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Multiple Core Regions: Regional Inequality in Switzerland, 1860 to 2008

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Abstract

This paper estimates regional GDP for three different geographical levels in Switzerland. My analysis of regional inequality rests on a heuristic model featuring an initial growth impulse in one or several core regions and subsequent diffusion. As a consequence of the existence of multiple core regions Swiss regional inequality has been comparatively low at higher geographical levels. Spatial diffusion of economic growth has occurred across different parts of the country and within different labor market regions at the same time. This resulted in a bell-shape evolution of regional inequality at the micro regional level and convergence at higher geographical levels. In early and in late stages of the development process, productivity differentials were the main drivers of inequality, whereas economic structure was determinant between 1888 and 1941.

Keywords: Regional data, inequality, industrial structure, productivity, comparative advantage, switzerland

JEL Codes: R10, R11, N93, N94, O14, O18

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This paper estimates regional GDP for three different geographical levels in Switzerland. My analysis of regional inequality rests on a heuristic model featuring an initial growth impulse in one or several core regions and subsequent diffusion. As a consequence of the existence of multiple core regions Swiss regional inequality has been comparatively low at higher geographical levels. Spatial diffusion of economic growth has occurred across different parts of the country and within different labor market regions at the same time. This resulted in a bell-shape evolution of regional inequality at the micro regional level and convergence at higher geographical levels. In early and in late stages of the development process, productivity differentials were the main drivers of inequality, whereas economic structure was determinant between 1888 and 1941.

1. Introduction

Over the last decades regional inequality has become a widely studied topic in economic history. Historians have estimated regional GDP for many countries. Most of these studies rely on a method proposed by Geary and Stark (2002). This method distributes national value added of each sector to different regions according to regional employment shares and uses regional wages as a proxy for productivity differentials (Crafts 2005; Buyst 2009; Felice 2011; Enflo et al. 2010; Badia-Miró et al. 2012; Martínez-Galarraga et al. 2013; Enflo 2014). Other studies have adopted a more eclectic method making use, where possible, of direct estimates of regional value-added or output (Schulze 2000; Schulze 2007; Combes et al. 2011). This paper also applies an eclectic approach, which provides a solution to the problem of lacking regional wage data in Switzerland and, at the same time, allows me to take advantage of very detailed regional data available on agriculture (land use and cattle censuses) as well as manufacturing and services (fine-grained employment data and value-added estimates). The advantage of this method is that it rests on more detailed data than the Geary-Stark method and that instead of relying on a proxy it uses data that is directly related to production and productivity.

In a seminal paper Williamson (1965) argued that in most countries regional inequality followed a bell-shape evolution along the development trajectory. He provided evidence for this pattern from both longitudinal data and cross-section analysis. His finding has been confirmed in recent research on regional inequality in the USA (Kim 1998), Britain (Crafts 2005), Spain (Martínez-Galarraga et al. 2013), Italy (Felice 2011), and Portugal (Badia-Miró et al. 2012). But other studies have found evidence for continuous convergence e.g. in Sweden (Enflo & Rosés 2015), in France (Combes et al. 2011), and Finland (Enflo 2014).

Williamson's explanation of the bell-shape evolution of regional inequality rests on a model of diffusion, according to which an initial growth impulse first affects only one core region and then diffuses to other regions (Williamson 1965). By focusing only on large geographical entities, such as the North and the South of the USA, Williamson's diffusion model neglects different forms of diffusion and inequality. Hence, it cannot explain, why some countries suffered from a very strong and durable rise in regional inequality, while others experienced very early convergence. To distinguish different forms of diffusion and inequality I extend Williamson's model to a system of regions with several geographical levels. This allows me to distinguish situations with a single core region from situations with multiple core regions and diffusion within large regions from diffusion across large regions. These different modalities imply different patterns for both inequality between and inequality within large regions.

My fine-grained GDP estimates for Switzerland allow me to observe regional inequality at three different geographical levels and apply the extended Williamson model to a particular case study. Switzerland is an interesting case not only because data is available for three different levels, but also because it is a case where regional inequality is low compared to the countries that have attracted most attention. In order to understand the drivers of regional inequality we need to study not only cases where regional inequality is high but also cases where it is low. Note also that regional inequality is not related to the size of a country (Felsenstein 2005). Portugal, Finland, and recently Belgium have seen comparatively high levels of regional inequality, while Sweden and Switzerland experienced rather low regional inequality.

The paper is organized as follows: section 1 presents the territorial subdivisions of Switzerland; section 2 explains the method and data used to estimate regional GDP; section 3 develops a heuristic model of regional inequality; section 4 analyzes Swiss regional inequality at different levels; and section 5 decomposes regional inequality into structure and productivity effects.

1. Territorial subdivisions

The Federal statistical office proposes a two-tiered territorial subdivision suitable for spatial analyses. The lower level *MS regions* are functional micro labor market regions, organized around central place municipalities. They are commonly used for spatial analyses and readily capture agglomeration mechanisms. The second level *Bassin d'emploi* are aggregations of *MS regions* organized around the 16 largest urban agglomerations. They are commonly used for structural regional analyses for example in internationally comparative studies of the OECD (OECD 2001)[1].

Data for these regions is available only since the 1980s. For earlier periods most available data was collected on the basis of administrative entities such as *municipalities*, *districts*, and *cantons*, whereby detailed data was generally not published for municipalities. But, districts and cantons

[1] For a extensive discussion of these and other territorial subdivisions see Schuler (2005).

are not very well suited for spatial economic analyses because these regions are of very different sizes and do not correspond to functional areas. In order to overcome this problem I have reconstructed *MS regions* and *Bassins d'emploi* from the administrative *districts*, for which historical data is available. I call the resulting territorial subdivisions *MSR regions* (=reconstructed *MS regions*) and *BER regions* (=reconstructed *Bassins d'emploi*). By aggregating BER regions I construct a third level of territorial subdivision meant to capture broad regional disparities along topographical and cultural-historical cleavages. The elaboration of these territorial subdivisions allows me to have historical data for regions that are suitable for spatial analysis. Appendix A.1 provides details on the reconstruction of these three territorial subdivisions. And table A4 in the appendix reports descriptive statistics on population and employment for the three geographical levels considered in this paper.

2. Estimating regional GDP for Switzerland

Over the last two decades regional GDP estimates have been developed for many countries. Often these estimates rely on the method proposed by Geary and Stark (2002), which uses the following formula to distribute national value added of large economic sectors on subnational aggregates:

$$Y_r = \sum_{s=1}^{S} \frac{Y_s}{L_s} \beta_s \Pi_{r,s} L_{r,s}$$

with $$\Pi_{r,s} = \frac{w_{r,s}}{w_s} \qquad \beta_s = \frac{Y_s}{\sum_{r=1}^{R} \frac{Y_s}{L_s} \Pi_{r,s} L_{r,s}}$$

where Y_r stands for regional GDP, Y_s/L_s for national value added per worker in sector s, and $L_{r,s}$ for regional employment in sector s. Regional wage differentials, $\Pi_{r,s}$, are used as a proxy for differences in labor productivity among regions and β_s is a scalar that assures that the regional values added in each sector sum up to the national total.

The advantage of this method is the limited data requirement. Most applications use data for only three to five sectors. But there are a few shortcomings as well. First, in production theory and under perfect competition and constant returns to scale, wages are equal to *marginal* productivity. However, the Geary-Stark method uses wages as a proxy for *average* labor productivity. It is well known that in the presence of scale economies and imperfect competition, marginal productivity is not equal to average labor productivity. Regions might well be specialized in industries with significant scale economies and imperfect competition. Second, wage differentials can arise from other factors such as differences in workers' bargaining power, social norms, local amenities, or the institutional context. Third, even if wages were *theoretically* a strong proxy for average labor productivity, the Geary-Stark method relies *practically* too much on wage data. For historical periods, wage data is often difficult to find or its quality and representativeness is highly questionable. The following quotation makes this point clear:

> For purposes of the regional output estimates, we make three main assumptions with respect to wages: first, that male wages relatives accurately reflect the relative average productivity across sectors and countries for all employees; second that industry sector wages may be represented by an average of those in shipbuilding and engineering, and construction; and third, that service sector wages may be represented by a weighted average of the above plus agriculture sector wages. All of these assumptions are imposed on us by data deficiencies. (Geary & Stark 2002, pp.924–5)

For the case of Switzerland, the availability of wage data is actually a major problem, in particular for small geographical subdivisions like the MSR regions or the districts. But luckily there is extremely detailed and geographically fine-grained data on agriculture (cattle and land use) and on employment in manufacturing and services as well as on value added at the national level. These detailed datasets largely compensate for the lacking information on wages. The rest of this section presents the estimation methods and data used for the three sectors.

Agriculture

The available data on agriculture is simply amazing and allows for an estimation that comes close to a direct output measure, rather than an indirect estimate via employment data.

Appendix A.2 reports the original data and intermediate estimation steps. The general estimation procedure is described by the following formula:

$$Y_{r,Agric} = \sum_{j=1}^{J} Y_j \frac{X_{r,j}}{X_j}$$

where $Y_{r,A}$ stands for regional value added in agriculture, Y_j for national value added in subsector *j*, and $X_{r,j}/X_j$ is the region's share of the most important input used in subsector *j*. The subsectors are: cow milk production, veal and beef meat, pork meat, horse meat, chicken meat and eggs, lamb meat and sheep milk, goat meat and milk, fruit, grain, wine, and other plants. The respective inputs are: cows, calves and bulls, pigs, non-work and non-luxury horses, chicken, sheep, goats, fruit trees, grain acres, vine yards, and acres used for other commercial plants.

One might argue that the productivity of the different inputs has probably varied from one region to the other. Particularly, fertility of the soil must be much lower in alpine regions. However, already in 1860 almost fifty percent of agricultural value added originated from animal husbandry, where regional differentials of the main production factor's productivity were certainly less important. By 1910 animal husbandry accounted for 78 percent of agricultural value added. Also, the composition of agricultural value added was very different among regions, with regions heavily specialized in meet or milk production, in grain, vegetable, or fruit growing, or in wine making. This suggests that regions specialized in those subsectors for which the natural environment was best. For example, regions that were not suitable for wine production simply did not have many vineyards, while ideal wine growing regions had fewer prairies and thus fewer cows, veal and bulls. This specialization reduces the bias that might arise from input productivity differentials.

These estimates of agricultural value added rely on much more data than a Geary-Stark estimate and they are much closer to a direct estimate of output. Relying only on wages to infer agricultural productivity differentials might lead to a bias, because peasant family members, who did not stand in a regular employment relation, provided a large part of agricultural labor in some regions, while more institutionalized employment relations were the rule in other regions. Wages of agricultural laborers might not be representative of average labor productivity.

Manufacturing and services

Appendix A.3 provides details on the data and intermediate estimations carried out in the manufacturing and service sectors. The following three steps describe the general procedure applied to the manufacturing sector:

$$\Pi^{P}_{r,Manuf} = \frac{\sum_{i=1}^{I} \frac{Y_i}{L_i} \frac{L_{r,i}}{L_{r,Manuf}}}{\frac{Y_{Manuf}}{L_{Manuf}}} \tag{1}$$

For P = 1 t = 1860, … , 1888; and I = 7

For P = 2 t = 1888, … , 1941; and I = 61

For P = 3 t = 1941, … , 2001; and I = 15

For P = 4 t = 2001, … , 2008; and I = 23

$$\hat{\Pi}_{r,Manuf} = \begin{pmatrix} \Pi^{P=1}_{r,Manuf} \frac{\pi^{P=2,t=1888}_{r,Manuf}}{\pi^{P=1,t=1888}_{r,Manuf}} \\ \Pi^{P=2}_{r,Manuf} \\ \Pi^{P=3}_{r,Manuf} \frac{\pi^{P=2,t=1941}_{r,Manuf}}{\pi^{P=3,t=1941}_{r,Manuf}} \\ \Pi^{P=4}_{r,Manuf} \frac{\pi^{P=2,t=1941}_{r,Manuf}}{\pi^{P=3,t=1941}_{r,Manuf}} \frac{\pi^{P=3,t=2001}_{r,Manuf}}{\pi^{P=4,t=2001}_{r,Manuf}} \end{pmatrix} \tag{2}$$

$$Y_{r,Manuf} = \sum_{s=1}^{S} \frac{Y_{Manuf}}{L_{Manuf}} \beta_{Manuf} \Pi_{r,Manuf} L_{r,Manuf} \tag{3}$$

In a first step I estimate regional labor productivity relative to national labor productivity using national value added per worker and regional employment for as many industries as possible. These productivity differentials are assumed to be most accurate for period 2, where I have data for 61 manufacturing industries. In a second step I use therefore period 2 as a benchmark from which I project the evolution of relative productivity differentials backward and forward. In a third step, these chained productivity differentials are implemented in a Geary-Stark-like estimation.

The procedure applied to services was similar, but the period with the most detailed information was that from 1991 to 2008 (23 subsectors), from which productivity differentials were projected backward to 1860. More details are provided in appendix A.3.

These estimates have several advantages over Geary-Stark-type estimates. First, they rely on much more data and have therefore a stronger empirical substance. Second, they avoid the problems that are inherent to the use of historical wages as a proxy for average labor productivity, and cope with the problem that reliable wage data that covers all sectors at the regional level is not available for Switzerland anyway. This prevents shortcuts as the one proposed for the service sector by Geary and Stark. Third, as my estimates rely on actual data on labor productivity instead of wages, they are much more sensitive to medium term fluctuations of productivity, which might not be captured by wages, that tend to be more sticky.

3. A heuristic model

3.1. *Williamson's bell-shape curve*

Williamson (1965) suggested that regional inequality follows a bell-shape evolution along an economy's long-run development path. The rational behind this bell-shape evolution is that modern economic growth first appears in one region (I will call it the core region). This initial shock leads to divergence between core and periphery, which is then further accentuated by skilled labor migration and capital movements from the periphery to the core as well as by central government policy favoring investment in the core region in order to maximize national growth. In later stages of development, interregional linkages and regional policies become more important leading to transfers of knowledge and capital from core to periphery, triggering ultimately a process of convergence. In the recent literature, the existence of such a spatial Kuznets curve has been confirmed for the USA, Britain, Italy, Spain, and Portugal (Kim 1998;

Crafts 2005; Felice 2011; Martínez-Galarraga et al. 2013), while studies on France, Sweden, and Finland have found a long-term trend of convergence (Combes et al. 2011; Enflo & Rosés 2015; Enflo 2014).

Note that a simple diffusion process implies a bell-shape evolution. Assume a model with one hundred regions, all of which have a per capita income of 1. If one region makes a transition to another economic structure, which multiplies its per capita income, the Gini coefficient of inequality rises from zero to 0.01. This is still a low level of inequality because all regions but one remain perfectly equal. Suppose that this transition diffuses to one region after another. This will lead to an increase in the Gini coefficient until a point is reached where a large proportion of regions have made the transition. At this point further diffusion will reduce inequality and ultimately, when all regions have made the transition, the Gini coefficient will be zero again. In our example the turning point between divergence and convergence is at 41 out of 100 regions. If the transition implies a multiplication of per capita income by 10, the turning point would occur earlier (at 24 out of 100 regions). This bell-shape evolution is not specific to the Gini index. It can also be verified with the Theil index or the coefficient of variation, although the turning point does not occur exactly at the same point.

Williamson's heuristic model can be extended to a hierarchical system of regions with micro regions, labor market basins, and large regions. Furthermore, one can allow for the emergence of several core regions.

3.2. Three geographical levels

In this section I extend Williamson's model to three geographical levels: micro regions, labor market basins, and large regions. Micro regions are functional regions composed of several municipalities organized around one central place town or city. Labor market basins are composed of several micro regions, one of which is a higher-level central place. For simplicity assume that all labor market basins are composed of the same number of micro regions. Finally, labor market basins can be aggregated into different large regions. Assume again that all large regions count the same number of labor market basins.

Inequality can be observed in six different perspectives. At the highest geographical level one can observe inequality between all large regions. At the intermediate level, two perspectives are possible: regional inequality between all labor market basins or regional inequality between labor market basins within each large region. Three perspectives can be taken at the lowest geographical level: inequality between all micro regions, inequality between the micro regions within each labor market basin, or inequality between the micro regions within each large region.

