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THE RISE OF EASTERN EUROPE AND GERMAN LABOR MARKET REFORM: DISSECTING THEIR EFFECTS ON EMPLOYMENT

Timo Walter
University of Hohenheim

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The Rise of Eastern Europe and German Labor Market Reform: Dissecting their Effects on Employment*

Timo Walter†

University of Hohenheim, Germany

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Abstract

From the early 1990s until 2005 the unemployment rate rose in Germany from 7.3% to 11.7%. While the unemployment rate reached its peak in 2005, it decreased steadily in the following years. On the one hand, the fourth stage of the German labor market reform (Hartz IV) was implemented in 2005 with the intent to cut the unemployment rate. On the other hand, the productivities in Germany and Eastern Europe grew strongly during the same period, enhancing the joint trade. The "rise of the East", in terms of rising trade, is likely to have had an ambiguous effect on the German labor market. This paper investigates the employment effects of the "Hartz IV-Reform". Further, it concentrates on the labor market effects of the German and Eastern European productivity shock. The focus lies on the national and county level (including 402 counties). As the effects on regional labor markets differ and take time, the paper builds on the dynamic and spatial trade model of Caliendo et al. (2019). I find that the "Hartz IV-Reform" and the German productivity contributes positively to the decline of unemployment, whereas the increase in Eastern European productivity is only responsible for a minor increase in unemployment.

Keywords: Dynamic Trade Model, Labor Market Reform, Trade Liberalization, Productivity Shocks, Germany, Eastern Europe

JEL Classification Codes: F14 F16 F17

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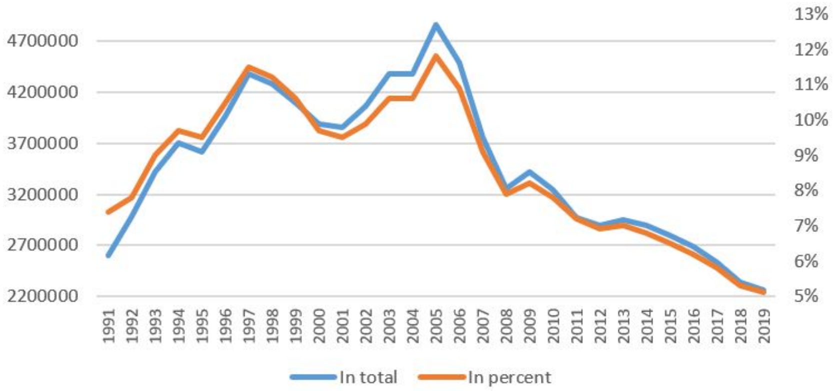
† University of Hohenheim (520E), Schloss Hohenheim 1C, 70599 Stuttgart, Germany. Email: t.walter@uni-hohenheim.de

1. Introduction

A pivotal year in the German labor market development was 2005: After the German reunification the unemployment rate grew from 7.3% to 11.4% in 1997. Followed by a phase of recovery, which was mainly driven by the "new economy". The bursting of the dot-com bubble led to an increase of the German unemployment rate to its all-time high in 2005 with 11.7%. However, up to the financial crisis in 2008 the unemployment rate fell sharply to 7.8% and even to 5% in the following decade. Figure 1.1 illustrates the development of the unemployment rate and the number of unemployed over the period 1991-2019. Hereby, the question about the cause of the strong decrease in the unemployment rate since 2005 naturally arises.

Figure 1.1.: Development of Unemployment in Germany



Source: Statistik der Bundesagentur für Arbeit (2020); Author's own calculations.

To shed more light on this matter, I show in Figure 1.2 that the German imports from Eastern Europe and the German exports to Eastern Europe grew stronger since 2005 (up to the financial crisis in 2008/09), compared to the previous years. This is indicated by the fact that the actual German imports from and exports to Eastern Europe are lager since 2005 than the import and export trend (if the imports and exports of 2005 would rise as between 2004 and 2005). Dauth et al. (2014) refer to the rise in trade as the "rise of the East". They find that the growing trade flows have led to net-employment gains in Germany, as new export opportunities economically stimulated regions with strong export-oriented sectors. Yet, other regions with sectors vulnerable to import competition experienced higher levels of unemployment triggered by the trade exposure. This led to unevenly distributed employment gains or even losses across different regions.[1] Dauth et al. (2016) suggest the rising productivity in Eastern Europe as a driving force behind the increasing trade flows.[2] Especially through the economic transformation the Eastern European productivity levels grew substantially, and hence, could have led to more pressure on the German labor market through increasing import competition. At the same time the German productivity grew as well and could have contributed to the increase in exports to Eastern Europe. However, less is known about the precise impact of productivity on the rising trade between Germany and Eastern Europe, and henceforth on the effects on the German labor market. This paper tries to explore the German and Eastern European productivity effects on the German labor market via the export and import channel.

Furthermore, the German labor market "Hartz-Reforms" impose themselves as a potential channel for the reversal of unemployment.[3] They had their focus on the restructuring of the low-wage sector in Germany. The labor market reforms were implemented between 2003 and 2005 in four stages (Hartz I – Hartz IV). Especially through the fourth stage (Hartz IV) and the introduction of the long-term unemployment benefit "Arbeitslosengeld II" (hereafter "ALG II") on January 1st, 2005 it was hoped to cut the unemployment: On the one hand, the long-term unemployment benefit was initiated to provide a life of human dignity for all people living in Germany between the age of 15 and 65 (or 67), who are capable of working and cannot afford to satisfy their basic material needs.[4] On the other hand, the long-term unemployment benefit is conditional, and the recipients are obliged to aim actively for integration into the labor market. In the case of a breach of duty, the long-term unemployment benefit is reduced by 30%,

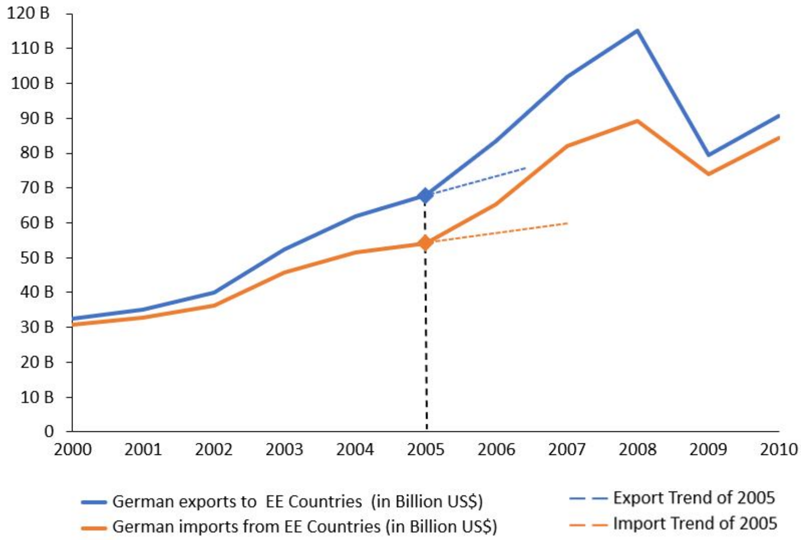
[1] In addition to the "rise of the East", the rising trade with China could also have impacted the labor market in Germany. Dauth et al. (2014) investigate in their paper the employment effect of the so-called "China Shock" and the "rise of the East". Their findings indicate that the impact of the increasing trade flows of the "China Shock" was less significant than the effects of the "rise of the East". The authors argue that the reason for a smaller impact of the "China Shock" is that Germany already imported goods from other countries where China had its comparative advantage in. For example Germany imported labor intensive goods like textiles from Italy, but after the "China Shock" trade divergence took place and the source of imports to China changed. Through this trade divergence the German labor market was less impacted by the increase in import competition from China.

[2] Several other factors could also play major roles behind the rising trade flows between Germany and the Eastern European countries. Especially the trade integration of the Eastern European countries could have led to a decrease in trade cost and hence to an increasing trade flow with Germany. Particularly, the eastward enlargement of the European Union between 2004 and 2007 could have contributed to the reduction of the unemployment level in Germany. However, the precise impact on the German labor market by the trade liberalization remains unclear, as the estimation of the economic effect of the trade barrier reduction is empirically challenging, Dauth et al. (2014).

[3] Other factors could also have contributed to the rapid fall of unemployment, e.g. wage moderation, economic improvement or the increasing flexibility of the labor market institution, see Dustmann et al. (2014).

[4] According to the Second Book of the Code of Social Law (§ 8 SGB II), a worker is capable of working if he is able to work for at least three hours a day and not handicapped due to illness or disability. Foreigners can also receive the unemployment benefits if they live in Germany and have a valid work permit (not for the first three months), and if they are no asylum seekers, see § 7 SGB II.

Figure 1.2.: German Trade Development to Eastern Europe



The analysis in my study includes eleven Eastern European countries. Thus, the data on Eastern Europe (in this graph) include those same countries, namely Czech Republic, Hungary, Poland, Slovakia, Estonia, Latvia, Lithuania, Slovenia, Bulgaria, Croatia, Romania.

Source: World Bank (2021); Author's own calculations.

in the case of a second time by 60%, and in the case of a third time the benefit is cut all together. The long-term unemployment benefit is financed by the federal government via the Federal Employment Agency ("Bundesagentur für Arbeit"), except for housing and other costs that are usually paid by municipalities and counties (§ 6 SGB II). Typically, the long-term unemployment benefit ("ALG II") is paid after a person is unemployed for more than 12 months and thus is not eligible for the short-term unemployment benefit "Arbeitslosengeld I" ("ALG I") anymore. Moreover, a person can be eligible for the long-term unemployment benefit even if the person is working, yet earns less than he needs to satisfy the basic demands. This group makes about one third of all long-term unemployment benefit ("ALG II") recipients.[5]

My paper investigates and disentangles the impact of the German labor market reform (Hartz IV) and the "rise of the East" (caused by the productivity shocks in Eastern Europe and Germany) on the German labor market at the German county level ("Kreisebene"). For my analysis I build on the new spatial multi-country and multi-sector equilibrium model of Caliendo et al. (2019). The advantage of the model is that it includes a dynamic set-up, which considers the adjustments of the labor market, as the economic and policy effects on employment differ for each sector and need time to adapt. Further, the trade model provides a rich theoretical framework which takes input-output linkages, labor mobility

[5]Besides those main groups there are other groups (e.g. students) which are eligible for the long-term unemployment benefit. But, as those groups are not part of the accessible workforce, I will not consider them in the analysis in more detail.

frictions, goods mobility frictions as well as spatial factors into account.

In order to incorporate the German labor market reform (Hartz IV) in a dynamic general equilibrium setting I apply the extension of the basic Caliendo et al. (2019) model, as it considers the policy effects of the Social Security Disability Insurance (SSDI) program in the United States. Since productivities play a crucial part in my study, I identify the precise productivity changes on the sectoral level driving the rising trade between Germany and Eastern Europe. I calibrate for Germany the changes in productivity that corresponds to the increase of Eastern European imports. For Eastern Europe I conduct the productivity changes, which are responsible for the import increase in Germany. I calibrate the productivity changes in two steps: In the first step, I use the instrumental-variable strategy by Autor et al. (2013) to conduct the predicted import changes for Germany and also for Eastern Europe, which arise from the productivity shocks. In the second step, I apply the iteration approach of Caliendo et al. (2019) to detect the productivity changes. By iteration the productivity changes are identified, when the predicted import changes match with the model's import changes.

The analysis includes a counterfactual part. Thereby, I answer the question: How would German employment have evolved, if the "Hartz IV-Reform" and the "rise of the East" would not have taken place? I do this by constructing first a baseline economy where the data develop as they actually did. Second, I then construct a counterfactual economy for each case: For the "Hartz IV-Reform", the Eastern European and the German productivity shock. By taking the difference between the baseline and the counterfactual economy (for each case) I am able to identify the employment impact of the "Hartz IV-Reform" and the two productivity shocks.

The time of interest of my analysis are the years between 2005 and 2014, as during that time the German labor market reforms were introduced, and the Eastern European countries experienced a rapid productivity growth. My focus is on eleven Eastern European countries, which are represented in the World Input-Output Database (WIOD) (Release 2016) by Timmer et al. (2015). Namely Czech Republic, Hungary, Poland, Slovakia, Estonia, Latvia, Lithuania, Slovenia, Bulgaria, Croatia and Romania. As the impact of the labor market reform (Hartz IV) and the "rise of the East" varies across regions I am interested in the economic and labor effects on the German county level (NUTS 3 Level). Therefore my analysis includes 402 counties. Hereby, I construct an input-output table for the German counties, compatible with the World Input-Output Database (WIOD). I follow the approach of Krebs and Pflüger

(2018) and use the production value added data for each county. The data is obtainable from the regional statistic data ("Regionalstatistik") of the German Federal and Regional Statistical Offices ("Statistische Ämter des Bundes und der Länder"). It includes seven sectors, which are the sectors of interest in my analysis.[6] Regarding the trade flow data, I make use of the World Input-Output Database (WIOD), that includes data on 43 countries and an aggregate of the rest of the world. I combine the 56 sectors of the database into the seven sectors used in my simulation.

To identify income taxes and the costs of the long-term unemployment benefit ("ALG II") I rely on the data of the federal government budget ("Bundeshaus halt"). Employment, short-term unemployment and long-term unemployment data are provided by the Statistics of the Federal Employment Agency ("Bundesagentur für Arbeit"). In order to identify the movement of households across sectors and counties, I construct a labor mobility matrix. In addition, I identify the probabilities of households becoming employed, short-term unemployed and long-term unemployed.

My analysis shows, that without the labor market reform (Hartz IV) the German short-term unemployment would have been 0.4 percentage points larger. The "rise of the East" contributes to the fall in short-term unemployment by 0.03 percentage points. Hereby, the German productivity shock contributes positively to the decline of short-term unemployment, whereas the Eastern European productivity shock is responsible for a minor increase in short-term unemployment. On the county level I find that the rise in Eastern European productivity primarily impacts the east of Germany and counties geographically closer to Eastern Europe. Further, I find a "push effect" at the sectoral level due to the rise of Eastern European productivity: The employment of the import penetrated manufacturing sector declines and short-term unemployment increases, at the same time I discover an employment shift into service sectors. This "push effect" is in line with the findings of Dauth et al. (2016). Regarding the impact of the "Hartz IV-Reform" counties in the eastern part of Germany are benefiting the most as the short-term unemployment declines more than in the west, which corresponds to the results ofLaunov and Wälde (2013).

Concerning the effect of the "Hartz Reforms" several major studies have been conducted. Most notably by Hochmuth et al. (2019), Krause and Uhlig (2012) and Hartung et al. (2018) with varying results. Using

[6] The sectors include four manufacturing and three service sectors: Agriculture and forestry, fisheries (Sector 1); production industry without construction (Sector 2); manufacturing and processing (Sector 3); construction (Sector 4); trade, transport, hotels and restaurants, information and communication (Sector 5); financial, insurance services (Sector 6); public services, education, health services (Sector 7). With those seven sectors I am able to construct the input-output table on the county level. Further I include a short-term unemployment sector and a sector for the long-term unemployment ("ALG II").

different approaches and matching models the results of the impact of the "Hartz" reforms vary from a decline of unemployment by 0.1% to 3%. Many of these studies cover the entire impact of the "Hartz" reforms (Hartz I – Hartz IV). Krebs and Scheffel (2014) find a decline of unemployment by the "Hartz" reforms of 3% and traces about 1% particularly to the effect of Hartz IV.

The most recognizable work on the German trade exposure of Eastern Europe with its effect on the German labor market has been explored in a series of papers by Dauth et al. (2014, 2016, 2017). However, they do not explore the underlying fundamentals of the rising trade flows, e.g. a rise in productivity and fall of trade costs. My paper contributes to this literature in showing the impact of the rise in productivity of Germany and Eastern Europe on the German labor market. Related work has explored the effect of the "China Shock" on the U.S. labor market. Autor et al. (2013, 2014) and Acemoglu et al. (2016) suggest the productivity growth in China led to the "China Shock", whilst Pierce and Schott (2016) demonstrate that the reduction of trade barriers, e.g. China joining the World Trade Organization (WTO) in 2001, led to the growth of Chinese trade flows.

My paper is based on several ideas from previous research. The approach of *"dynamic hat algebra"* used in my paper and developed by Caliendo et al. (2019) is based on the approach of relative changes of Dekle et al. (2008) and its *"hat algebra"*. Moreover, the applied Caliendo et al. (2019) model builds on the work of Eaton and Kortum (2002), Artuç et al. (2010) and Dvorkin (2014). It is linked to a strand of dynamic equilibrium models such as Artuc and McLaren (2010) and Dix-Carneiro (2014).

The structure of this paper is as follows: In section 2, I introduce a long-term unemployment state into an otherwise standard dynamic trade model à la Caliendo et al. (2019). Section 3 provides a description of the calibration of the data necessary to numerically solve the model. In section 4 I present my findings of the economic impact of the German labor market reform (Hartz IV) and the "rise of the East". In section 5 I conclude.

2. Model

I incorporate a long-term unemployment benefit into the version of the Caliendo et al. (2019) model with Social Security Disability Insurance (SSDI). Caliendo et al. (2019) is a dynamic version of a multi-sector, multi-country Ricardian trade model à la Eaton and Kortum (2002). It is a spatial general equilibrium trade model and allows for labor market dynamics via labor mobility.

The model features the following ingredients: Households are forward looking and decide, depending on their expected utility, in which region and "sector" to work and where to move in the next period, whilst taking transition costs into account. In each region, there is a short-term unemployment sector ("sector 0") and a long-term unemployment sector ("sector A"). With some probabilities households change the "sector" e.g. getting into another sector, becoming short-term unemployed or even long-term unemployed. On the production side, intermediate goods are produced with labor, materials, and structures. The structures are composite local factors; firms rent the structures from rentiers. The intermediate goods go into the production of local sectoral aggregate goods from the same sector. The local sectoral aggregate goods are then used by the firms either to produce intermediate goods or final goods. The firms' productivities are Fréchet distributed and depend on the sectoral Fréchet distribution parameter θ^j. The model consists out of many exogenous factors (*fundamentals*), that are constant or time-varying. The model applies the equilibrium conditions in relative changes to avoid the need of solving for the *fundamentals*. Thus, the model embeds the *"hat algebra"* approach of Dekle et al. (2008) in a time-varying setting, labeled as the *"dynamic hat algebra"* method by Caliendo et al. (2019). I introduce the long-term unemployment benefit to the SSDI extended model.

2.1. Households

The model consists of a world with N regions labeled as n or i and of J sectors, indexed as j or k. As the model concentrates on the labor market reform in Germany regions can be seen as German counties. In the numerical analysis the German labor market model is incorporated into the multi-country context of Caliendo et al. (2019). A competitive labor market exists in each sector j of region n. Households can either be *employed* and work in sector j or they can be *short-term unemployed* (in "sector 0") or *long-term unemployed* (in "sector A"). Representative consumers in region n that are employed in sector j get the market wage w_j^{nj} and provide in turn one-unit of labor. Depending on their preferences $U(C_t^{nj})$, they can choose from a consumption bundle of final local goods C_t^{nj}. The consumption bundle consists of local consumption goods $(c_t^{nj,k})$ from different sectors: $C_t^{nj} = \prod_{k=1}^{J} (c_t^{nj,k})^{\eta^k}$, where η^k is the share of final consumption of sector k. The households are forward looking and consider their potential future utility levels.

This also includes the option of becoming short-term unemployed and even long-term unemployed. The households decide, depending on the expected value, in what region-sector combination they want to provide their unit of labor. I apply a standard approach used in dynamic discrete choice models to solve the households' optimization problem. A key to identify the lifetime utility plays the idiosyncratic shock ϵ_t^{ik}, which is standardized distributed Type I Extreme Value. In this context, the idiosyncratic shock can be interpreted as additional benefits the households receive, when moving into region i and sector k (including the short-term unemployment "sector 0"). However, the households do not know the value of the idiosyncratic shock beforehand.

The value of being employed in region n and sector j at time t is given by:

$$\begin{aligned} V_t^{nj} &= U(C_t^{nj}) + \upsilon \log \left(\sum_{i=1}^{N} \exp(\beta V_{t+1}^{i0} - \tau^{nj,i0})^{1/\upsilon} \right) + \\ \upsilon(1-\alpha_{t+1}^{nj}) \log & \left(\sum_{i=1}^{N} \sum_{k=1}^{J} \exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{1/\upsilon} \right) + \alpha_{t+1}^{nj} \beta V_{t+1}^{nA} \end{aligned} \tag{2.1}$$

The second term on the right-hand side represents the expected value of being short-term unemployed in the next period. Where $\tau^{nj,i0}$ is the transition cost of moving from region n in sector j into short-term unemployment in region i, as subscript 0 denotes the short-term unemployment sector. The discount factor is given by β and the scale variance of the idiosyncratic shock is denoted by υ. The third term is the expected value when working in any sector of any region. Hereby $\tau^{nj,ik}$ is the transition cost of moving from region n in sector j into region i and sector k. The fourth term is the expected value of being long-term unemployed. Thus, V_{t+1}^{nA} is the value of the long-term unemployed households in period $t+1$. Furthermore, α_{t+1}^{nj} is the probability that workers from region n of sector j end up in the long-term unemployed "sector". In that case the income of the households are not high enough, and the households need to be supported via the long-term unemployment benefit. Vice versa $(1-\alpha_{t+1}^{nj})$ is the probability that the households working in region n and sector j receive in that particular region-sector combination an income which is above the ALG II threshold.

