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Abstract

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Keywords: Industrialization, regional inequality, regional income, economic growth.
JEL Classification: N93; N94; R11.

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This paper uses a method devised by Geary and Stark to estimate regional GDPs for 24 Swedish provinces 1855-2007. In empirical tests, we find that the Swedish estimations yield results of good precision, comparable to those reported in the international literature. From the literature, we generate six expectations concerning the development of regional GDPs in Sweden. Using the GDP estimations, we test these expectations empirically. We find that the historical regional GDPs show a high correlation over time, but that the early industrialization process co-evolved with a dramatic redistribution of productive capacity. We show that the regional inequalities in GDP per capita were at their lowest point in modern history in the early 1980s. However, while efficiency in the regional system has never been as equal, absolute regional differences in scale of production has increased dramatically over our investigated period. This process has especially benefited the metropolitan provinces. We also sketch a research agenda from our results.

1. Introduction

Long-term economic growth and change is characterized by regional heterogeneity. Traditionally, historical regional development has been studied by means of, for example, distribution of population (Söderberg and Lundgren 1982), sector employment (Söderberg and Lundgren 1982, Lundmark and Malmberg 1986) or regional distribution of wages and income differentials (Andersson 1978, Persson 1996). In some contexts, regional sector employment data may indeed be used as a way to proxy the *scale* and value of regional production. However, regional employment data frequently obscures spatial differences in economic activity, since it does not take into account differences in *efficiency* (productivity). Lack of historical regional production data has therefore partly hindered any attempt to measure a vital aspect of the spatial distribution of economic activities in the long term. To the extent that they can be estimated, historical regional factor-cost GDP data therefore provide important complementary information about the long-term economic development of regions.[1]

In 2002, Geary and Stark designed a method to *estimate* regional GDP using a minimum of historical data (we will henceforth refer to this as the G-S method). In its most basic form, the implementation of the method requires data on national value added for a set of broad industries (usually 3 or 4), regional employment in these industries, and information about regional wage differentials. Currently, the G-S method constitutes the technical base for an ESF (European Science Foundation) effort to compile regional historical GRP data for a large number of European countries.[2] Within this wider context, the aim of this paper is to (1) estimate regional GDP series for Sweden on province (län) level from 1855, (2) to describe and discuss the different data sources for the estimations in detail, and (3) to consider the quality and outcomes of the estimates compared to some literature-derived expectations concerning:

- the precision of the G-S method in estimating regional GDP.
- the long-run path dependency and geographical inertia in regional production structures.
- the industrialization period as a process inducing spatial redistribution of production, followed by increased stability in spatial production patterns.

[1] In the paper, the term regional GDPs is used. Sometimes, the literature refers to this as GRP (Gross Regional Product).

[2] The ESF-funded network initiative ”Historical Economic Geography of Europe”.

- the often stated argument that the Swedish industrialization process was not connected to and co-occurring with the urbanization process to the same extent as in many other countries.

Despite its limited economic size, Sweden is an interesting case for analyses of long-term regional economic growth and change. The country features a range of different types of regions (some differentiated in economic structure, and some extremely specialized) that are markedly separated in space. The small Swedish economy has also throughout the history of capitalism been an open one, forced to react fast to international economic trends. The spatial dynamics of the Swedish industrialization process is also said to be of a very different character compared to other countries. In terms of data, definitions of the borders of the 24 Swedish provinces (län) have been stabile over the time period investigated, and national border changes and wars have had little effect on the consistency of the information used to estimate regional GDPs.

The structure of the paper is as follows. In section 2, we formulate some literature-derived expectations for the analysis of the historical Swedish GDP data. These expectations will serve both as a base for analyzing the quality of the estimations, and as a base for analyzing some aspects of the spatial dynamics of Swedish economic development over 150 years. In section 3, we explain and discuss the G-S method used to estimate the historical regional GDP. Section 4 then discusses the data sources and the implementation of the G-S method on the Swedish data. We also investigate some potential errors accruing from three specific technical features of the method. Section 5 features our final regional GDP estimations for the Swedish provinces 1855-2007. In this section, the literature-derived expectations about the Swedish economic development during the period studied are also evaluated. Section 6 concludes and suggests some further avenues of research. Appendix A and B contain some specifics about our implementation of the G-S method, while Appendix C contains the outcomes of the estimations in tabular form.

2. The expectations

To structure the empirical description of our regional GDP estimation results in section 4, the discussion will evolve around six expectations about the spatial distribution of Swedish regional GDP in a historical perspective. These expectations are derived using a selection of the existing literature in the field.

The first expectation concerns the errors of the regional estimations. For many countries, historical *national* accounts already exist and are used as inputs in the Geary-Stark method. When these already known historical national GDPs are proportioned out to the regions according to the G-S method, an error will likely appear on the regional level. The estimated regional value will probably, to a greater or smaller extent, diverge from the "true" GDP of the region. Naturally, we wish to minimize this "spatial mis-allocation". For historical data, no information is normally available to test the precision of the regional estimations (if so, there would of course be no use to estimate regional GDP according to the G-S method). Usually, we can however compare the estimated regional GDP to official estimates for some modern year, where statistical offices have provided regional GDP calculations. In their estimations for UK and Ireland, Geary and Stark (2002) report that their "best" specification estimates deviate with a maximum of 7.5% for one region from the official estimates (country within the UK). Using the G-S method, we should therefore expect a small error also for the Swedish data:

E1: The spatial mis-allocation error is small.

More to the fundamental side of how spatial economies evolve, inertia and path dependency processes can be expected to characterize historical economic development (Martin and Sunley 2006). This means that the scale of regional production normally changes at a slow and incremental pace (provided that they are not subject to drastic chocks, see Davis and Weinstein 2006). Moreover, recent empirical results suggest that the specific economic structures of regions *condition* their future economic evolution. For example, regions are unlikely to embark on development paths that are technologically very different from the paths that they have already established in the past (Neffke *et al.*, 2009). Even though many clarifying issues remain about the concept of regional path dependency and how it could be quantified, it still leads us to expect that the regional distribution of GDP will show very high correlations across time in the short run. Over longer time spans, we should however expect the incremental evolution of regional production structures to result in greater changes in the regional system. One reason to expect this is because different phases of economic growth place varying emphasis on different production factors and inputs (Schön 2000). As the access to production factors and inputs may have a distinct spatial dimension, the economic fortune of regions will also shift in the longer run. The lowered relative transport prices have, for example, over time changed the degree to which some industries need to be based in spatial proximity to their inputs. Due to these considerations, we expect to find slightly different short- and long-term correlation structures in the regional Swedish GDP data:

E2: Comparing regional distribution of GDP over time, there is very strong correlation between regional production shares in the short run.

E3: Comparing regional distribution of GDP over time, there is less strong correlation between regional production shares in the long run.

More context-informed contributions concerning periods of turbulence and stability in the Swedish regional system may however be used to form complementary expectations. When analyzing the distribution of population and income shares in the Swedish regional system between 1920 and 1975, Andersson (1978) found a very high degree of stability in regional distributions during this period. This led Andersson to argue that a long-term equilibrium of regional production and income distribution in Sweden was reached already in 1920. According to this view, the Swedish regional system essentially consisted of a number of rather self-sufficient regional economies in the beginning of the industrialization period (until around 1850). During the early industrialization period however, investments were seeking out their highest returns. Combined with a historically high mobility of capital, a comparatively large degree of production redistribution took place in the regional system during the early industrialization period. With the establishment of a new transportation and communication structure from the late 19th century (for example the railroads), a number of new infrastructural node-cities also became favored as economic growth centers.

The largest turbulence in terms of spatial reallocation of productive capacity therefore took place 1870-1920, according to Andersson. Workers and population migrated to equalize the spatial production/population structures, so that there would also be long-run convergence in production per capita. The regional production system remained thereafter rather stabile in a spatial sense, at least until 1975.[3] A large predicament concerning the arguments of Andersson was that he could not test his expectations in a rigorous way, partly because of imperfect substitutes to regional production data, partly because of limited time series. The arguments of Andersson (1978) may however lead us to formulate the following expectation for our dataset:

E4: There was turbulence (spatial re-distribution of production) in the Swedish regional system until 1910/1920, thereafter a period of stability dominated.

From a more general perspective, international literature partly complements the expectations concerning convergence and divergence in the regional system that can be formulated using the

[3] In such an theoretically informed description, only investments and changes in infrastructure can shock the stable system (apart from, of course, truly exogenous chocks such as natural disasters or wars, which in most cases indeed tend to show up during the time perspectives that we now dwell upon).

contextual Swedish perspectives discussed above. The historical analysis of Williamson (1965) concerning regional income convergence/divergence connected to the development stage of nations, suggests that regional inequality of incomes will take an inverted u-shape over the economic evolution of a nation. Williamson uses a classification of growth stages of nations that has its origins in the works of Kuznets. Early stages of national development should, according to this perspective, be associated with regional income divergence. Lack of integration between regional markets during the early growth stage inhibits the diffusion of technological change and multipliers associated with rising income, and furthers the selective migration from less favored regions. This causes regional income to diverge spatially. Further down the growth path, integration of markets and increased factor mobility will facilitate for the traditional equilibrating forces to exert influence. Even though Williamson finds empirical evidence to support such time-bound tendencies, the data situation at the time inhibited a real long-term test of the hypothesis. The empirical exposition relies heavily on the comparison between countries in different growth stages, and on rather limited time periods. Williamson is also not very specific concerning the timing of the "peak" of inequality of income during the economic growth process. Translated to the perspective of our data that covers the period from the very start of the industrialization process in Sweden, Williamson's arguments lead us to form expectations not about income levels, but rather distribution of GDP per capita in the Swedish provinces. Taking the period around 1850 to be beginning of the "late" stages of development, we can form the following expectation (which is complementary to the discussion above):

E5: There was convergence in GDP/capita from the 1850s that equalized the regional differences in GDP/capita that were established during earlier growth regimes.