I separate this development into three stages: the initial impulse; the second stage, when the core attracts resources from the periphery; and the third stage, when the transition diffuses from core to periphery. For simplicity assume that the initial impulse is a one-shot increase in per capita income, rather than an increase of the growth rate. This makes the model more easily tractable. Most scholars have interpreted the initial growth impulse of Williamson's model as the transition from an agricultural to an industrial society. However, other transitions can be imagined to have had similar effects, notably the Second industrial revolution or the transition from an industrial to a service economy.

The evolution of regional inequality through the three stages of the model must be more nuanced than in a model with a single geographical level, because the impact on regional inequality depends on the geographical level to be considered. The baseline unit of the model is the micro region: e.g. the initial growth impulse affects a particular micro region. What happens in a micro region also affects the labor market basin and the large region to which this micro region belongs. However, effects will be weaker at higher geographical levels unless all micro regions belonging to the labor market basin (or large region) are affected in the same way. The number of affected micro regions and their belonging to the same or to different labor market basins (or large regions) has therefore an important effect on regional inequality at higher geographical levels. For example the question if growth diffuses only to micro regions within the same large region or also to micro regions in other large regions is essential for inequality at the large region level.

In the next three sections I discuss the evolution of regional inequality at different geographical levels during the three stages of the model. For each stage I distinguish different modalities and their impact on regional inequality.

3.3. The initial impulse: one or several core regions

Following Williamson I assume that the initial impulse does not affect all regions at the same time. Only one or a few micro regions are affected. For simplicity, assume that initially all regions have the same income per capita and that all regions count the same number of workers and inhabitants. Under these circumstances, the initial impulse will lead to a rise in regional inequality. To what extent the different levels are affected depends on how many micro regions are affected by the impulse. I consider three different situations, which are represented by the simulated Gini coefficients in table 1. There are 3 large regions, 15 (=3*5) labor market basins, and 90 (=15*6) micro regions. The corresponding numbers for the Swiss territorial subdivisions are 3, 16, and 97.

In the first situation one micro region of each labor market basin is affected by the impulse. The impulse has the same strength in all affected micro regions (namely a multiplication of per capita income by 2). This will cause an increase of inequality between micro regions in all three perspectives: inequality between all micro regions, inequality of micro regions within each labor market basin, and inequality between micro regions within each large region. Inequality at the level of labor market basins will remain stable, because every labor market basin is affected in the same way (by one of its micro regions). Analogously, inequality at the large region level remains constant as well.

In the second situation only one micro region (and thus only one labor market basin and one large region) is affected by the growth impulse. In this situation inequality between all micro regions, inequality between all labor market basins, and inequality between large regions will rise. Logically, the effect will be largest at the lowest geographical level, whereas it will be “diluted” at higher levels. Regional inequality among micro regions within labor market basins (large regions) will increase only for that labor market basin (large region) to which the affected micro region belongs. And by analogy, regional inequality among labor market basins within large regions increases only for that large region to which the affected micro region belongs.

The third situation is an intermediate case where a few but not all labor market basins have one affected micro region: Seven micro regions located in seven different labor market regions are affected. Two large regions count 3 affected micro regions and one large region has only one affected region. Again, inequality rises at all three levels, but the increase is strongest at the lowest geographical level, as the effect is “diluted” at higher levels.

Compare the coefficients of the different situations. At the micro regional level, inequality is weakest if there is only one affected micro region (situation 2) and highest if each labor market basin counts one affected micro region (situation 1). With 15 out of 90 micro regions we are still situated below the turning point of the bell-shape curve that is typical for diffusion processes. At the level of labor market basins, the coefficients are highest in the intermediate case, where 7 out of 15 labor market regions are affected. This is close to the turning point of the bell-shape curve. Inequality at the large region level remains weak in all situations because the micro level impulses are “diluted”.

3.4. Attraction of resources from within the labor market region or from outside

As in Williamson’s description, selective migration, capital flows, and growth policies increase regional inequality at the micro regional level, but the effect on inequality at higher levels depends on where these resources come from: within or outside the labor market basin. Attraction of resources from micro regions within the same labor market basin will accentuate inequality within the labor market basin and between all micro regions, but it will attenuate inequality between labor market basins. On the other hand, attraction of resources from outside the labor market basin will accentuate inequality between labor market basins and attenuate it within the labor market basin. The rational is analogous for attraction of resources from micro regions within or outside the large region.

3.5. *Diffusion within or across labor market basins*

One can distinguish two modalities of diffusion: diffusion within the same labor market basin or diffusion to micro regions in other labor market basins (or large regions). How do these two types of diffusion affect regional inequality?

Logically, this distinction has no importance for inequality between all micro regions. Here, the relation between the number of affected regions and inequality follows the simply the bell-shaped evolution pointed out above. A similar logic applies to the effect of within diffusion on inequality within the concerned labor market basin. However, as there are only 6 micro regions in a labor market basin the turning point is reached relatively quickly (between 2 and 3 affected regions).

Within diffusion has also an impact on inequality between labor market regions. But the impact depends on how many core regions there are and if within diffusion also occurs in other labor market regions. In a situation combining a single core region (situation 2 of table 1) with pure within diffusion inequality between labor market basins will increase. On the contrary a situation with many core regions (situation 1 of table 1) and simultaneous within diffusion in all labor market basins inequality between labor market basins remains stable.

The effect of diffusion across labor market basins also depends on the situation in the first stage. Starting from a situation with a single core region (situation 2 of table 1), diffusion across labor market basins will first increase and then decrease inequality between labor market basins. Starting from a situation with several core regions (situation 3 of table 1), diffusion across labor market regions will reduce inequality between labor market basins right away.

3.6. *Three ideal-types*

To conclude this section, I distinguish three ideal-type developments.

Type 1, which features a *single core region* and *diffusion within* before diffusion across labor market basins (large regions), is characterized as follows: Initial inequality is low at all geographical levels; subsequently all levels experience a bell-shape evolution; inequality rises faster at higher geographical levels; and convergence occurs earlier at lower geographical levels. This type leads to persistent high inequality at higher geographical levels. Attraction of resources from other labor market basins could even accentuate this feature.

Type 2, which features a single core region and diffusion across before diffusion within labor market basins (large regions), is characterized as follows: Initial inequality is low at all geographical levels; subsequently all levels experience a bell-shape evolution; inequality rises faster at lower geographical levels; and convergence occurs earlier at higher geographical levels. This type leads to persistent high inequality at lower geographical levels. Core regions cast a shadow on their hinterlands. Attraction of resources from within the labor market basin could even accentuate these features.

Type 3, which features many core regions and simultaneous within diffusion from all core regions, is characterized as follows: Initial inequality is high at lower geographical levels, but low at higher geographical levels; subsequently inequality at low levels follows a bell-shape evolution, while inequality remains low or converges quickly at higher geographical levels. This type leads to low inequality at higher geographical levels and to a short but modest increase of inequality at the lowest level.

4. Regional inequality in Switzerland

4.1. Switzerland's regional inequality in international comparison

Figure 1 illustrates regional inequality measured by the Gini index of GDP per capita among the three large regions of Switzerland (LGR) and among the 16 labor market basins (BER). For the labor market basins I provide also a bootstrapped 90% confidence interval. The figure also presents Gini indices of GDP per capita for a few other countries. The comparison clearly shows that Swiss regional inequality was very low during the entire observed period. The Gini coefficient of GDP per capita among the three large regions was lower than the corresponding measure in any other country at any time. The coefficient for the 16 labor market basins was only slightly higher and remained below most of the estimates for other countries.

However, many of the observations for other countries remained within or close to the 95% confidence interval for Switzerland. Many other countries experienced comparably low levels at some moment but much higher regional inequality at other times. Italy and Portugal, which experienced a similar level of regional inequality as Switzerland in the 19th century, stand out for their very high regional inequality in the 20th century. In Finland regional inequality was not significantly higher than in Switzerland around 1920, but it soared between 1930 and 1950. British regional inequality was at the same level as Switzerland's in 1870 but rose in the early 20th century. The remarkable characteristic of Swiss regional inequality is thus not only its low level but also the fact that it remained permanently low.

4.2. GDP per capita versus GDP per worker

Figures 2 to 4 plot different measures of inequality for the three geographical levels for GDP per capita and GDP per worker. Figure 5 provides Gini indices for inequality among micro regions within each labor market region. Note that the different measures of inequality are sensitive to different parts of the distribution. The richest-to-poorest ratio focuses only at the two most extreme cases, while the Gini index focuses on the middle of the distribution. The Theil index is sensitive to the top of the distribution, while the coefficient of variation attributes more weight to large regions in terms of population (for GDP per capita) or employment (for GDP per worker).

The difference between GDP per capita and GDP per worker is driven by differentials in employment rates and by commuting, which is taken into account only from 1910 onwards. For the large regions the difference between the two measures was driven by the fact that the poorer Alpine region had higher employment rates than the two regions of the flat country. This compensated partly for productivity differentials and attenuated inequality in terms of GDP per capita. Commuting started to have an impact on large regions only after 1990.

For labor market regions and micro regions commuting became very important after WWII. As a consequence, inequality was more important in terms of GDP per capita than in terms of GDP per worker. On the one hand, this spatial disconnection between economic activity and residence led to divergence of GDP per capita illustrating the shadow effect that metropolitan areas throw on their hinterlands by attracting economic activity and depriving them of their productive resources. On the other hand, commuting may have contributed to convergence of GDP per worker by three centripetal effects: First, commuters pay taxes at their residence, which implies important transfers of tax income from the centers to the surrounding regions because the lion share of tax collection and public spending in Switzerland occurs at the cantonal and municipal levels. Second, commuters spend an important part of their income at their location of residence supporting the demand for local goods and services. Third, commuting increases knowledge transfers from the center to surrounding regions.

In the heuristic model I noted that attraction of resources from within the labor market basin leads to shadow effects of core regions on their hinterland. In the case of Switzerland this is clearly visible if we focus on GDP per capita, but not if we focus on GDP per worker. This difference stems from the predominant form of resource attraction: commuting, which implies also transfers from core to periphery.

Having discussed the impact of commuting on GDP per capita, the rest of this section will focus on the evolution of GDP per worker.

4.3. Inequality at different geographical levels in Switzerland

Inequality level comparisons across different territorial subdivisions can be made with the Gini index and with the maximum-to-minimum ratio. The latter ratio suggests that regional inequality was higher at lower geographical levels. At the climax of the ratio in 1888 GDP per worker in the micro region of *Zürich und Limmattal* was 2.96 times higher than in *Sierre*, while at the large regions' level the maximum difference between the Western flat country and the Alpine region in 1870 amounted to only 39 percent. Inequality among labor market regions was at an intermediate level, where the ratio reached a maximum of 2.39 in 1888. We can also investigate micro regional inequality within labor market regions. Logically, this type of inequality was lower than inequality among all micro regions pooled together. However, for the most unequal labor market regions (*Lausanne*, *Bern*, and *Sion*) the maximum ratio was larger than two.

As the maximum-to-minimum ratio is very sensitive to extreme cases, one should also consider the Gini index, which is more sensitive to the middle of the distribution. With this measure, inequality levels are practically identical for large regions and for labor market regions. The Gini index for micro regions was somewhat higher, but the difference was significant only after 1970. Micro regional inequality within the different labor market basins varied substantially from one observation to the other. The highest values are found in the labor market regions with the biggest cities (*Basel*, *Genève*, *Bern*, *Zürich*) and in regions of the alpine area (*Lugano*, *Sion*, *Bellinzona*).

In sum, inequality was low at the level of large regions and higher at the micro regional level as it is typical for ideal-types 2 and 3 of the heuristic model. The fact that the Gini coefficients for the three geographical levels were not significantly different from each other in 1860 corresponds rather to type 2.

4.4. The evolution of inequality at different levels

At the micro regional level inequality clearly followed a bell-shape curve. All measures in figure 4 point at a bell-shape evolution of GDP per worker. There is also ample evidence for the bell-shape evolution of micro regional inequality within labor market regions. All regions of the Alpine region, all but one region of the Western flat country, and four out of six regions of the Eastern flat country exhibit a bell-shape evolution. This general trend is summarized by the geometric average of these Gini indices and by a prinicipal component computed from the 16 time series. Hence, the diffusion model, with its inherent bell-shape curve is an adequate theory to explain regional inequality in Switzerland.

The timing of the turning point in the different series of micro regional inequality is also interesting. The most dynamic labor market basins of *Genève*, *Lausanne*, *Zürich*, and *Basel* reached the climax of micro regional inequality at the end of the 19th century. The regions with second tier cities reached the highest values only in 1920 or 1930. *Bern* and *Fribourg*, which contain many agricultural regions, stand out by the very slow convergence among their micro regions. The lagging regions of the alpine area reached the highest inequality levels only in 1930, when the agricultural sector started to decline. Regions that were highly specialized in industries of the First industrial revolution (textiles in *St. Gallen* and watch making in *Bienne*) do not exhibit a bell-shape evolution but rather continuous convergence, suggesting that the turning point has occurred before 1860.

For large regions, on the other hand, all measures indicate a long-term trend of convergence. For labor market basins the evidence is more ambiguous. The maximum-to-minimum ratio follows a bell-shape evolution, while the other measures exhibit no clear trend until 1920. Also, the number of observations is relatively small leading to large confidence bands around the Gini index. Within these bands no clear inference can be made as to the existence of a bell-shaped coefficient. We can therefore neither reject nor confirm that there is a bell-shaped evolution at this level between 1860 and 2008. In fact, even if there was no bell-shape evolution between 1860 and 2008, we can imagine that inequality was lower in the early 19th century than in 1860, which implies a bell-shape evolution over the past 200 years.

How does this evidence refer to our heuristic model? Switzerland does definitely not correspond to ideal-type 1, which implies stronger divergence at higher geographical levels and early convergence at the lowest level. Ideal-type 2 suggests a bell-shape evolution at all levels with stronger divergence at the lowest level and earlier convergence at the higher levels. Ideal-type 3 features a bell-shape at the lowest level and stability or convergence at higher levels. As we can neither confirm nor exclude the bell-shape evolution at higher levels it is difficult to choose between the two ideal-types.

Figure 5 provides additional information. Several labor market basins exhibited rising inequality at the end of the 19th century, suggesting that they were affected by a growth impulse. Also, there seem to be affected labor market basins in all three large regions. However, the increase of inequality was stronger in some cases than in others and there are also labor market basins, where micro regional inequality did not increase at this moment. This suggests that Switzerland counted several core regions but some of them experienced weaker impulses than others.

Some labor market basins exhibited a sharp rise of micro regional inequality in the interwar period. This might well correspond to an incident of cross labor market diffusion. Inspection of the underlying data provides some evidence. Between 1920 and 1930 several micro regions of the labor market basin *Valais* have forged ahead between 1920 and 1930 due to fast growth in a few industries that were at the forefront of the growth impulse of the Second industrial revolution at the end of the 19th century, namely aluminum, chemicals, electricity, and railways. This is in line with ideal type 2.

Switzerland was thus an intermediate case with several core regions, but some labor market basins that were affected only later by diffusion across labor market basins. It was this coexistence of several core regions and the ease of diffusion across different labor market basins and large regions, which allowed for Switzerland's permanently low inequality at higher geographical levels. At the micro regional level inequality has risen temporarily following the typical bell-shape evolution. But, as diffusion occurred also within labor market regions the turning point was reached early and micro regions converged already from 1900 onwards.

Finally, the transition from an industrial economy to a service economy, which accelerated after 1990, seems to have launched a new cycle corresponding to our heuristic model. Inequality-increasing growth impulses occurred in several micro regions of different labor market basins and large regions at roughly the same time. This increased regional inequality at the micro regional level and at the level of labor market basins and caused a halt of convergence among large regions. But as the impulse occurred in several labor market regions and large regions at more or less the same time, divergence was only short lived at these higher geographical levels. Again, there seem to have been several core regions implied in this transition.