The utility value for short-term unemployed households is

$$V_t^{n0} = \log b^n + \upsilon(1-\delta_{t+1}) \log \left(\sum_{i=1}^{N} \sum_{k=0}^{J} \exp\left(\beta V_{t+1}^{ik} - \tau^{nj,ik}\right)^{1/\upsilon} \right) + \delta_{t+1} \beta V_{t+1}^{nA} \tag{2.2}$$

The households in the short-term unemployment sector receive and consume the value of their home production b^n. I assume the value of home production to be time invariant, as the home production value is less changing over time and therefore can be seen as a constant in the model. With a probability δ_{t+1} the households become long-term unemployed,[7] while the probability $1-\delta_{t+1}$ denotes the likelihood that households will not enter into ALG II in the next period. The second term indicates the expected

[7] In the quantitative analysis, it is the probability that households become long-term unemployed after 12 months.

value if one is moving to any sector in any region. This includes the possibility of being short-term unemployed denoted by $k = 0$. The third term represents the expected value if short-term unemployed households become long-term unemployed in the next period.

The value of the long-term unemployed households at time t can be written as

$$V_t^{nA} = \log(b_t^A/P_t^n) + (1 - \rho_{t+1}^{nA})\beta V_{t+1}^{nj} + \rho_{t+1}^{nA}\beta V_{t+1}^{nA} \tag{2.3}$$

Recipients receive long-term unemployed benefit of b_t^A, which is time varying. Unlike the short-term unemployed benefit b^n (in terms of home production), the real long-term unemployed benefits b_t^A/P_t^n depend on the price index of the specific region n. With $1 - \rho_{t+1}^{nA}$, it is the probability that the households start working again, the second term denotes the expected value if the households will enter into the workforce. With the probability of ρ_{t+1}^{nA}, the third term indicates the expected utility value if the households will stay in the long-term unemployment program.

2.2. Migration Share and Labor Mobility

The share of moving households is given by

$$\mu_t^{nj,ik} = \frac{\exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{1/v}}{\sum_{m=1}^{N}\sum_{h=0}^{J}\exp(\beta V_{t+1}^{mh} - \tau^{nj,mh})^{1/v}} \tag{2.4}$$

which is the expected utility value a household would gain from moving to region i in sector k relative to the sum of the expected value of all sectors J and all regions N. In other words, region-sector combinations which have higher expected values attract more households than other region-sector combinations.[8]

Next, I show how the *employed*, *short-term unemployed* and *long-term unemployed* mass of households evolve over time. The mass of employed households in period $t + 1$ in region n and sector j is given by:

$$L_{t+1}^{nj} = \sum_{i=1}^{N}\sum_{k\neq 0}^{J}\mu_t^{ik,nj}(1 - \alpha_t^{ik})L_t^{ik} + \sum_{i=1}^{N}\mu_t^{i0,nj}(1 - \delta)L_t^{i0} + (1 - \rho_t^{nA})L_t^{nA}/J \tag{2.5}$$

The first term is the mass of employed households, which earn enough to satisfy their basic needs. The second term represents the mass of short-term unemployed households that are moving into the workforce of sector j. The third term displays the mass of households which transfer from long-term

[8] According to Caliendo et al. (2019), $1/v$ can in this context be understood as a migration elasticity.

unemployment into a new job in region n in sector j.[9] Further, the mass of households which are short-term unemployed is:

$$L_{t+1}^{n0} = \sum_{i=1}^{N} \sum_{k \neq 0}^{J} \mu_t^{ik,n0} (1 - \alpha_t^{ik}) L_t^{ik} + \sum_{i=1}^{N} \mu_t^{i0,n0} (1 - \delta_t) L_t^{i0} \tag{2.6}$$

It consists of the mass of employed households that become short-term unemployed and those households that stay short-term unemployed in period t. The number of households that are long-term unemployed in period $t + 1$ can be represented as:

$$L_{t+1}^{nA} = \rho_t^{nA} L_t^{nA} + \delta_t L_t^{n0} + \sum_{j \neq 0}^{J} \alpha_t^{nj} L_t^{nj} \tag{2.7}$$

The first part is the mass of ALG II households that stay in the program, the second part shows the amount of short-term unemployed households getting into ALG II and the third part of the equation represents the mass of employed households earning too less and therefore are applicable for ALG II.[10]

2.3. Production

Intermediate goods are produced in each region-sector combination by a continuum of perfectly competitive firms. Inputs for the production of intermediate goods are labor and materials (they can come from any sector of the same region) as well as structures. The structures are composite local factors and rented by firms from rentiers.[11] The rentier structure is necessary in order to have the feature of trade unbalances, which becomes essential in section 2.5. Further the intermediate good is produced with the total factor productivity (TFP) which consists of a productivity unique for each good and a time-varying

[9] Note, that in the third term, J does not include the short-term and the long-term unemployment sector in this case.

[10] In principle the households can move across counties and enter the long-term unemployment benefit from other counties. However, the number of moving people is relatively low as the long-term unemployment benefit is paid by the Federal Employment Agency and each recipient receives the same standard rate independent of the location. Hereby, I neglect the extra subsidies payed by the local council for costs like housing since the focus of my study lies on the federal payments.

[11] According to the model those rentiers are located in each region, however, cannot move and shift from a region. They transfer their rents to a global portfolio $\chi_t = \sum_{i=1}^{N} \sum_{k=1}^{J} r_t^{ik} H^{ik}$, which they have stake ι^n in (with $\sum_{n=1}^{N} \iota^n = 1$.). The rentiers can use their shares of the global portfolio to purchase and consume final goods in region n.

sectoral-regional component A_t^{nj}. After solving for optimization, the price of the intermediate good can be written as

$$x_t^{nj} = B^{nj}((r_t^{nj})^{\xi^n}(\omega_t^{nj})^{1-\xi^n})^{\gamma^{nj}} \prod_{k=1}^{J}(P_t^{nj,nk})^{\gamma^{nj,nk}} \tag{2.8}$$

where B^{nj} is a constant, r_t^{nj} is the factor price of the structure (rental) and ω_t^{nj} is the factor price of labor (wages). $P_t^{nj,nk}$ is the price index of the intermediate good which comes from sector k into sector j of the same region n. Further, ξ^n is the value added share of the structure. The equation adds to unity $\sum_{k=1}^{J}\gamma^{nj,nk} = 1-\gamma^{nj}$, where $\gamma^{nj,nk}$ is the share of intermediates from sector k that goes into the production of sector j of the same region j. The share of value added of the intermediate goods produced in the same sector j of the same region n is given by γ^{nj}. Shipping an intermediate good from one region to another is costly and requires iceberg trade costs $\kappa_t^{nj,ij} \geq 1$. It needs the production of $\kappa_t^{nj,ij}$ in region i in order that one unit of the intermediate good arrives in region n.

The local sectoral aggregate good, also labeled as material, is a bundle of intermediate goods acquired from different regions. Thereby the intermediate goods come from different regions of the same sector. The intermediate goods are purchased from the lowest-cost supplier. The local sectoral aggregate good is used to produce either intermediate- or final goods. The model then gives rise to the optimal local sectoral aggregate good price:

$$P_t^{nj} = \Gamma^{nj}\left(\sum_{i=1}^{N}(x_t^{ij}\kappa_t^{nj,ij})^{-\theta^j}(A_t^{ij})^{\theta^j\gamma^{ij}}\right)^{-1/\theta^j} \tag{2.9}$$

Thus, the local sectoral aggregate good price depends on the time-varying sectoral-regional component of the total factor productivity (TFP) A_t^{ij} as well as on the prices of the intermediate goods and iceberg costs, while taking γ^{ij} and θ^j into account.[12] As the productivities are Fréchet distributed, θ^j is defined as the parameter of the Fréchet distribution which captures the productivity dispersion. Moreover, Γ^{nj} is a constant. By making use of the local sectoral aggregate good price the model then determines the share of total expenditure:

$$\pi_t^{nj,ij} = \frac{(x_t^{ij}\kappa_t^{nj,ij})^{-\theta^j}(A_t^{ij})^{\theta^j\gamma^{ij}}}{\sum_{m=1}^{N}(x_t^{mj}\kappa_t^{nj,mj})^{-\theta^j}(A_t^{mj})^{\theta^j\gamma^{mj}}} \tag{2.10}$$

The share of total expenditure is region n's spending on imports of sector j from region i relative to region n's total expenditure on imports of sector j.

[12] Thus, γ^{ij} is the share of value added of the intermediate goods produced in region i of sector j.

2.4. Government Budget Constraint

In Germany, the long-term unemployed benefit is mainly financed by the federal government.[13] This is reflected by the budget constraint:

$$\sum_{n=1}^{N}\sum_{k=1}^{J}\tau_t^T\omega_t^{nk}L_t^{nk}+G_t=\sum_{n=1}^{N}b_t^AL_t^{nA} \tag{2.11}$$

The government income comes on the one hand from the revenue of the labor income tax (labor income tax is denoted by τ_t^T) and on the other hand from lump-sum taxes or transfers G_t which are charged from rentiers.[14] The government budget is then spent to finance the long-term unemployed benefit (see the right side of equation 2.11). The short-term unemployed households receive income in terms of home production, but no government support takes place for the short-term unemployed households in this model. Hence, expenses for short-term unemployment do not show up in the government budget constraint.

2.5. Good-, Labor- and Structure Market Clearing

The total supply of good j in region n has to match up with the demand of the good. The good market clearing condition (in value terms) is given by:

$$\begin{aligned}X_t^{jn}=\sum_{k=1}^{J}\gamma^{nk,nj}\sum_{i=1}^{N}\pi_t^{ik,nk}X_t^{ik}+\eta^j\\ \left((1-\tau_t^T)\sum_{k=1}^{J}\omega_t^{nk}L_t^{nk}+b_t^AL_t^A+\iota^n\chi_t-G_t/N\right)\end{aligned} \tag{2.12}$$

The good is used as an intermediate input into production (first term on the right-hand side) and for the final demand. The term in brackets represents the aggregate expenditure.[15]

[13]According to § 46 SGB II "the Federation shall bear the costs of basic needs for jobseekers, including administrative costs, insofar the services are provided by the Federal Agency." Only housing and other smaller costs are paid by the municipalities.

[14]This is consistent with the German federal budget, as 96% of the budget is financed by taxes. Out of the total tax revenue, 24.09% is contributed by income tax. Sales tax makes about 24.40%.

[15]Hereby $(1-\tau_t^T)\sum_{k=1}^{J}\omega_t^{nk}L_t^{nk}$ is the effective total labor income revenue, $b_t^AL_t^A$ represents the total long-term unemployment benefit and $(\iota^n\chi_t-G_t/N)$ is the effective income revenue of the rentiers in Germany. N is here the total number of counties in Germany, which is assigned to spread the lump-sum tax/transfer for each rentier uniformly across counties.

Labor market clearing is given by:

$$L_t^{nj} = \frac{\gamma^{nj}(1-\xi^n)}{\omega_t^{nj}} \sum_{i=1}^{N} \pi_t^{ij,nj} X_t^{ij} \tag{2.13}$$

The labor market clearing condition implies that labor L_t^{nj} is required to produce goods for all regions of the same sector j, depending on the wages of sector j in region n.

In addition, market clearing of structures commands:

$$H^{nj} = \frac{\gamma^{nj}\xi^n}{r_t^{nj}} \sum_{i=1}^{N} \pi_t^{ij,nj} X_t^{ij} \tag{2.14}$$

Similar to the labor market clearing condition, the structures serve as inputs of the production of goods for all regions n of the same sector (conditional on the specific sector-region rent r_t^{nj}).

2.6. Solving the Dynamic Equilibrium Model

The model considers two types of equilibria: The first is the *temporary equilibrium* and involves the equilibrium equations (2.8) - (2.14). Thereby so-called *fundamentals* are introduced to make the exogenous state parameters more operable. The *constant fundamentals* $\tilde{\Theta} = (\Upsilon, H, b)$ include home production across regions $b = \{b^n\}_{n=1}^{N}$, structures across markets $H = \{H^{nj}\}_{n=1,j=1}^{N,J}$ and labor relocation costs $\Upsilon = \{\tau^{nj,ik}\}_{n=1,j=0,i=1,k=0}^{N,J,J,N}$. Whereas the *time-varying fundamentals* $\Theta = (A_t, \kappa_t)$ involve the sectoral-regional productivities $A_t = \{A_t^{nj}\}_{n=1,j=1}^{N,J}$ and bilateral trade costs $\kappa_t = \{\kappa_t^{nj,ij}\}_{n=1,i=1,j=1}^{N,N,J}$. Given the *constant fundamentals* and *time-varying fundamentals* as well as the total number of labor in the economy L_t, the temporary equilibrium can be solved via a vector of equilibrium wages $\omega(L_t, \Theta_t, \bar{\Theta}_t)$.

The second equilibrium is the *sequential competitive equilibrium.* It solves for the equilibrium conditions (2.1) - (2.7) by the application of across time vectors $\{L_t, \mu_t, V_t, \omega(L_t, \Theta_t, \bar{\Theta})\}_{t=0}^{\infty}$, as well as relying on the solution of the temporary equilibrium at any time t and given $L_0, \{\Theta_t\}_{t=0}^{\infty}, \bar{\Theta}$.

In order to be able to conduct the counterfactual equilibrium Caliendo et al. (2019) introduce a *baseline economy.* Hereby the *baseline economy* is defined as an allocation $\{L_t, \mu_{t-1}, \pi_t, X_t\}_{t=0}^{\infty}$ across time, which relies on $\{\Theta_t\}_{t=0}^{\infty}$ and $\bar{\Theta}$. However, as with each time period t the number of necessary parameters increase the empirical estimation becomes more challenging. Therefore, the well-known *"hat algebra"* approach of Dekle et al. (2008) is applied to solve the baseline economy in relative time differences, which reduces the need to estimate certain parameters (in particular the level of fundamentals). Caliendo et al. (2019) sets the Dekle et al. (2008) method in a *"dynamic hat algebra"* time-varying setting to solve the baseline economy in relative time differences. Thereby a vector $\dot{y}_{t+1} \equiv \left(\frac{y^1_{t+1}}{y^1_t}, \frac{y^2_{t+1}}{y^2_t}, ... \right)$ can be seen as the relative change of a vector's value y between two periods. To solve the baseline economy at period $t+1$ I apply *Proposition 1* suggested by Caliendo et al. (2019):

"*Given the allocation of the temporary equilibrium at* t*:* $\{L_t, \pi_t, X_t\}$*. The solution to the temporary equilibrium at* $t+1$ *for a given change in* $\dot{L}_{t+1}$ *and* $\dot{\Theta}_{t+1}$ *does not require information on the level of fundamentals at* t*,* Θ_t *or* $\bar{\Theta}$*.*" (Caliendo et al., 2019, p. 754)

$$\dot{x}^{nj}_{t+1} = (\dot{L}^{nj}_{t+1})^{\gamma^{nj}\xi^n} (\dot{\omega}^{nj}_{t+1})^{\gamma^{nj}} \prod_{k=1}^{J} (\dot{P}^{nj}_{t+1})^{\gamma^{nj,nk}} \tag{2.15}$$

$$\dot{P}^{nj}_{t+1} = \left(\sum_{i=1}^{N} \pi^{nj,ij}_t (\dot{x}^{ij}_{t+1} \dot{\kappa}^{nj,ij}_{t+1})^{-\theta^j} (\dot{A}^{ij}_{t+1})^{\theta^j \gamma^{ij}} \right)^{-1/\theta^j} \tag{2.16}$$

$$\pi^{nj,ij}_{t+1} = \pi^{nj,ij}_t \left(\frac{\dot{x}^{ij}_{t+1} \dot{\kappa}^{nj,ij}_{t+1}}{\dot{P}^{nj}_{t+1}} \right)^{-\theta^j} (\dot{A}^{ij}_{t+1})^{\theta^j \gamma^{ij}} \tag{2.17}$$

$$\begin{aligned} X^{nj}_{t+1} = \sum_{k=1}^{J} \gamma^{nk,nj} \sum_{i=1}^{N} \pi^{ik,nk}_{t+1} X^{ik}_{t+1} + \eta^j \Bigg(\sum_{k=1}^{J} \dot{\omega}^{nk}_{t+1} \dot{L}^{nk}_{t+1} \omega^{nk}_t L^{nk}_t + \\ b^A_{t+1} L^A_{t+1} + \iota^n \chi_{t+1} - G_{t+1}/N \Bigg) \end{aligned} \tag{2.18}$$

$$\dot{\omega}^{nj}_{t+1} \dot{L}^{nj}_{t+1} \omega^{nj}_t L^{nj}_t = \gamma^{nj} (1 - \xi^n) \sum_{i=1}^{N} \pi^{ij,nj}_{t+1} X^{ij}_{t+1} \tag{2.19}$$

Where the vector of the real wage equilibrium in time differences $\dot{\omega}^{nj}_{t+1}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})$ solves the equilibrium equations above. The model further defines the *sequential competitive equilibrium* in relative time differences. Thus, in order to solve for the baseline economy in time differences I make use of *Proposition 2*:

"Conditional on an initial allocation of the economy, $\{L_0, \pi_0, X_0\, \mu_{-1}\}$*, given an anticipated convergent sequence of changes in fundamentals,* $\{\Theta_t\}^{\infty}_{t=1}$*, the solution to the sequential equilibrium in time differences does not require information on the level of the fundamentals* $\{\Theta_t\}^{\infty}_{t=0}$ *or* $\bar{\Theta}$*"* (Caliendo et al., 2019, p. 755).

Hence, the *sequential competitive equilibrium* in relative time differences solves for the equilibrium conditions below, in addition $\{\dot{\omega}^{nj}(\dot{L}_t, \dot{\Theta}_t)\}_{n=1,j=0,t=1}^{N,J,\infty}$ and $\{\dot{L}_t, \dot{\Theta}_t)\}_{t=1}^{\infty}$ have to hold:[16]

$$\mu_{t+1}^{nj,ik} = \frac{\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/v}}{\sum_{m=1}^{N}\sum_{h=0}^{J}\mu_t^{nj,mh}(\dot{u}_{t+2}^{mh})^{\beta/v}} \tag{2.20}$$

$$\begin{aligned}\dot{u}_{t+1}^{nj} = [\dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})]\left[\sum_{i=1}^{N}\mu_t^{nj,i0}(\dot{u}_{t+2}^{i0})^{\beta/v}\right]^{v} * \\ \left[\sum_{i=1}^{N}\sum_{k=0}^{J}\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/v}\right]^{v(1-\alpha^{nj})} (\dot{u}_{t+2}^{nA})^{\alpha^{nj}\beta}\end{aligned} \tag{2.21}$$

$$\dot{u}_{t+1}^{n0} = \dot{b}^{n}\left[\sum_{i=1}^{N}\sum_{k=0}^{J}\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/v}\right]^{v(1-\delta)} (\dot{u}_{t+2}^{nA})^{\delta\beta} \tag{2.22}$$

$$\dot{u}_{t+1}^{nA} = \frac{\dot{b}^{A}}{\dot{P}_{t+1}^{n}}(\dot{u}_{t+2}^{nj})^{(1-\rho)\beta}(\dot{u}_{t+2}^{nA})^{\rho\beta} \tag{2.23}$$

$$L_{t+1}^{nj} = \sum_{i=1}^{N}\sum_{k\neq 0}^{J}\mu_t^{ik,nj}(1-\alpha_t^{k})L_t^{ik} + \sum_{i=1}^{N}\mu_t^{i0,nj}(1-\delta)L_t^{i0} + (1-\rho_t^{nA})L_t^{nA}/J \tag{2.24}$$

$$L_{t+1}^{n0} = \sum_{i=1}^{N}\sum_{k\neq 0}^{J}\mu_t^{ik,n0}(1-\alpha_t^{k})L_t^{ik} + \sum_{i=1}^{N}\mu_t^{i0,n0}(1-\delta_t)L_t^{i0} \tag{2.25}$$

$$L_{t+1}^{nA} = \rho_t^{nA}L_t^{nA} + \delta_t L_t^{n0} + \sum_{j\neq 0}^{J}\alpha_t^{j}L_t^{nj} \tag{2.26}$$

2.7. Counterfactual Equilibrium

After having conducted the *baseline economy* in relative time differences, let us turn our attention to the counterfactual equilibrium in relative time changes to be able to execute the empirical analysis.[17] In this counterfactual equilibrium the counterfactual allocations are set in comparison to the allocation of the *baseline economy*. Like that the ratio of time changes between the counterfactual variable y'_{t+1} and the

[16] The equilibrium conditions contain the extension of the German labor market reform. The calculation to derive the *sequential competitive equilibrium* conditions are displayed in A.1.