Finally, scholars have stressed the argument that the connection and co-occurrence between the industrialization and urbanization processes was weaker in Sweden than in many other countries. Söderberg and Lundgren (1982) claim by reference to historical data that the shares of manufacturing workers working in countryside locations in 1900 were vastly higher (around 60%) in Sweden than in a range of comparable nations, such as United States, Germany and Denmark. Consequently, the regional distribution of GDP in Sweden should not unambiguously be expected to favor the bigger cities, especially not in the early industrialization period. One reason for this might be that the early industrialization process in Sweden favored many capital intensive industries. Combined with an increasingly mobile capital, this would have led to larger shares of production taking place in areas with ample natural resource endowments rather than agglomerations of inexpensive labour. With the progression of industrialization however, one might expect migration to equalize the regional differences between shares of population and production (GDP):

E6: In beginning of industrialization a large gap quickly arises between regional shares of population and GDP. This should diminish with long-term market integration and migration, but also with a larger concentration of production to the large city areas compared to the phase of early industrialization.

3. Regional production data and the Geary-Stark metod

We use a method to estimate historical regional GDPs suggested by Geary and Stark (2002). The version of the method that we use requires the following input data: (1) historical national GDP estimates and industry value added, preferably also including estimates of number of workers on the national industry level, (2) regional number of employees per industry, and (3) regional wages per industry. For a specific year, it is assumed that the total national GDP at factor cost is defined as the sum of regional GDPs:[4]

(1)

$$Y_{nat} = \sum^{i} Y_i$$

where Y_{nat} is the total national GDP at factor cost, and Y_i is the GRP of region *i*. The latter is defined as:

(2)

$$Y_i = \sum^{j} y_{ij} \times L_{ij}$$

where y_{ij} is the average value added per worker in region *i* and industry *j*, and L_{ij} the number of employees (workers) in region *i* and industry *j.* From this follows also the definition:

(3)

$$Y_{nat} = \sum^{j} Y_j$$

[4] All equations refer to the calculations of regional GDP in a specific year.

where Y_j is the GDP (value added) of industry *j*.

The term "industry" can be used very flexibly in the context of the G-S method.[5] Normally, it here refers to the three sectors of agriculture, manufacturing and services. One of the prime advantages with the G-S method is that it offers a solution to the predicaments that arise when there is no available data for y_{ij} (value added per employee on industry/region level). This situation is likely to arise often in historical research. y_{ij} is then proxied by taking information about the output per worker in each industry on national level, then assuming that regional differentials in labour productivity in each industry is reflected by the regional industry wage level relative to the national industry wage level $\left(w_{ij}/w_j\right)$. Therefore, it is assumed that the final regional GDP will be given by:

(4)

$$Y_i = \sum^{j} y_j \; \beta_j \left(\frac{w_{ij}}{w_j}\right) \times L_{ij}$$

where β_j is a scalar that will preserve regional relative differences, but ensures that regional totals add up to the known national total for each industry. This scalar takes the form

(5)

$$\beta_j = \frac{Y_j}{\Sigma^i \left[y_j \left(w_{ij}/w_j\right)\right] L_{ij}} \,.$$

Essentially, the Geary-Stark method distributes already known GDP estimates on nation/industry levels regionally by making use of regional labor inputs and wage differentials. For the Swedish case, the method therefore allows for estimates of regional GRPs that are consistent with existing national estimates from the Swedish Historical National Accounts (SHNA) to 2000 (2007).

Geary and Stark (2002) show, using UK data, that their method yields results of promising precision. However, when investigating a subset of Swedish yearly estimations (for 1910, 1993 and 2006), Enflo *et al.* (2009) identify three potential problems with the method: (1) the unreliable assumption problem, (2) the sector aggregation problem and (3) the correlation of sector/regional structure problem. The unreliable assumption problem concerns two potentially problematic aspects of the G-S method. The first is to what extent the regional wage differentials reflect the marginal productivity

[5] We do not make any distinction between "industry" and "sector".

in the regions.[6] Of course, one could think of many reasons why this assumption would not hold. Institutional wage barriers (such as influential labor unions), inertia in wage changes and imperfect information on the labor market are only some. For example, if there are serious obstacles in the flow of information between regions, the assumption would be dubious.

The second issue concerns the problem of how industries should be treated where no historical industry-specific regional wage data is available. We have already mentioned that lack of historical data for service wages, especially on regional level, is a common problem. In such cases, Geary and Stark (2002) suggest that an average between the regional agriculture and manufacturing wages can be used to estimate the regional service wage level. The viability of this assumption builds on the condition that between-sector labor mobility is not stalled by any major obstacles (i.e. that people are free and willing to move into sectors with higher relative wages). Indeed, investigations have shown that higher wage levels affect flows to industries positively, but also that there are quite some obstacles to migrate between sectors. Industries are for example characterized by the use of different industry-specific skills, which make a friction-free labor force transfer between industries problematic (Neffke and Svensson Henning 2009). However, the literature on de-skilling of the labor force during the industrial revolution suggests that this might be more of a contemporary phenomenon.

The sector aggregation problem refers to the sensitiveness of the G-S method to industry aggregations. It is an important question how many different industries should be used, and what the consequences of using a broad aggregate instead of many fine-grained industries are. A conventional approach is, as mentioned above, to use an agriculture/ manufacturing/ service distinction. However, regional and national specificities may cause these aggregates to bias regional estimations. An example is when a small subset of regionally concentrated activities in the agricultural sector elevates the productivity in agriculture, also on national level. But it is not self-evident that more detailed industry data is always better. Distinguishing between a large number of industries may bias estimations over time, as the risk of errors associated with problematic and unstable specifications of industries increases. Usually this is however not a major practical problem, since researches commonly do not have the possibility to choose among a wide variety of historical industry aggregations.

[6] We refer to differences in labor productivity (value added per employee), which of course implicitly takes into account productivity differences stemming from a wide variety of traditional productivity sources.

The correlation of sector/regional structure problem is related to the problems discussed above, and concerns the consequences of the G-S estimation principles for small regions with very specialized production portfolios. In such small regions, a broad national productivity measure can be expected to bias the GRP estimations. For example, if a small region is very specialized in a fraction of the manufacturing industries which is highly productive, using an average productivity given on a national level and for a broad set of manufacturing industries will bias the GRP estimations in that specific region. Reasonable outcomes for such regions will be very sensitive to industry productivity deviances from the national industry mean.

4. Data and implementation for Swedish regions and some preliminary tests

In the implementation of the Geary-Stark method on the Swedish data we use four different data sets: (1) total population data per province, (2) historical GDP and employment data on national level from the Swedish National Historical Accounts (SNHA), (3) regional employment data from a variety of sources, and (4) regional wage data from a variety of sources.

Total population data per province (län)

The total population data per province (län) we use data is provided by Statistics Sweden (www.scb.se). Table 1 lists the provinces and the average number of inhabitants 1855-2007. Stockholms län (consisting both of Stockholm city and the Stockholm province) is by far the most populated province, followed by Malmöhus län and Göteborgs och Bohus län. Gothenburg, the second largest city in Sweden, is located in the latter province. Together with the Uppsala province (close to Stockholm), the Stockhom, Göteborg and Malmö provinces have also experienced the most dramatic population growth during the investigated period. Interestingly, quite a few provinces experienced rather meager population growth, below the national average. Many of these provinces have historically been dominated by agriculture, and some of them were also subject to large migration to the United States before and around the turn of the century 1800/1900 (for example Kronobergs, Kalmar and Blekinge län).

-Table 1-

In 2000 and 2007, an administrative change took place in the definition of the provinces. Malmöhus and Kristianstad län were merged into Skåne län. Göteborg och Bohus län, Älvsborgs län and Skaraborgs län were merged into Västra Götalands län. As the "older" provinces give a more detailed picture of the regional development in Sweden, we use municipality data for 2000 and 2007 to adjust modern data to the older provinces, and therefore comparable over time.

Historical GDP and employment data on national level

The Swedish Historical National Accounts (SHNA, Krantz & Schön 2007) provide national data on industry value added, number of employees and total GDP measured at factor costs 1855-2000. In the Swedish implementation of the G-S method we generally use four different industries: agriculture, manufacturing, private services and public services.

- "Agriculture" consists of the SHNA categories
  - Agriculture
  - Forestry
- "Manufacturing" consists of the SHNA categories
  - Manufacturing industry
  - Building and construction
- "Private services" consists of the SHNA categories
  - Transport and communication
  - Private services
- "Public services" consists of the SHNA category
  - Public services

The SHNA also identifies *services of dwellings*, which in for example 1910 contributed to about 10% of total national GDP. This industry does however not employ many people, and the incomes mainly originate from returns of house ownership. There might of course exist regional differences in productivity in this sector, but probably to a lesser extent than for other sectors. We therefore simply regionalize these incomes according to the size of regional population.