5. Structure, productivity, and comparative advantage

In this section I investigate three proximate determinants of regional inequality, namely structural differences, productivity differentials, and interactions between specialization and relative productivity. The decomposition of regional inequality used in this section is an improvement on a methodology first proposed by Hanna (1951), and subsequently employed by Kim (1998), LaCroix (1999), Rosés et al. (2010) and Martinez-Galarraga et al. (2013). Appendix A.4 provides a detailed discussion of this decomposition method. Here I limit myself to a short exposition.

Relative GDP per worker of region *r* is defined by the following index number:

$$\Upsilon_r = \frac{\mathrm{Y}_r/\mathrm{L}_r}{\mathrm{Y}/\mathrm{L}} = \frac{\sigma_{A,r}p_{A,r} + \sigma_{M,r}p_{M,r} + \sigma_{S,r}p_{S,r}}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S} \tag{4}$$

The shares of agriculture, manufacturing, and services in total employment are noted by σ_A, σ_M, and σ_S; and $p_A = \mathrm{Y}_A/\mathrm{L}_A$, $p_M = \mathrm{Y}_M/\mathrm{L}_M$, and $p_S = \mathrm{Y}_S/\mathrm{L}_S$ stand for labor productivity in the three sectors. Parameters with subscript *r* refer to region *r*, while parameters without subscript refer to the national level. Equation (4) minus one provides a measure of the region's productivity gap to the national level, which is positive for regions with comparatively high productivity and negative for regions with comparatively low productivity. There are two sources of variation in equation (4), namely economic structure and productivity, but there can also be an interaction effect between the two.

The structure effect is straightforward. *Ceteris paribus*, a region, which specializes in sectors with relatively high productivity, will have a high GDP per worker. This relates to our heuristic model. As productivity was higher in manufacturing and services, regions that reallocated resources from agriculture to these sectors increased their GDP per worker. Thus, if the initial growth impulse of our heuristic model is related to this structural transformation, we expect the structure effect to be important. I measure the structure component with a Laspeyres structure index

$$\Sigma_r^L = \frac{\sigma_{A,r}p_A + \sigma_{M,r}p_M + \sigma_{S,r}p_S}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S} \tag{5}$$

The productivity component measures the effect of within-sector productivity differentials. These can arise from disparities in endowments (e.g. capital intensity, land-labor ratio), factor productivity (e.g. technology, human capital, fertility of the land), or scale economies (which depend on market access). I measure the productivity component with a Laspeyres productivity index

$$\mathrm{P}_r^L = \frac{\sigma_A p_{A,r} + \sigma_M p_{M,r} + \sigma_S p_{S,r}}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S} \tag{6}$$

The interaction effect is related to comparative advantage. According to the Ricardian trade model, regions specialize in that sector in which they enjoy comparatively high relative productivity. I measure the comparative advantage component with the ratio of the Paasche and Laspeyres structure indices. The intuition behind this measure is that the Paasche structure index measures the effect of structure taking the relative productivity levels of the *region* into account, whereas the Laspeyres structure index measures the effect of structure taking *national* relative productivity levels as given.

$$C_r^P = \frac{\Sigma_r^P}{\Sigma_r^L} \tag{7}$$

Multiplication of the three components yields relative GDP per worker.

$$\Upsilon_r = \mathrm{P}_r^L \Sigma_r^L \mathrm{C}_r^P \tag{8}$$

5.1. Decomposition of the Alpine region's productivity gap

At the large region level, the main symptom of inequality was the lag of the Alpine region, while GDP per worker of the two regions of the flat country remained most of the time within 5 percent of the national average. Until 1920 the Western flat country was leading, and thereafter the Eastern part took a slight advantage.

Table 2 decomposes the Alpine region's productivity gap. Until 1930, GDP per worker was roughly 20 percent lower than the national average. Thereafter, it converged toward the national level and by 2008 it was only 5.3 percent below. Generally, all three components contributed to the productivity gap. The relative weight of the two components varied over time. In 1870 and 1880, productivity dominated; while structure was more important between 1888 and 1941; and productivity was again clearly dominant after 1970, while economic structure had only a very weak impact. Until 1941, agriculture drove the productivity component; whereas low productivity in services was the problem after 1970. Surprisingly, manufacturing productivity was often even an inequality-reducing factor.

The fact that the structure component dominates between 1888 and 1941 is in line with the heuristic model. The alpine region fell further behind, because it remained predominantly agricultural, while the transition to manufacturing and services was already well advanced in the flat country. However, the strength of the productivity component until 1941 reveals that endowments, factor productivity, or market access contributed also significantly to the alpine region's lag. My guess would be that in agriculture the fertile land-to-labor ratio, capital intensity (use of machines), and the cattle-to-labor ratio were most important, while human capital and market access were determinant in services.

The comparative advantage effect was generally negative. Closer inspection of the economic structure and productivity patterns in the Alpine region shows how come. The region was strongly specialized in agriculture. Until 1941, the share of agricultural employment in this region was generally about 20 percentage points higher than at the national level. At the same time relative agricultural productivity was particularly low in the alpine region. The important point here is that *relative* agricultural productivity was lower in the alpine region than at the national level

$$\frac{p_{A,r}}{p_r} < \frac{p_A}{p} \tag{5}$$

For example in 1910, the left hand side of equation (5) was 0.48 and the right hand side was 0.58. This translates a comparative disadvantage in agriculture. Hence, according to Ricardo's theory of comparative advantage, the alpine region should rather have specialized in manufacturing, where the corresponding ratio was 1.20 for the alpine region compared to 0.92 for the national level. As we will see in the next section, the failure to specialize along comparative advantage is emblematic for the poorest regions, which suffer from triple negative effect: unfavorable structure, low productivity, and a negative interaction between structure and productivity.

5.2. Structure, productivity, and comparative advantage in micro regions

Instead of discussing the structure and productivity effects in each of the 97 micro regions, I isolate a few general patterns. Figure 7 provides a summary of productivity and structure effects among different segments of the distribution. Regions are ordered from richest to poorest in terms of GDP per worker and then aggregated by groups of five. The top left panel shows averages of GDP per worker by group. The relation between rank and GDP per worker resembles a cubic function, indicating that differentials were particularly large among the richest and the poorest regions. Over time, the curvature of the tails first increased slightly and then decreased markedly. This flattening out of the tails of the distribution drove the reduction of inequality after 1920, while the slope in the middle of the distribution remained stable. That means that increasing and decreasing differentials among the richest and among the poorest regions drove divergence and convergence, while inequality remained stable in the middle of the distribution. This translates the forging ahead of a few core regions and the lack of diffusion of growth to the most backward regions.

The bottom panels show averages of structure effects and averages of productivity effects for the same groups of regions. The structure effect has a pronounced cubic form with a long bottom tail and a short but steep upper tail. Again the curvature of the tails became more pronounced in the second and third periods and in the last two periods the tails bent back, so that after 2001 all groups had weak average structure effects. Until 1990 almost all groups had negative average structure effects. Only the top three groups benefitted from positive effects. This is in line with our heuristic model, particularly with ideal-type 2. Core regions had undergone a structural transformation, which gave them a distinct advantage.

Average productivity effects exhibit an almost linear relation to GDP per worker rankings. Over time, the curve shifted to the left indicating that the proportion of groups that had positive average effects diminished. The comparison of the two graphs allows for an evaluation of the relative weight of structure and productivity effects. For the richest group, the structure effect dominated. For the rest of the upper half of the distribution the two effects were roughly equilibrated. For the bottom half of the distribution the relative weight of the effects evolved over time with productivity dominating in the first period and the last two periods and structure dominating between 1888 and 1941.

The upper right panel shows the extent to which regions were specialized along comparative advantage. Not surprisingly the largest part of the distribution specialized along comparative advantage. However, one can distinguish four groups of regions with respect to structure effects and comparative advantage. First, regions with positive structure effects and successful Ricardian specialization were regions with either big cities or high-productivity clusters. This combination was typical for the richest regions. Second, regions that combine positive structure effects with a Ricardian failure are second tier cities or clusters of industries with medium to low productivity. This combination is found among regions ranked 5th to 30th. Third, regions with a negative structure effect and successful Ricardian specialization were mostly agricultural areas of the flat country, which enjoyed comparatively high relative agricultural productivity. This was the most frequently found configuration, which was typical for regions ranked 30th to 75th. Fourth, regions combining a negative structure effect and a Ricardian failure were typically agricultural regions of the alpine area with very low (relative) agricultural productivity. These were the poorest regions ranked 75th to 97th.

5.3. *The bell-shape curve*

How did structure and productivity effects evolve over time and how does this evolution refer to our heuristic model? Figure 8 illustrates Gini coefficients on the three component indices for the three geographical levels. The structure component followed a bell-shape evolution on all three levels. This is an intuitive result and corroborates our heuristic model. The initial impulse triggered structural change in a few regions. As some regions became dominated by manufacturing and services, while others remained predominantly agricultural, the structure effect increased but when a large number of regions had made the transition structure effects decreased again.

The productivity component followed a U-shape evolution. Decreasing agricultural productivity effects and increasing productivity effects of manufacturing and services drove this result. Again, this is in line with the heuristic model. As more and more regions reduce the share of agriculture, the effect of productivity differentials in this sector became smaller and the effect of productivity differentials in the other sectors increased. Note that the productivity component was higher in the early periods when agriculture dominated than during the later periods when manufacturing and services dominated. This is a consequence of the fact that productivity differentials tend to be larger in agriculture than in manufacturing and services. Switzerland's strong topographic diversity probably accentuated productivity differentials in agriculture.

The comparative advantage effect, which was generally weaker than the structure and the productivity effect, exhibited a slight bell-shape evolution. In the middle of the structural transition the opportunities for successful and the risk of unsuccessful specialization were certainly most important.

Given that the structure and productivity effects followed opposite patterns, it is the relative importance of the two effects that determined whether GDP per worker followed a bell-shape evolution, a constant trend, convergence or divergence. The situation in Switzerland was one of mulitple core regions that were scattered over several labor market basins and over all three large regions. Thus the structure effect was more important at the micro regional level than at higher levels. We therefore observe a bell-shape evolution at this level. At higher geographical levels the structure effect was weaker and in early periods when the productivity effect was particularly high, the rise of the structure component was compensated by the falling productivity component.

6. Conclusion

This paper estimates regional GDP for three different geographical levels in Switzerland. The estimation method distributes national value added by sector on the different regions, which is similar to the method proposed by Geary and Stark (2002). But instead of relying on wage data for broad economic sectors, my estimates for agriculture rely on detailed information on cattle and usage of the soil, while the estimates for manufacturing and services draw on very fine-grained data on industrial structure.

I adapt Williamson's (1965) heuristic model of the relation between economic development and regional inequality to a system of regions with three geographical levels. Three ideal-types are developed. The first one features a single or very few core regions and a type of diffusion that occurs predominantly within certain larger regions. This leads to strong divergence at higher geographical levels. The second ideal-type features a single core region but subsequent diffusion across different large regions. This leads to high inequality between micro regions but low inequality between large regions. The ideal-third type features many core regions and subsequent within diffusion. This leads to a very low level of regional inequality at all levels, although in an intermediate stage of the development process inequality rises at the lowest geographical level.

Switzerland appears to be an intermediate case of types 2 and 3. There were multiple initial core regions in several labor market basins and large regions and there is evidence for both diffusion within and diffusion across different labor market basins and large regions. Swiss regional inequality between labor market basins and large regions was thus relatively low in international comparison, while inequality at the micro regional level was considerable. Unfortunately, international comparisons are impossible for this level, because comparable data is not available for other countries.

Further research should investigate what determines the different types of development. More precisely, what allows for the emergence of multiple core regions and what facilitates diffusion across different parts of a country or diffusion within certain larger regions? A few particularities of the Swiss case might explain the emergence of multiple core regions and the diffusion across different areas. First, market and state integration was comparatively low in the mid-19th century (Bernegger 1990; Humair 2004; Chilosi et al. 2013). Nonetheless a few regions such as Geneva, Basel, Zurich, Neuchâtel, and St. Gallen benefitted from direct links to world markets. This situation may be more conducive to the emergence of several core regions than a situation with a well-established central power and integrated internal markets. Second, market integration was very fast after 1850 due to the construction of one of the densest railway networks of Europe. This may have fostered both types of diffusion. Third, Switzerland has a strong federalist structure, which attributes large competencies to regional and local governments. This may have fostered emulation of core regions and diffusion across labor market regions and large regions.

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Tables and figures

Table 1: Simulated Gini coefficients for the heuristic model

	Situation 1: One core region per labor markt basin	Situation 2: One micro region in one labor market basin	Situation 3: Seven core regions in seven labor market basin of three large regions (3,3,1)
Inequality among micro regions			
all micro regions	0.119	0.011	0.067
within affected labor market basin	0.119	0.119	0.119
within non-affected labor market basin		0.000	0.000
within affected large region	0.119	0.031	0.082
within non-affected large region		0.000	
Inequality among labor market basins			
all labor market regions	0.000	0.010	0.038
within affected large region	0.000	0.026	0.036
within non-affected large region		0.000	
Inequality among large regions			
all large regions	0.000	0.007	0.014

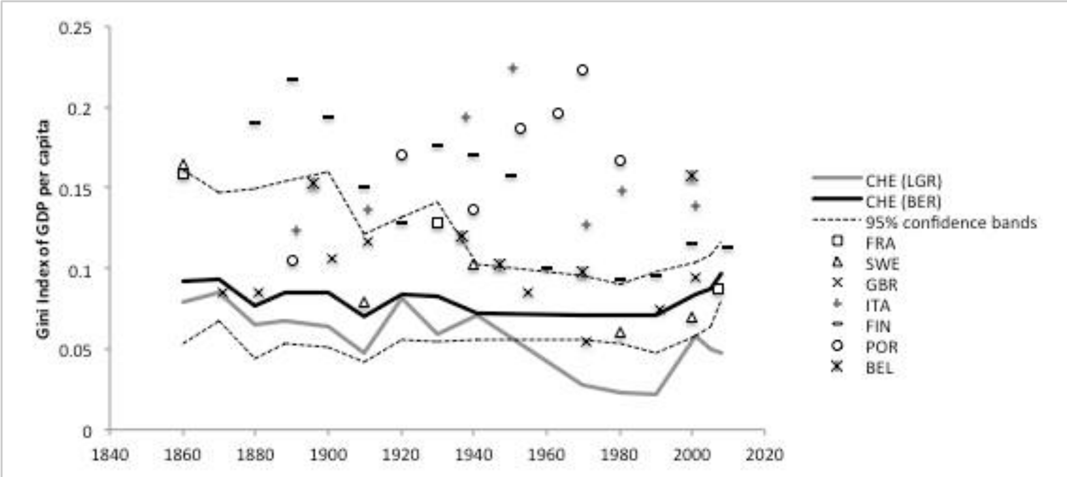
Note: Affected regions experience a multiplication of income per capita by 2, but no increase in growth rates. Initially all regions have the same income per capita.