[17] As in the *baseline economy* scenario, it follows that the relative time changes are in particular helpful as the *fundamentals* of the counterfactual economy $\{\Theta'_t\}_{t=0}^{\infty}$ do not have to be estimated.

baseline economy variable $\dot{y}_{t+1}$ is given by $\hat{y}_{t+1} = \frac{\dot{y}'_{t+1}}{\dot{y}_{t+1}}$, where $\dot{y}'_{t+1} = \frac{y'_{t+1}}{y'_t}$ and $\dot{y}_{t+1} = \frac{y_{t+1}}{y_t}$.[18] In order to boil down the solutions of the counterfactual equilibrium conditions, the forward-looking household is a key feature in the model: In Caliendo et al. (2019) it is assumed that the households do not anticipate the counterfactual fundamentals in the first period $t = 0$ as only the initial fundamentals are known. However, the households gain perfect knowledge of the rest of the entire counterfactual allocations $t \geq 1$, through which the counterfactual equilibrium in relative time changes can be determined. To disentangle the impact of the German Labor market reform and the "rise of the East" counterfactually I follow *Proposition 3*:

"Given a baseline economy, $\{L_t, \mu_{t-1}, \pi_t, X_t\}_{t=0}^{\infty}$, and a counterfactual convergent sequence of changes in fundamentals (relative to the baseline change), $\{\hat{\Theta}_t\}_{t=1}^{\infty}$, solving for the counterfactual sequential equilibrium $\{L'_t, \mu'_{t-1}, \pi'_t, X'_t\}_{t=1}^{\infty}$ does not require information on the baseline fundamentals $(\{\Theta_t\}_{t=0}^{\infty}, \bar{\Theta})$ and solves the following system of nonlinear equations:"[19] (Caliendo et al., 2019, p. 757)

$$\mu_t'^{nj,ik} = \frac{\mu_{t-1}'^{nj,ik} \dot{\mu}_t^{nj,ik} (\hat{u}_{t+1}^{ik})^{\beta/v}}{\sum_{m=1}^{N} \sum_{h=0}^{J} \mu_{t-1}'^{nj,mh} \dot{\mu}_t^{nj,ik} (\hat{u}_{t+1}^{mh})^{\beta/v}} \tag{2.27}$$

$$\begin{aligned} \hat{u}_{t+1}^{nj} = \hat{\omega}^{nj}(\hat{L}_{t+1}, \hat{\Theta}_{t+1}) \left[\sum_{i=1}^{N} \mu_t'^{nj,i0} \dot{\mu}_{t+1}^{nj,i0} (\hat{u}_{t+2}^{i0})^{\beta/v} \right]^{v} \\ \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t'^{nj,ik} \dot{\mu}_{t+1}^{nj,ik} (\hat{u}_{t+2}^{ik})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\hat{u}_{t+2}^{nA})^{\alpha^{nj}\beta} \end{aligned} \tag{2.28}$$

$$\hat{u}_{t+1}^{n0} = \hat{b}^n \left(\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t'^{nj,ik} \dot{\mu}_{t+1}^{nj,ik} (\hat{u}_{t+2}^{ik})^{\beta/v}) \right)^{v(1-\delta)} (\hat{u}_{t+2}^{nA})^{\delta\beta} \tag{2.29}$$

$$\hat{u}_{t+1}^{nA} = \frac{\hat{b}^A}{\hat{P}_{t+1}^n} (\hat{u}_{t+2}^{nj})^{(1-\rho)\beta} (\hat{u}_{t+2}^{nA})^{\rho\beta} \tag{2.30}$$

$$L_{t+1}'^{nj} = \sum_{i=1}^{N} \sum_{k \neq 0}^{J} \mu_t'^{ik,nj} (1 - \alpha_t^k) L_t'^{ik} + \sum_{i=1}^{N} \mu_t'^{i0,nj} (1 - \delta) L_t'^{i0} + (1 - \rho_t^{nA}) L_t'^{nA} / J \tag{2.31}$$

[18] Here $\dot{y}'_{t+1} = \frac{y'_{t+1}}{y'_t}$ and $\dot{y}_{t+1} = \frac{y_{t+1}}{y_t}$ are the changes in between time periods for the counterfactual and the baseline economy respectively.

[19] The following equations correspondingly include the extension of the *long-term unemployed* benefit. For derivation details, see A.2.

$$L_{t+1}^{\prime n0} = \sum_{i=1}^{N}\sum_{k\neq 0}^{J} \mu_t^{\prime ik,n0}(1-\alpha_t^k)L_t^{\prime ik} + \sum_{i=1}^{N}\mu_t^{\prime i0,n0}(1-\delta_t)L_t^{\prime i0} \tag{2.32}$$

$$L_{t+1}^{\prime nA} = \rho_t^{nA}L_t^{\prime nA} + \delta_t L_t^{\prime n0} + \sum_{j\neq 0}^{J}\alpha_t^j L_t^{\prime nj} \tag{2.33}$$

In addition, for the *counterfactual sequential equilibrium* to hold, the solution of the *counterfactual temporary equilibrium* $\{\hat{\omega}^{nj}(\hat{L}_t,\hat{\Theta}_t)\}_{n=1,j=0,t=1}^{N,J,\infty}$ and $\{\hat{L}_t,\hat{\Theta}_t)\}_{t=1}^{\infty}$ needs to satisfy the following equations for each time period t:

$$\hat{x}_{t+1}^{nj} = (\hat{L}_{t+1}^{nj})^{\gamma^{nj}\xi^n}(\hat{\omega}_{t+1}^{nj})^{\gamma^{nj}}\prod_{k=1}^{J}(\hat{P}_{t+1}^{nk})^{\gamma^{nj,nk}} \tag{2.34}$$

$$\hat{P}_{t+1}^{nj} = \left(\sum_{i=1}^{N}\pi_t^{\prime nj,ij}\dot{\pi}_{t+1}^{nj,ij}(\hat{x}_{t+1}^{ij},\hat{\kappa}_{t+1}^{nj,ij})^{-\theta^j}(\hat{A}_{t+1}^{ij})^{\theta^j\gamma^{ij}}\right)^{-1/\theta^j} \tag{2.35}$$

$$\pi_{t+1}^{\prime nj,ij} = \pi_t^{\prime nj,ij}\dot{\pi}_{t+1}^{nj,ij}\left(\frac{\hat{x}_{t+1}^{ij}\hat{\kappa}_{t+1}^{nj,ij}}{\hat{P}_{t+1}^{nj}}\right)^{-\theta^j}(\hat{A}_{t+1}^{ij})^{\theta^j\gamma^{ij}} \tag{2.36}$$

$$\begin{aligned} X_{t+1}^{\prime nj} &= \sum_{k=1}^{J}\gamma^{nk,nj}\sum_{i=1}^{N}\pi_{t+1}^{\prime ik,nk}X_{t+1}^{\prime ik} + \\ \eta^j&\left(\sum_{k=1}^{J}\hat{\omega}_{t+1}^{nk}\hat{L}_{t+1}^{nk}\dot{\omega}_{t+1}^{nk}\dot{L}_{t+1}^{nk}\omega_t^{\prime nk}L_t^{\prime nk} + \iota^n\chi_{t+1}^{\prime} + b_{t+1}^{\prime}{}^{A}L_{t+1}^{\prime}{}^{A} - G_{t+1}^{\prime}/N\right)\end{aligned} \tag{2.37}$$

$$\hat{\omega}_{t+1}^{nk}\hat{L}_{t+1}^{nk} = \frac{\gamma^{nj}(1-\xi^n)}{\omega_t^{\prime nk}L_t^{\prime nk}\dot{\omega}_{t+1}^{nj}\dot{L}_{t+1}^{nj}}\sum_{i=1}^{N}\pi_{t+1}^{\prime ij,nj}X_{t+1}^{\prime ij} \tag{2.38}$$

3. Data Sources & Measurement

In this chapter I concentrate on the empirical strategy to bring the data to the model. Thus, I pave the way to simulate the impact of the long-term unemployment benefit and the "rise of the East" on employment in Germany. The strategy for the empirical simulation is provided in Appendix A.4, which involves the algorithm to solve the *sequential competitive equilibrium* (A.5) and the algorithm for *counterfactuals*

(A.6).[20] My analysis centers its attention on the German county-level *"Kreisebene"* which includes in total 402 counties. The sectors of interest consist of four manufacturing and three service sectors plus a short-term unemployment and a long-term unemployment sector. Moreover, the years after the introduction of the long-term unemployment benefit in 2005 are in the spotlight of my study (2005 to 2014). In the following section I describe the data calibration of those parameters used in the simulation that have to be empirically determined.[21]

3.1. Country- and County-Trade Data

As a main data source, I rely on the World Input-Output Database (WIOD) (Release 2016) by Timmer et al. (2015). I use the input-output data for the time period between 2005 and 2014, which cover in total 43 countries plus an aggregate of the rest of the world. To simulate the "rise of the East" I rely on the 11 eastern European countries provided in the data set: Czech Republic, Hungary, Poland, Slovakia, Estonia, Latvia, Lithuania, Slovenia, Bulgaria, Croatia and Romania. In addition, the data includes in total 56 sectors which are classified according to the ISIC Rev. 4.

However, since I am interested in the policy effects on the county level in Germany, I need the input-output data on the regional level. Unfortunately, the input-output data at this level is not available for Germany. Therefore, I construct the input-output table following the approach of Krebs and Pflüger (2018): Hereby, I use value added data on the county level from the "Regionalstatistik" of the German Federal and State Statically Office ("Statistische Ämter des Bundes und der Länder"). I consider that the production value added share for each sector is constant, therefore it is possible to determine the county share for each sector in Germany. Through the county share I can construct the German input-output table at the county level, that is then put in alignment to the World Input-Output Database (WIOD). As the value added data of the "Regionalstatistik" includes only seven sectors, I put my focus on these industries: Agriculture and forestry, fisheries (Sector 1); production industry without construction (Sector 2); manufacturing and processing (Sector 3); construction (Sector 4); trade, transport, hotels and restaurants, communication (Sector 5); financial, insurance services (Sector 6); public services, education, health services (Sector 7). To bring the input-output data on the sectoral level in alignment with the data

[20]I am thankful for the *Matlab-Code* provided by Caliendo et al. (2019) which my simulation builds on. I further extend the code to be able to simulate the impact of the long-term unemployment benefit and the "rise of the East".

[21]The other parameters resolute endogenously by the modification of the model.

of the World Input-Output Database (WIOD), I aggregate the 56 sectors to those seven described above. For the purpose of data preparation, I follow the approach of Costinot and Rodríguez-Clare (2014) and eliminate negative inventories. I do this to avoid possible negative values when summing up for the final demand. In addition, I compute the bilateral trade flows and the gross output[22] for the 43 countries plus the 402 German counties.

3.2. Population Composition

The population composition consists of employed, short-term unemployed and long-term unemployed people, I am interested in the distribution of those groups on the county level. Regarding the employment data L_t^{nj}, I rely on the data "Beschäftigungsstatistik" of the Federal Employment Agency. I aggregate the sectors to obtain the seven sectors used in my analysis. Data of short-term unemployment L_t^{n0} (according to SGB III people are short-term unemployed if they are out of work for up to 12 months) are taken from the statistics of the Federal Employment Agency as well.[23] As mentioned in the introduction, recipients of the long-term unemployment benefit do not necessarily have to be long-term unemployed to be applicable for the long-term unemployment benefit. To be applicable for the benefits people have to be able to work, but are not able to satisfy their basic material needs by their employment. Out of this group, people can be long-term unemployed recipients "arbeitslose Erwerbsfähige Leistungsberechtigte" (over 12 months unemployed) and non-unemployed recipients "nicht-arbeitslose Erwerbsfähige Leistungsberechtigte". The group of non-unemployed recipients can consist of different cases: 1. People can be employed, but earn less than a certain minimum existence wage to be applicable. 2. People are able to receive "ALG II" benefit if they are in job training programs with the goal of getting into the workforce again ("in arbeitsmarktpolitischen Maßnahmen"). 3. People can be in school or in university and can receive under certain conditions "ALG II" benefit ("in Schule, Studium, ungeförderter Ausbildung"). 4. People are in full-time caring for their family members ("in Erziehung, Haushalt, Pflege"). 5. People are unable to work ("in Arbeitsunfähigkeit"). 6. Under some conditions elderly people are applicable for "ALG II" benefit (§§ 428 SGB III/65 SGB II, 53a SGB II). As my analysis focuses on the employment effects, I consider, out of the mass of people which are in principle applicable for the "ALG II" benefit, those who are already working, but earn less than the minimum existence wage ("in ungeförderter Erwerbstätigkeit") and those who are over 12 months long-term unemployed. Those two groups make up the majority

[22]Gross output includes the total sales of each sector (for final and intermediate goods).

[23]Data is available on the county level only for the years 2008 to 2014. I take the development of short-term unemployment for 2008 and 2009 and use the change as an approximation to calculate the years 2005 to 2007 for each sector.

of people who receive the “ALG II” benefit. I collect the data for each county from the statistics of the Federal Employment Agency.[24] In Table 3.1 I provide an overview of the development of the population composition in Germany.

Table 3.1.: Overview Unemployment, Long-term Unemployment and Employment Shares in Germany

in %	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Unemployed	4.6%	4.2%	3.6%	3.1%	3.7%	3.3%	2.7%	2.7%	2.9%	2.7%
ALG II	11.5%	10.9%	9.8%	9.0%	8.9%	8.8%	8.5%	8.2%	8.1%	8.0%
Employed	84.0%	84.9%	86.6%	87.8%	87.4%	87.9%	88.8%	89.1%	89.1%	89.3%

Source: Statistik der Bundesagentur für Arbeit (2020); Author’s own calculations.

3.3. Probabilities

In this section let us turn to the probabilities that households are changing their status between employed, short-term unemployed and long-term unemployed. The probability that an employed person of region n of sector j at time t earns less than the minimum existence wage (“in ungeförderter Erwerbstätigkeit”) and therefore is applicable for the “ALG II” benefit is given by α_t^{nj}. In this case the person receives a certain part of the benefit, till the total income is equivalent to the amount of the primary “ALG II” benefit.[25] To calculate α_t^{nj} I rely on the data of the statistics of the Federal Employment Agency for the years 2007 to 2014. Hereby I consider α_t^{nj} at t for each year. The probability α_t^{nj} is calculated as the share of people in unsubsidized employment (“in ungeförderter Erwerbstätigkeit”) in terms of total employment. For the years 2005 and 2006 the dataset is restricted, therefore I construct the average of the years 2007 to 2014 for each sector and apply them for each sector in 2005 and 2006.

The probability that a short-term unemployed person at time t is longer than 12 months unemployed and therefore enters into the status of long-term unemployment is given by δ_t. In order to conduct δ_t I use the unemployment data of the statistics of the Federal Employment Agency. I define δ_t as the inflow of people who are short-term unemployed and are getting long-term unemployed compared to the total stock of short-term unemployed people at time t. As the data of inflows are only available at the national level, I consider δ_t to be a constant for each region-sector combination. I construct δ_t for

[24] As the data is only available for the years 2007 to 2014, I use the change rate of the years 2007 to 2008 for each county, and use this as an approximate to calculate the values for the years 2005 and 2006.

[25] The group consists mainly of self-employed, mini-jobbers, part-time employees, but also full-time employees are applicable for the “ALG II” benefit.

the years 2005 to 2014. The inflow data as well as the stock data of short-term unemployed people are merely available for the years 2007 to 2014. For the years 2005 and 2006 only the stock data are available, for the inflow data I rely on the change rate between 2007 and 2008. I use this as a trend to construct the data for 2005 and 2006.

ρ_t^{nA} defines the probability that a person in region n who is long-term unemployed will stay in the long-term unemployed program and will further receive the long-term unemployed benefit. My focus of interest is again on the time between 2005 and 2014 for each county. I make use of the short-term and long-term unemployment data of the statistics of the Federal Employment Agency and use the outflow of people of long-term unemployment compared to the stock of the long-term unemployed.[26] However, the county data is only available for the years 2009 to 2014. For the years 2005 to 2008 I take the average of the years 2009 to 2014. In some cases data for sector-region combination are not available. Hence, I use the average of the previous year of the sector-region combination as an approximation.

3.4. Productivity Shock

As the growing productivities of the Eastern European countries and Germany are thought to be possible drivers of the "rise of the East", they play a crucial role in my simulation. I am specifically interested in those productivity changes, which are responsible for the increasing trade flows between Germany and Eastern Europe.

By applying the approach of Caliendo et al. (2019) I calibrate the productivity changes. For Germany, I conduct the changes in productivity corresponding with the rising imports into the eleven Eastern European countries. Vice versa I calibrate for each of those eleven Eastern European countries the productivity changes which cause the import increase to Germany (imports from the particular country into Germany). Moreover, I conduct for every country the productivity changes on the sectoral level. In order to attain the productivity changes two steps based on Caliendo et al. (2019) are necessary: First, I apply the instrumental-variable strategy of Autor et al. (2013) to get the predicted import changes for Germany and the eleven Eastern European countries respectively. In the second step I calibrate by iteration the productivity changes as the model's import changes have to match with the predicted import changes. The instrumental-variable strategy of Autor et al. (2013) contains the import change

[26] In a one minus relationship.

from Germany (or one of the eleven Eastern European countries) by other advanced economies. At the core of the instrumental-variable strategy lies a first-stage regression:

$$\Delta M_{GER,j} = a_1 + a_2 \Delta M_{other,j} + u_j \tag{3.1}$$

The dependent variable $\Delta M_{GER,j}$ is the sectoral j import change in Germany for the years between 2005 and 2014, which the regression tries to predict by the explanatory variable. $\Delta M_{other,j}$ is the sectoral change of imports by advanced countries. Following Caliendo et al. (2019) I use here Australia, Denmark, Finland, Japan and Spain as advanced economic countries and rely on the World Input Output Database (WIOD) as data source. For Germany, I find the coefficient a_2 to be 3.058 with a standard error of 0.022 and a high R-squared of 0.99.[27] The regressions for each of the eleven Eastern European countries are similar:

$$\Delta M_{EE_i,j} = a_1 + a_2 \Delta M_{other,j} + u_j \tag{3.2}$$

Where $\Delta M_{EE_i,j}$ denotes the sectoral import change for each Eastern European country i in the same time period. Likewise, $\Delta M_{other,j}$ is the change of sectoral j imports of the advanced economies between 2005 and 2014. The results are displayed in Table 3.2, most countries, besides Estonia and Latvia, have high R-squared values that indicate respectable prediction power.

Table 3.2.: Coefficient Results for a_2 (for Eastern European Countries)

	Coefficient	**Standard Error**	**R-squared**
CZE	5.402	0.201	0.997
HUN	5.813	0.256	0.996
POL	4.154	0.413	0.982
SVK	4.892	0.351	0.986
EST	0.113	0.081	0.235
LVA	0.787	0.638	0.516
LTU	2.305	0.296	0.974
SVN	15.298	0.083	0.999
BGR	18.097	0.605	0.998
HRV	3.177	0.441	0.984
ROU	7.173	0.583	0.988

Source: World Input Output Database, Release 2016;
Author's own calculations.

[27] Caliendo et al. (2019) find for the U.S. a coefficient of 1.386 with a standard error 0.033 and an R-squared of 0.99.

After having estimated the coefficients I use the baseline economy and the counterfactual economy[28] of the model to calibrate the sectoral productivity changes for each of the eleven Eastern European countries and Germany. This is done by iteration to find the optimal productivity change of each sector and country in order that the model's import changes matches the predicted import changes $a_2 \Delta M_{other,j}$ respectively. For Germany, I find a productivity change in "agriculture and forestry, fisheries" (Sector 1) of 0.1%; in "production industry without construction" (Sector 2) of 2,8%; in "manufacturing and processing" (Sector 3) of 3.4% and in "construction" (Sector 4) of 9.4%. The findings are supported by a high correlation between the model's import changes and the predicted import changes $a_2 \Delta M_{other,j}$ of 0.998. The results of the sectoral productivity changes of the eleven Eastern European countries are displayed in the appendix Table A.7.1.

3.5. Labor Income Tax & Long-term Unemployment Benefit

The labor income tax τ_t^T plays a major role in financing the long-term unemployment benefit. The tax is levied on every German labor income. The total amount of labor income tax revenue various each year. To compute the labor income tax, I rely on the data of the federal budget ("Bundeshaushalt"). Thereby τ_t^T is composed by using the federal expenditure of the long-term unemployment benefit as a share of the total amount of income taxes. An overview of the development of the labor income tax for the years between 2005 and 2014 is provided in Table 3.3. Besides that, it is necessary for my analysis to identify the per capita long-term unemployment benefit b^A for the base year of 2005. By taking the data from statistics of the Federal Employment Agency I calculate a per capita expenditure for the recipients of 4080 Euro.[29] Having identified the labor income tax and the long-term unemployment benefit I can endogenously determine the lump sum tax/transfer G_t charged by the German rentiers by applying equation 2.11 of the model.