SHNA provides no estimates for 2007. For this year we have used data from the National Accounts of Statistics Sweden in our G-S estimations. To ensure consistency with the time series of the SNHA, the official 2007 figure has been depreciated with 11.3%, which is the average difference between the

SNHA and official estimates 1993-2000.[7] For 2007 we also use only three industries: production of commodities (including agriculture), production of services and public sector.

Regional employment data

The collection and organization of the historical regional employment data is complex and involves compiling information from a range of different original sources. Different kinds of population censuses that provide data on employees per industry per province are most frequently used.[8] For the cases where the original regional employment data is more detailed than needed for the four-industry implementation of the G-S method, we generally use the following scheme to collapse the data into four industries:[9] [10]

- As "Agriculture" we define
    - Farming
    - Fishing
    - Forestry
- As "Manufacturing" we define
    - Manufacturing
    - Construction
    - Power and gas
- As "Private services" we define
    - Retail

[7] The difference is very stable over these years. This operation does not have any implication for the calculation of regional shares of GDP, but only for the nominal figures. The large difference is due to the fact that we use GDP at factor prices from the SHNA, and market prices from Statistics Sweden.

[8] For some years, the census reports population size per industry including all children, wives and servants, even if they are not directly employed in the particular industry. However, since the census data is only used to calculate the regional shares of employees for the different industries, which we then compare to the national known total of employees in each sector from the SHNA, this does not matter for our results.

[9] This is also the most detailed aggregation level where we can get consistence and decent wage data.

[10] The most notable exception from this scheme is 1855, for which we have occupation level data only. We have made a different but comparable scheme to aggregate the occupations into our four sectors. This scheme can be found in Appendix A.

  - Wholesale
  - Financial services
  - Transportation
  - Hotels and restaurants
  - Household services
- As “Public services” we define
  - Public administration
  - Education
  - Healthcare
  - Other services

Table 2 lists the exact sources of the regional employment information.

-Table 2-

Regional wage data

The most complicated data in our datasets, with least complete coverage, are the regional wage data series. In many cases, our ambitions have to be limited to establishing a decent proxy for the relative wage differentials. Since these data are used only to establish *relative* regional wage differentials, the inconsistency of the data over time should not pose an overwhelming problem.

For some years and for some industries, the wage information is provided for spatial aggregations that are geographically different from the provinces. The *Dyrortsgruppper* is a regional hierarchy of cities, based on estimations of living cost levels and constructed for salary adjustment purposes. Where we have data for such Dyrortsgruppper, we have used the dyrortsgrupp of the largest city in the province as a proxy for the cost level in the province as a whole. Where there is only wage data for larger regions than the provinces (*Riksområden*), we take the wage level in the area to which the province belongs to be representative of the wage level of the province itself. Admittedly, these proxies of the wage level of the region are much less than perfect. However, our tests suggests that leaving out wage differentials would cause estimations to be more biased.

Table 3 lists the sources of the regional wage data for *agriculture* together with some important remarks.

-Table 3-

Table 4 lists the sources of the regional wage data for manufacturing together with some important remarks.

-Table 4-

Table 5 lists the sources of the wage data for private services together with some important remarks.

-Table 5-

For the public services, no regional productivity differentials assumed until 2000 due to lack of reliable data. Where we do have more detailed data, the regional differences in wages for the public sector 2000 are considerably smaller than for other industries.[11] However, for the years 2000 and 2007 where we have almost perfect wage data, we do use the information we have to calculate regional wage differentials for the public sector. Table 6 lists the sources of the wage data for public services.

-Table 6-

Essentially, this data is sufficient to estimate regional GDPs for the Swedish regions 1855-2007 according to equation (4). We use this equation, with one exception as we do not make use of the scalar β_j. It can be shown that with our definition of the input variables, the scalar reduces to 1 and is unnecessary (see Appendix B). Appendix B also provides some information about how the industry value added per worker (y_i) and the wage differential are estimated in a practical sense.

Some preliminary tests

Using preliminary estimations for 1910, 1993 and 2006, we can assess the impact of the unreliable assumption problem, the sector aggregation problem and the correlation of sector/regional structure problem on the Swedish estimations.[12] First, results in Geary and Stark (2002) as well as Enflo *et al.* (2009) suggest that estimates using wage differentials as productivity proxy yield more precise estimates than using only an average national productivity measure (leaving out the w_{ij}/w_j in equation 4). In the examples of Enflo *et al.* (2009), use of wage differentials reduces the average

[11] Due to this uncertainty, we have calculated the indicators with and without public sector. This does not change the interpretation of the empirical results.

[12] For 1910 we use the procedure and data outlined above. For 1993 and 2006 we estimate using the data provided in the national accounts in this preliminary test.

"mis-specification" of regional GDPs, and drastically reduces the maximum regional difference between the estimations and the official estimates (this holds true for both 1993 and 2006). Thus, accounting for regional wage differentiation drastically improves the precision of the estimates. Concerning the suggestion that a weighted average between agriculture and service wages is a reasonable proxy for regional wages in the service sector (see Geary and Stark 2002), this will obviously hold for the case where there is some degree of voluntary labor mobility between sectors. For the Swedish case, authors have indeed argued that regional competition for labor from manufacturing sectors led to an upward pressure on agricultural wages in some regions during the industrialization process (see Söderberg and Lundgren 1982). So far, we however have too incomplete data to systematically test the exact empirical consequences of this assumption.

When it comes to the sector aggregation problem for the Swedish estimations, results in Enflo *et al.* (2009) suggest that the number of industries distinguished between may have some but comparatively small implications for the aggregate results. The differences between outcomes when distinguishing between seven manufacturing industries (food, textile, mineral, metal & machinery, mining, wood and power production) compared to using one aggregate manufacturing industry (see above) in 1910 are rather small. The difference is less than 10 % for all Swedish provinces apart except Stockholm, which obtains a smaller value added with the 7 industries disaggregation than with the one-manufacturing sector alternative. However, more differentiated sector data is not at all always better. In fact, making the estimation for economy as a whole (one "industry") instead of distinguishing between three industries yielded somewhat higher precision in the regional estimates for 2000. The convergence in productivity patterns, together with the fact that the public sector has expanded enormously since the 1960s in Sweden, suggests that such a result can however not be taken as an imperative to reduce all historical G-S estimations using one whole-economy average only.

In all, Enflo *et al.* (2009) find that the two conditions that causes the most significant sector aggregation problems in 1910 are 1) how services of dwellings are distributed regionally, and 2) whether forestry is separated from agriculture or not. The forestry sector strongly deviates from other parts of agriculture in Sweden with a considerably higher value added per worker. Notwithstanding this, we include the forestry in the agriculture industry (this is further discussed below). We distribute service dwellings incomes according to the population size of the region.

Concerning the sector/regional structure problem, it has already been concluded that the recommended G-S three-sector disaggregation performs generally well in comparison to specifications that rely on more disaggregated data. In their tests, Enflo *et al.* (2009) also discover estimation problems of more regional-specific character, that need to be addressed in order to arrive at regional theoretically and empirically sound GDP. The comparative higher labor productivity of forestry compared to agriculture might cause a regional bias in the Swedish case, as the forestry industry is unevenly distributed regionally with a large share of forestry taking place in the Northern provinces. As many wood workers however also work in the agricultural sector under conditions of mixed and seasonal farming, we prefer to treat agriculture and forestry as integrated sectors. Also under these conditions, the higher productivity of the Northern provinces is reflected in favorable wage differentials compared to the rest of the country.

Contrary to what could be expected, separation of mining and power production from manufacturing industries does not appear to make a difference for the most northern regions in Sweden in 1910. We find no indications that mining had an extraordinary high labor productivity, and power production still constituted a small part of total manufacturing value added (around 2%). However, the sensitivity of the estimations will increase the smaller the size of the region, as the risk of sector/regional structure problem will increase. Based on our results for 2000 the use of the G-S GDP estimation method for regions of less than about 150 000 inhabitants can, as a rule of thumb, not be recommended.

As the preliminary tests of this section has provided us with some confidence in using the estimation method outlined in sections 3 and 4, but also pointed to some problematic aspects that should be considered in empirical situations, we now turn to the final estimation outcomes. The findings will be structured according to the expectations E1-6.

5. The final regional GDP estimation results[13]

According to **E1**, we expect the G-S method to yield high precision estimates for the Swedish regional GDP data 1855-2007. To test this expectation, two reference points are created (2000 and 2007), where the estimations can be compared to official data from Statistics Sweden.[14] Results are displayed in table 7. In 2000, the mis-allocation (i.e. error or the sum of value added attributed to the

[13] In Appendix C, the outcomes of the final GDP estimations are displayed per province. Here, aggregated GDP figures for the 8 Swedish NUTS 2 regions can also be found.

[14] We use 21 provinces to match the SCB data which is adjusted to the more recent administrative system. We also adjust for the difference between the factor cost and market price estimations in our different sources.

wrong region) is 5% of total GDP (first column).[15] In 2007 the error is smaller, 4% of total GDP (second column). If we instead measure at the level of the regions, the unweighted average error is around 5% of regional GDP (third and fourth columns).[16] For the vast majority of our provinces, the differences created by our estimates compared to official data are very similar to the reported differences in Geary and Stark (2002). In 2000 however, differences exceed 10% in three provinces. The least precise estimate is that of Uppsala län, which yields a 12% underestimation of regional GDP compared to the official estimates. Also in 2007 differences in three provinces exceed 10%. The least precise estimate is now that of Kalmar län (-16%). The most precise estimate for both sample years is for Skåne län.[17] In general, the G-S method applied to the Swedish data yields fairly precise estimates. However, the method may for some few individual regions mis-estimate GDP with up to 16%. To tell if trends and longer term indications in the data are at all interpretable, we should therefore need to know if errors are systematic or occur due to more or less hap-hazard circumstances.[18] For our comparison points, we find little systematic errors in the regional estimations. The correlation between regional errors in 2000 and 2007 is 0.08. This suggests that the measurement errors for individual provinces are at least temporary compared to the errors of other regions.

