic and Greece." *paper prepared for the 118th seminar of EAAE* .

Tondl, G. & G. Vuksic (2008): "What helps regions in eastern europe catch up? the role of foreign investment, human capital and geography." In

U. Stierle-Von Schütz (editor), "Regional Economic Policy in Europe," Cheltenham, UK: Edward Elgar.

Vousden, N. (1990): *The economics of trade protection.* Cambrdige, UK: Cambridge U.P.

Ward, B. & J. Lewis (2002): *Plugging the Leaks.* New Economics Foundation.

Williamson, J. G. (1965): "Regional Inequality and the Process of National Development: A Description of the Patterns." *Economic Development and Cultural Change* **13(4)**: pp. 1–84.

World Bank (2009): "Reshaping Economic Geography. World Development Report." Washington DC, US.

Appendix A

Derivation of regional I-O tables

We use the methodology developed under the project FoodIMA led by Aristotle University of Thessaloniki (FoodIMA 2008) based on GRIT methodology.

We have national input-output matrix, divided on transaction matrix Z_N, column vector of final demand Y_N and row vector of import M_N. Row sums of intermediate consumption and final demand give the amount of total used resources X_N. Direct requirement matrix is computed using the basic equation:

$$\underset{n\times n}{A_N} = \underset{n\times n}{Z_N} \cdot \operatorname{diag}\left(\underset{1\times n}{X_N}\right)^{-1} \tag{A.1}$$

where n is number of sectors in national economy and matrices are described above. Authors of FoodIMA suggest to delete the main diagonal from the national transaction matrix before this computation from the reason that intrasectoral flows include interregional trade and thus the computed regional intermediate purchases would be overestimated. We decided to let the intrasectoral flows in the table as it would be very strong and unlikely assumption.

In order to derive the regionalised I-O table for a particular region, we need to eliminate the non-existing sectors in the region from the national direct requirement matrix. It would nevertheless imply that the region not just does not produce the respective products, but it does not even use them for any other production. To avoid this inaccuracy we add the row to the national import coefficients:

$$\underset{1\times n-j}{\bar{m}_N} = \underset{1\times n-j}{m_N} + \underset{1\times j}{i} \cdot \underset{j\times n-j}{A_N} \tag{A.2}$$

where j is the number of eliminated sectors, m_N is the national import coefficients computed as a ratio of import in a particular sector to total resources

used in the sector, $\bar{m}_N$ is the coefficient augmented with the coefficients from national direct requirements matrix A_N for the eliminated sectors, and i is a unit vector.

For the regionalisation purposes we need to construct location quotients characterizing structural differences between the regional and national economy. It must be constructed from additional data, either about employment distribution or value added. We use data on value added as it is the only indicator which is gathered by Czech Statistical Office in a desired detail.

First location quotient is called simple location quotient and is computed as follows:

$$SLQ_i = \frac{V_i^R}{V_T^R} \cdot \frac{V_T^N}{V_i^N} \tag{A.3}$$

where V_i^R and V_i^N is value added in sector i in region R or nationally respectively and V_T^R and V_T^N are totals (sums for all sectors). This location quotient takes into account just overall size of regional economy relatively to the national economy, but does not deal with structural differences. Therefore we use the location quotient developed by Flegg *et al.* (1995) and marked as FLQ:

$$FLQ_{ij} = \frac{V_i^R}{V_j^R} \cdot \frac{V_j^N}{V_i^N} \cdot \lambda \tag{A.4}$$

and

$$\lambda = \log_2 \left(1 + \frac{V_T^R}{V_T^N}\right)^{\delta} \tag{A.5}$$

where i and j are two sectors and $0 \leq \delta \leq 1$ is the weighting parameter reflecting the relative importance of the sector in the region. If $FLQ_{ij} > 1$ it means that the supply of region i is sufficient form demand of sector j and in that case it is not necessary to change the technical coefficient from national matrix, so we set $FLQ_{ij} = 1$. In other cases the coefficient is over-estimated and must be lowered.

Estimating of δ is one of the fields, where researcher can improve the computation for any particular region in order to get more credible results. But it is also something what is most recently a subject of many disputations among researchers. We use the method proposed by Lehtonen & Tykkyläinen (2014),

because it does not need special primary data as does the method of Flegg & Tohmo (2014). The used formula is hence as follows:[1]

$$\delta = \frac{\log\left(\frac{V_T^R}{V_T^N} / \log_2\left(1 + \frac{V_T^R}{V_T^N}\right)\right)}{\log\left(\log_2\left(\frac{V_T^R}{V_T^N}\right)\right)} \tag{A.6}$$

Now we can compute the regional direct requirements matrix and regional import coefficients as:

$$\underset{m\times m}{A_R} = \underset{m\times m}{FLQ_R} \cdot \underset{m\times m}{A_N} \tag{A.7}$$

and

$$\underset{1\times m}{m_R} = \underset{1\times m}{\bar{m}_N} + i\left(\underset{m\times m}{A_N} - \underset{m\times m}{A_R}\right) \tag{A.8}$$

where m is number of sectors in the region reduced by the non-existing sectors in the region $n - j$, i is a unit row vector and $\bar{m}_N$ is row of adjusted national import coefficients as derived in (A.2).

Regional sectoral output can be computed using the logic of SLQ (A.3) as follows:

$$X_i^R = \frac{V_i^R}{V_i^N} X_i^N \tag{A.9}$$

where $i = 1, \ldots, m$ is a particular sector. Finally we can compute the (estimated) regional transaction matrix and imports vector:

$$\underset{m\times m}{Z_R} = \underset{m\times m}{A_R} \cdot \operatorname{diag}\left(\underset{1\times m}{X_R}\right) \tag{A.10}$$

and

$$\underset{1\times m}{M_R} = \underset{1\times m}{m_R} \cdot \operatorname{diag}\left(\underset{1\times m}{X_R}\right) \tag{A.11}$$

where X_R is vector of regional sectoral output computed in (A.9). Regional production can be estimated as $Y_R = X_R - M_R$.

[1] For all Czech regions the coefficient is very close to $\delta = 0.1$, which according to Flegg & Tohmo (2014) is too low and it would lead to underestimation of the regional transaction matrices.