[28] Similar to Caliendo et al. (2019), the fundamentals in the baseline economy develop as they did between 2005 and 2014 and the counterfactual economy includes the same development of fundamentals. However, the sectoral productivity changes are set in such a way that the import changes of the model are close to the predicted import changes $a_2 \Delta M_{other,j}$.

[29] Thus, I use the total expenditure of 14.6 billion Euros (based on federal budget "Bundeshaushalt") and divide it by 3578719 recipients which leads us to a per capita expenditure for the recipients of 4080 Euro. For calculation reasons it is in U.S. Dollar $5534.

Table 3.3.: Development of Labor Income Tax responsible for financing ALG II

2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
0.076	0.129	0.098	0.087	0.098	0.098	0.078	0.061	0.063	0.066

Source: Bundesministerium der Finanzen (2020); Author's own calculations.

3.6. Share of Value Added in Gross Production

The share of the value added in gross production by sector j of region n (countries and counties) is denoted as γ^{nj}. In order to conduct the share of the value added in gross production for the 42 countries (without Germany) of the year 2005 I rely on the value added and gross production data provided by the socio-economic accounts (WIOD 2016 Release). For each country, I aggregate the 56 sectors of the dataset to fit the seven sectors used in my analysis. Regarding the aggregate of the "Rest of the World" of the World Input-Output Database (WIOD), I take the average of the 42 countries for each of those seven sectors. For the 402 counties in Germany I set up the share of the value added in gross production by applying the data from the regional statistic ("Regionalstatistik") and of the German Federal and State Statistics Office ("Statistische Ämter des Bundes und der Länder"). Especially for the manufacturing and processing (Sector 3) and construction sector (Sector 4) the value added and the gross production is available by the regional statistic ("Regionalstatistik").[30] For the other five sectors the value-added data is provided, however, I have no gross output data available on the county level. Therefore, I construct the value added in gross production of Germany from the socio-economic accounts for those sectors and apply those shares as a constant on the county level.[31]

3.7. Share of Structures in Value Added

The value-added share of structures is denoted as ξ^n. On the country level I make use of the socio-economic accounts (WIOD 2016 Release) to construct the share of structures in value added for each of the 42 countries (Germany not included) plus the aggregate of the "rest of the world" for the year 2005. The value-added share of structures is not directly taken from the data. However, as a work-around I use the relationship of one minus the share of labor compensation in value added which gives the value-added share of structures. I apply this relationship and use the labor compensation (in millions of

[30]For 44 counties data points are missing in the manufacturing and processing sector. Thus, I take the average share of the value added in gross production of the rest of the counties and implement the average share for those 44 counties.

[31]A similar approach is used in Caliendo et al. (2019).

national currency) and the gross value added at current basic prices (in millions of national currency) to identify the value-added share of structures for each country. As there is no data available for the aggregate of the "rest of the world" I use the average of the 42 countries as an approximation for the value-added share of structures. For the German county level, I make use of the regional statistics ("Regionalstatistik") data of the German Federal and State Statistics Office ("Statistische Ämter des Bundes und der Länder"). Since no data are available for the year 2005 I rely on the closest available data of 2004 to construct the value added share of structures. I apply the same approach as above for the relationship of the share of labor compensation in value added to identify the share of value added for the structures at the county level. I construct the share of labor compensation in value added by dividing the total amount of income per person in employment by the gross domestic product per person in employment of each county. For some counties data points are missing, thus, I use the average of the other German counties as an estimate.

3.8. Dispersion of Sector Productivity

In my analysis θ reflects the dispersion of productivity of each sector.[32] I rely on the values for Germany on the sector-specific productivity dispersion parameter of Aichele et al. (2014), which are based on the approach of Eaton and Kortum (2002) and are Fréchet distributed. For agriculture and forestry, fisheries (Sector 1) I take the average of the dispersion of productivity of the grains & crops; cattle, sheep, goats, horses; forestry; fishing sectors in Aichele et al. (2014). The same approach holds true for the production industry without construction (Sector 2), manufacturing and processing (Sector 3); construction (Sector 4) as I rely on the respective sectors of Aichele et al. (2014).[33] Regarding the service sectors: Trade, transport, hotels and restaurants, communication (Sector 5); financial, insurance services (Sector 6); public services, education, health services (Sector 7). I consider the approach of Egger et al. (2012) which is applied in Aichele et al. (2014) and Walter (2018). Hereby θ can be considered a constant in the service sectors. Egger et al. (2012) estimate an inverse θ of 5.959. This translates in my case to a θ of 0.1678. Table 3.4 summarizes all dispersion productivity parameters used in my paper.

[32]The dispersion of productivity θ can take on values between 0 and 1, a low θ indicates that the productivity levels are highly concentrated on a few varieties.

[33]In Aichele et al. (2014) the values are defined as $-1/\theta$ therefore to identify θ I take the negative inverse of each sector.

Table 3.4.: Dispersion of German Sector Productivity

Dispersion of Productivities	θ
Agriculture and forestry, fisheries (Sector 1)	0.3542
Manufacturing without construction (Sector 2)	0.1849
Manufacturing (Sector 3)	0.3201
Construction (Sector 4)	0.1678
Trade, transport, hotels and restaurants, communication (Sector 5)	0.1678
Financial, Insurance services (Sector 6)	0.1678
Public services, education, health services (Sector 7)	0.1678

Source: Aichele et al. (2014); Egger et al. (2012); Author's own calculations.

3.9. Labor Mobility & Mobility Elasticity

In order to estimate the labor mobility μ for the years 2005 to 2014, I construct a matrix of counties-sector input-outflows. The matrix shows the mobility of labor across counties and sectors (including the short-term unemployed and long-term unemployed sector). The value of each element of the county-sector input-outflow matrix represents the probability that a household working in sector j of county n and will be doing work in this county-sector combination (of the element) in the following year. Hereby, I denote higher probabilities to the circumstance that the household will stay in the same sector j and the same county n in the next time period. I make further assumptions that when a household decides to move, it is more likely to move into another neighbor region but staying in the same sector. Moving to more distant regions further decreases the probability. Also changing jobs to less similar sectors (e.g. having a job in construction and moving to the financial sector is less likely) reduces the probability of the element. My assumptions are based on the findings of Dauth et al. (2016), who identify the labor mobility across the county and sector level in Germany by using the data of Integrated Labor Market Biographies (IEB) from the German Institute for Employment Research. 70% of the workforce stay in the sector and do not move to a different county. Out of the remaining 30% I assume that roughly two-third stay in the same sector, but move into other counties.[34] The other one third consists of the people staying in the same county, but switching work to another sector (25%), the rest being people

[34] Out of the 73% of workers staying, 52% of workers move into neighbor counties, while the other 21% move to other counties in Germany, with the same probability.

who move to other counties and switching work. My assumptions of the 30% of worker switching jobs and/or counties are differing to the findings of Dauth et al. (2016) which find that 10% get a new job in the same sector with or without switching counties, and the other 20% changing sectors with or without switching counties. As they consider 3-digit industry and I am only considering 7 sectors, my probability to stay in the same sector is higher than the finding of Dauth et al. (2016). In order to construct the mobility for short-term unemployed and long-term unemployed people I rely on the regional statistics data "Regionalstatistik" of the German Federal and Regional Statistical Offices and as well the statistics of the Federal Employment Agency. Applying those assumptions, I denote for each possible element of the region-sector input-outflow matrix a certain probability, by which I can construct the labor mobility matrix μ for 2005 to 2014. As an estimation for the mobility elasticity ν I adopt the result of the annual rate of $\nu = 2.02$ of Caliendo et al. (2019).

3.10. Discount Interest Rate

As my analysis relies on a dynamic model and considers the time change, it is necessary to identify the interest rates. In particular, β reflects the discount interest rate. To conduct the discount factor, I rely on the long-term interest-rate data from the OECD for the years 2005 to 2014. I find an average discount factor of annually 0.9687 and apply this value in my analysis.

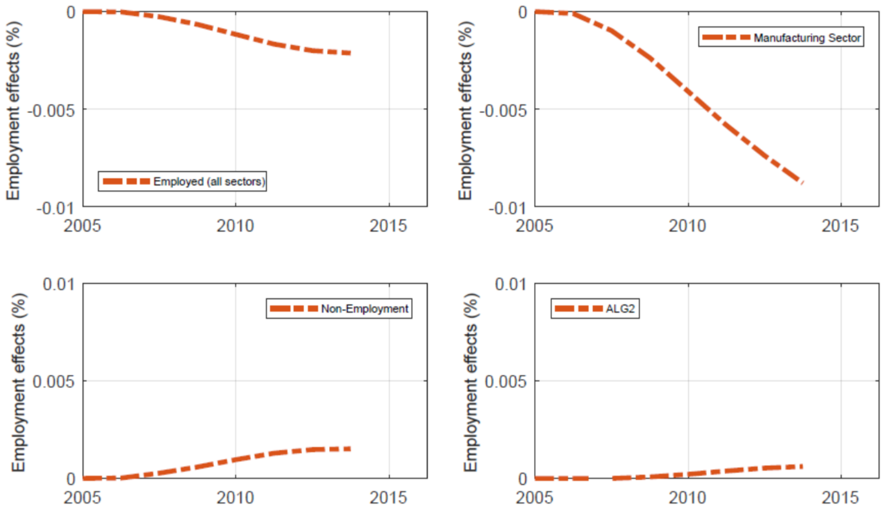
4. Simulation

After having derived the key variables let us turn our attention to the analysis. In the following I present a short outline of the approach to conduct the simulation. Hereby the simulations build on the Caliendo et al. (2019) extension of the Social Security Disability Insurance (SSDI) program. I construct the baseline economy for the years 2005 and 2014 which consist of the development of the actual fundamentals. The baseline economy is needed to apply *Proposition 3* to solve for the counterfactual equilibrium. In my counterfactual analysis I simulate the impact of the "rise of the East" and the German labor market reform. As regards the scenario of the "rise of the East", I test changes on the German labor market caused by the rising productivities in Eastern European countries as well as the productivity growth in Germany, which triggered the import competition in the Eastern European countries. As in Caliendo et al. (2019) I am doing this by letting the fundamentals in the counterfactual economies develop as they did in the data, except for the calibrated sectoral changes in productivities. This holds true for the two scenarios of the eleven Eastern European productivities and the German productivity. In order to estimate the impact of the German labor market reform (in particular Hartz IV) I conduct the counterfactual economy. Specifically, I let the fundamentals develop as they did, but eliminate the parameters of the long-term unemployment benefit and cut the respective labor income tax.

4.1. Eastern European Productivity Effect

I start by focusing on the Eastern European productivity rise, associated with the export growth of the eleven Eastern European countries to Germany. Figure 4.1 displays the impact of the rise in Eastern European productivity on the German labor market between 2005 and 2014. I primarily observe two effects: On the one hand there is a direct effect, as the Eastern European productivity leads to a short-term unemployment growth by 0.001% and a rise in long-term unemployment by 0.0005%. On the other hand, I find a severe change in the sectoral composition. Most notably the employment of the manufacturing sector is decreasing by around 0.01%. Out of the manufacturing sector a certain number gets unemployed. However, there is also a movement into other sectors as construction, but especially into the service sectors trade and commerce, finance and the public sector.

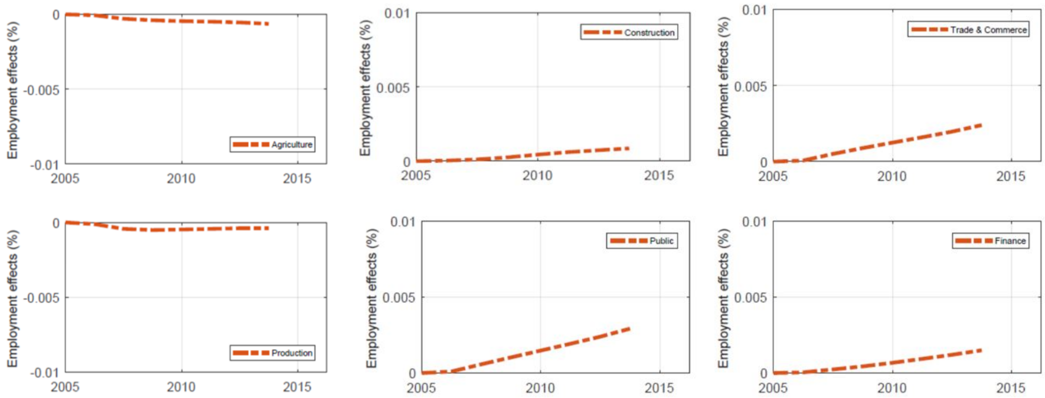
Figure 4.1.: Eastern European Productivity Effect on the German Labor Market (between 2005 and 2014)



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

This can be seen in Figure 4.2 as the employment in the construction sector, trade and commerce, finance and the public sector increases. Whereas the agriculture and the production sector are declining in employment by only a margin. My findings are in line with Dauth et al. (2016) who call this employment adjustment from the import penetrated sectors to the service sectors “push effect”.

Figure 4.2.: Eastern European Productivity Effect on Sectoral Employment (between 2005 and 2014)



The figures are based on the Author’s own calculations and rely on the data explained in chapter 3.

Now turning to the employment changes on the German county level. Figure 4.3 presents the changes of the regional short-term unemployment share relative to the total employment of a county.[35] I find that the regional short-term unemployment shares remain merely constant in the west, however, the regional short-term unemployment shares increase in counties particularly in the Eastern part of Germany more strongly. Predominantly counties as “Nordwest-Mecklenburg”, “Oberhavel” and “Tetlow Fläming” experience a larger increase in the share of regional unemployment. This is due to an employment decline in the agriculture sector, caused by the import penetration of Eastern Europe.

Further Figure 4.4 displays the fact that the highest contribution to the increase of unemployment (in share of total unemployment change) is coming from the counties of the Eastern part of Germany. In addition, I find that larger cities such as Berlin, Leipzig, Munich or Nuremberg, which are geographically closer to Eastern Europe than other major German cities contribute severely to the increase of short-term unemployment.

Next let us turn our attention in Figure 4.5 to the regional long-term unemployment results. I discover that counties, especially in Mecklenburg-Western Pomerania, Berlin and Brandenburg experience the largest increase in the regional long-term unemployment shares. Interesting are the findings that in other parts of Eastern Germany specifically in Saxony-Anhalt, Thuringia and Saxony the county-share composition of the regional long-term unemployment shares decreases. Even as there is a positive

[35]In this context regional refers to the county level.

Figure 4.3.: Changes in Regional Unemployment Shares

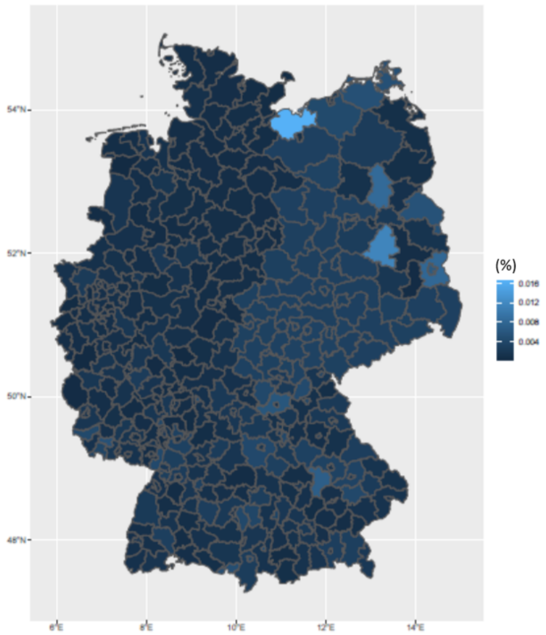
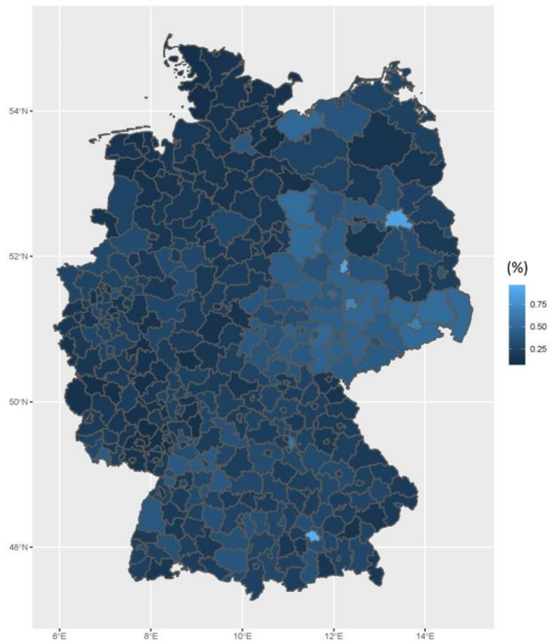


Figure 4.4.: Regional Contribution to total Short-Term Unemployment Increase



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

contribution of those areas to the total long-term unemployment growth in Germany, as Figure 4.6 demonstrates. The difference can be explained by the fact that the long-term unemployment grows due to the "rise of the East" and at the same time the total working population of those counties declines. This is caused by retirements and the move of portions of the working population into other counties, e.g. mostly to Western Germany. Furthermore, Figure 4.6 displays that Berlin is contributing strongly to the increase of the aggregate long-term unemployment rise, whilst Munich experiences a fall in long-term unemployment and contributes negatively to the total long-term unemployment growth in Germany.

As seen in Figure 4.1 the manufacturing sector is the most impacted by the Eastern European productivity growth. Figure 4.7 displays the changes of the regional manufacturing shares at the county level. Predominately counties in Lower Saxony, but also in North Rhine Westphalia and Hessen as well as in some counties of Baden Württemberg and in the Munich and Nuremberg area see a decline in regional manufacturing shares. On the other side, most counties of Eastern Germany experience a slight growth of the regional manufacturing shares. Figure 4.8 shows that those counties, in which the regional manufacturing shares decline, are responsible for the aggregated manufacturing decrease. Particularly Munich contributes the highest to the aggregated decline of the manufacturing sector.

Figure 4.5.: Changes in Regional Long-Term Unemployment Shares

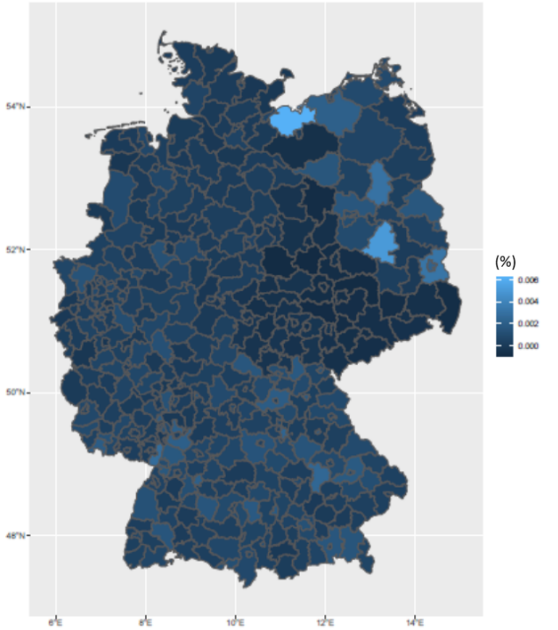
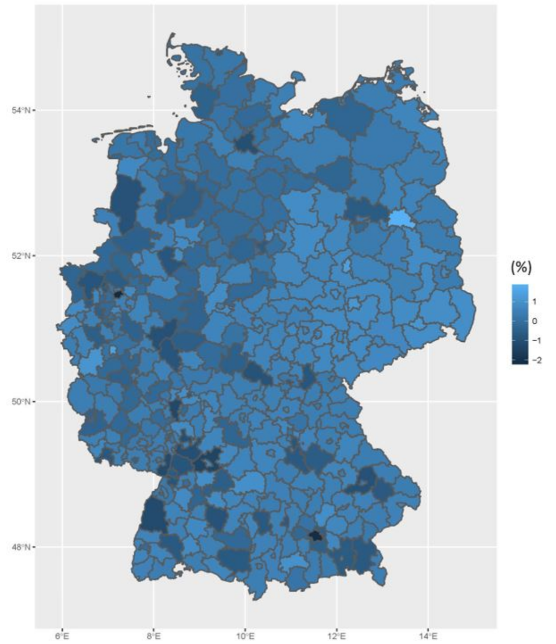


Figure 4.6.: Regional Contribution to total Long-Term Unemployment Increase



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure 4.7.: Changes in Regional Manufacturing Shares