-Table 7-

Overall, the G-S method implemented for the Swedish data yields results in line with **E1**. The results are of course tested for two sample years only, but the differences between our G-S estimates and official province estimates are generally well within the range of those reported in the international literature. The fact that errors for individual regions seem not to be persistent and systematic over time, open up for interpretations of long-term results and trends, even if not for exact interpretations of the value of an individual province in a specific year. There are also few reasons to expect that historical estimations should be less precise than the estimations for our more

[15] This is calculated as the sum of absolute differences between our estimates and the official province GDP across all regions, as share of total GDP.

[16] This is calculated as the average difference between our estimates and the official province GDP for each region as share of the regional GDP.

[17] One reason for this could be that Skåne has an economy that is structurally very representative of the Swedish general economy (Henning *et al.* 2009).

[18] For example by the temporary fluctuation of value added in a region. Svensson Henning (2009) has shown that regional value added can fluctuate extensively in individual industries on an annual basis.

contemporary reference points (2000 and 2007). Even though the wage information about the service industries is scarce in a historical perspective, we do have good historical data for agriculture. This is important, as agriculture was of course extremely dominating in a historical sense (and accounted for over 70% of labor force in 1855). In fact, the post-WWII period until 1980 could be expected to be the most problematic period for our estimations, as this period features neither the almost perfect regional wage data on the expanding service sector that exist for later years, nor does it feature the period the extreme dominance of agriculture as the earlier years, or the mediating effects on regional GDP that the expansion of the public sector later could be presumed to generate.

According to **E2** we expect, for a variety of reasons many of which have to do with regional path dependency and structural inertia, very high correlation between regional production shares in the short run. Indeed, we do find that the degree of stability in the regional system in terms of regional GDP is very large in the shorter run. If we measure the shares of national GDP that individual regions account for in each year, and then correlate the regional distribution of shares between each ten-year period (1870-1880, 1880-1890, etc.), the average correlation coefficient for the 14 combinations is .99.[19] According to the **E3**, we also expect high (but lower than E2) correlation between regional production shares in the long run. Indeed, if we correlate the regional distribution of national GDP shares in 1855 and 2007, the correlation is high, about .85. This correlation is as expected lower than the average ten-year correlations of E2.

As expected, the regional system is extremely stable over time in term of production values. This is true for shorter periods (ten years), but also to a lesser extent for very long time spans. Considering the information in our aggregate regional production data, regional production structures indeed appear to be very sticky. Even if this is in itself an interesting empirical observation, one can also regard it as a result that is favorable in terms of our method. Contrary to what we obtain here, instable regional GDP results with many spikes would suggest that the G-S method yields unreliable outcomes.

The stability of the Swedish regional system measured in terms of average correlations might however still hide incremental changes that are specific to particular growth regimes. According to **E4**, we expect some turbulence (spatial re-distribution of production) in the Swedish regional system until 1920, and thereafter more stabile structures. Investigating this, we first consider the correlation of the shares of each region of national GDP in 1855, with regional shares in each consecutive year.

[19] We exclude the first and last combinations as these are not ten-year periods, but the results do not change if they are included.

Turning to a visual inspection of the results (Figure 1), the correlation between the distribution of production every estimation year and the distribution in 1855 suggests three broad phases of regional development. 1855-1910 was indeed a (comparatively, NB the scale of the y-axis) turbulent period with a decreasing correlation with the distribution of 1855. With some variations, the correlation was then actually rather stabile until the 1980s. After this, the correlation turns downwards again, but admittedly this change is not drastic compared to the preceding years. Indeed, we do observe a greater instability of the regional system during early stages of industrialization. Changes in the distribution after this do occur, but at a much more incremental pace than in the period before 1910.

-Figure 1-

The results of Figure 2 are even more suggestive of these findings. In Figure 2, we plot the correlation between the regional shares of national GDP for each consecutive observation combination (1855-1860, 1860-1870 etc.). The curve also suggests an initial period of quite severe instability of the system (even though all correlations are above .9). The decisive point of stability seems to have been reached in 1920/1930.

-Figure 2-

To complement the correlations, Figure 3 shows the coefficient of variation of regional GDP in the Swedish regional system.[20] The graph suggests that the inequality (measured by the standard deviation) in distribution of production in the regional system has increased substantially over the time period that we investigate. This is less the case if Stockholm is excluded, but the process is still visible. Visually, the graph however suggests a broad-brush periodization of more or less dramatic sequences of increasing convergence. From 1855 to 1900, the divergence in regional GDP did not increase substantially in the system. Between 1900 and 1940 however, the dispersion of production in the system increased each year combination until 1940. During the post-war period until 1980 the process once again came to a stand-still, but only to diverge again from the 1980s.

-Figure 3-

[20] This is the (unweighted) standard deviation of regional GDP divided by the (unwieghted) mean regional GDP. A CV weighted by regional size (population) yields very similar results with a slight difference in levels. For all coefficients of variations in this paper, we have in fact also experimented with weighed version. Since the results of these are not distinguishable from the ones discussed here, we remain with the unweighted versions.

The anatomy of the same process can be clearly illustrated by considering the percentages of national GDP per province (Figure 4). Even though the names of all provinces are not displayed, the three larger provinces (including the three major urban centers of Stockholm, Gothenburg and Malmö) can be easily distinguished. The upper most line represents Stockholm. Clearly, the increasing CVs in figure 4 are driven by the relative expansion of the big city regions, especially Stockholm. Over the while period 1855-2007, Stockholm increases its share from about 12% of total national GDP to about 28%. Many other regions decrease their shares, but this is of curse connected to the enormous relative expansion of Stockholm. This trend is remarkably persistent over time. Even though the redistribution of production was more pronounced during early industrialization, divergence in the system has continued to take place caused by the growth of the metropolitan areas, mainly Stockholm.

-Figure 4-

Turning to the connected issue of regional growth, Figure 5 suggests that there was also a drastic convergence in the yearly standard deviation in the growth of the provinces. The regional differences in growth were significantly larger in the beginning of the period that we study, than in the later period. This also underlines the notion of E4 with an early redistribution of production values in the system. In the early years of industrialization, some regions would show an average annual growth of 5-7%. Since 1980, the Stockholm region has been the leading region with an average annual growth between 2 and 3%.

-Figure 5-

According to **E5,** we also expect a slow convergence in GDP/capita in the Swedish regional system, primarily after 1920. Figure 6 shows the coefficient of variation of GDP per capita in the Swedish regional system. It is quite clear from the figure that there is a trend-wise convergence over time of GDP per capita across the provinces. Also after excluding Stockholm, which might again be suspected to be an outlier in this context, the pattern overall persists. However, the early 1900s seem not to be a decisive point in this regard. Instead, the convergence trend appears to be systematically interrupted during the process of growth.

-Figure 6-

According to **E6**, the Swedish industrialization process is, compared to other countries, supposed to have benefited countryside locations to a large extent. As we saw previously, the convergence tendencies in GDP per capita have been very strong over time in the Swedish system. However we have also seen that the metropolitan areas, most notably Stockholm, has expanded drastically over time in terms of production size. In 1980, the regional differences in GDP/capita were at their lowest level since the introduction of modern statistical measurement. But this process is not only fuelled by the fact that Stockholm has become more equal in this sense, to other parts of the country (Figure 7). The less fortunate provinces in the beginning of industrialization also converged towards the national mean. This dual process would have served to reduce regional deviations in GDP per capita. However, 1980 seems to have introduced yet another period of divergence in regional GDP per capita. With the introduction of the knowledge driven economy, the regional differences are once again increasing.

-Figure 7-

In terms of efficiency therefore, the industrialization process indeed early benefited peripheral locations, as the GDP/capita gap in the system quickly decreased. On the other hand, this might have well to do with the migration of population to Stockholm and the other major city provinces. Even if we only have province data, it is probably safe to say that early industrialization indeed benefited peripheral locations, but in terms of scale, this process was fast taken over by the expansion of the most densely populated provinces. This conclusion is also supported in our concluding reflections below.

Lastly, we might consider the fact that aggregate accounts of the kind above tend to obscure the development paths of individual regions. We conclude by creating a regional growth taxonomy where we take the two structural periods of growth that many of the figure above indicate (-1910 and 1910-), and study which regions have positive or negative differentials in terms of shares of regional GDP and population. For each province and year, this means that we calculate the following difference

(6)

$$D_i = \left(\frac{GDP_i}{GDP} - \frac{Pop_i}{Pop}\right) * 100$$

Where D_i is the difference indicator, GDP_i is the GDP of region *i,* GDP is the national GDP, Pop_i is the population of region *i*, and Pop is the national population.