Table 2: Decomposition of the Alpine region's productivity gap

	Productivity						
	Agriculture	Manufacturing	Services	Total	**Structure**	**Comparative Advantage**	**GDP per worker**
1860	-5.7	0.0	-0.5	-6.2	-8.7	-3.3	-17.2
1870	-7.5	-3.3	-1.6	-12.4	-8.2	-3.0	-22.1
1880	-6.5	-0.3	-3.2	-10.0	-6.5	-3.7	-19.0
1888	-6.1	-0.5	-1.6	-8.2	-12.2	-4.1	-22.8
1900	-6.2	0.8	-1.0	-6.4	-11.6	-5.3	-21.6
1910	-5.6	2.8	-2.1	-4.9	-8.9	-5.3	-18.0
1920	-5.7	2.2	-3.5	-7.1	-12.0	-6.7	-23.7
1930	-4.3	0.2	-1.9	-6.0	-9.3	-3.9	-18.1
1941	-3.6	0.6	-3.3	-6.3	-9.0	-3.1	-17.4
1970	-2.0	-2.0	-4.6	-8.6	-0.8	-0.7	-10.0
1980	-1.7	-2.0	-4.2	-7.9	-0.2	-0.3	-8.3
1990	-0.4	-1.7	-4.4	-6.5	0.5	0.0	-6.0
2001	-0.4	0.0	-5.0	-5.4	-0.3	-0.1	-5.7
2005	-0.4	0.1	-5.1	-5.5	-0.1	0.0	-5.6
2008	-0.4	-1.4	-3.4	-5.2	-0.1	0.0	-5.3

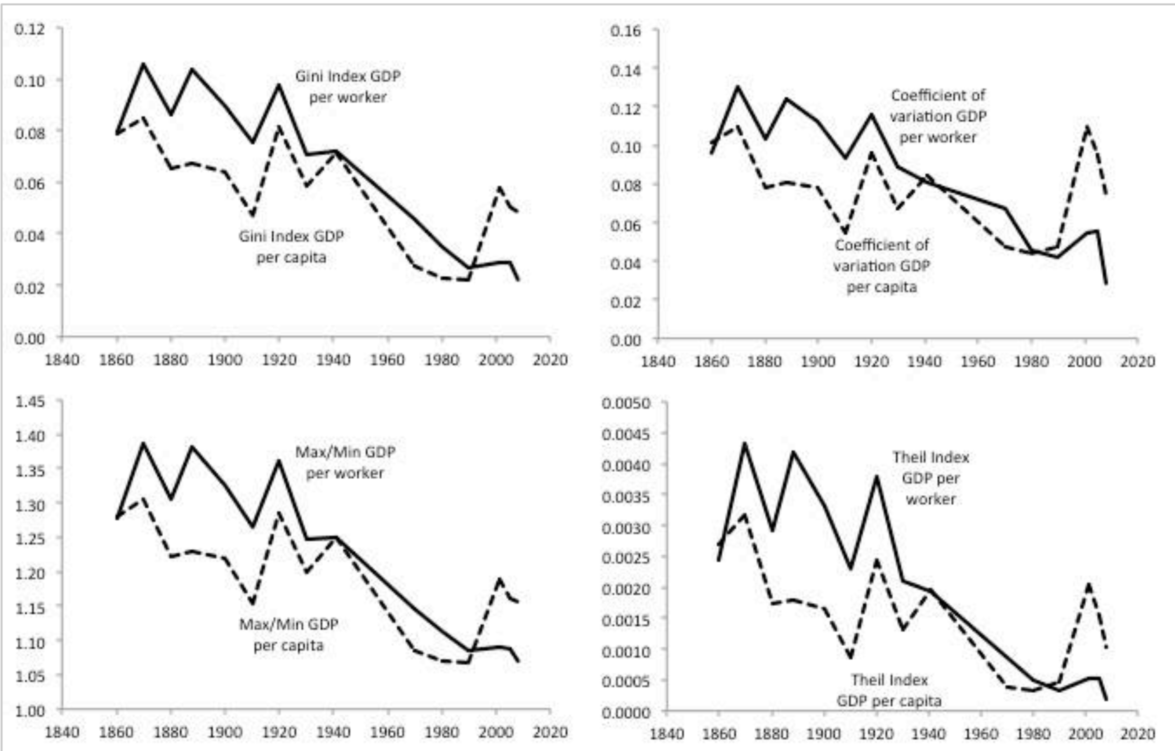
Note: The reported numbers are Laspeyres indices minus 1 and expressed as percentages. The measure for comparative advantage is the ratio between the Paasche and Laspeyres structure indices minus one and expressed as a percentage. For details on the methodology see Appendix A.4.

Figure 1: Regional inequality in international comparison



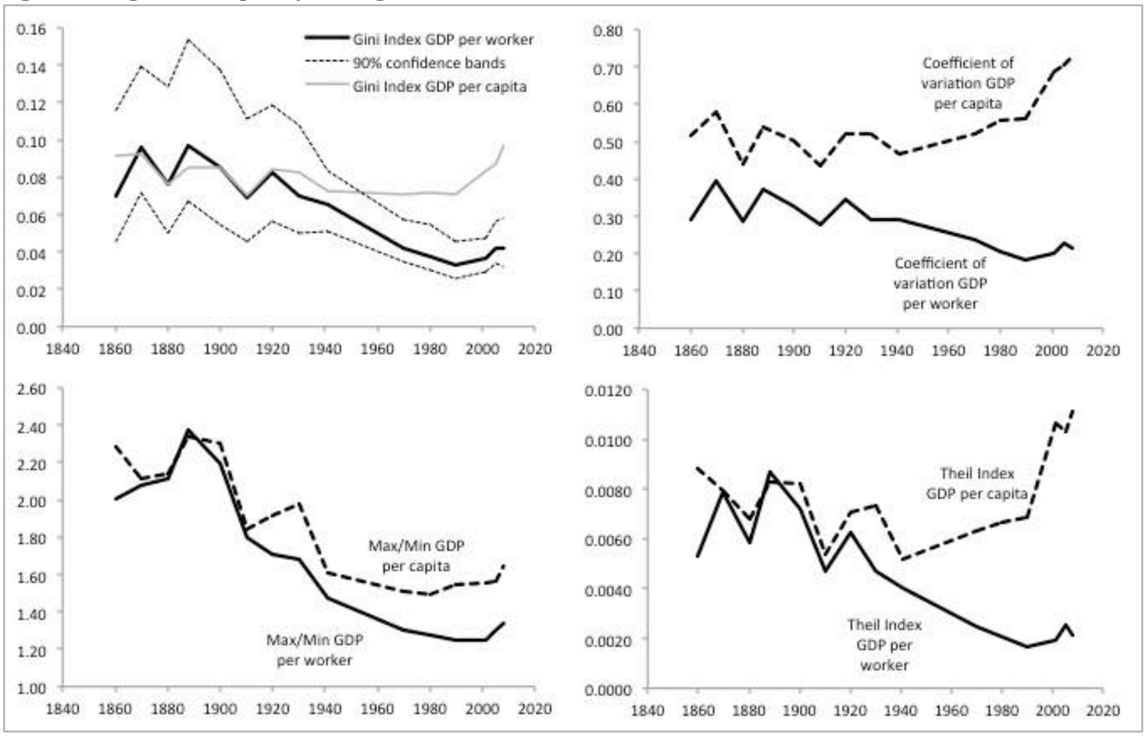
Note: Gini coefficients are bias-corrected. Confidence intervals were calculated from 1000 bootstrap repetitions. Data for French departments in 1860 and 1930 from Combes et al (2011); for French departments in 2007 from Eurostat GDP at current market prices by NUTS 3 regions [nama_10r_3gdp]; for Sweden from Enflo et al. (2015); for Britain from Crafts (2005); for Italy from Felice (2011); for Finland from Enflo (2014); for Portugal from Badia-Mirò et al (2012); and for Belgium from Buyst (2009).

Figure 2: Regional inequality among large regions



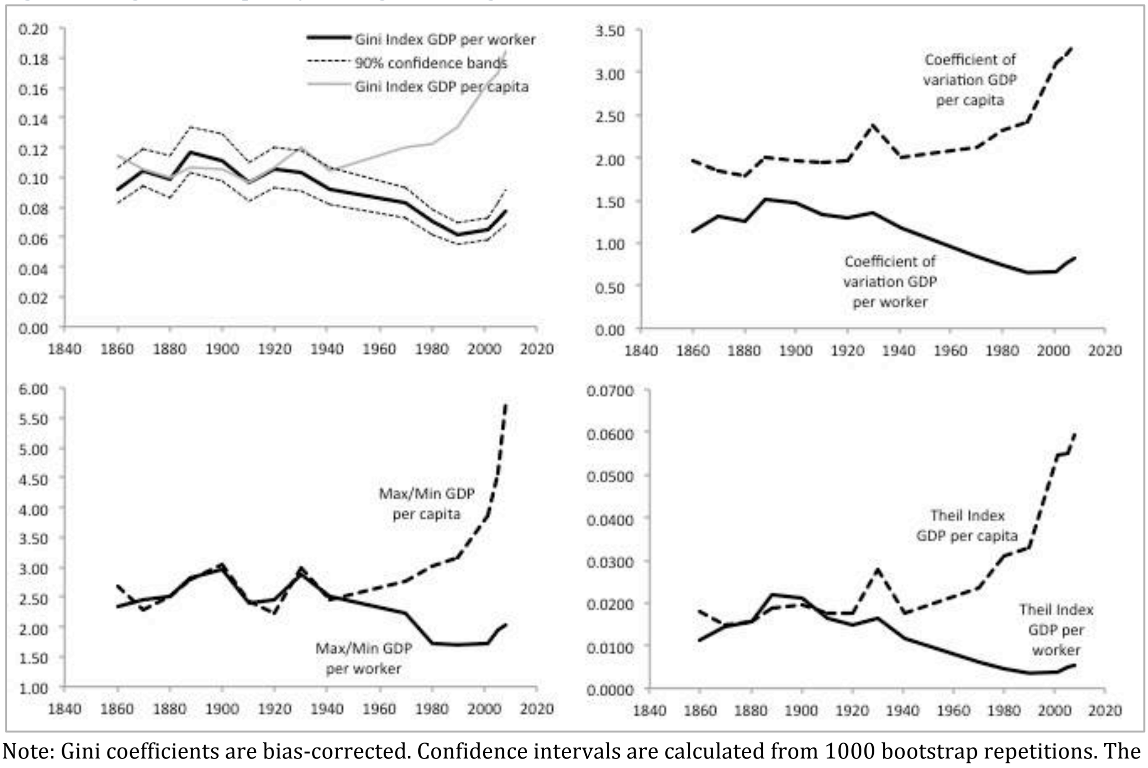
Note: Gini coefficients are bias-corrected. The coefficient of variation of GDP per capita is weighted by population as suggested by Williamson (1965). Analogously, the coefficient of variation of GDP per worker is weighted by employment. The Theil T index is weighted by GDP shares.

Figure 3: Regional inequality among labor market basins



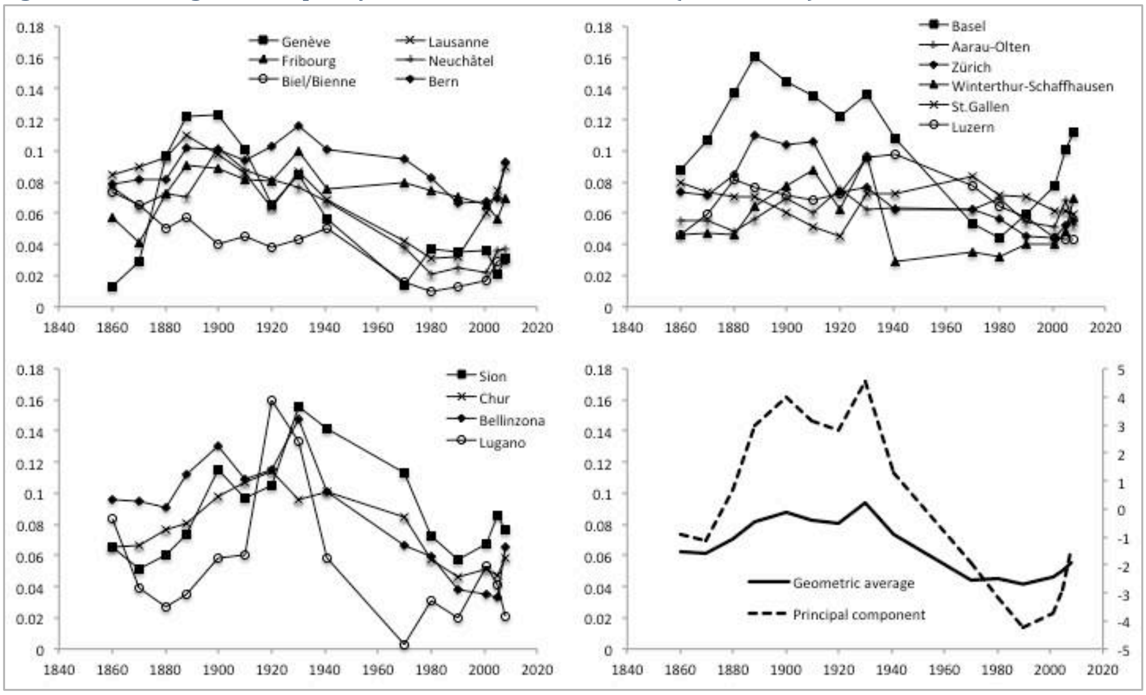
Note: Gini coefficients are bias-corrected. Confidence intervals are calculated from 1000 bootstrap repetitions. The coefficient of variation of GDP per capita is weighted by population as suggested by Williamson (1965). Analogously, the coefficient of variation of GDP per worker is weighted by employment. The Theil T index is weighted by GDP shares.

Figure 4: Regional inequality among micro regions



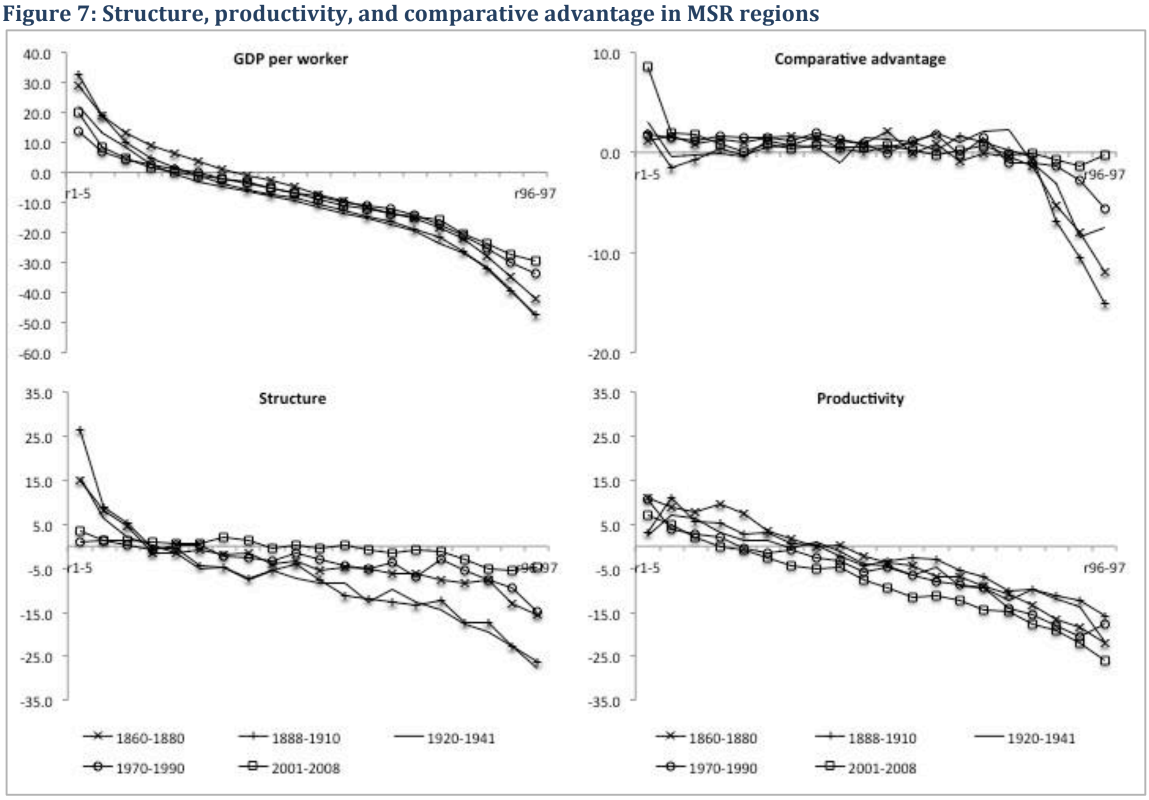
Note: Gini coefficients are bias-corrected. Confidence intervals are calculated from 1000 bootstrap repetitions. The coefficient of variation of GDP per capita is weighted by population as suggested by Williamson (1965). Analogously, the coefficient of variation of GDP per worker is weighted by employment. The Theil T index is weighted by GDP shares.