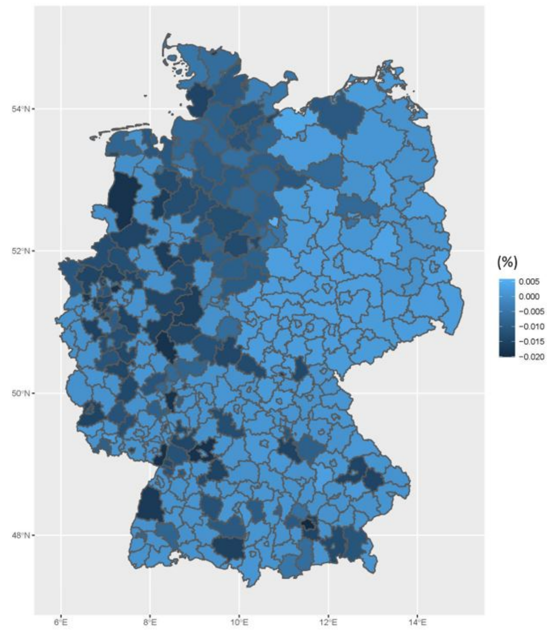
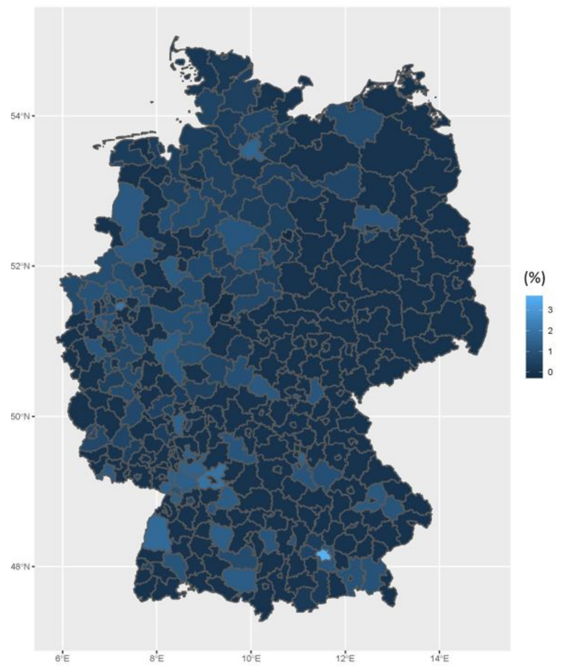


Figure 4.8.: Regional Contribution to total Manufacturing Decrease

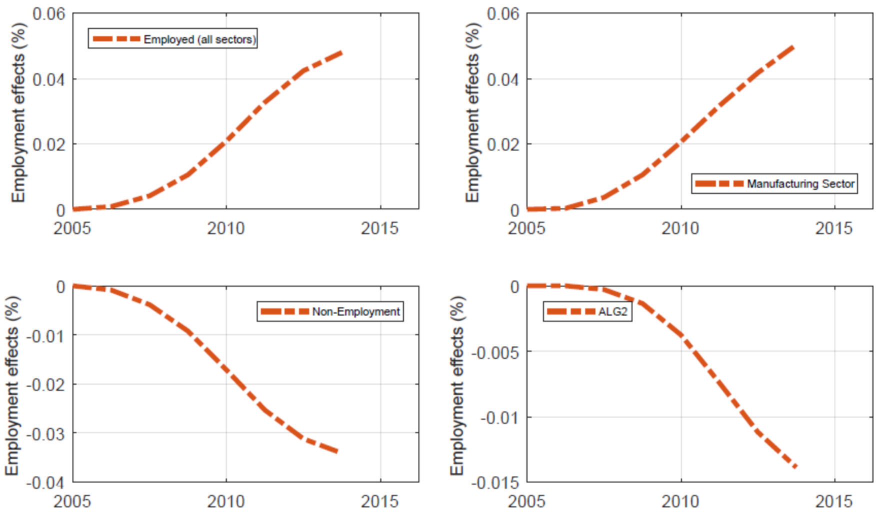


The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

4.2. German Productivity Effect

In this section let us turn to the increase of the German productivity, which is responsible for the export growth to Eastern Europe between 2005 and 2014. Figure 4.9 provides a contour of the labor market effects in Germany. Compared to the rise of the Eastern European productivity I find that the impact on the German labor market is stronger. Germany experiences a decline in short-term unemployment by -0.034% and a reduction of long-term unemployment by around -0.015%. The employment change is driven to a large extent by the manufacturing sector, as the sector sees an increase of 0.05%. Other sectors are varying just slightly, as it can be noticed in appendix A.7.3.

Figure 4.9.: German Productivity Effect on the German Labor Market (between 2005 and 2014)



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

In Figure 4.10 the regional short-term unemployment shares decrease more strongly in Eastern German counties. Districts close to the Polish border are facing the strongest reduction of the regional unemployment shares. Counties in the north west experience almost no changes of the regional unemployment shares, while in the south the reduction of the regional unemployment shares varies between counties. As regards the weight of the aggregate reduction in short-term unemployment, counties in the east contribute the strongest to the decline, Figure 4.11. Cities with a larger population as Berlin and Munich, but also Magdeburg and Dresden are the highest contributors in the reduction of unemployment.

Figure 4.10.: Changes in Regional Unemployment Shares

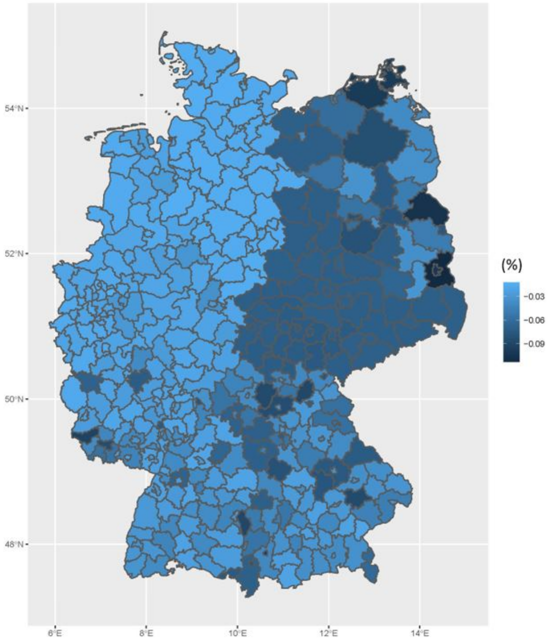
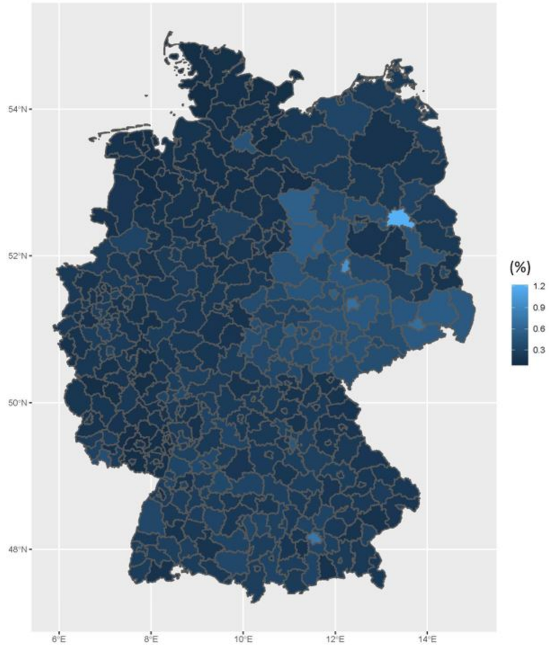


Figure 4.11.: Regional Contribution to total Short-Term Unemployment Decrease



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Focusing on the changes of the regional long-term unemployment shares I find a similar pattern as in the Eastern European productivity scenario, as Figure 4.12 displays. Due to the decrease of the working population in Saxony-Anhalt, Thuringia and Saxony the share of the long-term unemployment grows in those areas.[36] Together with larger cities such as Berlin, Leipzig and Dresden those counties are in fact contributing the most to the decline of the total long-term unemployment in Germany, Figure 4.13.

The manufacturing sector is highly impacted by the German productivity gain. Figure 4.14 shows that the manufacturing sector in the counties of North Rhine Westphalia and Hessen are profiting the most as a consequence of the productivity improvement. Especially Kassel is experiencing the highest growth of the regional manufacturing share with an increase of 0.3%. Likewise, some counties in the south are showing increasing regional manufacturing shares. However, regions in the east as well in

[36]To illustrate why the regional long-term unemployment shares increase in those areas, I provide an example of the county "Altenburger Land" in Thuringia: In 2005 the regional share of long-term unemployment was 0.20%, which is derived from 0.0002 long-term unemployed share to 0.0011 total employment in the region (0.0011 is here the share of the total employment in that region compared with the total employment in Germany). From 2005 to 2014 the long-term unemployment share would rise in the counterfactual scenario to 0.25%, holding the German productivity constant at the 2005 level. However, in the baseline scenario when all fundamentals develop as they did, the long-term unemployment declines to 0.00019 and at the same time the total working population of the county decreases to 0.0007. Hence, there is an increase of long-term unemployment share in the region by 0.26%. Therefore, the share of the county's long-term unemployment rises by 0.01%.

Figure 4.12.: Changes in Regional Long-Term Unemployment Shares

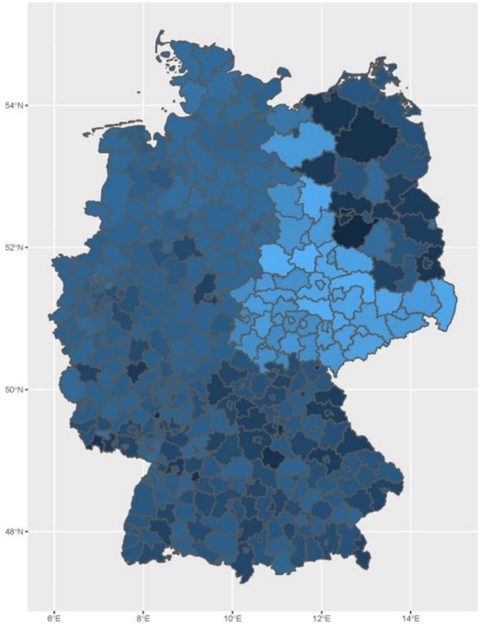
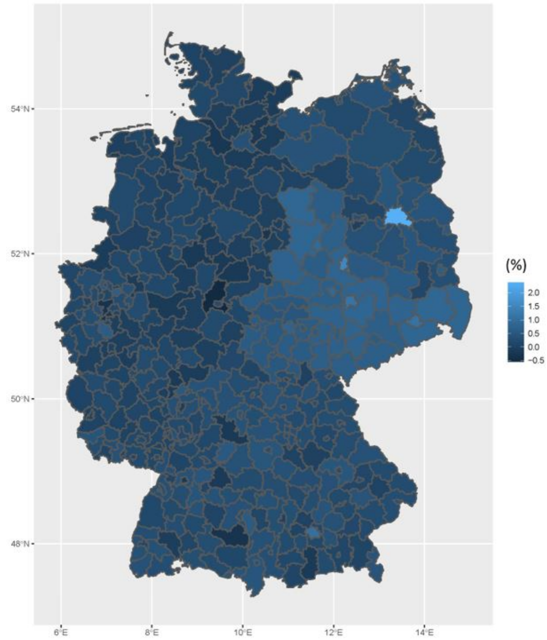


Figure 4.13.: Regional Contribution to total Long-term Unemployment Decrease



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Bavaria are mostly unaffected by a change, though some even display negative regional manufacturing shares. Further, I can show that those counties which have increasing regional manufacturing shares, add correspondingly to the aggregate employment rise of the manufacturing sector, see Figure 4.15.

Summing up the impact of the "rise of the East", I can conclude that the productivity rise of Eastern Europe has a small negative impact on the German labor market, while the German productivity - responsible for the exports to Eastern Europe - has a positive effect. Taking both "productivity rises" together, I find a decrease in total net-unemployment of 49.000. [37] Compared to the findings of Dauth et al. (2014) which find an increase of the "rise of the East" by 442.000 additional jobs, one might think the result to be small. However, Dauth et al. (2014) included in their analysis 21 Eastern European countries. For my counterfactual analysis I use the convenient World Input-Output Database (WIOD), which is limited to 11 Eastern European countries. Due to the time of interest I test for the "rise of the East" between 2005 and 2014, while Dauth et al. (2014) analyze a much longer time period of 20 years between 1988 and 2008. None the less, the differences provide a hint, that besides the rise in productivities the

[37]This summarizes the effect of short-term unemployment and long-term unemployment while taking the rise of the Eastern European productivity and also the increase of the German productivity into account.

Figure 4.14.: Changes in Regional Manufacturing Shares

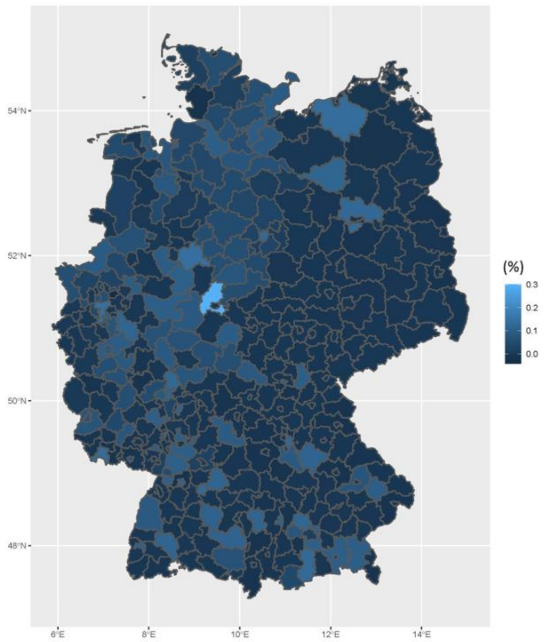
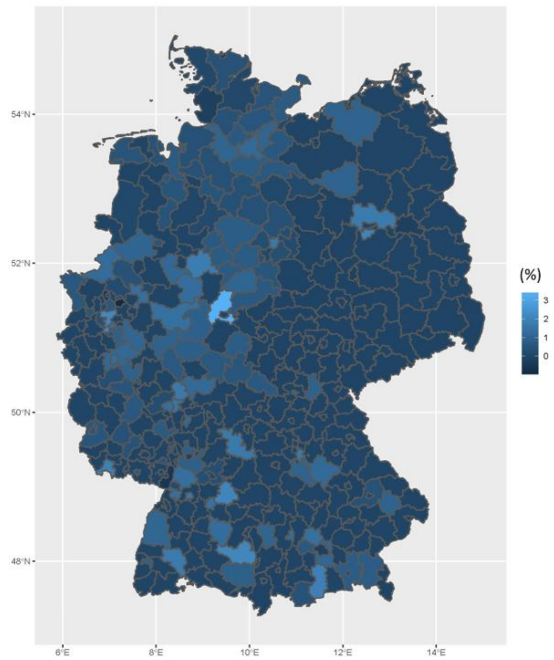


Figure 4.15.: Regional Contribution to total Manufacturing Increase



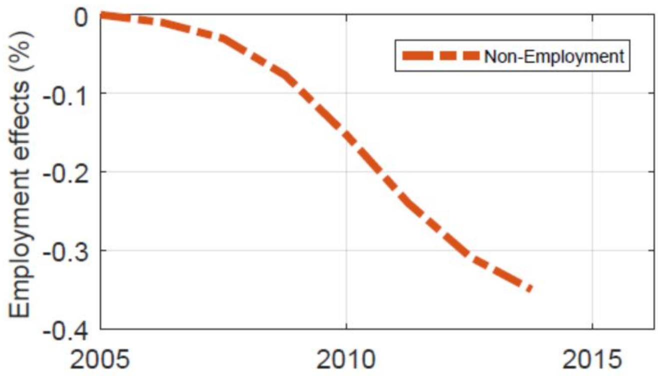
The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

eastward enlargement of the European Union (2004 and 2007) and the resulting reduction in trade costs could play a main role in the trade flow gains between Germany and Eastern Europe.

4.3. Long-Term Unemployment Benefit

In this section I investigate the impact of the long-term unemployment benefit which was introduced during the labor market reforms. I focus especially on the fourth phase of the reform also known as Hartz IV and in particular on the long-term unemployment benefit "Arbeitslosengeld II". My counterfactual question to answer is: What would have happened to the German labor market, if the long-term unemployment benefit would have been eliminated? [38] Through this question I can examine the labor market changes due to Hartz IV. Figure 4.16 shows the effect of the long-term unemployment benefits on the German unemployment between 2005 and 2014.

Figure 4.16.: Short-Term Unemployment Decrease due to the Long-Term Unemployment Benefit



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Thus, the long-term unemployment benefit would account for an around 0.4% decrease in short-term unemployment.[39] That would correspond to an approximated reduction of unemployed people by 385.000 over time. My finding is in line with the literature. The results vary from an unemployment decrease of 0.1% estimated by Launov and Wälde (2013) to 2% by Hochmuth et al. (2019) and of 2.82% by Krause and Uhlig (2012) as well as around 3% by Hartung et al. (2018). Krebs and Scheffel (2014) discover an unemployment reduction through the German labor market reforms (Hartz I to Hartz IV) by around 3%. However, they trace a 2% decrease to the impact of Hartz I to Hartz III (e.g. restructuring and

[38] In the counterfactual analysis, the agent expects to receive the long-term unemployment benefit, however, it is eliminated for the rest of the time period. Due to the elimination of the benefit, also the taxes which are financing the long-term unemployment benefit are cut.

[39] A brief explanation of the approach to identify the labor market impact of the long-term unemployment benefit: First, I let the fundamentals develop as they did in the data. Second, I simulate the counterfactual analysis and cut the long-term unemployment benefit as well as the responsible taxes. This leads to a higher unemployment level in the counterfactual scenario. The difference between the unemployment levels of the baseline and the counterfactual scenario is the short-term unemployment effect due to the introduction of the "Hartz IV-Reform".

increasing the number of “jobcenters” as well as the establishment of “minijobs”) and a 1% reduction to Hartz IV.[40] I further find that some sectors are profiting from the introduction of the long-term unemployment benefit as for example the employment of the manufacturing sector would increase by 0.15%. Thus, I see an increase in the service sectors: Trade and commerce increase by 0.2%, public sector by 0.2% and finance sector by 0.08%. Other sectors as for example agriculture, production and construction would decrease in the long run.

Figure 4.17.: Change in Regional Unemployment Shares

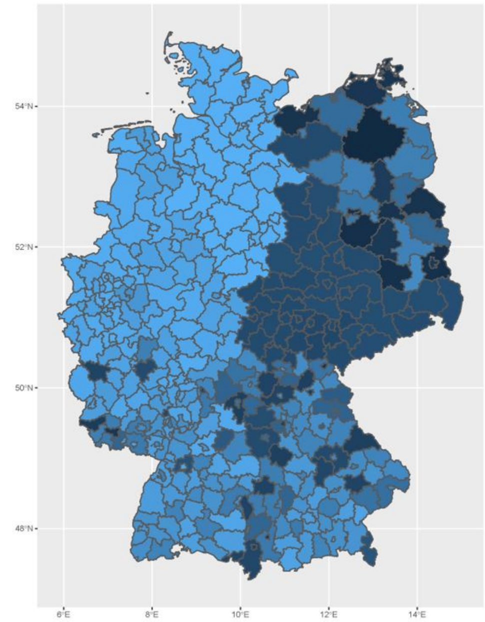
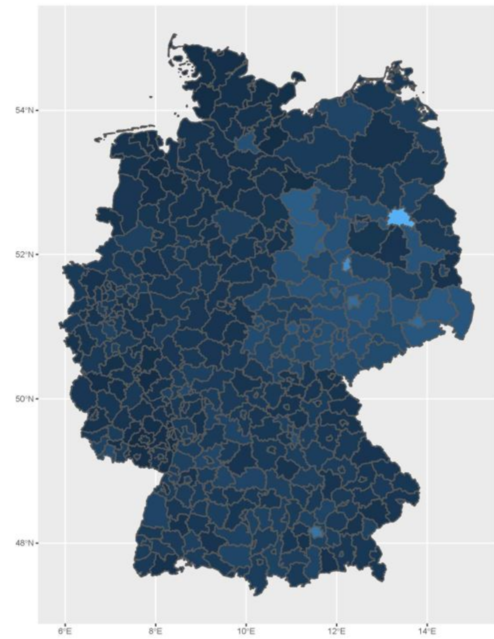


Figure 4.18.: Regional Contribution to total Short-Term Unemployment Decrease



The figures are based on the Author’s own calculations and rely on the data explained in chapter 3.

Next, I present the findings for the impact of the long-term unemployment benefit introduction on the German county level. Figure 4.17 displays the decreasing regional short-term unemployment shares. The regional unemployment shares are more affected by the German labor market reform than counties in

[40]It is argued that the “Hartz IV-Reform” has two main mechanisms which lead to the decrease in short-term unemployment via negative incentives. In the old labor market system, the unemployment benefits “Arbeitslosengeld” (60% of income) was paid for 12 and even up to 32 months. Afterwards the lower unemployment help “Arbeitslosenhilfe” (53% of income) was paid. Under the new system the “Arbeitslosengeld I” (60% of income) is only paid 12 months (in rare occasions 18 months). Hence, the unemployed would have an incentive to get a job. In addition, the long-term unemployment benefit “Arbeitslosengeld II” is much lower than the former unemployment help “Arbeitslosenhilfe” which gives an additional incentive for the unemployed to get into workforce again. In my model I focus on the effect of the “Arbeitslosengeld II” and not explicitly count for the time of the first mechanism. I therefore would assume that my findings would be closer to 1 once the impact of the shorter “Arbeitslosengeld II” is accounted for.

the west. Although, some counties, especially in Bavaria experience a stronger decline as well. However, as Figure 4.18 shows, the counties in the East contribute more to the decline of aggregate unemployment in Germany, corresponding to the finding of Launov and Wälde (2013). Berlin has with 1.25% the highest contribution to the total reduction of Germany's unemployment.