The D_i for a specific year and province then is the degree to which it has an "excess" share of regional GDP compared to its shares of population. This is of course similar to calculating the relative regional GDP per capita. Then we simply say that a province that has an average positive D_i in both 1855-1910 and 1910-2007 is a generally above-average performing region (on average, it always had a larger share of GDP than population). On the other hand, a province that had a negative average D_i in both 1855-1910 and 1910-2007 was a generally below-average performing region. A province that had an average D_i of above 0 in 1855-1910 but below 0 in 1910-2007 is called an early grower, and the opposite is called a late grower.[21]

This simple taxonomy yields surprisingly clear results (Table 8). The big-city provinces are the only ones that display a general above-average growth during the entire period we study. Early growers, provinces that early during industrialization had a larger share of GDP than population, are primarily provinces along the coast in the North of Sweden. The dramatic expansion of these provinces is primarily connected to the dependence on natural resources that characterized early stages of industrialization in Sweden. The rest of the provinces are categorized as general below-average performers. However, this is a heterogeneous group, since some very expansive provinces (i.e. the metropolitan regions) tend to elevate the national GDP to which we refer. But especially for the countries that experienced a large migration to the United States, the D_i was very negative during the beginning of our investigated period.

5. Conclusions and Implications

While characterized by slowly changing structures, the 150 years of regional economic development in Sweden that we analyze in this paper are marked by clearly visible turning points. The general trend is towards a more homogenous system in terms of value added per capita in the different provinces. Especially in the early stages of industrialization, convergence was fast. This lends support to the presumed existence of equilibrating forces through the infrastructure and communication networks that were established already during the later part of the 18th century. However, the development in the scale of production structures in the provinces is characterized by quite a contrasting evolution. Here, the metropolitan provinces (Stockholm, Gothenburg and Malmö) have increased shares substantially. This is especially the case for Stockholm. The factor linking these seemingly contradicting observations is of course migration. As migration has worked to equilibrate

[21] A multiplicative measure (i.e. when shares are divided) yields exactly the same final outcomes for the provinces.

differences in GDP per capita, so have the absolute geographical differences in production and population become more marked in Sweden. Even if early industrialization was marked by substantial turmoil, it seems to have set out development path that was perhaps only changed in the late 1980s. The structural crisis in the late 1970s seems to have marked the beginning of a new period of divergence in the knowledge learning economy, also in GDP per capita. In a historical perspective, this is a quite spectacular finding.

The estimates of regional GDP that this paper provides, opens up to a whole range of novel long-term research questions. Especially interesting is the periodization of convergence and divergence in GDP per capita in the regions, and to what extent these are connected to macro developments in the wider economy. Another fruitful avenue of research could be to further investigate the relations between economic growth and migration under 150 years of regional development. Within the framework of the larger ESF project, it will also be possible to relate the Swedish experiences to a larger European context.

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See also Tables 2-6.

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Appendix A: Occupations and sectors for 1855

Occupation	*Our sectors*
Men	
Senior clergymen (Högre prästerskap)	Public services
Military clergymen (Regementspastorer)	Public services
Other clergymen (Vice pastorer mm)	Public services
Preachers in healthcare facilities (Lasarettspredikanter mm)	Public services
Preachers on industry estates (Bruks- och huspredikanter)	Public services
Cleargymen teachers in high schools (Prästvigda lärare mm vid läroverk)	Public services
Private clergymen teachers (Prästvigda enskilda lärare)	Public services
Parish clerks (Prästvigda klockare)	Public services
Church assistants (Kyrkobetjänter)	Public services
Teachers/ Church assistants (Skollärare/kyrkobetjänter)	Public services
Other elementary school teachers (Övriga folkskolelärare)	Public services
Academic teachers (Lärare vid akademier och elementärläroverk)	Public services
Other teachers in public schools (Lärare vid andra allmäna läroverk)	Public services
Private teachers (Enskilda lärare)	Public services
Royal estates (Kronobetjäning)	Public services
City white-collar staff (Städernas tjänstemän mm)	Public services
White-collar staff in mines (Tjänstemän vid bergverken)	Manufacturing
Forestry and hunting services (Skogs- och jägeribetjäning)	Agriculture
Customs (Tullbetjäning)	Public services
Physicians (Läkare mm)	Public services
Other civil white-collar staff (Övrige civile tjänstemän)	Public services
Police (Polis)	Public services
Other civilian government officials (Övrig statlig civil betjäning)	Public services
Officers army (Officerare armén)	Public services
Soldiers army (Soldater mm armén)	Public services
Officers navy (Officerare flottan)	Public services

Soldiers navy (Soldater mm flottan)	Public services
Boatswains (Båtsmän)	Public services
Musicians (Musikanter mm)	Private services
Skippers (Skeppare och ångbåtsförare)	Private services
Boat skippers (Båtskeppare)	Private services
Seamen international (Sjömän utrikes sjöfart)	Private services
Seamen domestic (Sjömän inrikes sjöfart)	Private services
Pilots (Lotsar)	Public services
Lighthouse-keepers (Fyrvaktare)	Public services
Other workers (Diverse arbetare)	-
Retired (Ur tjänst avgångne personer)	-
Private services, not agriculture (I enskild tjänst, utom jordbruket)	Private services
Leaseholders (Possessionater, arrendatorer mm)	Agriculture
Farmers (Bönder, torpare mm)	Agriculture
Agricultural labourers (Stattorpare)	Agriculture
Crofters (Arbetsföre backstuguhjon)	Agriculture
Gardeners (Trädgårdsmästare)	Agriculture
Fishermen (Skärbönder och fiskare)	Agriculture
Miners (Bergshantering idkande)	Manufacturing
Mill and work workers (Brukshantering idkande)	Manufacturing
Manufacture workers (Fabrikshantering idkande)	Manufacturing
Craftsmen (Hantverk idkande)	Manufacturing
Artists (Konstnärer)	Private services
Wholesaler (Grosshandlare)	Private services
Brokers (Mäklare och skeppsklarerare)	Private services
Shop-keepers (Minuthandlare)	Private services
Booksellers (Bokhandlare)	Private services
Pharmacists (Apotekare)	Private services
Innkeepers (Gästgivare mm)	Private services

Women	
Own agriculture (Lantbruk för egen räkning)	Agriculture
Own manufacturing (Bruks- eller fabriksrörelse egen räkning)	Manufacturing
Own craftsmen (Hantverk och handel egen räkning)	Manufacturing
Hustrur med särskilt näringsfång	-
Manufacture assistants (Bruks- och fabriksbiträden)	Manufacturing
Shop assistants (Hantverks- eller handelsbiträden)	Private services
I övrigt levande av sitt arbete	-
Midwifes (Barnmorskor)	Public services
Teachers in public schools (Lärarinnor i folkskolor)	Public services
Governesses and private teachers (Guvernanter och enskilda lärarinnor)	Public services
Private services (I enskild tjänst)	Agriculture

Appendix B: The scalar β_j

Since we use the consistent SNHA series for value added and employment per industry, our definition the value added per worker is, using the subscripts introduced above, is

(A1)

$$y_j = \frac{Y_j}{L_j}$$

thus inserting this into equation (5)

(A2)

$$\beta_j = \frac{Y_j}{\Sigma^i \left[\left({Y_j}/{L_j} \right) \left({w_{ij}}/{w_j} \right) \right] L_{ij}}$$

As Y_j is known, let us not focus solely on the denominator of (A2). The first element can in our context be viewed as a constant. Thus, the denominator takes the form

(A3)

$$\frac{Y_j}{L_j} \sum^i \frac{w_{ij}}{w_j} L_{ij}$$

For the moment disregarding the constant and focusing on the latter part of (A3) after the sigma, considering our definition of the wages, this last part takes the form:

(A4)

$$\sum^i \frac{w_{ij}}{\left(\frac{(\Sigma^i [w_{ij} * L_{ij})]}{L_j} \right)} * L_{ij}$$

Rearranging and simplifying the expression (A4), we obtain

(A5)

$$\sum^i \frac{w_{ij} L_{ij} L_j}{(\Sigma^i w_{ij} L_{ij})}$$

As L_j can be viewed as a constant in our context, rearranging expression (A5) yields

(A6)

$$L_j \sum^{i} \frac{w_{ij} L_{ij}}{(\Sigma^i w_{ij} L_{ij})}$$

Obviously, as the latter part of A6 refers to sum of shares, this will sum to 1 which leaves only L_j .

Feeding this information into (A3), the denominator of the scalar now takes the form

(A7)

$$\frac{Y_j}{L_j} L_j$$

which makes the expression of the scalar (5) to take the form

(A8)

$$\beta_j = \frac{Y_j}{Y_j}$$

and becomes trivial. With our definition of the variable, the scalar becomes unnecessary to introduce in this version of the Swedish estimations.

Appendix C. Estimated regional GDPs for Swedish provinces (län) 1855-2007.