Figure 5: Micro regional inequality within labor market basins (Gini indices)



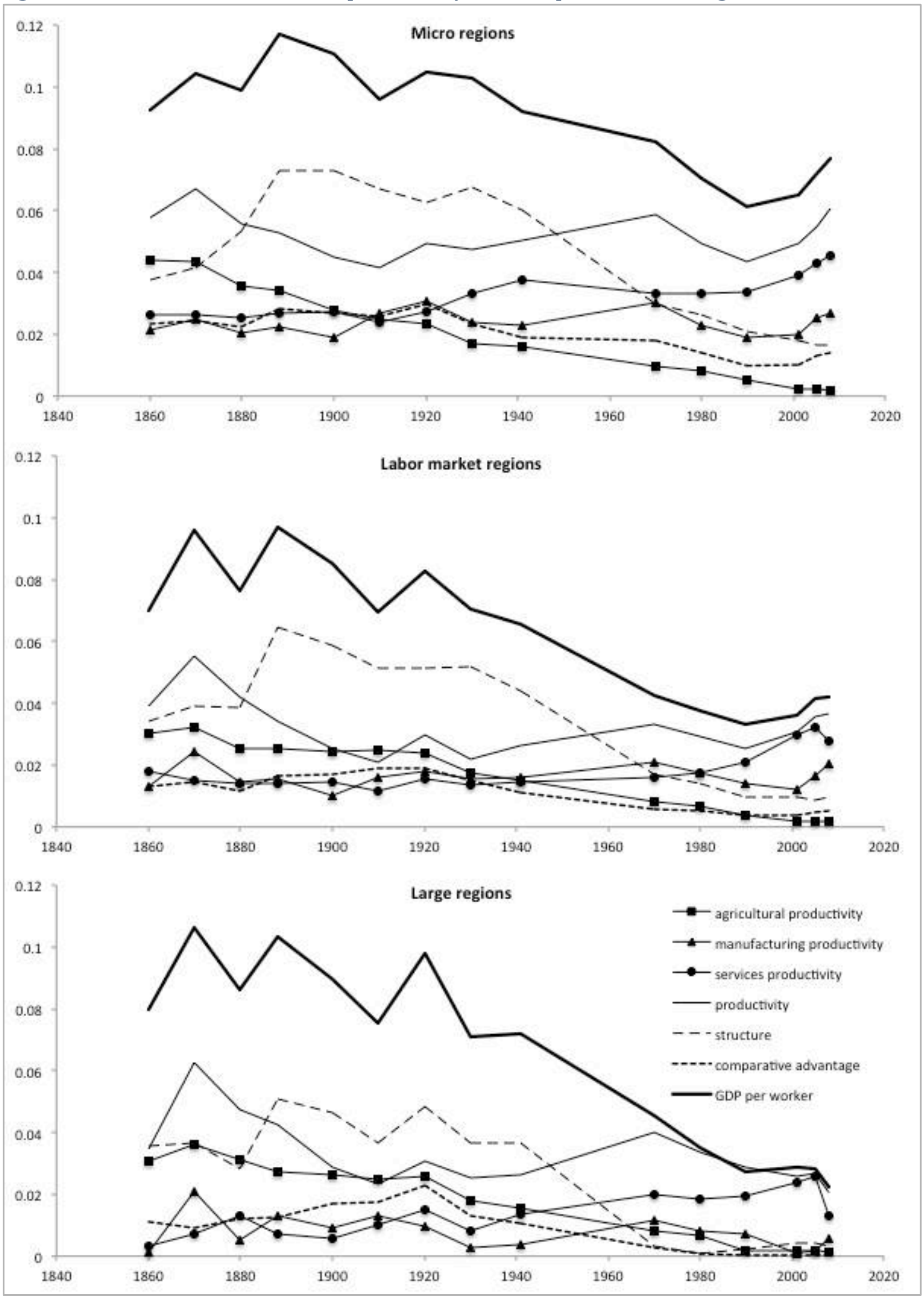
Note: Gini coefficients are bias-corrected. Confidence intervals are calculated from 1000 bootstrap repetitions. The coefficient of variation of GDP per capita is weighted by population as suggested by Williamson (1965). Analogously, the coefficient of variation of GDP per worker is weighted by employment. The Theil T index is weighted by GDP shares.

Figure 7: Structure, productivity, and comparative advantage in MSR regions



Note: Regions are ordered from richest to poorest in terms of GDP per worker and aggregated by groups of five (r1-5: regions ranked first to fifth, r.6-10: regions ranked sixth to tenth). The last group is composed of only 2 regions. The presented values are group averages of relative GDP per worker minus 1, the Laspeyres structure index minus 1, the Laspeyres productivity index minus 1, and the ratio of Paasche to Laspeyres structure indices.

Figure 8: The evolution of structure, productivity, and comparative advantage over time



Note: Graphs report Gini coefficients computed on Laspeyres structure and productivity indices, the ratio of Paasche to Laspeyres structure indices, and GDP per worker.

Multiple Core Regions: Regional Inequality in Switzerland, 1860 to 2008

Online Appendix

This appendix explains the construction of territorial subdivisions (appendix A.1); provides sources and details on intermediate steps of the estimation of regional value added in agriculture (appendix A.2), industry (appendix A.3), and services (appendix A.3); and provides a detailed discussion of the method of decomposition of regional relative value added into structure, productivity, and comparative advantage components (appendix A.4).

Appendix A.1: Territorial subdivisions for Switzerland

Different types of territorial subdivisions exist in Switzerland. The institutional entities order the territory on three distinct hierarchical levels: 26 cantons, 184 districts (internal subdivisions of cantons), and 2896 municipalities (state in the year 2000). While cantons and municipalities play an important political role, the districts have only administrative importance. The main advantage of these institutional entities for the historian is that they have been the key territorial entities for statistical data publication since 1798 and that they have remained remarkably stable until the year 2000. Most statistics published since the formation of the modern Federal state in 1848 are reported for the national and the cantonal level. For multidimensional data, for example employment by industry, publication for the municipal level was impossible before numerical data treatment, so that the districts were often the lowest level for which such data was published. This gives a certain importance to the districts for historical statistics (Schuler et al. 2005). A clear disadvantage of the institutional entities is that they are not comparable in terms of size. This is particularly true with the cantons. Table A1 reports descriptive statistics of area size for the different territorial subdivisions. The smallest canton fits 183 times into the largest one. The standard deviation of the cantons' areas is even larger than the mean area of a canton. The ratio between the largest and the smallest district is even bigger than for cantons, but the coefficient of variation shows that districts are on average more comparable than cantons. To some extent different sizes are acceptable, because alpine regions are often large but include a lot of unproductive and not inhabitable terrain. But the large differences among the cantons and the districts even outside the alpine area are a serious problem for statistical analysis of spatial economic phenomena. Another problem of cantons and districts is that economic, social and cultural structures do not always coincide with administrative borders. In many cases administrative borders separate completely integrated agglomerations or lump together regions that belong to different functional areas. To tackle these problems, different territorial subdivisions have been constructed for spatial analysis.

The most important territorial entities for spatial analysis are the 106 MS regions (MS = *movement spatial*), the 16 *bassins d'emploi* (hereafter BE regions), and the 7 NUTS II regions (*Nomenclature des Unites Territoriales Statistiques*). MS regions are comparable and functional micro-regions that were constructed in 1982 for the analysis of spatial mobility (Bassand et al. 1985). They have been constructed from existing, policy relevant, and functional regions: the territorial planning regions of the flat country; and the HIG (*Bundesgesetz über die Investitionshilfe für Berggebiete*) regions of the alpine zone that have been elaborated in 1974 for the administration of subsidies to mountain regions (Schuler et al. 2005). MS regions can be qualified as local labor market regions. Schuler et al. classify MS regions into 12 types of regions according to their social, cultural, and economic structures as well as their interaction with other regions (Schuler 1983). MS regions are more homogeneous and comparable in terms of area size than the institutional entities. However a certain inequality remains. This is partly due to the fact that MS regions of the alpine zone are larger because they include large parts of uninhabitable terrain.

The BE regions constitute regional labor markets composed of several MS regions. BE regions essentially reproduce a central-place structure organized around the MS regions that correspond to the large and intermediate urban centers of Switzerland. Surrounding MS regions were aggregated to the centers according to patterns of spatial mobility (Schuler et al. 2005). BE regions are most relevant for the analysis of regional economic structures. This is why the OECD also uses those regions for international comparisons of regional disparities, while for most other countries NUTS II regions are used (OECD 2001). BE regions are not only functional but also comparable among each other. Differences in size among these regions are due to three facts: larger cities attract commuters from farther away (e.g. *Zürich*); some cities operate as centers for large rural areas (e.g. *Chur*, *Sion*); and some cities have part of their hinterland in neighboring countries, which are not included (*Genève*, *Basel*, *Lugano*). Ideally cross-border regions should be included entirely, which is on the agenda for future research.

The elaboration of Eurostat-compatible NUTS II regions has started 1989. But the process has rapidly turned into a political issue with certain cantons refusing to be aggregated and others spanning together in order to militate for a strong common position (Schuler et al. 2005). In 1997, Switzerland finally adopted a supra-cantonal subdivision of the territory into 7 regions, aggregated from cantons. However a number of problems are inherent to this territorial decomposition. First, for a subdivision in only 7 regions, the differences in area sizes are considerable. Second, these territorial delimitations stand at odds with functional integration of areas. For example, *Zürich* is the largest and most important metropolitan area but the smallest NUTS II region. In fact, parts of *Zürich*'s metropolitan area fall into the NUTS II regions of Eastern, Central, and Northwestern Switzerland. The cantons of *Aargau*, *Zug*, *Glarus*, and *Schaffhausen*, which are part of other NUTS II regions have certainly a stronger functional relationship to Zürich than to the centers of their own region. In comparison the *Région lémanique* appears very large, including important rural areas of the alpine region, that have no particular connection with the urban centers of *Genève* or *Lausanne*. Given the differential treatment of *Zürich* and the *Région lémanique* a comparison of these two areas is seriously flawed.

In sum, MS and BE regions are very well suited for the analysis of spatial economic phenomena, while the institutional subdivisions and the NUTS II regions must be used cautiously. A problem for historical analysis however is that MS and BE regions were created only in 1982 and historical data for these entities does not exist. Here, I propose to use the districts as a basis for reconstructing historical MS and BE regions. I call the resulting subdivisions MSR regions (MSR = Reconstructed MS) and BER regions (BER = Reconstructed *Bassins d'emploi*). Here is a description of the procedure, how the MSR were assembled:

1) I constructed a data set for all Swiss municipalities with: population in 2000 by municipality according to the population census (BFS 02); district to which a municipality belongs (BFS 01); MS region to which a municipality belongs (BFS 01).
2) I calculated the percentage of each district's population, which belongs to a certain MS Region: 123 out of 184 districts have 100% of their population in only one MS region; 20 districts have between 90% and 100% of their population in one MS region; 30 districts have between 60% and 90% in one MS region; and only 11 districts have less than 60% of their population in one MS region.
3) I assigned districts to the MS region to which the largest percentage of their population belongs.
4) Some MS regions could not be reconstructed. This was the case if the population of two MS regions was contained in one single district. In such cases I merged the corresponding MS regions into one MSR region. This happened for 8 regions.
5) Additionally, I decided to merge *Baselstadt* and *Unteres Baselbiet*. Two reasons lead to this decision. First *Baselstadt* is much smaller than all other MS regions, in particular it is not comparable to the MS regions of the other large cities, *Zürich*, *Genève*, *Bern* that include a larger part of their cities hinterland. Second, commuting

was very important between these two regions already in 1910. By merging the two regions, I circumvent the problem of lacking data on commuting before 1910.

Points 4) and 5) imply that the resulting territorial subdivision counts only 97 MSR regions instead of 106. Table A2 provides the corresponding conversion table. Table A1 shows that MSR regions are much more comparable than districts and cantons.

BER regions are assembled from MSR regions. The aggregations are analogous to the official conversion from MS regions to BE regions provided by the Federal statistical office. Table A3 offers an adapted conversion table from MSR to BER regions. The highest territorial subdivision separates Switzerland into three large regions. These regions are again assembled from the lower BER level (table A3). The aggregations follow broad topographic and cultural-historical patterns, separating the alpine region from the flat country and dividing the flat country into East and West. The Western part of the flat country comprises the French-speaking parts including the bilingual BER region of Biel/Bienne as well as the BER region of Bern, which as the center of the *Burgundian Eidgenossenschaft* was historically rather westward oriented (Zahnd 2003).

Table A4 provides descriptive statistics on population and employment for the three geographical levels to be considered in this paper.

Appendix A.2: Estimation of regional value added in agriculture

This and the next section provide details on data and methods of the regional GDP estimates. These estimates rely on the production approach. National value added in different industries and subsectors of the agricultural and service sectors is distributed on different regions. The regions correspond to the three geographical levels presented in the last section. The periods for which regional value added was estimated are 1860, 1870, 1880, 1888, 1900, 1910, 1920, 1930, 1941, 1970, 1980, 1990, 2001, 2005, and 2008.

The general estimation procedure of regional value added in agriculture is described by the following formula:

$$Y_{r,Agric} = \sum_{j=1}^{J} Y_j \frac{X_{r,j}}{X_j} \quad \text{(A2.1)}$$

where $Y_{r,A}$ stands for regional value added in agriculture, Y_j for national value added in subsector j, and $X_{r,j}/X_j$ is the region's share of the most important input used in subsetor j. The subsectors and respective inputs are summarized in table A5.

The rest of this section provides the data sources and describes the intermediate estimation procedures.

A.2.1. National value added by agricultural subsector

Value added of agricultural subsectors is available from the following sources

- 1866-1965: BFS 01 based on Ritzmann (1990) and Ritzmann and David (2012);
- 1960-1991: BFS 02
- 1990-2010: BFS 03

Values were fitted in order to make the sum correspond to total agricultural value added in Stohr (2016). Values for 1860 were estimated using subsectors' shares implied by 5-year averages for 1870.

A.2.2. Regional data on animal husbandry

Regional data on animal populations is available from the cattle census carried out once or twice per decade from 1866 to 1973 (BFS 04). Thereafter, cattle were counted twice per decade in the Census of agricultural exploitations (BFS 05). For most subsectors the corresponding statistic was straightforward, as can be seen from table A5. But some subsectors require explanation.

Bovines to be slaughtered:

The most valuable meat is veal and beef. The census distinguished calves to be slaughtered, calves to be raised, weaners (0.5 to 1 year), heifers (1 to 2 years), and cows. The difficulty was thus to measure the input for beef meat. Both weaners and heifers might be destined to slaughter within a year. But not all of them would necessarily be slaughtered, because a certain proportion of the females should replace older cows for milk production or breeding. Assume that cows be used for breeding or milk production until the age of 7 and that the population of cows should remain stationary. Then the 1.5-year cohort of weaners and heifers must replace one third of the population of cows. This is corroborated by the ratio of cows to weaners and heifers at the national level, which is most of the time between 2.5 and 3. Thus, I estimated the input for veal and beef meat as follows:

Bovines to be slaughtered = Calves to be slaughtered + weaners + heifers – 1/3*cows

The consulted years of the census are 1866, 76, 86, 96, 1901, 11, 20, 31, 41, and 73. The values of the years for which I estimated regional GDP were linearly interpolated (retropolated in the case of 1860).

Unfortunately, the Census of agricultural exploitations provides less detail on different types of bovines. I thus used the proportion of cows and bovines to be slaughtered from the Cattle census of 1973 and multiplied it with the total number of bovines in the Census of agricultural exploitations of 1980, 1990, 2001, 2005, and 2008. The same procedure was applied to horses, because the Census of agricultural exploitations did not distinguish between horses held for leisure and horses raised for breeding or meat production. However, production from horses generally accounted for less than one percent of total agricultural value added.

Beehives and chicken:

Beehives were not counted before 1876 and chicken not before 1931. In these cases I assumed that their distribution in space was equal to that of agricultural employment. Note that these sectors were not very important. Value added from beehives accounted for less than one percent of agricultural value added in 1860; the percentage of value added from chicken remained below 5 percent until 1910 (only in 1920 it rose to 6.8 percent).