Figure 4.19.: Changes in Regional Manufacturing Shares

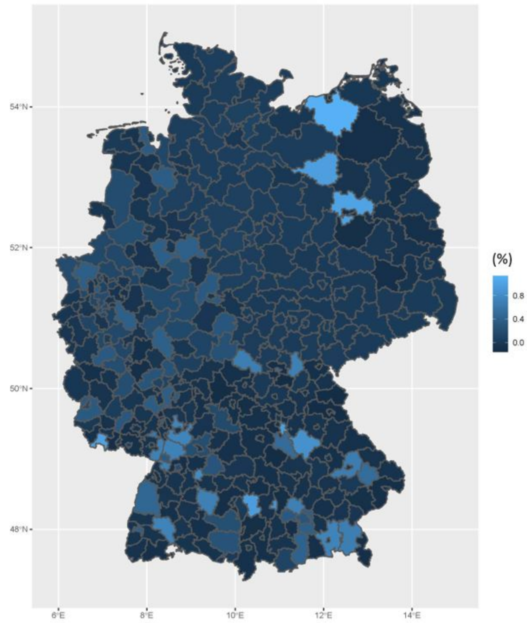
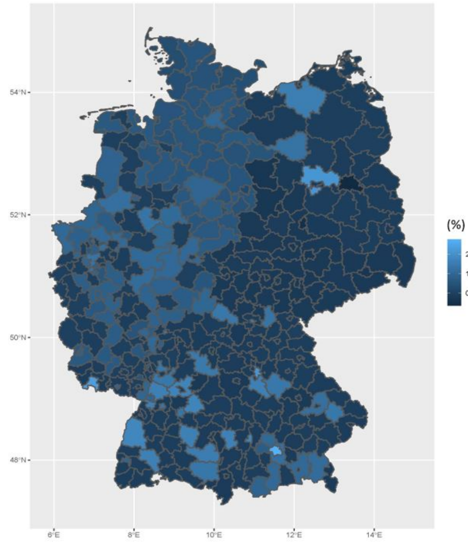


Figure 4.20.: Regional Contribution to total Manufacturing Increase



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

The decrease of short-term unemployment leads to an increase of employment in other sectors. For the manufacturing sector I find an increase in the regional manufacturing share in Baden-Württemberg and Bavaria. In Mecklenburg-Western Pomerania and Brandenburg some counties experience the highest increase in the regional manufacturing share, which together with the named counties in the south contribute the largest to the aggregate increase of the manufacturing sector in Germany, see Figure 4.19 and 4.20. Further, I discover a shift into the trade and commerce sector as well as into the public sector, see appendix A.7.4. I find a similar pattern for counties in the southern part of Germany as well as in Mecklenburg-Western Pomerania and Brandenburg that contribute the largest to the employment increase in those sectors.

5. Conclusion

Germany has seen a rapid decline in unemployment after 2005. This paper tries to shed more light on the cause of this development focusing on the employment impact of the "Hartz IV-Reform" (specifically the long-term unemployment benefit effect) and the "rise of the East", which both happened during the same time period. Hereby, my work builds on the dynamic spatial multi-country and multi-sector equilibrium Caliendo et al. (2019) model. I extend the model by including the structure of the long-term unemployment benefit in order to simulate the impact of the "Hartz IV-Reform". My analysis contains 402 German counties and 43 countries with 7 sectors plus a sector for unemployment and a long-term unemployment sector. To conduct the analysis, I use the World Input-Output Database (WIOD) and data from the German Federal and Regional Statistical Offices as well as the statistics from the Federal Employment Agency as the main data sources.

My findings show that the "Hartz IV-Reform" reduces the short-term unemployment by 0.4%, particularly in the east of Germany. The finding is in line with literature, however, those studies which test for all stages of the labor market reform (Hartz I - Hartz IV) find larger effects. Therefore, my result suggests that the long-term unemployment benefit (Hartz IV) certainly had its impact on the unemployment in Germany, though other parts of the Hartz reform (e.g. restructuring the Federal Labor Institution) could have played a major role as well. As I further tested for the impact of the increasing productivities as a possible cause of the "rise of the East" I find a modest impact. Without the "rise of the East" the short-term unemployment would have been 0.03% larger. Dissecting the effects on employment I find that the labor market effects caused by the German productivity shock is larger than those of Eastern Europe. The moderate result in terms of productivity effects can be traced back to the limited number of Eastern European countries available in the World Input-Output Database (WIOD) as well as the short time period of nine years. For a potential further study, it would be interesting to test for the reduction of trade costs (due to the eastward enlargement of the European Union in 2004 and 2007) as another possible cause of the rising trade flows.

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A. Appendix

A.1. Equilibrium in Relative Time Differences

In this section I show how the equilibrium conditions of the three different lifetime utilities in relative time differences are determined.

Starting with the *employment lifetime utility*, the conditions for period t and $t+1$ are given by:

$$V_t^{nj} = U(C_t^{nj}) + \upsilon \log \left(\sum_{i=1}^{N} \exp(\beta V_{t+1}^{i0} - \tau^{nj,i0})^{1/v} \right) +$$
$$\upsilon(1-\alpha^{nj}) \log \left(\sum_{i=1}^{N} \sum_{k=0}^{J} \exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{1/v} \right) + \alpha^{nj} \beta V_{t+1}^{nA}$$

$$V_{t+1}^{nj} = U(C_{t+1}^{nj}) + \upsilon \log \left(\sum_{i=1}^{N} \exp(\beta V_{t+2}^{i0} - \tau^{nj,i0})^{1/v} \right) +$$
$$\upsilon(1-\alpha^{nj}) \log \left(\sum_{i=1}^{N} \sum_{k=0}^{J} \exp(\beta V_{t+2}^{ik} - \tau^{nj,ik})^{1/v} \right) + \alpha^{nj} \beta V_{t+2}^{nA}$$

Putting these equations together in terms of time differences:

$$V_{t+1}^{nj} - V_t^{nj} = U(C_{t+1}^{nj}) - U(C_t^{nj}) + \upsilon \log \left[\frac{\sum_{i=1}^{N} \exp(\beta V_{t+2}^{i0} - \tau^{nj,i0})^{1/v}}{\sum_{i=1}^{N} \exp(\beta V_{t+1}^{i0} - \tau^{nj,i0})^{1/v}} \right] +$$
$$\upsilon(1-\alpha^{nj}) \log \left[\frac{\sum_{i=1}^{N} \sum_{k=0}^{J} \exp(\beta V_{t+2}^{ik} - \tau^{nj,ik})^{1/v}}{\sum_{i=1}^{N} \sum_{k=0}^{J} \exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{1/v}} \right] + \alpha^{nj} \beta (V_{t+2}^{nA} - V_{t+1}^{nA})$$

The equation can be simplified by the application of $\exp(\beta V_{t+1}^{i0} - \tau^{nj,i0})^{1/v}$ and $\mu_t^{nj,i0}$ for the third term, and by the application of $\exp(\beta V_{t+1}^{ik} - \tau^{nj,ik})^{1/v}$ and $\mu_t^{nj,ik}$ for the fourth term:

$$V_{t+1}^{nj} - V_t^{nj} = U(C_{t+1}^{nj}) - U(C_t^{nj}) + \upsilon \log \left[\sum_{i=1}^{N} \mu_t^{nj,i0} \exp\left(V_{t+2}^{i0} - V_{t+1}^{i0}\right)^{\beta/v} \right] +$$
$$\upsilon(1-\alpha^{nj}) \log \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{nj,ik} \exp\left(V_{t+2}^{ik} - V_{t+1}^{ik}\right)^{\beta/v} \right] + \alpha^{nj} \beta (V_{t+2}^{nA} - V_{t+1}^{nA})$$

I further apply the assumption of Caliendo et al. (2019) that agents have logarithmic preferences, as well as $u^{i,0}_{t+1}$ and $u^{i,k}_{t+1}$. With the help of the exponential transformation I get an expression of the *employment lifetime utility* in relative time differences:

$$\dot{u}^{nj}_{t+1} = [\dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})] \left[\sum_{i=1}^{N} \mu_t^{nj,i0} (\dot{u}^{i0}_{t+2})^{\beta/v} \right]^{v} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{nj,ik} (\dot{u}^{ik}_{t+2})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\dot{u}^{nA}_{t+2})^{\alpha^{nj}\beta}$$

The approach to identify the *short-term unemployment lifetime utility* in relative time differences follows in a similar fashion:

$$V_t^{n0} = \log b^n + v(1-\delta) \log \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \exp\left(\beta V^{ik}_{t+1} - \tau^{nj,ik}\right)^{1/v} \right] + \delta\beta V^{nA}_{t+1}$$

$$V_{t+1}^{n0} = \log b^n + v(1-\delta) \log \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \exp\left(\beta V^{ik}_{t+2} - \tau^{nj,ik}\right)^{1/v} \right] + \delta\beta V^{nA}_{t+2}$$

$$V_{t+1}^{n0} - V_t^{n0} = \log \dot{b}^n + v(1-\delta) \log \left[\frac{\exp\left(\beta V^{ik}_{t+2} - \tau^{nj,ik}\right)^{1/v}}{\exp\left(\beta V^{ik}_{t+1} - \tau^{nj,ik}\right)^{1/v}} \right] + \delta\beta (V^{nA}_{t+2} - V^{nA}_{t+1})$$

$$V_{t+1}^{n0} - V_t^{n0} = \log \dot{b}^n + v(1-\delta) \log \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{nj,ik} \exp\left(V^{ik}_{t+2} - V^{ik}_{t+1}\right)^{\beta/v} \right] + \delta\beta (V^{nA}_{t+2} - V^{nA}_{t+1})$$

Making use of the logarithmic preferences and $u^{i,k}_{t+1}$ as well as applying the exponentials, I can rearrange the equation in terms of relative time differences:

$$\dot{u}^{n0}_{t+1} = \dot{b}^n \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{nj,ik} (\dot{u}^{ik}_{t+2})^{\beta/v} \right]^{v(1-\delta)} (\dot{u}^{nA}_{t+2})^{\delta\beta}$$

The *long-term unemployed lifetime utility* can also be expressed in relative time differences:

$$V_t^{nA} = \log(b_t^A / P_t^n) + (1-\rho^A)\beta V^{nj}_{t+1} + \rho^A \beta [V^{nA}_{t+1}]$$

$$V_{t+1}^{nA} = \log(b_{t+1}^A / P_{t+1}^n) + (1-\rho^A)\beta V^{nj}_{t+2} + \rho^A \beta [V^{nA}_{t+2}]$$

$$V_{t+1}^{nA} - V_t^{nA} = \log(\dot{b}^A / \dot{P}_{t+1^n}) + (1-\rho^A)\beta (V^{nj}_{t+2} - V^{nA}_{t+1}) + \rho^A \beta (V^{nA}_{t+2} - V^{nA}_{t+1})$$

Transforming and rearranging by taking the exponential I get the *long-term unemployed lifetime utility* in relative time differences:

$$\dot{u}^{nA}_{t+1} = \frac{\dot{b}^A}{\dot{P}^n_{t+1}} (\dot{u}^{nj}_{t+2})^{(1-\rho^A)\beta} (\dot{u}^{nA}_{t+2})^{\rho^A\beta}$$

A.2. Counterfactual Equilibrium in Relative Time Differences

Next, the counterfactual equilibrium of the *employment lifetime utility* is derived:

$$\dot{u}_{t+1}^{\prime nj} = \dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})' \left[\sum_{i=1}^{N} \mu_t^{\prime nj,i0} (\dot{u}_{t+2}^{\prime i0})^{\beta/v} \right]^v \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{\prime nj,ik} (\dot{u}_{t+2}^{\prime ik})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\dot{u}_{t+2}^{\prime nA})^{\alpha^{nj}\beta}$$

$$\dot{u}_{t+1}^{nj} = [\dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})] \left[\sum_{i=1}^{N} \mu_t^{nj,i0} (\dot{u}_{t+2}^{i0})^{\beta/v} \right]^v \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{nj,ik} (\dot{u}_{t+2}^{ik})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\dot{u}_{t+2}^{nA})^{\alpha^{nj}\beta}$$

Rewrite the equations in relative terms:

$$\frac{\dot{u}_{t+1}^{\prime nj}}{\dot{u}_{t+1}^{nj}} = \frac{\dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})'}{\dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})} \left[\frac{\sum_{i=1}^{N} \mu_t^{\prime nj,i0} (\dot{u}_{t+2}^{\prime i0})^{\beta/v}}{\sum_{i=1}^{N} \mu_t^{nj,ik} (\dot{u}_{t+2}^{ik})^{\beta/v}} \right]^v * \left[\frac{\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{\prime nj,ik} (\dot{u}_{t+2}^{\prime ik})^{\beta/v}}{\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t^{nj,ik} (\dot{u}_{t+2}^{ik})^{\beta/v}} \right]^{v(1-\alpha^{nj})} \left(\frac{\dot{u}_{t+2}^{\prime nA}}{\dot{u}_{t+2}^{nA}} \right)^{\alpha^{nj}\beta}$$

By the application of $\frac{\mu_t^{nj,i0}(\dot{u}_{t+2}^{i0})^{\beta/v}}{\mu_t^{nj,i0}(\dot{u}_{t+2}^{i0})^{\beta/v}}$ and $\frac{\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/v}}{\mu_t^{nj,ik}(\dot{u}_{t+2}^{ik})^{\beta/v}}$ the equation can be rearranged:

$$\hat{u}_{t+1}^{nj} = \hat{\omega}^{nj}(\hat{L}_{t+1}, \hat{\Theta}_{t+1}) \left[\sum_{i=1}^{N} \frac{\mu_t^{\prime nj,i0} (\dot{u}_{t+2}^{\prime i0})^{\beta/v}}{\sum_{m=1}^{N} \mu_t^{nj,m0} (\dot{u}_{t+2}^{m0})^{\beta/v}} \right]^v * \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \frac{\mu_t^{\prime nj,ik} (\dot{u}_{t+2}^{\prime ik})^{\beta/v}}{\sum_{m=1}^{N} \sum_{h=0}^{J} \mu_t^{nj,mh} (\dot{u}_{t+2}^{mh})^{\beta/v}} \right]^{v(1-\alpha^{nj})} (\hat{u}_{t+2}^{nA})^{\alpha^{nj}\beta}$$

$$\hat{u}_{t+1}^{nj} = \hat{\omega}^{nj}(\hat{L}_{t+1}, \hat{\Theta}_{t+1}) \left[\sum_{i=1}^{N} \left(\frac{\mu_t^{\prime nj,i0}}{\mu_t^{nj,i0}} \right) \frac{\mu_t^{nj,i0} (\dot{u}_{t+2}^{\prime i0})^{\beta/v}}{\sum_{m=1}^{N} \mu_t^{nj,m0} (\dot{u}_{t+2}^{m0})^{\beta/v}} \left(\frac{\dot{u}_{t+2}^{\prime nj,i0}}{\dot{u}_{t+2}^{nj,i0}} \right)^{\beta/v} \right]^v * \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \left(\frac{\mu_t^{\prime nj,ik}}{\mu_t^{nj,ik}} \right) \frac{\mu_t^{nj,ik} (\dot{u}_{t+2}^{\prime ik})^{\beta/v}}{\sum_{m=1}^{N} \sum_{h=0}^{J} \mu_t^{nj,mh} (\dot{u}_{t+2}^{mh})^{\beta/v}} \left(\frac{\dot{u}_{t+2}^{\prime nj,ik}}{\dot{u}_{t+2}^{nj,ik}} \right)^{\beta/v} \right]^{v(1-\alpha^{nj})} (\hat{u}_{t+2}^{nA})^{\alpha^{nj}\beta}$$

Make use of $\mu^{nj,i0}_{t+1}$, $\mu^{nj,ik}_{t+1}$ to write the equation as the following:

$$\hat{u}^{nj}_{t+1} = \hat{\omega}^{nj}(\hat{L}_{t+1}, \hat{\Theta}_{t+1}) \left[\sum_{i=1}^{N} \left(\frac{\mu'^{nj,i0}_t}{\mu^{nj,i0}_t} \right) \mu^{nj,i0}_{t+1} (\hat{u}^{i0}_{t+2})^{\beta/v} \right]^{v} * \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \left(\frac{\mu'^{nj,ik}_t}{\mu^{nj,ik}_t} \right) \mu^{nj,ik}_{t+1} (\hat{u}^{ik}_{t+2})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\hat{u}^{nA}_{t+2})^{\alpha^{nj}\beta}$$

This leads to the value of the *employment lifetime utility* in counterfactual equilibrium:

$$\hat{u}^{nj}_{t+1} = \hat{\omega}^{nj}(\hat{L}_{t+1}, \hat{\Theta}_{t+1}) \left[\sum_{i=1}^{N} \mu'^{nj,i0}_t \dot{\mu}^{nj,i0}_{t+1} (\hat{u}^{i0}_{t+2})^{\beta/v} \right]^{v} * \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu'^{nj,ik}_t \dot{\mu}^{nj,ik}_{t+1} (\hat{u}^{ik}_{t+2})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\hat{u}^{nA}_{t+2})^{\alpha^{nj}\beta}$$

The *short-term unemployment lifetime utility* in the counterfactual equilibrium is calculated in the following:

$$\dot{u}'^{n0}_{t+1} = \dot{b}'^{n} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu'^{nj,ik}_t (\dot{u}'^{ik}_{t+2})^{\beta/v} \right]^{v(1-\delta)} (\dot{u}'^{nA}_{t+2})^{\delta\beta}$$

$$\dot{u}^{n0}_{t+1} = \dot{b}^{n} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu^{nj,ik}_t (\dot{u}^{ik}_{t+2})^{\beta/v} \right]^{v(1-\delta)} (\dot{u}^{nA}_{t+2})^{\delta\beta}$$

Rewrite the equations in relative terms:

$$\hat{u}^{n0}_{t+1} = \hat{b}^{n} \left[\frac{\sum_{i=1}^{N} \sum_{k=0}^{J} \mu'^{nj,ik}_t (\dot{u}'^{ik}_{t+2})^{\beta/v}}{\sum_{i=1}^{N} \sum_{k=0}^{J} \mu^{nj,ik}_t (\dot{u}^{ik}_{t+2})^{\beta/v}} \right]^{v(1-\delta)} (\hat{u}^{nA}_{t+2})^{\delta\beta}$$

As before, apply $\frac{\mu^{nj,ik}_t (\dot{u}^{ik}_{t+2})^{\beta/v}}{\mu^{nj,ik}_t (\dot{u}^{ik}_{t+2})^{\beta/v}}$:

$$\hat{u}^{n0}_{t+1} = \hat{b}^{n} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \frac{\mu'^{nj,ik}_t (\dot{u}'^{ik}_{t+2})^{\beta/v}}{\sum_{m=1}^{N} \sum_{h=0}^{J} \mu^{nj,mh}_t (\dot{u}^{mh}_{t+2})^{\beta/v}} \right]^{v(1-\delta)} (\hat{u}^{nA}_{t+2})^{\delta\beta}$$

$$\hat{u}^{n0}_{t+1} = \hat{b}^{n} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \left(\frac{\mu'^{nj,ik}_t}{\mu^{nj,ik}_t} \right) \frac{\mu^{nj,ik}_t (\dot{u}'^{ik}_{t+2})^{\beta/v}}{\sum_{m=1}^{N} \sum_{h=0}^{J} \mu^{nj,mh}_t (\dot{u}^{mh}_{t+2})^{\beta/v}} \left(\frac{\dot{u}'^{nj,ik}_{t+2}}{\dot{u}^{nj,ik}_{t+2}} \right)^{\beta/v} \right]^{v(1-\delta)} (\hat{u}^{nA}_{t+2})^{\delta\beta}$$

Use $\mu_{t+1}^{nj,ik}$ and rewrite:

$$\hat{u}_{t+1}^{n0} = \hat{b}^n \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \left(\frac{\mu_t'^{nj,ik}}{\mu_t^{nj,ik}} \right) \mu_{t+1}^{nj,ik} (\hat{u}_{t+2}^{ik})^{\beta/v} \right]^{v(1-\delta)} (\hat{u}_{t+2}^{nA})^{\delta\beta}$$

The *short-term unemployment lifetime utility* in the counterfactual equilibrium is given by:

$$\hat{u}_{t+1}^{n0} = \hat{b}^n \left(\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_t'^{nj,ik} \dot{\mu}_{t+1}^{nj,ik} (\hat{u}_{t+2}^{ik})^{\beta/v}) \right)^{v(1-\delta)} (\hat{u}_{t+2}^{nA})^{\delta\beta}$$

Lastly, I derive the *long-term unemployed lifetime utility* in the counterfactual equilibrium:

Starting with the counterfactual and baseline scenario:

$$\dot{u}_{t+1}'^{nA} = \frac{\dot{b}'^A}{\dot{P}_{t+1}'^{\,n}} (\dot{u}_{t+2}'^{nj})^{(1-\rho^A)\beta} (\dot{u}_{t+2}'^{nA})^{\rho^A\beta}$$

$$\dot{u}_{t+1}^{nA} = \frac{\dot{b}^A}{\dot{P}_{t+1}^n} (\dot{u}_{t+2}^{nj})^{(1-\rho^A)\beta} (\dot{u}_{t+2}^{nA})^{\rho^A\beta}$$

I then derive the equations in relative terms of the counterfactual equilibrium:

$$\hat{u}_{t+1}^{nA} = \frac{\hat{b}^A}{\hat{P}_{t+1}^n} (\hat{u}_{t+2}^{nj})^{(1-\rho^A)\beta} (\hat{u}_{t+2}^{nA})^{\rho^A\beta}$$

A.3. Version - Punishment

In this section let us introduce sanctions on the lifetime utility of a long-term unemployed household. As mentioned in the introduction, in the case of a breach of duty the long-term unemployment benefit is cut by 30%. I introduce ψ^A, which is the probability that a long-term unemployed recipient will not take up an offered job and is therefore punished by receiving 30% less benefit in the next period. The value of the long-term unemployed households at time t is then given by:

$$V_t^{nA} = \log\left(\frac{b_t^A}{P_t^n}\right) + (1-\rho^A)\beta V_{t+1}^{nj} + \rho^A\beta\Bigg[(1-\psi^A)\log\left(\frac{[b_{t+1}^A]}{P_{t+1}^n}\right) + (\psi^A)\log\left(\frac{[b_{t+1}^A * 0.3]}{P_{t+1}^n}\right) + (1-\rho^A)\beta V_{t+2}^{nj} + \rho^A\beta[V_{t+2}^{nA}]\Bigg]$$

A.4. Strategy to solve the Model

To analyze the effects of the German labor market reform and the "rise of the East" my simulations are based on the code and the algorithms provided by Caliendo et al. (2019). The strategy to conduct the simulation involves first the construction of the *Base Economy*, which solves for the equilibrium conditions of the base year of 2005 (when the German labor market reform (in particular Hartz IV) was introduced). In a second step the so called *Baseline Economy* for the time span of 2005 to 2014 is composed. This is done by the calibration of the time series data for each year.[41] Using the results of the *Base Economy* and the time series data the equilibrium allocations of the *Baseline Economy* for all the years are constructed by the application of *Algorithm I*. After having identified the *Baseline Economy* I can then turn to the *Counterfactual Economy*, which is solved by the use of *Algorithm II*[42]. Herewith, I simulate the scenarios were on the one hand the German labor market reform is eliminated and on the other hand the productivity rise of the Eastern European countries (or Germany) do not occur. Taking the difference between the *Base Economy* and the *Counterfactual Economy* provides the results of the effect.