National data	*1855*	*1860*	*1870*	*1880*	*1890*	*1900*	*1910*	*1920*	*1930*	*1940*	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*	*2007*
Swedish GDP (nominal)	793	764	926	1260	1380	2147	3192	12670	10138	14096	31516	69914	165382	504553	1283479	1991364	2683447
Swedish GDP (1910/1912 price lvl)	842	960	1206	1465	1664	2359	3182	4104	5630	7126	10660	14990	24730	30383	37512	45532	
Source: SHNA and own calculations																	

Percentages of national GDP	*1855*	*1860*	*1870*	*1880*	*1890*	*1900*	*1910*	*1920*	*1930*	*1940*	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*	*2007*
Stockholms län	12,17%	13,29%	10,76%	12,48%	14,83%	12,82%	13,78%	15,75%	17,14%	21,12%	19,29%	21,08%	21,85%	20,36%	23,34%	27,09%	27,84%
Uppsala län	2,63%	3,30%	2,41%	2,44%	2,16%	2,10%	2,10%	2,25%	2,08%	1,99%	1,96%	1,97%	2,43%	2,49%	2,57%	2,54%	2,57%
Södermanlands län	3,14%	3,90%	3,02%	3,16%	3,17%	2,99%	3,15%	2,92%	2,71%	2,88%	2,89%	2,94%	2,99%	2,92%	2,64%	2,33%	2,41%
Östergötlands län	6,98%	7,60%	6,15%	5,79%	5,97%	5,18%	5,50%	4,87%	4,68%	4,67%	4,59%	4,59%	4,55%	4,69%	4,46%	4,24%	3,94%
Jönköpings län	3,05%	3,31%	3,17%	3,90%	3,17%	3,09%	3,57%	3,12%	3,14%	3,23%	3,80%	3,48%	3,64%	3,75%	3,61%	3,69%	3,61%
Kronobergs län	2,22%	2,25%	2,60%	2,71%	2,40%	2,17%	2,29%	1,91%	1,78%	1,62%	1,82%	1,83%	1,95%	2,09%	2,03%	2,02%	1,92%
Kalmar län	5,66%	4,26%	4,60%	4,36%	4,04%	3,77%	3,42%	3,30%	3,15%	2,72%	2,88%	2,65%	2,70%	2,81%	2,56%	2,29%	2,48%
Gotlands län	1,32%	1,22%	1,38%	1,08%	1,03%	0,87%	0,97%	0,77%	0,73%	0,68%	0,67%	0,60%	0,55%	0,61%	0,53%	0,46%	0,43%
Blekinge län	3,16%	2,52%	2,60%	2,58%	2,46%	2,42%	2,73%	2,30%	2,15%	2,03%	1,71%	1,79%	1,80%	1,83%	1,60%	1,53%	1,42%
Kristianstads län	4,02%	5,34%	4,22%	4,01%	3,83%	3,58%	4,01%	3,52%	3,34%	3,11%	3,12%	2,93%	3,08%	3,03%	2,90%	2,90%	2,77%
Malmöhus län	6,80%	6,54%	8,33%	9,08%	9,22%	9,24%	10,53%	9,55%	9,52%	9,27%	8,81%	8,33%	9,30%	9,10%	9,03%	8,62%	8,90%
Hallands län	2,64%	2,65%	2,94%	2,31%	1,80%	2,23%	2,32%	2,16%	2,05%	1,89%	2,13%	1,94%	2,29%	2,47%	2,57%	2,31%	2,46%
Göteborg och Bohus län	8,52%	6,92%	7,66%	6,31%	6,79%	7,74%	7,00%	9,19%	9,78%	9,33%	9,33%	8,86%	9,42%	9,30%	10,07%	9,83%	10,38%
Älvsborgs län	6,04%	5,32%	4,76%	4,28%	3,72%	4,04%	4,11%	4,34%	4,60%	4,78%	5,32%	4,73%	5,06%	4,73%	4,56%	4,55%	4,31%
Skaraborgs län	3,79%	4,28%	4,50%	4,63%	3,87%	3,58%	3,66%	3,05%	2,85%	2,87%	3,09%	2,82%	2,87%	3,07%	2,89%	2,80%	2,71%
Värmlands län	4,81%	5,50%	4,94%	4,49%	4,13%	3,94%	3,82%	3,91%	3,80%	3,50%	3,59%	3,65%	3,20%	3,29%	2,98%	2,72%	2,60%
Örebro län	2,91%	3,04%	3,76%	3,32%	3,10%	3,37%	3,39%	3,63%	3,52%	3,75%	3,50%	3,49%	3,34%	3,01%	2,95%	2,91%	2,72%
Västmanlands län	2,26%	2,90%	2,73%	2,98%	2,73%	2,89%	2,58%	2,63%	2,38%	2,59%	2,80%	3,08%	3,26%	3,31%	2,95%	2,83%	2,59%
Kopparbergs län	2,96%	3,17%	4,00%	3,80%	3,98%	3,92%	4,35%	3,86%	3,66%	3,48%	3,59%	3,58%	3,14%	3,34%	3,01%	2,83%	2,70%
Gävleborgs län	4,31%	4,19%	4,85%	5,55%	5,46%	5,92%	4,84%	4,59%	4,55%	3,83%	3,82%	3,65%	3,37%	3,51%	3,13%	2,81%	2,71%
Västernorrlands län	5,16%	3,45%	3,79%	4,27%	5,14%	5,29%	4,30%	4,43%	4,42%	3,62%	3,60%	3,80%	2,99%	3,11%	2,86%	2,50%	2,40%
Jämtlands län	1,38%	1,82%	1,95%	2,14%	2,30%	2,61%	1,89%	1,99%	1,79%	1,81%	1,71%	1,77%	1,23%	1,38%	1,32%	1,16%	1,16%
Västerbottens län	2,25%	1,76%	2,24%	2,05%	2,25%	2,70%	2,34%	2,68%	2,83%	2,45%	2,83%	3,07%	2,40%	2,77%	2,67%	2,52%	2,54%
Norrbottens län	1,83%	1,47%	2,63%	2,27%	2,43%	3,55%	3,35%	3,29%	3,37%	2,79%	3,16%	3,37%	2,60%	3,04%	2,78%	2,51%	2,42%

Percentages of national GDP per NUTS region	*1855*	*1860*	*1870*	*1880*	*1890*	*1900*	*1910*	*1920*	*1930*	*1940*	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*	*2007*
SE11 Stockholm	12,17%	13,29%	10,76%	12,48%	14,83%	12,82%	13,78%	15,75%	17,14%	21,12%	19,29%	21,08%	21,85%	20,36%	23,34%	27,09%	27,84%
SE12 Ö Mellansverige	17,91%	20,73%	18,07%	17,69%	17,13%	16,53%	16,72%	16,31%	15,36%	15,87%	15,73%	16,07%	16,58%	16,42%	15,57%	14,87%	14,24%
SE21 Småland med öarna	12,24%	11,04%	11,75%	12,05%	10,64%	9,90%	10,24%	9,10%	8,80%	8,24%	9,17%	8,55%	8,84%	9,26%	8,73%	8,47%	8,45%
SE22 Sydsverige	13,98%	14,40%	15,15%	15,67%	15,52%	15,24%	17,27%	15,36%	15,01%	14,41%	13,64%	13,05%	14,18%	13,95%	13,53%	13,05%	13,09%
SE23 Västsverige	20,99%	19,16%	19,86%	17,53%	16,18%	17,59%	17,09%	18,74%	19,27%	18,87%	19,88%	18,35%	19,64%	19,56%	20,09%	19,50%	19,87%
SE31 N Mellansverige	12,08%	12,86%	13,80%	13,83%	13,58%	13,79%	13,01%	12,36%	12,01%	10,80%	11,00%	10,88%	9,70%	10,14%	9,12%	8,35%	8,01%
SE32 Mellersta Norrland	6,54%	5,27%	5,74%	6,42%	7,45%	7,89%	6,19%	6,41%	6,21%	5,44%	5,31%	5,58%	4,22%	4,49%	4,17%	3,66%	3,55%
SE33 Övr Norrland	4,09%	3,24%	4,87%	4,32%	4,68%	6,25%	5,69%	5,97%	6,20%	5,24%	5,98%	6,44%	5,00%	5,81%	5,45%	5,02%	4,96%