A.2.3. Regional data on land use

Data on land use is available from the Census of agricultural exploitations (BFS 06, BFS 05), the Statistic of cultivation areas (BFS 07), and the Census of fruit trees (BFS 08). Valuable information can also be found in Ritzmann (1990) and Brugger (1968; 1985).

Grain acres:

Regional shares of grain acres in 1920, 1930, and 1941 were taken from the Statistic of cultivation areas of 1919, 1929, and 1941 (BFS 07). For the period 1860 to 1910 the surface of grain acres had to be estimated. The total surface of grain acres in Switzerland must have declined strongly between 1850 and 1917. Ritzmann (1990) guesstimates a total surface of 300'000 ha in 1850 (BFS 09), while the Census of agricultural exploitations of 1905 (BFS 05) counted roughly 135'000 ha. This strong decline is the exact mirror image of the increase of the number of cows. After 1860, when grain started to be massively imported numerous grain acres were transformed into prairies.

To estimate the regional surfaces I started by elaborating an estimate for 1860. Two assumptions were used for this estimation. First, I assumed that each region had a potential surface of land that could be used for grain growing. This surface would logically depend on the topography and climate of the region. Second, the fact that cows and grain are in competition for land, suggests that the number of cows in 1860 multiplied with the surface of prairies necessary to feed a cow can be subtracted from the potential grain growing land to obtain an estimate of the actual surface of grain acres.

To estimate the potential surface of grain acres, I used a famous historical episode as an instrument, namely the *Battle for cultivation*, also known as *Plan Wahlen* (Tanner 2010). During WWII, Switzerland implemented a cultivation plan designed to assure alimentary self-sufficiency of the country. Friedrich Traugott Wahlen, head of the *Eidgenössisches Kriegsernährungsamt*, had been working secretely on this plan since 1935 calculating potential food production capacities. The plan put a particular emphasis on the cultivation of grain and numerous prairies and acres for other plants were transformed into grain acres. In 1943, when the battle for cultivation reached its climax, the surface of grain acres in Switzerland had risen to roughly 216'000 ha (compared to 118'000 ha in 1929). Adding to this the number of cows in 1941 multiplied by 25 a, which is about the amount of prairies necessary to feed a cow, yields some 432'000 ha of potential grain acres. Finally, subtracting from this the number of cows in

1860 multiplied by 25 a, yields 294’000 ha of actual grain acres in 1860. This number is reassuringly close to Ritzmann’s 1850 estimate of 300’000 ha (BFS 09). This procedure was applied to every region in order to estimate regional grain acres in 1860. Values for 1870, 1880, 1888, 1900, and 1910 were calculated by region-wise linear interpolation between 1860 and 1917 and subsequent fitting to the national total.

Other acres:

The total surface for Switzerland in 1850, 1880, and 1905 was taken from Ritzmann (1990) (BFS 09). Values for 1860, 1870, 1888, 1900, and 1910 were interpolated. Regional values were estimated using the shares of the 1917 Statistic of cultivation areas (BFS 07).

Vineyards:

Values for 1930 were taken from the Statistic of cultivation areas of 1929 (BFS 07). Values for 1941 are based on the Census of agricultural exploitations (BFS 06), where a transformation of the data was necessary for the regions of the canton Ticino. In these regions, vines were planted as an intercalated culture together with other plants. The statistic does therefore not count the surface but the number of plants. I transformed the data counting 1 a per 110 plants. For 1910 and 1920 I estimated regional surfaces by interpolation between 1929 (BFS 07) and 1905 (BFS 06).

For periods before 1905 the estimation was more complicated. Ritzmann (1990) provides surfaces by canton for 1855, 1877, 1884, and 1894 (BFS 10). I have calculated cantonal values for the years of my estimations by interpolation. The intra-cantonal distribution of vineyards must be estimated. However, this estimation hints on a particular problem related to the culture of vines during the second half of the 19th century. During this period the culture of vines has undergone important changes. Certainly, market integration allowed for increasing specialization of different agricultural areas, leading to abandonment of vineyards in regions that were not well suited for the culture of vines and extension in regions with favorable conditions. But the most important trigger of these changes was the arrival of the *Phylloxera* plague, which destroyed the plants of a large number of vineyards. Subsequently, the culture of vines was abandoned in many regions (Ritzmann 1990).

This transformation of the spatial distribution of vineyards is problematic for the estimation of the intra-cantonal distribution of vineyards, because a similar increase of the degree of specialization has probably also occurred within cantons. If the spatial distribution had not changed between 1860 and 1905, one could simply multiply each districts share of the cantonal surface with the cantonal surface in 1860. But given the increasing specialization this would underestimate the 1860 surface in regions, which have subsequently abandoned many vineyards, and overestimate the 1860 surface of regions, which subsequently specialized even more in the culture of vines. Realistic estimates for 1860 should therefore imply a lower degree of specialization than the 1905 situation. In order to achieve such an estimate I calculated each district's surface as a weighted average of two versions. The first version reproduces the intra-cantonal spatial distribution of 1905. This version exaggerates specialization. The second version uses the intra-cantonal distribution of agricultural employment in the corresponding period to distribute the cantonal total on the different districts. This version implies no specialization. Now for 1900 I attributed a much greater weight to the first version (0.95), whereas for 1860 I attributed almost equal weight to the two versions (0.55 to the first and 0.45 to the second).

Fruit trees:

District level data on fruit trees is available for 1929, 1951, 1961, 1971, and 1981 (BFS 08). I used a linear interpolation to estimate the values for 1941. For the period before 1929, punctual cantonal data is available from Brugger (1968; 1985). Fifteen cantons carried out at least one census between 1859 and 1888. Some cantons made even two or three censuses. Thus I estimated the cantonal total by interpolation and retropolation. The intra-cantonal distribution was replicated from 1929 for all earlier periods. No data on fruit trees is available after 1981. I decided to use the 1981 data for 1990, 2001, 2005, and 2008.

A.2.4. Agricultural employment

The data on agricultural employment is from Stohr (2014).

Appendix A.3: Estimation of regional value added in manufacturing

The following three steps describe the general estimation procedure applied to the manufacturing sector:

$$\Pi^{P}_{r,Manuf} = \frac{\sum_{i=1}^{I} \frac{Y_i}{L_i} \frac{L_{r,i}}{L_{r,Manuf}}}{\frac{Y_{Manuf}}{L_{Manuf}}} \tag{A3.1}$$

For $P = 1$ $t = 1860, \dots, 1888;$ and $I = 7$

For $P = 2$ $t = 1888, \dots, 1941;$ and $I = 61$

For $P = 3$ $t = 1941, \dots, 2001;$ and $I = 15$

For $P = 4$ $t = 2001, \dots, 2008;$ and $I = 23$

$$\hat{\Pi}_{r,Manuf} = \begin{pmatrix} \Pi^{P=1}_{r,Manuf} \frac{\pi^{P=2,t=1888}_{r,Manuf}}{\pi^{P=1,t=1888}_{r,Manuf}} \\ \Pi^{P=2}_{r,Manuf} \\ \Pi^{P=3}_{r,Manuf} \frac{\pi^{P=2,t=1941}_{r,Manuf}}{\pi^{P=3,t=1941}_{r,Manuf}} \\ \Pi^{P=4}_{r,Manuf} \frac{\pi^{P=2,t=1941}_{r,Manuf}}{\pi^{P=3,t=1941}_{r,Manuf}} \frac{\pi^{P=3,t=2001}_{r,Manuf}}{\pi^{P=4,t=2001}_{r,Manuf}} \end{pmatrix} \tag{A3.2}$$

$$Y_{r,Manuf} = \sum_{s=1}^{S} \frac{Y_{Manuf}}{L_{Manuf}} \beta_{Manuf} \Pi_{r,Manuf} L_{r,Manuf} \tag{A3.3}$$

In a first step I estimate regional labor productivity relative to national labor productivity using national value added per worker and regional employment for as many industries as possible. These productivity differentials are assumed to be most accurate for period 2, where I have data for 61 manufacturing industries. In a second step I use therefore period 2 as a benchmark from which I project the evolution of relative productivity differentials backward and forward. In a third step, these chained productivity differentials are implemented in a Geary-Stark-like estimation.

The procedure applied to services was similar, but the chaining procedure in step 2 was more complicated. Generally, the period for which the data is most detailed is period 4 from 2001 to 2008. But for transportation and communication a lot of information (7 industries) is also available in period 2 from 1888 to 1941. Thus I operated a first separate splicing procedure for periods 2 and 3, whereby in transportations and communications I used period 2 as the benchmark period and in the rest of the service sector I used period 3 as the benchmark period. In a second step I spliced the series of relative value added per worker of the entire service sector using period 2001 to 2008 as the benchmark period. This two-step procedure allowed me to take advantage of the generally largest amount of detail for period 4, without loosing the detailed information on transportation from period 2.

The data on national value added by industry is from Stohr (2016). This dataset provides continuous value added series for agriculture, industry, and services from 1851 to 2008. But within these three sectors, the dataset is split into four different sub-periods, for which different industrial classifications were used (1851-1890, 1890-1960, 1960-1990, and 1990-2008).

The data on regional employment by industry is from Stohr (2014). This dataset covers the following years: 1860, 1870, 1880, 1888, 1900, 1910, 1920, 1930, 1941, 1970, 1980, and 1990. It is mainly based on the population census (BFS 11, BFS 12), which counts workers at their residence. However, using data on commuting (internal and international) and seasonal workers, the data was transformed from residential count to workplace count. For details on the methods and data see Stohr (2014). The data on regional employment in 1991, 2001, 2005, and 2008 is from the industrial census (BFS 13), which counts jobs according to the location of the plant.

In order to make these two datasets compatible a few modifications of the original datasets were necessary. I discuss these modifications for the four periods mentioned in equation 1.

A.3.1. Period 1: 1860-1888

For this period the dataset on value added by industry and the dataset on regional employment both use the same industrial classification (See table A6). For details on the elaboration of this classification see Stohr (2014).

A.3.2. Period 2: 1888-1941

Stohr (2016) provides data for 16 sub-sectors of the industrial sector and 17 sub-sectors of the service sector. This data relies on the data published in the historical statistics of Switzerland (HSSO Q.17), which is from Ritzmann and David (2012). For the estimation of regional GDP, Ritzmann and David kindly provided me with their original estimates, which are much more fine-grained. I also elaborated more detailed data on regional employment going back to the original source material that I had used in Stohr (2014). The classification that I ultimately used for this period represents so to say the *most detailed common classification* between the value added and the employment data. Table A7 provides the details.

Note that the value added data of this period starts in 1890. In order to estimate regional GDP for 1888, which is the year for which I have employment data, I projected the value added estimates of 1890 back to 1888 using the 1888-to-1890 growth rates of the corresponding aggregates in the dataset for period 1. Column 2 of table A7 identifies these corresponding aggregates from which I took growth rates.

A.3.3. Period 3: 1941-1990

National value added from 1970 to 1990 was taken from Stohr (2016). As for the previous period, the regional employment data was replicated with the corresponding classification using the methodology from Stohr (2014). Table A8 provides the classification.

The last two aggregates in table A8, namely housing rents and import duties, need some explanation. These are not economic activities *stricto sensu*, as there is no employment associated to them. To which region can we attribute this value added?

Rental apartments:

In the case of housing rents, a straightforward solution is to attribute the value added to the location of the property. Luckily there are some statistics on rental apartments in this period (BFS 14). This source counts the rental apartments in each municipality by number of rooms and rental price class, which allowed me to compute the total rental value of each municipality. Intermediate classes have a range of 200 CHF. For these classes I simply multiplied the number of apartments by the mean of the lower and upper bound rents.

For the lowest class, which contains apartments with rental prices from 1 to 399 CHF, I assumed different rental prices depending on the size of the apartment and the period. For example, in 1970 apartments of 10 and more rooms counted in the lowest class were assumed to have a rental price of 390 CHF, while one-room apartments were supposed to have a rental price of 100 CHF. By 1990, the prices of apartments were considerably inflated. Hence I assumed that one-room apartments in the lowest class were let for 310 CHF.

For the highest class, which contains apartments with rental prices of 2400 CHF and more, I also assumed a rental scale depending on the size of the apartment. Therefore I estimated the value of an additional room by regressing total rents by apartment size on the number of rooms. This regression was run for the whole of Switzerland. I further assumed that one-room apartments of the highest class had a rental price of 2400 CHF. For each additional room I added the estimated value of an additional room.

For apartments where the rental price class was unknown I used the municipality's average rental price for apartments of the corresponding size.

Finally, I calculated total rents by municipality, aggregated the data to the district level and scaled it to match the national value added from housing rents according to the value added by industry data.

Import duties:

Import duties are more difficult to attribute to a certain region. They arise at the national border but not in a particular subnational aggregate. As they are part of government revenue, I decided to attribute them on the different regions according to regional shares of employment in public administration.

Splicing between periods 2 and 3:

The splicing of relative value added per worker between periods 2 and 3 implied some difficulties. In the value added database the break between the two subsets is in 1960. But in the regional employment database, there is no data point between 1941 and 1970, as fine-grained regional data on employment is not available for the censuses in 1950 and 1960. Hence, I could not splice the series in 1960. But splicing in 1941 (for the industrial sector and transport/communication) or 1970 (for services except transportation/communication) was possible. For this it was necessary to replicate the 1970 classification in industry and transportation/communication with the 1941 data and the 1941 classification in services with the 1970 data. Column 3 in table A8 indicates how these industries were matched.

A.3.4. Period 4: 2001-2008

For the last period the data on value added by industry is from the Federal statistical office (BFS 15), and employment data is from the Industrial census (BFS 13). The former is based on the NOGA2008-2digit classification, while the latter relies on the NOGA2002-4digit classification. I used the official conversion table (BFS 16) to convert the employment data into NOGA2008-2digit (see table A9).

A complication arose again in the splicing procedure, because the data for period 4 starts only in 2001, while that of period 3 stops in 1990. For the industrial sector I applied a similar procedure as for 1941/70 replicating the classification of 1990 with the data of 2001 (see column 2 of table A9). For the service sector I elaborated an intermediate estimate for 1991 (based on a less detailed classification), which was spliced to 2001 by replicating the 1991 classification for 2001 (see column 3 of table A.9). Finally, the 1990 estimate was spliced to this intermediate 1991 estimate.

Appendix A.4: Decomposition of GDP per worker differentials

In order to measure regional productivity differentials we can express GDP per worker relative to a reference level. Commonly used references are the national average or the richest region. Studies of regional inequality in countries where one region remains richest throughout the entire period often choose the richest region as a reference. In Switzerland rankings including the top position change over time. Therefore, I prefer to use the national average as a reference. Relative GDP per capita of a region is thus defined as

$$\Upsilon_r = \frac{\mathrm{Y}_r/\mathrm{L}_r}{\mathrm{Y}/\mathrm{L}} = \frac{p_r}{p} \tag{A4.1}$$

Hanna (1951) has developed a decomposition of differentials in regional manufacturing wages into an industry-mix effect and a wage-rate effect. This decomposition has been used more recently by Kim (1998) Rosés et al (2010) and Martinez-Galarraga et al (2013) to decompose regional differentials in GDP per worker into an industry-mix and a labor productivity effect. The decomposition is based on the computation of a counterfactual estimate of regional GDP per worker. This counterfactual sets regional labor productivity levels in all sectors to national averages allowing only industrial structure to vary between regions. The industry mix effect is then measured as the percentage difference between the counterfactual and national aggregate labor productivity. And the productivity effect is measured as a residual, by taking the percentage difference between the actual regional GDP per worker and the industry-mix counterfactual.

La Croix (1999) has criticized Kim's application of this decomposition method by pointing out that the decomposition is not unique and that an alternative possible decomposition can yield significantly different results. La Croix's decomposition is based on an alternative counterfactual, which sets regional industrial structure equal to the national level and allows labor productivity to vary between regions. The productivity effect is then measured as the percentage difference between the counterfactual and national aggregate productivity, and the industry-mix effect is measured as a residual.