[41] Following Caliendo et al. (2019) in this step, time series data of the bilateral trade flows, bilateral trade shares, expenditure levels, labor allocations and the gross output flows for each year are identified.

[42] For the temporary equilibrium to be solved, which is necessary to help solve the *Algorithm II*, the *Algorithm I* is also applied.

A.5. Algorithm I: Sequential Competitive Equilibrium

I rely on the algorithms of Caliendo et al. (2019) and further extend it to fit my analysis. The Algorithm I has the allocations $\{L_0^{nj}, L_0^{n0}, L_0^{nA}, \pi_0, X_0\, \mu_{-1}\}$ and $\{\dot{\Theta}_t\}_{t=1}^{\infty}$ as input requirements.[43] In the following the superscript (0) denotes to the number of rounds of guesses, starting with zero. The Algorithm I starts in the following way:

1. **Guess a path of $\{\dot{u}_{t+1}^{nA(0)}\}_{t=0}^{T}$**
2. **Guess a path of $\{\dot{u}_{t+1}^{n0(0)}\}_{t=0}^{T}$**
   a) **Solve for the path of migration flows $\{\mu_t^{i0,nj}\}_{t=0}^{T}$**
3. **Guess a path of $\{\dot{u}_{t+1}^{nj(0)}\}_{t=0}^{T}$**
   a) **Solve for the path of $\{\mu_t^{nj,ik}\}_{t=0}^{T}$ by the application of $\{\dot{u}_{t+1}^{nj(0)}\}_{t=0}^{T}$ and $\mu_{-1}^{nj,ik}$ for $t \geq 0$.**
4. **Get the path for $\{L_{t+1}^{nj}\}_{t=0}^{T}$**

   By relying on $\{\mu_t^{nj,ik}\}_{t=0}^{T}$, $\{\mu_t^{i0,nj}\}_{t=0}^{T}$ and $L_0^{nj}, L_0^{n0}, L_0^{nA}$, as well as $\alpha^{ik}, \delta, \rho^A$ and solving with:

$$L_{t+1}^{nj} = \sum_{i=1}^{N} \sum_{k\neq 0}^{J} \mu_t^{ik,nj}(1-\alpha^{ik})L_t^{ik} + \sum_{i=1}^{N} \mu_t^{i0,nj}(1-\delta)L_t^{i0} + (1-\rho^A)L_t^{nA}/J$$

5. **Get the path for $\{L_{t+1}^{nA}\}_{t=0}^{T}$**

   By using $L_0^{nj}, L_0^{n0}, L_0^{nA}$, as well as $\alpha^{ik}, \delta, \rho^A$ and insert it in $L_{t+1}^{nA} = \rho^A L_t^{nA} + \delta L_t^{n0} + \alpha^{nj} L_t^{nj}$
6. **Determination of the temporary equilibrium:**
   a) With $\dot{L}_{t+1}^{nj}$, take a guess for $\dot{\omega}_{t+1}^{nj}$ $(t \geq 0)$
   b) Solve for $\dot{x}_{t+1}^{nj}$, $\dot{P}_{t+1}^{nj}$, and $\dot{\pi}_{t+1}^{nj}$ by applying the following equilibrium equations:

$$\dot{x}_{t+1}^{nj} = (\dot{L}_{t+1}^{nj})^{\gamma^{nj}\xi^n} (\dot{\omega}_{t+1}^{nj})^{\gamma^{nj}} \prod_{k=1}^{J} (\dot{P}_{t+1}^{nj})^{\gamma^{nj,nk}},$$

$$\dot{P}_{t+1}^{nj} = \left(\sum_{i=1}^{N} \pi_t^{nj,ij} (\dot{x}_{t+1}^{ij}, \dot{\kappa}_{t+1}^{nj,ij})^{-\theta^j} (\dot{A}_{t+1}^{ij})^{\theta^j \gamma^{ij}} \right)^{-1/\theta^j},$$

$$\pi_{t+1}^{nj,ij} = \pi_t^{nj,ij} \left(\frac{\dot{x}_{t+1}^{ij} \dot{\kappa}_{t+1}^{nj,ij}}{\dot{P}_{t+1}^{nj}} \right)^{-\theta^j} (\dot{A}_{t+1}^{ij})^{\theta^j \gamma^{ij}}$$

[43] In addition, $\gamma^{nk,nj}, L_0^{nj}, L_0^{n0}, L_0^{nA}, \mu_{-1}^{nj,ik}, \pi_0^{ni,nj}, w_0^{nj} L_0^{nj}, r_0^{nj} H_0^{nj}, \alpha^{ik}, \delta, \rho^A, \eta^j, b^A, G, \iota^n$ needs to be provided.

c) Solve for X_{t+1}^{nj} by relying on $\pi_{t+1}^{nj,ij}$, $\dot{\omega}_{t+1}^{nj}$, $\dot{L}_{t+1}^{nj}$ and

$$X_{t+1}^{nj} = \sum_{k=1}^{J} \gamma^{nk,nj} \sum_{i=1}^{N} \pi_{t+1}^{ik,nk} X_{t+1}^{ik} + \eta^{j} \left(\sum_{k=1}^{J} \dot{\omega}_{t+1}^{nk} \dot{L}_{t+1}^{nk} \omega_{t}^{nk} L_{t}^{nk} + b_{t+1}^{A} L_{t+1}'^{A} + \iota^{n} \chi_{t+1}' - G_{t+1}/N \right)$$

d) The following equation needs to hold

$\dot{\omega}_{t+1}^{nj} \dot{L}_{t+1}^{nj} \omega_{t}^{nj} L_{t}^{nj} = \gamma^{nj}(1-\xi^{n}) \sum_{i=1}^{N} \pi_{t+1}^{ij,nj} X_{t+1}^{ij}$,

otherwise, return to (a) until the temporary equilibrium conditions hold.

e) Get the path $\{\dot{\omega}_{t+1}^{nj}, \dot{P}_{t+1}^{nj}\}_{t=0}^{T}$ by conducting the temporary equilibrium for each period t.

7. **Solve for $\dot{u}_{t+1}^{nj(1)}$**

By inserting $\mu_{t}^{nj,i0}$, $\mu_{t}^{nj,ik}$, $\dot{\omega}_{t+1}^{nj}$ and the guesses of $\dot{u}_{t+2}^{n0(0)}$, $\dot{u}_{t+2}^{nj(0)}$, $\dot{u}_{t+2}^{nA(0)}$ for each period t into the equation:

$$\dot{u}_{t+1}^{nj} = [\dot{\omega}^{nj}(\dot{L}_{t+1}, \dot{\Theta}_{t+1})] \left[\sum_{i=1}^{N} \mu_{t}^{nj,i0} (\dot{u}_{t+2}^{i0})^{\beta/v} \right]^{v} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_{t}^{nj,ik} (\dot{u}_{t+2}^{ik})^{\beta/v} \right]^{v(1-\alpha^{nj})} (\dot{u}_{t+2}^{nA})^{\alpha^{nj}\beta}$$

a) **This gives a new result for $\{\dot{u}_{t+1}^{nj(1)}\}_{t=0}^{T}$**

b) **Check if $\{\dot{u}_{t+1}^{nj(1)}\}_{t=0}^{T} \simeq \{\dot{u}_{t+1}^{nj(0)}\}_{t=0}^{T}$ holds, otherwise start guessing at step 3 again.**

8. **Solve for $\dot{u}_{t+1}^{n0(1)}$**

By inserting $\dot{b}^{n}$, $\mu_{t}^{nj,ik}$ and the guesses of $\dot{u}_{t+2}^{nj(1)}$, $\dot{u}_{t+2}^{nA(0)}$ for each period t into the equation:

$$\dot{u}_{t+1}^{n0} = \dot{b}^{n} \left[\sum_{i=1}^{N} \sum_{k=0}^{J} \mu_{t}^{nj,ik} (\dot{u}_{t+2}^{ik})^{\beta/v} \right]^{v(1-\delta)} (\dot{u}_{t+2}^{nA})^{\delta\beta} \tag{A.1}$$

a) **This gives a new result for $\{\dot{u}_{t+1}^{n0(1)}\}_{t=0}^{T}$**

b) **Check if $\{\dot{u}_{t+1}^{n0(1)}\}_{t=0}^{T} \simeq \{\dot{u}_{t+1}^{n0(0)}\}_{t=0}^{T}$ holds, otherwise start guessing at step 2 again.**

9. **Solve for $\dot{u}_{t+1}^{nA}$**

By inserting $\dot{b}^{A}$, $\dot{P}_{t+1}^{n}$ and the guesses of$\dot{u}_{t+2}^{nj(1)}$, $\dot{u}_{t+2}^{nA(0)}$ for each period t into the equation:

$$\dot{u}_{t+1}^{nA} = \frac{\dot{b}^{A}}{\dot{P}_{t+1}^{n}} (\dot{u}_{t+2}^{nj})^{(1-\rho)\beta} (\dot{u}_{t+2}^{nA})^{\rho\beta} \tag{A.2}$$

a) **This gives a new result for $\{\dot{u}_{t+1}^{nA(1)}\}_{t=0}^{T}$**

b) **Check if $\{\dot{u}_{t+1}^{nA(1)}\}_{t=0}^{T} \simeq \{\dot{u}_{t+1}^{nA(0)}\}_{t=0}^{T}$ holds, otherwise start guessing at step 1 again.**

A.6. Algorithm II: Solving for Counterfactuals

Algorithm II requires the baseline economy $\{L_t, \pi_t, \mu_{t-1}, X_t\}_{t=0}^{\infty}$ as well as the sequential competitive equilibrium allocations of the baseline economy $\{\dot{L}_t, \dot{\pi}_t, \dot{\mu}_{t-1}, \dot{X}_t\}_{t=0}^{\infty}$ and $\{\hat{\Theta}_t\}_{t=1}^{\infty}$ as inputs.[44] In the following the superscript (0) denotes to the number of rounds of guesses, starting with zero. The Algorithm II begins as follows:

1. **Guess a path of $\{\hat{u}_{t+1}^{nA(0)}\}_{t=0}^{T}$**
2. **Guess a path of $\{\hat{u}_{t+1}^{n0(0)}\}_{t=0}^{T}$**
   a) **Solve for the path of migration flows $\{\mu_t'^{i0,nj}\}_{t=0}^{T}$ for $t \geq 0$.**
3. **Guess a path of $\{\hat{u}_{t+1}^{n,j(0)}\}_{t=0}^{T}$**
   a) **Solve for the path of $\{u_t'^{nj}\}_{t=0}^{T}$ by the application of $\{\hat{u}_{t+1}^{nj(0)}\}_{t=0}^{T}$ and $\{\dot{\mu}_{t-1}\}_{t=0}^{\infty}$ for $t \geq 0$.**
4. **Get the path for $\{L_{t+1}'^{nj}\}_{t=0}^{T}$**

   By relying on $\{\mu_t'^{nj,ik}\}_{t=0}^{T}$, $\{\mu_t'^{i0,nj}\}_{t=0}^{T}$ and $L_0'^{nj}, L_0'^{n0}, L_0'^{nA}$, as well as $\alpha^{ik}, \delta, \rho^A$ and solving with:

$$L_{t+1}'^{nj} = \sum_{i=1}^{N}\sum_{k\neq 0}^{J} \mu_t'^{ik,nj}(1-\alpha^{ik})L_t'^{ik} + \sum_{i=1}^{N} \mu_t'^{i0,nj}(1-\delta)L_t'^{i0} + (1-\rho^A)L_t'^{nA}/J$$

5. **Get the path for $\{L_{t+1}'^{nA}\}_{t=0}^{T}$**

   By using $L_0'^{nj}, L_0'^{n0}, L_0'^{nA}$, as well as $\alpha^{ik}, \delta, \rho^A$ to insert in $L_{t+1}'^{nA} = \rho^A L_t'^{nA} + \delta L_t'^{n0} + \alpha^{nj} L_t'^{nj}$

6. **Determination of the temporary equilibrium:**
   a) With $\hat{L}_{t+1}^{nj}$, take a guess for $\{\hat{\omega}_{t+1}^{nj}\}_{n=1,j=0}^{N,J}$
   b) Solve for $\hat{x}_{t+1}^{nj}$, $\hat{P}_{t+1}^{nj}$, and $\hat{\pi}_{t+1}^{nj,ij}$ by applying following equilibrium equations:

$$\hat{x}_{t+1}^{nj} = (\hat{L}_{t+1}^{nj})^{\gamma^{nj}\xi^n}(\hat{\omega}_{t+1}^{nj})^{\gamma^{nj}}\prod_{k=1}^{J}(\hat{P}_{t+1}^{nk})^{\gamma^{nj,nk}},$$

$$\hat{P}_{t+1}^{nj} = \left(\sum_{i=1}^{N} \pi_t'^{nj,ij}\dot{\pi}_{t+1}^{nj,ij}(\hat{x}_{t+1}^{ij}, \hat{\kappa}_{t+1}^{nj,ij})^{-\theta^j}(\hat{A}_{t+1}^{ij})^{\theta^j\gamma^{ij}}\right)^{-1/\theta^j},$$

$$\pi_{t+1}'^{nj,ij} = \pi_t'^{nj,ij}\pi_{t+1}^{nj,ij}\left(\frac{\hat{x}_{t+1}^{ij}\hat{\kappa}_{t+1}^{nj,ij}}{\hat{P}_{t+1}^{nj}}\right)^{-\theta^j}(\hat{A}_{t+1}^{ij})^{\theta^j\gamma^{ij}}$$

[44]In addition $\gamma^{nk,nj}, L_0^{nj}, L_0^{n0}, L_0^{nA}, \mu_{-1}^{nj,ik}, \pi_0^{ni,nj}, w_0^{nj}L_0^{nj}, r_0^{nj}H_0^{nj}, \alpha^{ik}, \delta, \rho^A, \eta^j, b^A, G, \iota^n$ needs to be provided.

c) Solve for X'^{nj}_{t+1} by relying on ${\pi'}_{t+1}^{nj,ij}$, ${\omega'}^{nk}_t \text{Ł}'^{nk}_t$, $\dot{\omega}^{nk}_{t+1}\dot{L}^{nk}_{t+1}$, $\hat{L}^{nj}_{t+1}$ and

$$X'^{nj}_{t+1} = \sum_{k=1}^{J} \gamma^{nk,nj} \sum_{i=1}^{N} {\pi'}_{t+1}^{ik,nk} {X'}_{t+1}^{ik} +$$

$$\eta^j \left(\sum_{k=1}^{J} \hat{\omega}^{nk}_{t+1} \hat{L}^{nk}_{t+1} \dot{\omega}^{nk}_{t+1} \dot{L}^{nk}_{t+1} {\omega'}^{nk}_t {L'}^{nk}_t + b^A_{t+1} L^A_{t+1} + \iota^n \chi_{t+1} - G_{t+1}/N \right)$$

d) The following equation needs to hold

$\hat{\omega}^{nk}_{t+1} \hat{L}^{nk}_{t+1} = \frac{\gamma^{nj}(1-\xi^n)}{{\omega'}^{nk}_t {L'}^{nk}_t \dot{\omega}^{nj}_{t+1} \dot{L}^{nj}_{t+1}} \sum_{i=1}^{N} {\pi'}_{t+1}^{ij,nj} {X'}_{t+1}^{ij},$

otherwise return to (a) until the temporary equilibrium conditions holds.

e) Get the path $\{\hat{\omega}^{nj}_{t+1} \hat{P}^{nj}_{t+1}\}^{N,J,T}_{n=1,j=0,t=0}$ by conducting the temporary equilibrium for each period t.

7. **Solve for $\hat{u}^{nj(1)}_{t+1}$**

   a) **This gives a new result for $\{\hat{u}^{nj(1)}_{t+1}\}^T_{t=0}$**

   b) **Check if $\{\hat{u}^{nj(1)}_{t+1}\}^T_{t=0} \simeq \{\hat{u}^{nj(0)}_{t+1}\}^T_{t=0}$ holds, otherwise start guessing at step 3 again.**

8. **Solve for $\hat{u}^{n0(1)}_{t+1}$**

   a) **Check if $\{\hat{u}^{n0(1)}_{t+1}\}^T_{t=0} \simeq \{\hat{u}^{n0(0)}_{t+1}\}^T_{t=0}$ holds, otherwise start guessing at step 2 again.**

9. **Solve for $\hat{u}^{nA}_{t+1}$**

   a) **Check if $\{\hat{u}^{nA(1)}_{t+1}\}^T_{t=0} \simeq \{\hat{u}^{nA(0)}_{t+1}\}^T_{t=0}$ holds, otherwise start guessing at step 1 again.**

A.7. Additional Results

A.7.1. Productivity Change

Table A.1.: Sectoral Productivity Changes for Eastern European Countries (between 2005 and 2014)

	Sector 1	**Sector 2**	**Sector 3**	**Sector 4**
CZE	16.90%	7.28%	8.32%	2.21%
HUN	21.50%	7.69%	10.98%	2.18%
POL	24.80%	10.47%	16.14%	5.87%
SVK	26.69%	0.01%	7.58%	20.50%
EST	8.47%	8.26%	16.56%	0.01%
LVA	12.16%	16.17%	13.09%	18.93%
LTU	6.88%	0.09%	19.60%	19.53%
SVN	28.88%	2.53%	13.07%	5.91%
BGR	5.98%	17.26%	9.02%	0.10%
HRV	16.26%	2.60%	5.49%	0.30%
ROU	18.81%	27.46%	15.38%	0.03%

Agriculture & forestry, fisheries (Sector 1), Manufacturing without construction (Sector 2), Manufacturing (Sector 3), Construction (Sector 4)

Source: World Input Output Database, Release 2016; Author's own calculations.