Regional GDP/capita, index, national average=1	*1855*	*1860*	*1870*	*1880*	*1890*	*1900*	*1910*	*1920*	*1930*	*1940*	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*	*2007*
Stockholms län	2,05	2,19	1,68	1,80	1,78	1,39	1,33	1,40	1,37	1,53	1,23	1,24	1,19	1,11	1,22	1,32	1,31
Uppsala län	1,05	1,37	1,00	1,00	0,85	0,87	0,91	0,97	0,92	0,92	0,89	0,88	0,90	0,85	0,82	0,77	0,73
Södermanlands län	0,92	1,19	0,93	0,98	0,98	0,92	0,97	0,91	0,88	0,95	0,95	0,97	0,97	0,96	0,89	0,81	0,83
Östergötlands län	1,10	1,22	1,01	0,99	1,07	0,95	1,03	0,94	0,93	0,94	0,93	0,96	0,96	0,99	0,95	0,92	0,86
Jönköpings län	0,67	0,75	0,74	0,91	0,78	0,78	0,92	0,81	0,83	0,85	0,99	0,91	0,96	1,03	1,01	1,05	0,99
Kronobergs län	0,56	0,57	0,68	0,73	0,71	0,70	0,80	0,71	0,70	0,68	0,81	0,86	0,95	1,00	0,98	1,02	0,97
Kalmar län	0,97	0,74	0,82	0,81	0,83	0,85	0,83	0,84	0,84	0,76	0,86	0,84	0,90	0,97	0,91	0,86	0,98
Gotlands län	1,03	0,94	1,06	0,90	0,96	0,84	0,97	0,81	0,78	0,74	0,79	0,83	0,83	0,91	0,80	0,72	0,70
Blekinge län	1,03	0,83	0,86	0,86	0,83	0,85	1,01	0,92	0,91	0,89	0,83	0,93	0,95	0,99	0,91	0,91	0,86
Kristianstads län	0,75	0,98	0,79	0,79	0,83	0,84	0,97	0,86	0,83	0,80	0,85	0,86	0,94	0,90	0,86	0,89	0,86
Malmöhus län	0,92	0,89	1,10	1,19	1,20	1,16	1,27	1,16	1,15	1,11	1,07	1,00	1,04	1,02	1,00	0,91	0,91
Hallands län	0,87	0,85	0,96	0,78	0,63	0,81	0,87	0,86	0,84	0,79	0,92	0,85	0,96	0,89	0,87	0,75	0,78
Göteborg och Bohus län	1,58	1,25	1,37	1,10	1,09	1,18	1,01	1,28	1,31	1,22	1,18	1,06	1,06	1,09	1,17	1,10	1,14
Älvsborgs län	0,86	0,76	0,71	0,68	0,65	0,74	0,79	0,85	0,90	0,93	1,04	0,95	1,01	0,92	0,89	0,91	0,87
Skaraborgs län	0,66	0,74	0,77	0,82	0,75	0,76	0,84	0,74	0,72	0,76	0,88	0,85	0,90	0,95	0,90	0,92	0,97
Värmlands län	0,75	0,86	0,79	0,76	0,78	0,80	0,81	0,86	0,86	0,83	0,90	0,94	0,91	0,96	0,91	0,88	0,87
Örebro län	0,74	0,77	0,93	0,83	0,81	0,89	0,90	0,98	0,99	1,05	1,00	1,00	0,98	0,91	0,93	0,94	0,91
Västmanlands län	0,83	1,08	1,00	1,06	0,95	1,00	0,92	0,92	0,90	0,98	0,97	0,99	1,01	1,06	0,98	0,98	0,96
Kopparbergs län	0,68	0,73	0,95	0,91	0,97	0,92	1,03	0,90	0,90	0,89	0,95	0,94	0,91	0,97	0,90	0,90	0,90
Gävleborgs län	1,24	1,19	1,37	1,42	1,26	1,28	1,05	1,01	1,00	0,89	0,94	0,93	0,93	0,99	0,93	0,89	0,90
Västernorrlands län	1,74	1,14	1,17	1,15	1,18	1,17	0,95	0,99	0,98	0,84	0,89	1,00	0,88	0,96	0,94	0,90	0,90
Jämtlands län	0,90	1,14	1,15	1,17	1,10	1,20	0,88	0,88	0,82	0,83	0,83	0,95	0,79	0,85	0,83	0,80	0,84
Västerbottens län	1,08	0,84	1,02	0,88	0,88	0,96	0,80	0,87	0,85	0,71	0,86	0,96	0,83	0,94	0,91	0,87	0,90
Norrbottens län	1,05	0,82	1,44	1,14	1,11	1,35	1,15	1,06	1,04	0,82	0,92	0,97	0,82	0,95	0,90	0,87	0,89

Tables and figures

Province	*Average population 1855-2007*	*Population growth 1855-2007*
Stockholms län	916 357	803%
Uppsala län	167 711	256%
Södermanlands län	195 669	114%
Östergötlands län	322 490	82%
Jönköpings län	243 854	100%
Kronobergs län	162 370	26%
Kalmar län	232 726	10%
Gotlands län	54 753	22%
Blekinge län	142 258	37%
Kristianstads län	246 980	52%
Malmöhus län	539 657	236%
Hallands län	173 363	163%
Göteborg och Bohus län	486 172	324%
Älvsborgs län	340 354	80%
Skaraborgs län	248 059	23%
Värmlands län	267 990	18%
Örebro län	222 108	93%
Västmanlands län	182 753	152%
Kopparbergs län	238 410	74%
Gävleborgs län	242 302	118%
Västernorrlands län	229 486	126%
Jämtlands län	114 378	126%
Västerbottens län	182 547	239%
Norrbottens län	182 085	294%
Total	*6 334 833*	*152%*

Table 1. Population and population growth for our 25 analyzed provinces (län). Own calculations from Statistics Sweden data.

Year	Publication	Table
1855	BISOS Befolkningsstatistik 1851-1855, avd 3.	Rikets folkmängd den 31 december 1855, efter levnadsyrken och näringar. Tabell 5.
1860	BISOS Befolkningsstatistik 1856-1860, avd 3.	Rikets yrkesidkande befolkning den 31 december 1860. Tabell 5.
1870	BISOS Befolkningsstatistik 1870, avd 3.	Rikets folkmängd fördelad efter yrken och kön 31 dec 1870. Tabell 5.
1880	BISOS Befolkningsstatistik 1880, avd 3.	Folkmängden efter yrken och kön länsvis den 31 december 1880. Tabell 6.
1890	BISOS Befolkningsstatistik 1890, avd 3.	Folkmängden efter yrken och kön länsvis den 31 december 1890. Tabell 11.
1900	BISOS Befolkningsstatistik 1891-1900, avd 3.	Folkmängden efter större grupper af yrken inom härader och städer den 31 december 1900. Tabell 17.
1910	Folkräkningen 1910.	Folkmängd efter särskilda yrken. Tabell 1.
1920	Folkräkningen 1940, del V.	Folkmängd efter huvudgrupper av yrken, länsvis 1920. Tabell 4.
1930	Folkräkningen 1930, del III.	Folkmängd och förmögenhet vid slutet av år 1930. Tabell 4.
1940	Folkräkningen 1940, del III.	Yrkesverksam befolkning och deras familjemedlemmar efter näringsgren. Tabell 5.
1950	Folkräkningen 1950, totala räkningen, del IV.	År 1950 Folkmängden efter näringsgren i kommuner och församlingar. Tabell 1.
1960	SOS Folkräkningen 1960, vol VIII.	Förvärvsarbetande dagbefolkning efter näringsgren. Tabell 2.
1970	FoB 1970, del 5.	Förvärvsarbetande (20-w tim). Tabell 2.
1980	FoB 1980, del 6:2.	Förvärvsarbetande (20-w tim), dagbefolkning. Tabell 9.
1990	FoB 1990, del 5.	Förvärvsarbetande, dagbefolkning. Tabell 21.
2000	Uttag från Statistikdatabasen SCB. www.scb.se	Förvärvsarbetande 16+ år med arbetsplats i regionen (RAMS) efter region och näringsgren.
2007	Uttag från Statistikdatabasen SCB. www.scb.se	Förvärvsarbetande 16+ år med arbetsplats i regionen (RAMS)

		efter region, näringsgren.

Table 2: sources of the regional employment information.

Year	**Publication**	**Table/source**	**Remarks**
1855	See 1860		Wages 1860 were used.
1860	Jörberg (1972).	Day laborer's wages, p. 588	Wages from Blekinge län missing, proxied with wages from Kronobergs län.
1870	Jörberg (1972).	Day laborer's wages, p. 588	Wages from Blekinge län missing, proxied with wages from Kronobergs län.
1890	Jörberg (1972).	Day laborer's wages, p. 588	Wages from Blekinge län missing, proxied with wages from Kronobergs län.
1900	Jörberg (1972).	Day laborer's wages, p. 588.	Wages from Blekinge län missing, proxied with wages from Kronobergs län.
1910	Jörberg (1972).	Day laborer's wages, p. 588.	Wages from Blekinge län missing, proxied with wages from Kronobergs län.
1920	See 1930.		We have used wages from 1930.
1930	SOS Lönestatistisk årsbok för Sverige 1930.	Total yearly wages by male servants in agriculture. Table 2, pp. 14-15.	
1940	SOS Lönestatistisk årsbok för Sverige 1940.	Average salaries for male day laborers in agriculture. Table 10, 36.	
1950	SOS Lönestatistisk årsbok för Sverige 1949.	Average salaries for male day laborers in agriculture. Table 15, p.43.	We use wage data for 1949, disaggregated into 8 regional units.
1960	Weighed average between manufacturing and private services wages.		Dyrortgrupper in the weighed series.
1970	Weighed average between manufacturing and		Dyrortgrupper in the weighed series.

	private services wages.		
1980	Weighed average between manufacturing and private services wages.		Riksområden in the weighed series.
1990	Weighed average between manufacturing and private services wages.		
2000	Weighed average between manufacturing and private services wages.		
2007			We use three sectors only. Agriculture is part of market production of goods.

Table 3: sources of the wage data and remarks for agriculture.

Year	**Publication**	**Table/source**	**Comments**
1855	See 1860		Wages 1860 were used.
1860	Lundh et al (2004).	Regional data from nine regional areas, p. 47.	Province wage levels proxied by the region that was closest in geographical location.
1870	Lundh et al (2004).	Regional data from nine regional areas, p. 47.	Province wage levels proxied by the region that was closest in geographical location.
1890	Lundh et al (2004).	Regional data from nine regional areas, p. 47.	Province wage levels proxied by the region that was closest in geographical location.
1900	Lundh et al (2004).	Regional data from nine regional areas, p. 47.	Province wage levels proxied by the region that was closest in geographical location.
1910	See 1900.		We have used wages from 1900.
1920	See 1930.		We have used wages from 1930.
1930	SOS Lönestatistisk årsbok för Sverige 1931.	Average yearly wage by male manufacturing workers. Table 19, p.	We use wages from 1931.