Closer inspection of the two procedures reveals that Kim's industry-mix effect is very similar to a Laspeyres index of industrial structure, which can be formulated as follows

$$\Sigma_r^L = \frac{\sigma_{A,r} p_A + \sigma_{M,r} p_M + \sigma_{S,r} p_S}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S} \tag{A4.2}$$

In this formula $\sigma_{A,r}$ stands for the share of agriculture in total regional employment, $\sigma_{M,r}$ for the share of manufacturing, and $\sigma_{S,r}$ for the share of services; p_A , p_M, and p_S denote national labor productivity in the three sectors; and Σ_r^L stands for Laspeyres structure index of region *r*. Kim's industry-mix effect is this index minus one. Analogously, the La Croix productivity effect is equal to a Laspeyres productivity index minus one. The Laspeyres productivity index is formulated as follows

$$\mathrm{P}_r^L = \frac{\sigma_A p_{A,r} + \sigma_M p_{M,r} + \sigma_S p_{S,r}}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S} \tag{A4.3}$$

There are two reasons why the two decompositions yield different results. First, the decomposition should not be additive but multiplicative, because employment shares have to be multiplied with labor productivity to yield value added of a sector. Kim's residual productivity index is equal to

$$\frac{p_r}{p} - \Sigma_r^L = \frac{\sigma_A (p_{A,r} - p_A) + \sigma_M (p_{M,r} - p_M) + \sigma_S (p_{S,r} - p_S)}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S}$$

This definition is structurally very different from his industry-mix effect, which equals equation (A4.2) minus 1. Since the two effects are measured differently it matters which one is computed directly and which one is measured as a residual. But there is no reason to measure the two effects with structurally different equations. A multiplicative decomposition is more appropriate because the multiplicative residual of equation (A4.2) has a similar form to equation (A4.2)

$$\mathrm{P}_r^P = \frac{p_r}{p} / \Sigma_r^L = \frac{\sigma_{A,r} p_{A,r} + \sigma_{M,r} p_{M,r} + \sigma_{S,r} p_{S,r}}{\sigma_{A,r} p_A + \sigma_{M,r} p_M + \sigma_{S,r} p_S} \tag{A4.4}$$

Closer inspection of this formula reveals the second reason why the Kim and La Croix decompositions are not equivalent. Equation (A4.4) is actually a Paasche index of productivity. This is a well-known result in price index number theory: the corresponding deflator of a Laspeyres quantity index is a Paasche price index and vice versa. As the structure effect of Kim and the productivity effect of La Croix are both of the Laspeyres type they are not complementary. If both authors had opted for a multiplicative decomposition and if La Croix had compared his difference between the counterfactual and the national average as a percentage of the counterfactual rather than as a percentage of the national average, the two decompositions would have been identical.

Now we have defined the Laspeyres structure index (A4.2), the corresponding Paasche productivity index (A4.4), and the Laspeyres productivity index (A4.3). Finally, we define the Paasche structure index:

$$\Sigma_r^P = \frac{p_r}{p} / \mathrm{P}_r^L = \frac{\sigma_{A,r} p_{A,r} + \sigma_{M,r} p_{M,r} + \sigma_{S,r} p_{S,r}}{\sigma_A p_{A,r} + \sigma_M p_{M,r} + \sigma_S p_{S,r}} \tag{A4.5}$$

To summarize: the Laspeyres structure index of equation (A4.2) multiplies with the Paasche productivity index of equation (A4.4) to yield a decomposition of relative GDP per worker (A4.1); and the Laspeyres productivity index of equation (A4.3) multiplies with the Paasche structure index of equation (A4.5):

$$\Upsilon_r = \mathrm{P}_r^L \Sigma_r^P = \mathrm{P}_r^P \Sigma_r^L \tag{A4.6}$$

The relative size of Laspeyres and Paasche indices depends on the specialization of a region. If a region is specialized in sectors where its relative productivity is comparatively high (i.e. regional sectoral productivity relative to regional aggregate productivity is higher than national sectoral productivity relative to national aggregate productivity), the Paasche structure index will be higher than the Laspeyres structure index. I call this situation a *Ricardian success*, as it implies a specialization according to comparative advantage. If a region is specialized in sectors where its relative productivity is comparatively low, the Paasche structure index will be lower than the Laspeyres structure index. I call this situation a Ricardian failure, as it implies specialization in a sector where the region has a comparative disadvantage.

Thus the ratio Σ_r^P / Σ_r^L is a measure of comparative advantage, i.e. an interaction effect of structure and productivity:

$$C_r^P = \frac{\Sigma_r^P}{\Sigma_r^L} = \frac{\sigma_{A,r}p_{A,r} + \sigma_{M,r}p_{M,r} + \sigma_{S,r}p_{S,r}}{\sigma_A p_{A,r} + \sigma_M p_{M,r} + \sigma_S p_{S,r}} \frac{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S}{\sigma_{A,r}p_A + \sigma_{M,r}p_M + \sigma_{S,r}p_S} \frac{\frac{1}{p_r}}{\frac{1}{p_r}} \frac{\frac{1}{p}}{\frac{1}{p}}$$

$$= \frac{\sigma_{A,r}\frac{p_{A,r}}{p_r} + \sigma_{M,r}\frac{p_{M,r}}{p_r} + \sigma_{S,r}\frac{p_{S,r}}{p_r}}{\sigma_A \frac{p_{A,r}}{p_r} L + \sigma_M \frac{p_{M,r}}{p_r} L + \sigma_S \frac{p_{S,r}}{p_r} L} \tag{A4.9}$$

with $$L = \left(\frac{\sigma_{A,r}p_A + \sigma_{M,r}p_M + \sigma_{S,r}p_S}{p}\right)$$

Equation (A4.9) takes the form of a structure index, but it multiplies shares with *relative* instead of *absolute* productivity. More precisely it is a Paasche index, as it takes relative productivity of the *region* as a reference. The term L controls for interactions between structure and *absolute* productivity levels, which must not be included, because they are already taken into account in the structure index (actually L *is* the structure index).

The decomposition in equation (A4.6) can now be extended to include all three components: structure, productivity, and their interaction.

$$\Upsilon_r = \mathrm{P}_r^L \Sigma_r^L \mathrm{C}_r^P \tag{A4.10}$$

This decomposition is superior to the two solutions in (A4.6) not only because it distinguishes interaction effects from pure structure or productivity effects. It is also superior because the relative weight between structure and productivity effects is not biased. In fact, the two decompositions in equation (A4.6) are biased toward one or the other component. The combination $\mathrm{P}_r^L \Sigma_r^P$ includes interaction effects entirely in the structure component, and the combination $\mathrm{P}_r^P \Sigma_r^L$ includes them entirely in the productivity component. Thus the former variant is biased toward structure and the latter toward productivity. Decomposition (A4.10) provides a solution to this bias. Fisher indices provide an alternative solution to eliminate this bias, because they attribute half of the interaction effect to productivity and half of it to structure. However, Fisher indices do not allow for a separate measure of interaction effects. Fisher indices are defined as follows:

$$\Sigma_r^F = \sqrt{\Sigma_r^L \Sigma_r^P} \qquad \mathrm{P}_r^F = \sqrt{\mathrm{P}_r^L \mathrm{P}_r^P} \qquad \Upsilon_r = \mathrm{P}_r^F \Sigma_r^F \tag{A4.11}$$

Finally, we can decompose the Laspeyres productivity index into three sectoral productivity indices.

$$\mathrm{P}^{L}_{A,r} = \frac{\sigma_A p_{A,r} + \sigma_M p_M + \sigma_S p_S}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S}$$

$$\mathrm{P}^{L}_{M,r} = \frac{\sigma_A p_A + \sigma_M p_{M,r} + \sigma_S p_S}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S} \qquad \text{(A4.11)}$$

$$\mathrm{P}^{L}_{S,r} = \frac{\sigma_A p_A + \sigma_M p_M + \sigma_S p_{S,r}}{\sigma_A p_A + \sigma_M p_M + \sigma_S p_S}$$

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Tables and figures

Table A1: Descriptive statistics of Area Size in Km2

	Cantons	Districts	MS	**MSR**	BE	**BER**	**3GR**
N	26	184	106	**97**	16	**16**	**3**
Min	39	6	39	**85**	433	**411**	**12369**
Max	7168	1057	1481	**1268**	7277	**7182**	**15134**
Sum	40189	40189	40189	**40189**	40189	**40189**	**40189**
Mean	1546	218	379	**414**	2512	**2512**	**13396**
Standard Deviation	1815	193	291	**291**	1839	**1822**	**1274**
Coefficient of Variation	1.17	0.89	0.77	**0.70**	0.73	**0.73**	**0.10**
Max/Min	182.8	185.2	37.8	**15.0**	16.8	**17.5**	**1.22**

Numbers refer to the territorial definitions of the year 2000. Minor changes have occurred between 1798 and 2000 (Schuler et al. 2005). But after 2000 several cantons have completely redefined their districts.

Table A2: Conversion table districts to MSR regions

MSR: Reconstructed MS Region		Districts						
Code	Name	Codes						Name
msr001.003[1]	Zürich und Limmattal	151						Zürich und Dietikon
msr004	Knonaueramt	101						Affoltern
msr005	Zimmerberg	106						Horgen
msr006	Pfannenstiel	107						Meilen
ms007.002[2]	Zürcher Oberland	105	108	109				Hinwil, Uster und Pfäffikon
msr008	Winterthur	110						Winterthur
msr009	Weinland	102						Andelfingen
msr010.002	Zürcher Unterland	103	104					Bülach und Dielsdorf
msr011	Bern	203	209					Bern und Fraubrunnen
msr012	Erlach-Seeland	201	208					Aarberg und Erlach
msr013	Biel/Bienne	204	216					Biel und Nidau
msr014	Jura bernois	214	215					Moutier et Neuveville
msr015	Oberaargau	202	226					Aarwangen und Wangen
msr016	Burgdorf	206	225					Burgdorf und Trachselwald
msr017	Oberes Emmental	223						Signau
msr018	Aaretal	212	222					Konolfingen und Seftigen
msr019	Schwarzwasser	221						Schwarzenburg
msr020	Thun	224	217					Thun und Niedersimmental
msr021	Saanen-Obersimmental	220	219					Saanen und Obersimmental
msr022	Kandertal	210						Frutigen
msr023	Oberland-Ost	211	218					Interlaken und Oberhasli
msr025	Laufental	1104	1302	1110				Dorneck, Laufen, Thierstein
msr026	Luzern	303	302					Luzern und Hochdorf
msr027	Sursee-Seetal	304						Sursee
msr028	Willisau	305						Willisau
msr029	Entlebuch	301						Entlebuch
msr030	Uri	400						Uri
msr031	Innerschwyz	506	504	502				Schwyz, Küssnacht und
msr032	Einsiedeln	501						Einsiedeln
msr033	March-Höfe	505	503					March und Höfe

[1] MSR001 and MSR003 have been merged because the district of Dietikon which composes MSR003 has been created only in 1980.

[2] MSR002 could not be reconstructed because no district belonged with at least 60% to this region and important parts of this region belong to districts that were assigned to other MSR regions.

msr034	Sarneraatal	600						Kanton Obwalden
msr035	Nidwalden	700						Kanton Nidwalden
msr036.037[3]	Glarus	800						Kanton Glarus
msr038	Zug	900						Kanton Zug
msr039	La Sarine	1004						Sarine
msr040	La Gruyère	1003						Gruyère
msr041	Sense	1006						Sense
msr042	Murten/Morat	213	1005	2203				Laupen, See und Avenches
msr043	Glâne-Veveyse	1002	1007					Glâne et Veveyse
msr044.045[4]	Olten und Thal	1101	1105	1108	1102			Olten, Gösgen, Gäu und Thal
msr046.024[5]	Solothurn und Grenchen	1106	1109	1103	1107	205		Solothurn, Lebern, Wasseramt, Bucheggberg und Büren
msr047.048[6]	Basel-Stadt und Unteres Baselbiet	1200	1301					Basel-Stadt und Arlesheim
msr049	Oberes Baselbiet	1303	1304	1305				Liestal, Sissach und Waldenburg
msr050	Schaffhausen	1403	1402	1405	1401	1406	1404	Kanton Schaffhausen
msr051	Appenzell A.Rh.	1501	1502	1503				Kanton Appenzell Ausser Rhoden
msr052	Appenzell I.Rh.	1600						Kanton Appenzell Innerrhoden
msr053	St.Gallen	1701	1702	1714				St. Gallen, Rorschach und Gossau
msr054	Rheintal	1704	1703					Ober- und Unterrheintal
msr055	Werdenberg	1705						Werdenberg
msr056	Sarganserland	1706						Sargans
msr057	Linthgebiet	1708	1707					See und Gaster
msr058	Toggenburg	1710	1709					Neu- und Obertoggenburg
msr059	Wil	2006	1713	1711	1712			Münchwilen, Wil, Unter- und Alttoggenburg

[3] MSR036 and MSR037 had to be merged because they are part of one and the same district.

[4] MSR044 and MSR045 had to be merged because until 1900 the districts Gäu and Thal were not reported separately.

[5] MSR046 and MSR024 had to merged because the districts Solothurn and Lebern were not reported separately before 1900.

[6] MSR047 and MSR048 were merged to be more comparable to the MSR regions corresponding to Zurich and Geneva and because they clearly form an agglomeration.

msr060.063[7]	Chur und Schanfigg	1812	1813	1806				Plessur, Unterlandquart und Imboden
msr061.062[8]	Prättigau und Davos	1811						Oberlandquart
msr064	Mittelbünden	1801						Albula
msr065	Viamala	1804	1805					Heinzenberg und Hinterrhein
msr066	Surselva	1803	1814					Glenner und Vorderrhein
msr067	Engiadina Bassa	1807	1810					Inn und Val Müstair
msr068	Oberengadin	1808	1802					Maloja und Bernina
msr069	Mesolcina	1809						Moesa
msr070	Aarau	1901	1910	1907	1905			Aarau, Zofingen, Lenzburg und Kulm
msr071	Brugg-Zurzach	1904	1911					Brugg und Zurzach
msr072	Baden	1902						Baden
msr073.074[9]	Mutschellen und Freiamt	1908	1903					Muri und Bremgarten
msr075	Fricktal	1909	1906					Rheinfelden und Laufenburg
msr076	Thurtal	2004	2008					Frauenfeld und Weinfelden
msr077	Untersee	2005	2003	2007				Kreuzlingen, Diessenhofen und Steckborn
msr078	Oberthurgau	2001	2002					Arbon und Bischofszell
msr079	Tre Valli	2107	2103	2102				Distretti di Riviera, Leventina et Blenio
msr080	Locarno	2104	2108					Distretti di Locarno e Vallemaggia
msr081	Bellinzona	2101						Distretto di Bellinzona
msr082	Lugano	2105						Distretto di Lugano
msr083	Mendrisio	2106						Distretto di Mendrisio
msr084	Lausanne	2207						Lausanne
msr085	Morges	2209	2216	2202				Morges, Rolle et Aubonne
msr086	Nyon	2211						Nyon
msr087	Vevey	2218	2208					Vevey et Lavaux
msr088	Aigle	2201						Aigle
msr089	Pays d'Enhaut	2215						Pays-d'Enhaut

[7] MSR060 and MSR063 had to be merged because the latter is composed entirely of inhabitants of district 1812, which though belongs to more than 80% to MSR060.

[8] MSR061 and MSR062 had to be merged because the latter is composed entirely of inhabitants of district 1811, which though belongs mainly to MSR061.