A.7.2. Productivity Effect of Eastern Europe

Figure A.1.: Changes in Regional Agriculture Shares

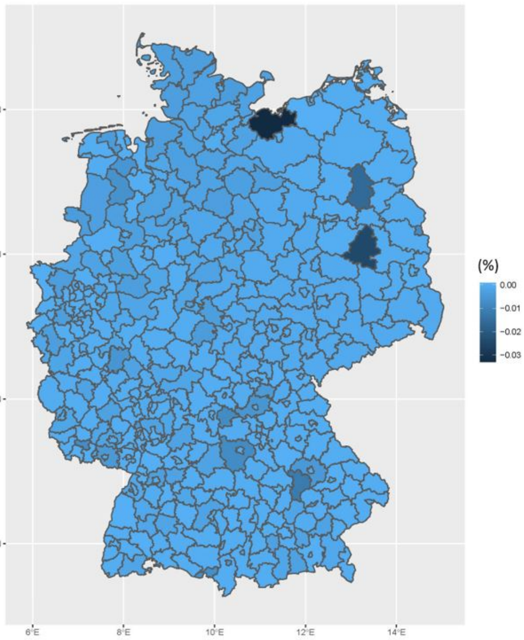
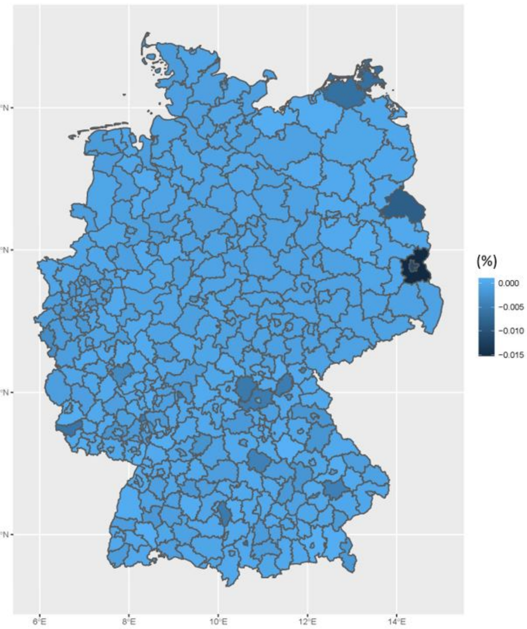


Figure A.2.: Changes in Regional Production Shares



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.3.: Changes in Regional Public Sector Shares

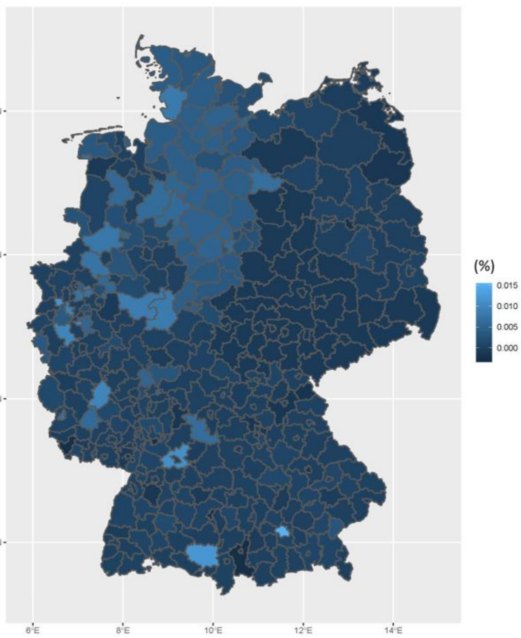
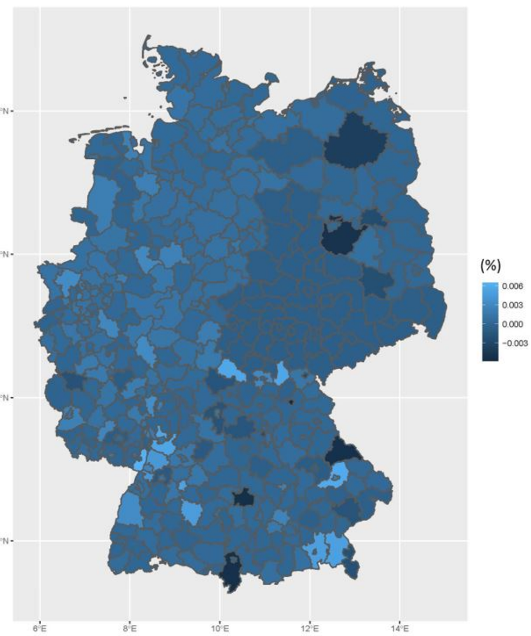


Figure A.4.: Changes in Regional Construction Shares



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.5.: Changes in Regional Trade and Commerce Shares

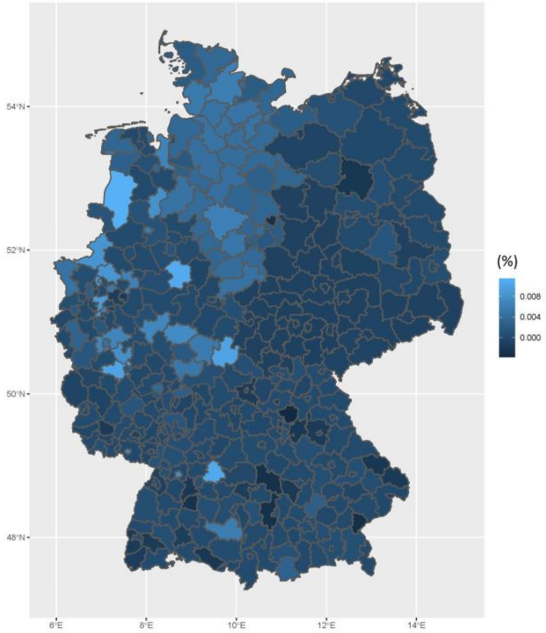
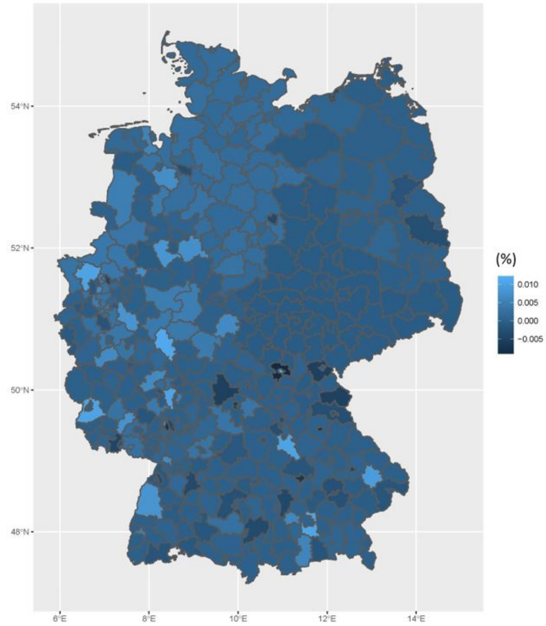


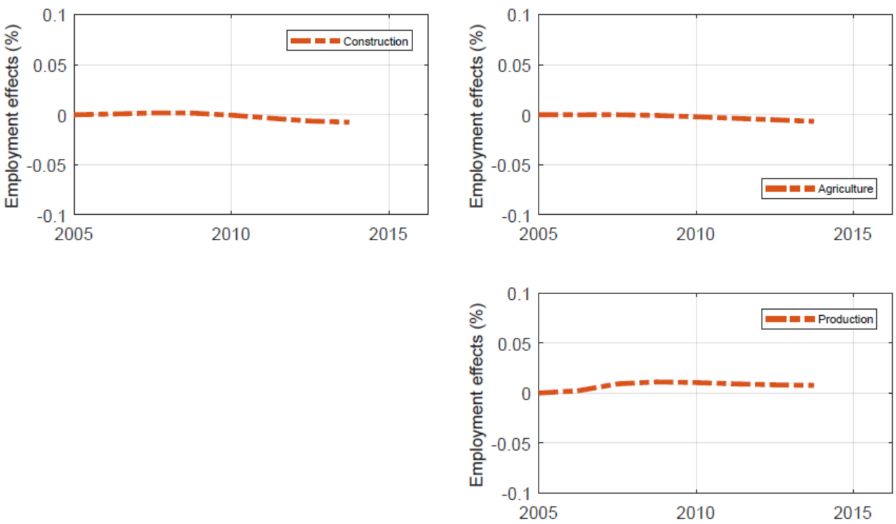
Figure A.6.: Changes in Regional Finance Sector Shares



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

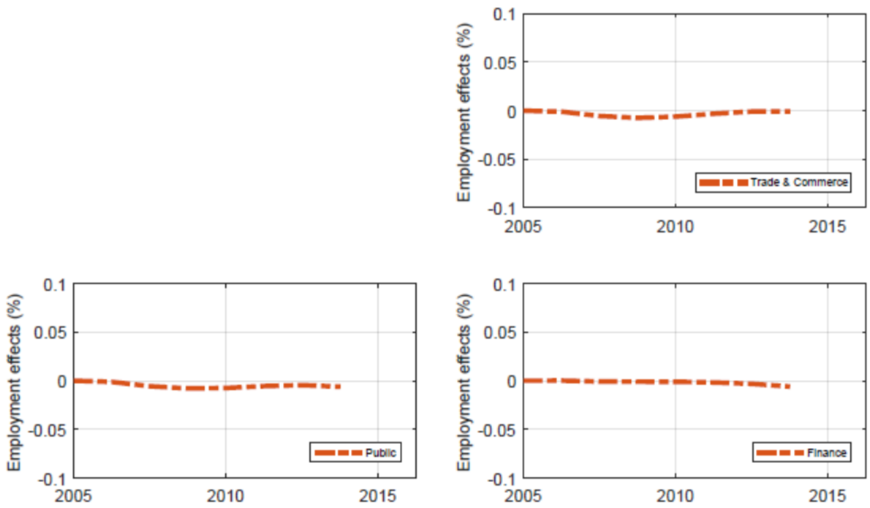
A.7.3. German Productivity Effect

Figure A.7.: Overview of the German Productivity Impact on the Agriculture-, Production- and Construction Sector



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.8.: Overview of the German Productivity Impact on the Trade-, Commerce-, Finance- and Public Sector



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.9.: Changes in Regional Agriculture Shares

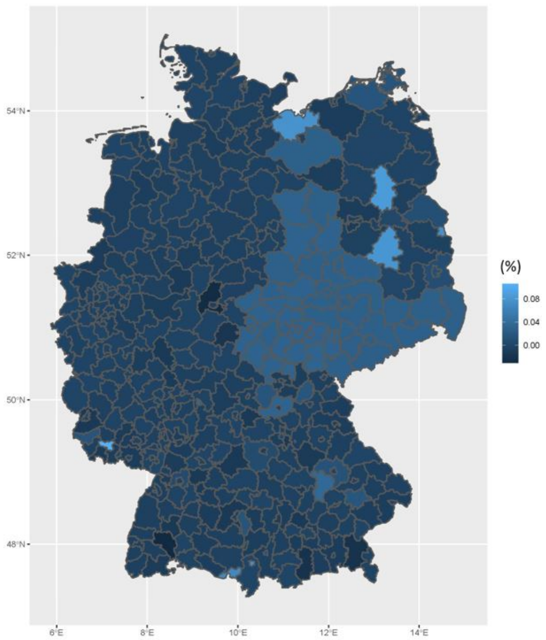
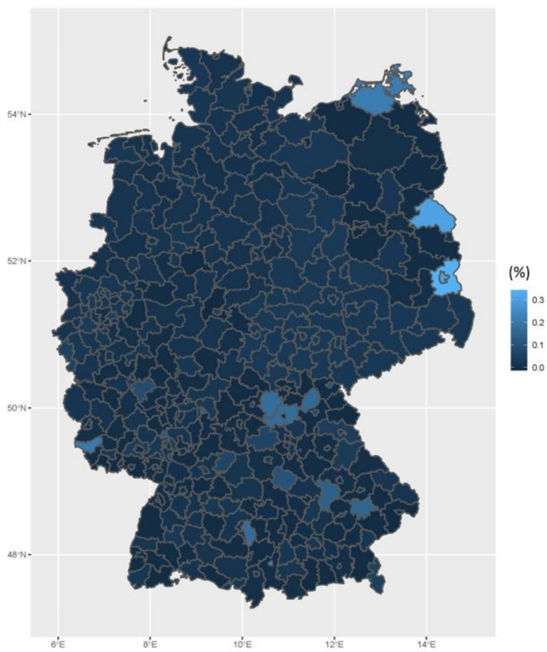


Figure A.10.: Changes in Regional Production Shares



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.11.: Changes in Regional Public Sector Shares

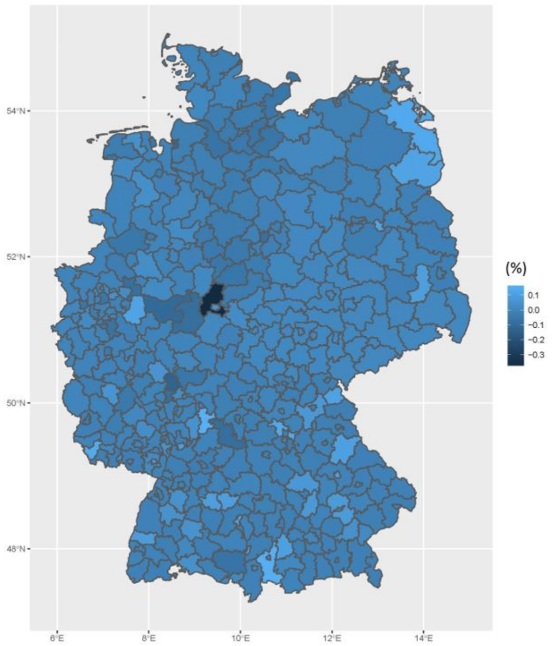
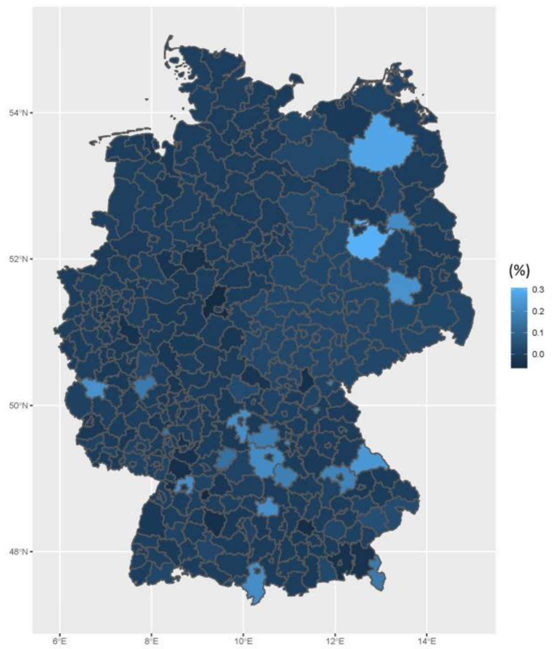


Figure A.12.: Changes in Regional Construction Shares



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.13.: Changes in Regional Trade and Commerce Shares

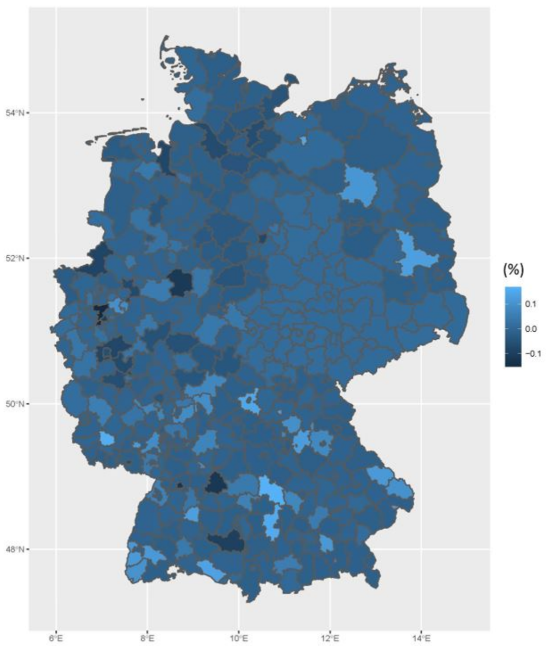
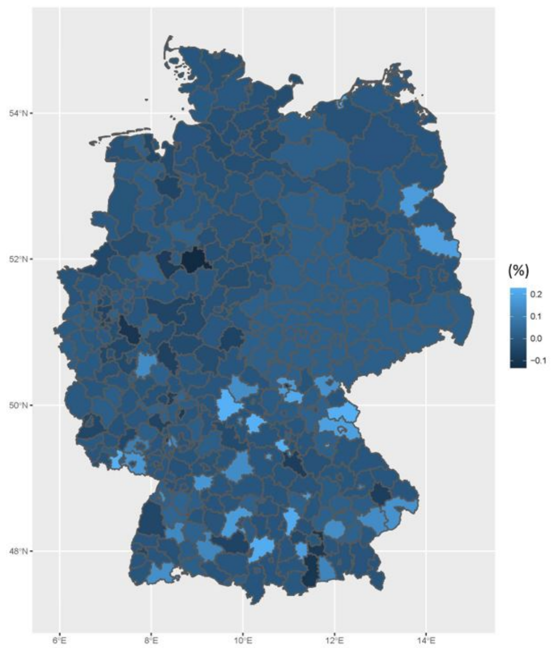


Figure A.14.: Changes in Regional Finance Sector Shares



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

A.7.4. Long-Term Unemployment Benefit Effect

Figure A.15.: Changes in Regional Trade and Commerce Shares

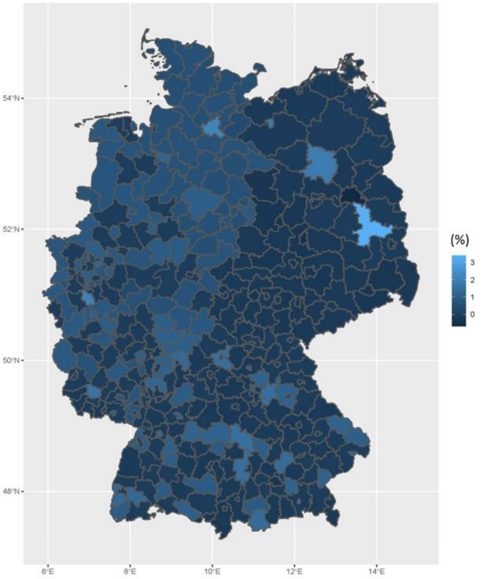
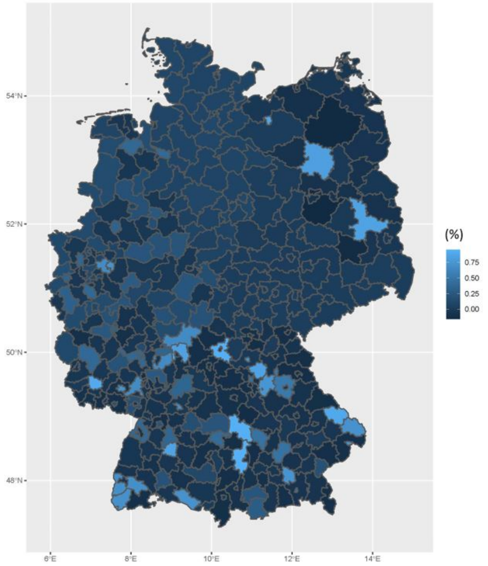


Figure A.16.: Regional Contribution to total Trade and Commerce Increase



The figures are based on the Author's own calculations and rely on the data explained in chapter 3.

Figure A.17.: Changes in Regional Public Sector Shares

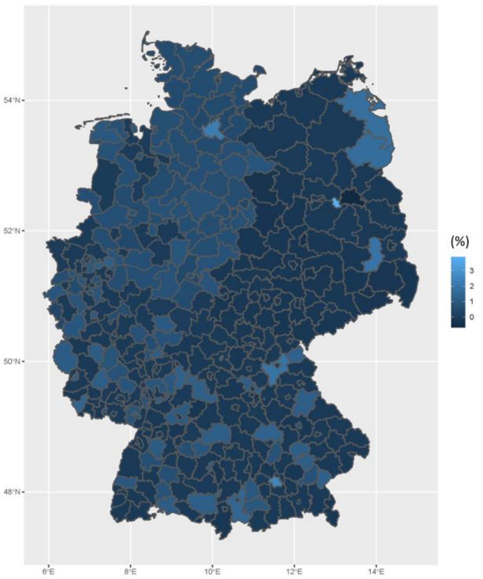
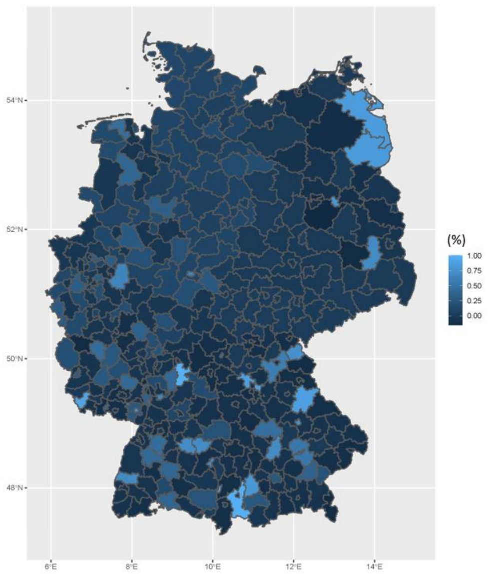


Figure A.18.: Regional Contribution to total Public Sector Increase



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University of Hohenheim
Dean's Office of the Faculty of Business, Economics and Social Sciences
Palace Hohenheim 1 B
70593 Stuttgart | Germany
Fon +49 (0)711 459 22488
Fax +49 (0)711 459 22785
wiso@uni-hohenheim.de
wiso.uni-hohenheim.de