[9] MSR073 and MSR074 had to be merged because district 1903 is difficult to attribute: it belongs mainly to MSR073 but contains an important part of MSR074.

msr090	Gros-de-Vaud	2204	2205	2212				Cossonay, Echallens et Orbe
msr091	Yverdon	2219	2206					Districts d'Yverdon et Grandson
msr092	La Vallée	2217						La Vallée
msr093	La Broye	1001	2214	2210	2213			Broye, Payerne, Moudon et Oron
msr094	Goms	2304						Goms
ms095	Brig	2301						Brig
msr096	Visp	2313	2309					Visp und Raron
msr097	Leuk	2306						Leuk
msr098	Sierre	2311						Sierre
msr099	Sion	2312	2302	2305				Sion, Conthey et Hérens
msr100	Martigny	2307	2303					Martigny et Entremont
msr101	Monthey	2308	2310					Monthey et Saint-Maurice
msr102	Neuchâtel	2404	2401	2405				Neuchâtel, Boudry et Val-de-Ruz
msr103	La Chaux-de-Fonds	2402	2403	207				Chaux-de-Fonds, Locle et Courtelary
msr104	Val-de-Travers	2406						Val-de-Travers
msr105	Genève	2500						Canton de Genève
msr106	Jura	2601	2602	2603				Canton du Jura

Table A3: Conversion table MSR regions to BER regions

BER		MSR
ber01	Genève	msr086, msr105
ber02	Lausanne	msr084, msr085, msr087, msr088, msr090, msr091, msr092, msr093, msr101
ber03	Sion	msr094, msr095, msr096, msr097, msr098, msr099, msr100,
ber04	Fribourg	msr039, msr040, msr041, msr042, msr043, msr089
ber05	Neuchâtel	msr102, msr103, msr104,
ber06	Biel/Bienne	msr013, msr014, msr046.024, msr106
ber07	Bern	msr011, msr012, msr016, msr017, msr018, msr019, msr020, msr021, msr022, msr023
ber08	Basel	msr025, msr047.048, msr049, msr075
ber09	Aarau-Olten	msr015, msr044.045, msr070
ber10	Zürich	msr001.003, msr004, msr005, msr006, msr007.002, msr010.002, msr032, msr033, msr036.037, msr038, msr057, msr071, msr072, msr073.074
ber11	Winterthur-Schaffhausen	msr008, msr009, msr050, msr076, msr077
ber12	St. Gallen	msr051, msr052, msr053, msr054, msr055, msr058, msr059, msr078
ber13	Chur	msr056, msr060.063, msr061.062, msr064, msr065, msr066, msr067, msr068
ber14	Luzern	msr026, msr027, msr028, msr029, msr030, msr031, msr034, msr035
ber15	Bellinzona	msr069, msr079, msr080, msr081
ber16	Lugano	msr082, msr083

Large regions	BER
Alpine region	Ber03 (Sion) ; Ber13 (Chur) ; Ber15 (Bellinzona) ; Ber16 (Lugano)
Western flat country	Ber01 (Genève) ; Ber02 (Lausanne) ; Ber04 (Fribourg) ; Ber05 (Neuchâtel) ; Ber06 (Biel/Bienne) ; Ber07 (Bern)
Eastern flat country	Ber08 (Basel) ; Ber09 (Aarau-Olten) ; Ber10 (Zürich) ; Ber11 (Winterthur-Schaffhausen) ; Ber12 (St. Gallen) ; Ber14 (Luzern)

Table A4: Descriptive statistics area, population, and Employment

	MSR		BER		3GR	
	1860	2008	1860	2008	1860	2008
N	97	97	16	16	3	3
Population						
Min	3’938	4’555	53’903	150’109	297’980	806’671
Max	82’876	441’982	399’076	1’730’559	1’261’278	4’149’929
Mean	25’881	78’835	156’906	477’935	836’831	2’548’987
Nb (pop<10'000)	12	7	0	0	0	0
Employment						
Min	1’967	1’833	25’326	65’702	157’078	409’448
Max	50’706	401’859	227’300	1’020’090	699’281	2’277’369
Mean	13’994	42’289	84’840	256’380	452’480	1’367’359
Nb (L<5'000)	13	7	0	0	0	0

Table A5: Subsectors and inputs for the estimation of regional value added in agriculture

Animal husbandry		Plant cultivation	
Subsector	Input	Subsector	Input
Cow milk	Cows	Fruit	Fruit trees
Bovine meat	Bovines to be slaughtered	Grain	Grain acre surface
Bovine breeding	Breeding calves	Wine	Vineyard surface
Pork meat	Pigs	Other commercial plants	Other acres’ surface
Chicken meat and eggs	Chicken		
Sheep meat, milk, wool	Sheep		
Goat meat and milk	Goats		
Honey	Beehives		
Horse breeding and meat, other animal production	Non-work, non-luxury horses		

Table A6: Classification 1860-1888

Code	Name
NFP 01	Mining
NFP 02	Agriculture
NFP 03	Forestry, Hunting, Fishing
NFP 04	Food, Beverages, Tobacco
NFP 05	Apparel incl. shoes
NFP 06	Textiles, Chemicals, Leather, and Paper
NFP 07	Metals, Machines, Watches
NFP 08	Construction, Wood and furniture, Stone and glass, Provision of water, gas, and electricity
NFP 09	Printing, Graphics
NFP 10	Commerce
NFP 11	Hotels and restaurants
NFP 12	Transportation and communications
NFP 13	Banks, Insurances, Intermediary and broker services
NFP 14	Public administration, Health care, Education, Art, Recreation, Religious services
NFP 15	Domestic and personal services, Cleaning and maintenance
Z	Unknown

Table A7: Classification 1888-1941

Code	S1888	S1970	Name
RVA.2.01.01	NFP 04	NUG	Müllerei
RVA.2.01.02	NFP 04	NUG	Bäckerei, Konditorei
RVA.2.01.03	NFP 04	NUG	Teigwaren
RVA.2.01.04	NFP 04	NUG	Zucker
RVA.2.01.05	NFP 04	NUG	Schokolade
RVA.2.01.06	NFP 04	NUG	Molkerei
RVA.2.01.07	NFP 04	NUG	Kondensmilch
RVA.2.01.08	NFP 04	NUG	Metzgerei
RVA.2.01.09	NFP 04	NUG	Konservenindustrie
RVA.2.01.10	NFP 04	NUG	Oel- und Fettindustrie
RVA.2.01.11	NFP 04	NUG	Bierbrauerei
RVA.2.01.12	NFP 04	NUG	übrige Nahrungsmittel
RVA.2.01.13	NFP 04	NUG	Zagarren
RVA.2.01.14	NFP 04	NUG	Zigarretten
RVA.2.01.15	NFP 04	NUG	Pfeifentabak, usw.
RVA.2.02.01	NFP 06	TEX	Baumwollspinnerei
RVA.2.02.02	NFP 06	TEX	Baumwollzwirnerei
RVA.2.02.03	NFP 06	TEX	Baumwollweberei inkl Verbandsstoffe
RVA.2.02.04	NFP 06	TEX	Seidenspinnerei
RVA.2.02.05	NFP 06	TEX	Seidenzwirnerei
RVA.2.02.06	NFP 06	TEX	Seidenstoffweberei
RVA.2.02.07	NFP 06	TEX	Seidenbeuteltuchweberei
RVA.2.02.08	NFP 06	TEX	Seidenbandweberei
RVA.2.02.09	NFP 06	TEX	Kunstseidenindustrie
RVA.2.02.10	NFP 06	TEX	Wollspinnerei
RVA.2.02.11	NFP 06	TEX	Wollweberei, Wolltücher
RVA.2.02.12	NFP 06	TEX	Leinenindustrie
RVA.2.02.13	NFP 06	TEX	Stickereiindustrie
RVA.2.02.14	NFP 06	TEX	Veredelungsindustrie
RVA.2.02.15	NFP 06	TEX	Stroh- und Hutgeflechtsindustrie
RVA.2.02.16	NFP 06	TEX	Rosshaarindustrie
RVA.2.02.17	NFP 06	TEX	übrige Textilindustrie
RVA.2.03.01	NFP 05	BKL	Wirkerei und Strickerei
RVA.2.03.02	NFP 05	BKL	Kleiderherstellung
RVA.2.03.03	NFP 05	BKL	Schuhfabrikation
RVA.2.03.04	NFP 05	BKL	Schuhreparatur
RVA.2.03.05	NFP 05	BKL	übrige Bekleidungsindustrie
RVA.2.04.01	NFP 06	LKK	Ledergerberei
RVA.2.04.02	NFP 06	LKK	Lederwaren
RVA.2.04.03	NFP 06	LKK	Kautschukwaren
RVA.2.04.04	NFP 06	LKK	Kunststoffindustrie
RVA.2.05.01	NFP 06	PUK	Zellulose
RVA.2.05.02	NFP 06	PUK	Papier und Karton
RVA.2.05.03	NFP 06	PUK	Papier- und Kartonwaren
RVA.2.06.01	NFP 09	DUG	Graphisches Gewerbe
RVA.2.07.01	NFP 08	HUM	Sägereinen
RVA.2.07.02	NFP 08	HUM	Schreinerei, Möbelindustrie
RVA.2.07.03	NFP 08	HUM	Holzwaren, Schnitzereien, Kork
RVA.2.08.01	NFP 08	STE	Natursteinbearbeitung
RVA.2.08.02	NFP 08	STE	Zement, Kalk, Gips
RVA.2.08.03	NFP 08	STE	Zement- und Gipswaren
RVA.2.08.04	NFP 08	STE	Ziegel, Backsteine, Tonröhren
RVA.2.08.05	NFP 08	STE	Glas und Glaswaren
RVA.2.08.06	NFP 08	STE	Schmirgelwaren
RVA.2.08.07	NFP 08	STE	übrige
RVA.2.09.00	NFP 06	CHE	CHE
RVA.2.10.01	NFP 07	MET	Roheisen und Ferrolegierungen
RVA.2.10.02	NFP 07	MET	Roh- und Walzstahl

RVA.2.10.03	NFP 07	MET	Eisen und Stahlverarbeitende Industrie
RVA.2.10.04	NFP 07	MET	Rohaluminium, Aluminiumhalbzeug
RVA.2.10.05	NFP 07	MET	Aluminiumwaren
RVA.2.10.06	NFP 07	MET	Blattmetall, Metallpulver
RVA.2.10.07	NFP 07	MET	Verarbeitende nichteisen Metallindustrie
RVA.2.10.06	NFP 07	MET	Metallwaren und Metallgewerbe
RVA.2.11.00	NFP 07	MAS	MAS
RVA.2.12.01	NFP 07	UHR	Uhren
RVA.2.12.02	NFP 07	UHR	Schmuck, Münzen
RVA.2.13.00	NFP 08	UIN	UIN
RVA.2.14.01	NFP 01	BBT	Erze und Kohlen
RVA.2.14.02	NFP 01	BBT	Asphalt
RVA.2.14.03	NFP 01	BBT	Salinen
RVA.2.14.04	NFP 01	BBT	Stein- und Schieferbrüche
RVA.2.14.05	NFP 01	BBT	übrige
RVA.2.15.00	NFP 08	BAU	BAU
RVA.2.16.01	NFP 08	EGW	Elektrizitätsindustrie
RVA.2.16.02	NFP 08	EGW	Gas-, Koks- und Teerindustrie
RVA.2.16.03	NFP 08	EGW	Wasserversorgung
RVA.3.01.01	NFP 10	GHT	Grosshandel
RVA.3.01.02	NFP 10	KHT	Kleinhandel
RVA.3.02.01	NFP 13	BKN	Banken
RVA.3.02.02	NFP 13	ASS	Versicherungen
RVA.3.03.01	NFP 11	HOT	Hotellerie, Parahotellerie
RVA.3.03.02	NFP 11	RES	Restaurants
RVA.3.04.01	NFP 12	SBB	Eisenbahnen, Schmalspurbahnen, Strassenbahnen
RVA.3.04.02	NFP 12	COM	Nachrichtenübermittlung
RVA.3.04.03	NFP 12	SUL	Schiff- und Luftfahrt
RVA.3.05.00	NFP 14	VWT	Öffentliche Verwaltung
RVA.3.06.00	NFP 14	GES	Gesundheitswesen
RVA.3.07.00	NFP 14	UFE	Unterricht, Forschung
RVA.3.08.00	NFP 14	KKK	Kirche, Kunst, Kultur, Sport, Erhohlung
RVA.3.09.00	NFP 15	REI	Reinigung
RVA.3.10.00	NFP 15	HDL	Dienstboten
RVA3.11.00	NFP 13	UDL	Vermittlungsdienstleistungen

Table A8: Classification 1970-1990

Code	Name
EWG	Provision of electricity, water and gas
NUG	Food, Beverages, Tobacco
TEX	Textiles
BKL	Apparel incl shoes
HUM	Wood and furniture
DUG	Printing and graphics
PUK	Paper
LKK	Leather, Plastics, Caoutchouk
CHE	Chemicals
STE	Stone and glas
MET	Metals
MAS	Machines
UHR	Watch making
BAU	Construction
REP	Reparations
HAT	Retail trade
GGT	wholesale trade
TRA	transportation
COM	communication
GES	Health care
BNK	Banks
ASS	Insurances
HDL	Domestic services
OEV	Public administration incl education
PDL	Cleaning, Maintenance, Hair dressing
IMO	Real estate
BER	Consulting, Ingeneering
UDL	Miscelaneous services (incl journalism and legal advice)
IMT	Import duties
MIE	Rents from Real estate property

Table A9: Classification 2001-2008

Code	S1990	S1991	Name
01 - 03			Landwirtschaft, Forstwirtschaft und Fischerei
05 - 09	STE		Bergbau und Gewinnung von Steinen und Erden
10 - 12	NUG		Herstellung von Nahrungsmitteln und Tabakerzeugnissen
13 - 15	TEX&BKL		Herstellung von Textilien und Bekleidung
16	HUM		Herstellung von Holz-, Flecht-, Korb- und Korkwaren (ohne Möbel)
17	PUK		Herstellung von Papier, Pappe und Waren daraus
18	DUG		Herstellung von Druckerzeugnissen; Vervielfältigung
19 - 20	CHE		Kokerei, Mineralölverarbeitung und Herstellung von chemischen Erzeugnissen
21	CHE		Herstellung von pharmazeutischen Erzeugnissen
22	LKK		Herstellung von Gummi- und Kunststoffwaren
23	STE		Herstellung von Glas und Glaswaren, Keramik, Verarbeitung von Steinen und Erden
24	MET		Metallerzeugung und -bearbeitung
25	MET		Herstellung von Metallerzeugnissen
26	MAS		Herstellung von Datenverarbeitungsgeräten und Uhren
27	MAS		Herstellung von elektrischen Ausrüstungen
28	MAS		Maschinenbau
29	MAS		Herstellung von Automobilen und Automobilteilen
30	MAS		Sonstiger Fahrzeugbau
31	HUM		Herstellung von Möbeln
32	HUM		Herstellung von sonstigen Waren
33	REP		Reparatur und Installation von Maschinen und Ausrüstungen
35	EWG		Energieversorgung
36 - 39	EWG		Wasserversorgung, Beseitigung von Umweltverschmutzungen
41 - 43	BAU		Baugewerbe/Bau
45		45-47	Handel und Reparatur von Motorfahrzeugen
46		45-47	Grosshandel
47		45-47	Detailhandel
49 - 51		49-53, 58-63	Landverkehr und Transport in Rohrfernleitungen, Schifffahrt, Luftfahrt
52		49-53, 58-63	Lagerei sowie Erbringung von sonstigen Dienstleistungen für den Verkehr
53		49-53, 58-63	Post-, Kurier- und Expressdienste
55		55-56	Beherbergung
56		55-56	Gastronomie
58 - 60		49-53, 58-63	Verlagswesen, audiovisuelle Medien und Rundfunk
61		49-53, 58-63	Telekommunikation
62 - 63		49-53, 58-63	Informationstechnologische und Informationsdienstleistungen
64, tw66		64-65	Erbringung von Finanzdienstleistungen
65, tw66		64-65	Versicherungen
68		68-82	Grundstücks- und Wohnungswesen
69 - 71		68-82	Erbringung von freiberuflichen und technischen Dienstleistungen
72		68-82	Forschung und Entwicklung
73 - 75		68-82	Sonstige freiberufliche, wissenschaftliche und technische Tätigkeiten
77 - 82		68-82	Erbringung von sonstigen wirtschaftlichen Dienstleistungen
84-85		84-85	öffentliche Verwaltung, Verwaltung und Unterricht
86		86-88	Gesundheitswesen
87 - 88		86-88	Heime und Sozialwesen
90 - 93		90-96	Kunst, Unterhaltung und Erholung
94 - 96		90-96	Erbringung von sonstigen Dienstleistungen