		95.	
1940	SOS Lönestatistisk årsbok för Sverige 1940.	Average yearly wage by male manufacturing workers. Table 34.	
1950	SOS Lönestatistisk årsbok för Sverige 1949.	Total salary per worker. Table 51.	We use 1949 wages. Wages proxied by ore- and metal industry workers (apart from Västernorrlands and Jämtlands län, were data refer to miscellaneous manufacturing workers).
1960	SOS Löner 1961, del 2.	Hour wage earnings 1961, adult male workers, men. Table 14, p. 58.	Dyrortsgrupper.
1970	SOS Löner 1971.	Average hourly wage earnings 1971, adult male workers in mining and manufacturing, 2nd quarter. Table 13, p. 126.	
1980	SOS Löner 1980, del 2	Average hourly wage earnings 1971, adult male workers in mining and manufacturing, 2nd quarter 1980. Table L.	
1990	SOS Löner i Sverige 1990-1991.	Salaries white collar workers private sector manufacturing, full time employees 1990. Table 9.	
2000	National accounts, www.scb.se	Production of goods, wage sum per employee.	
2007	National accounts, www.scb.se	Production of goods, wage sum per employee from the national accounts.	

Table 4: sources of the wage data and remarks for manufacturing.

Year	**Publication**	**Table/source**	**Comments**
1855	See 1860.		Wages 1860 were

			used.
1860			Weighed average of industry and agricultural wages per county.
1870			Weighed average of industry and agricultural wages per county.
1890			Weighed average of industry and agricultural wages per county.
1900			Weighed average of industry and agricultural wages per county.
1910	See 1900.		We have used wages from 1900.
1920	See 1930.		We have used wages from 1930.
1930	SOS Lönestatistisk årsbok för Sverige 1930.	Yearly average wages for male retail and storage workers by dyrort. Table 12.	Dyrorter reclassified to: A-B (=2), C-E (=3), F=4 and G=5.
1940	SOS Lönestatistisk årsbok för Sverige 1940.	Yearly average wages for male retail and storage workers by dyrort. Table 31.	Dyrorter reclassified to: A-B (=2), C-E (=3), F=4 and G=5.
1950	SOS Lönestatistisk årsbok för Sverige 1950.	Yearly median wages for male retail and storage workers by dyrort. Table 58, p. 128.	
1960	SOS Löner 1961.	Wages May 1961, male shop assistants 30-39 years, Table 15, p. 56.	
1970	SOS Löner 1971, del 1.	Male shop staff and drivers, hourly wages. Table 21, p. 180.	Riksområden.
1980	SOS Löner 1980, del 2.	Male shop staff, storage staff and drivers, hourly wages 2nd quarter 1980, full time employees. Table 29.	Riksområden.
1990	SOS Löner 1990.	White collar workers, monthly salaries, private sector, full-	

		time employees. Table 9.	
2000	National accounts. www.scb.se	Production of services, wage sum per employee from the national accounts.	
2007	National accounts. www.scb.se	Production of services, wage sum per employee from the national accounts.	

Table 5: sources of the wage data and remarks for private services.

Year	Publication	Table/source
2000	National accounts, www.scb.se	Public sector and non-profit organizations, wage sum per employee from the national accounts.
2007	National accounts, www.scb.se	Public sector and non-profit organizations, wage sum per employee from the national accounts.

Table 6: sources of the wage data for public services.

Mis-allocation, % of national GDP		**Average estimation error, regional level, % of regional GDP**		**Worst estimation error, % of regional GDP**		**Best estimation error, % of regional GDP**	
2000	*2007*	*2000*	*2007*	*2000*	*2007*	*2000*	*2004*
5%	4%	5%	5%	-12%	-16%	0%	0%
				(Uppsala)	(Kalmar)	(Skåne)	(Skåne)
Correlation between regional estimation errors 2000 and 2007: 0,08							

Table 7: comparison between Geary-Stark and official estimates for 2000 and 2007.

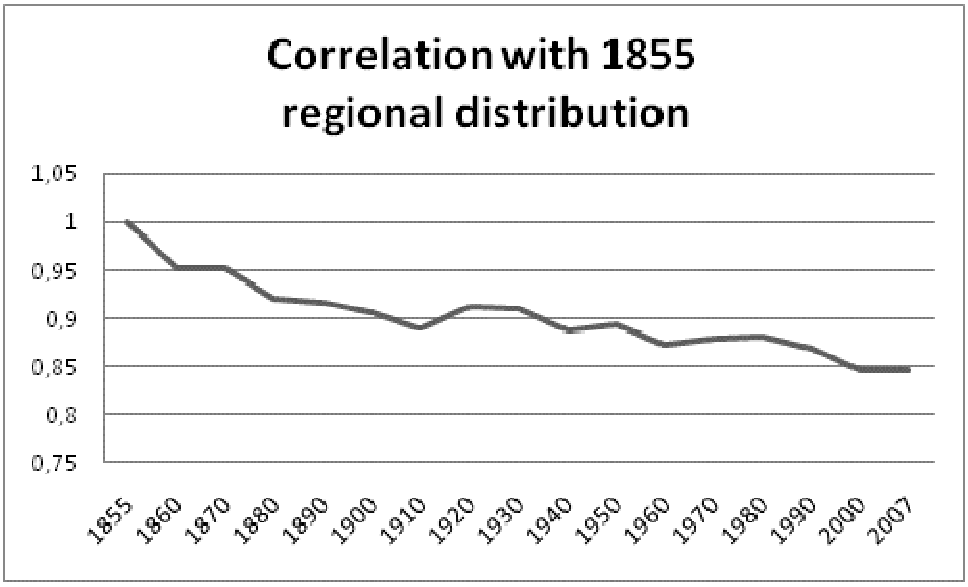

Figure 1. Correlation between yearly regional shares of national GDP and the regional shares in 1955.

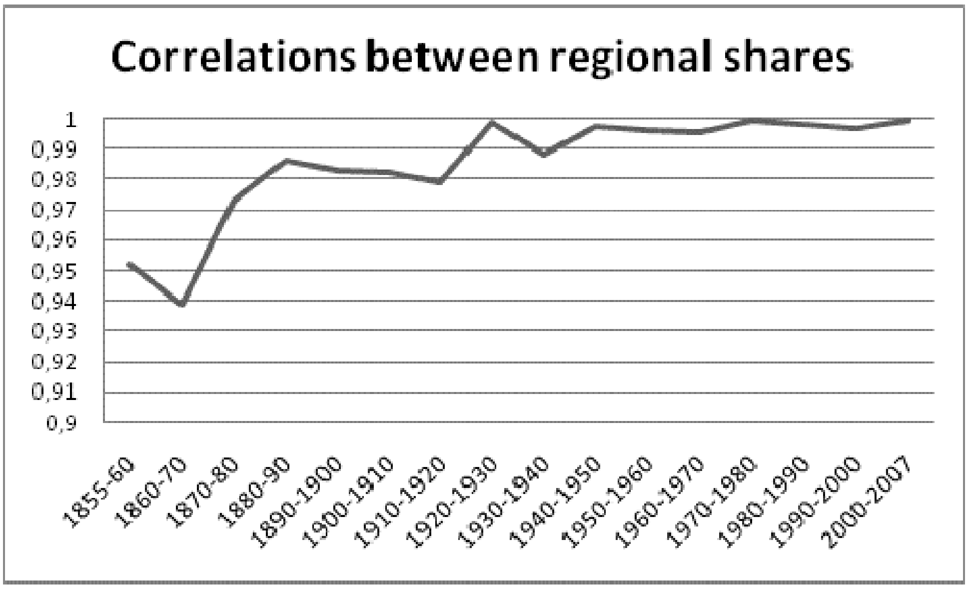

Figure 2. Correlation between yearly regional shares of national GDP between consecutive years of measurement.

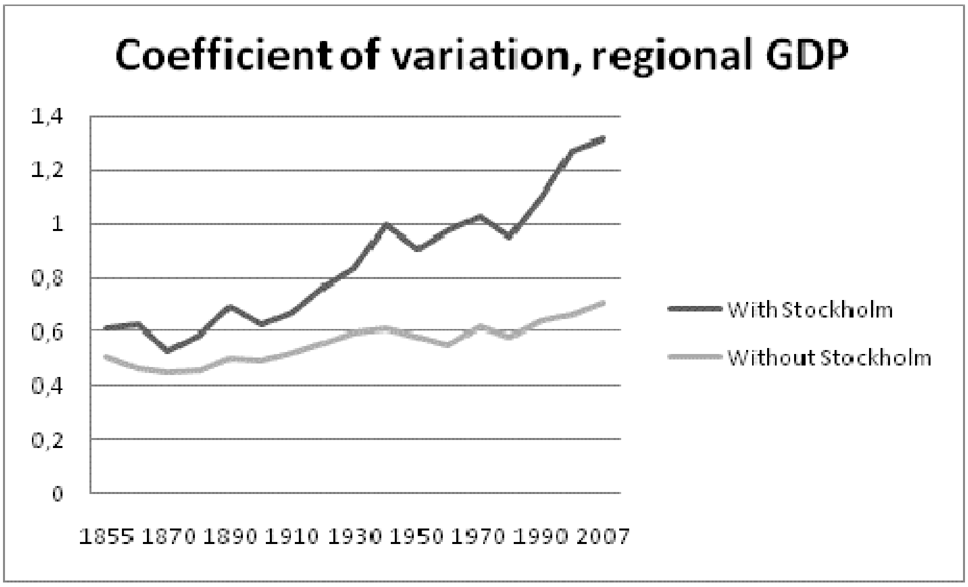

Figure 3: coefficient of variation for regional GDP.

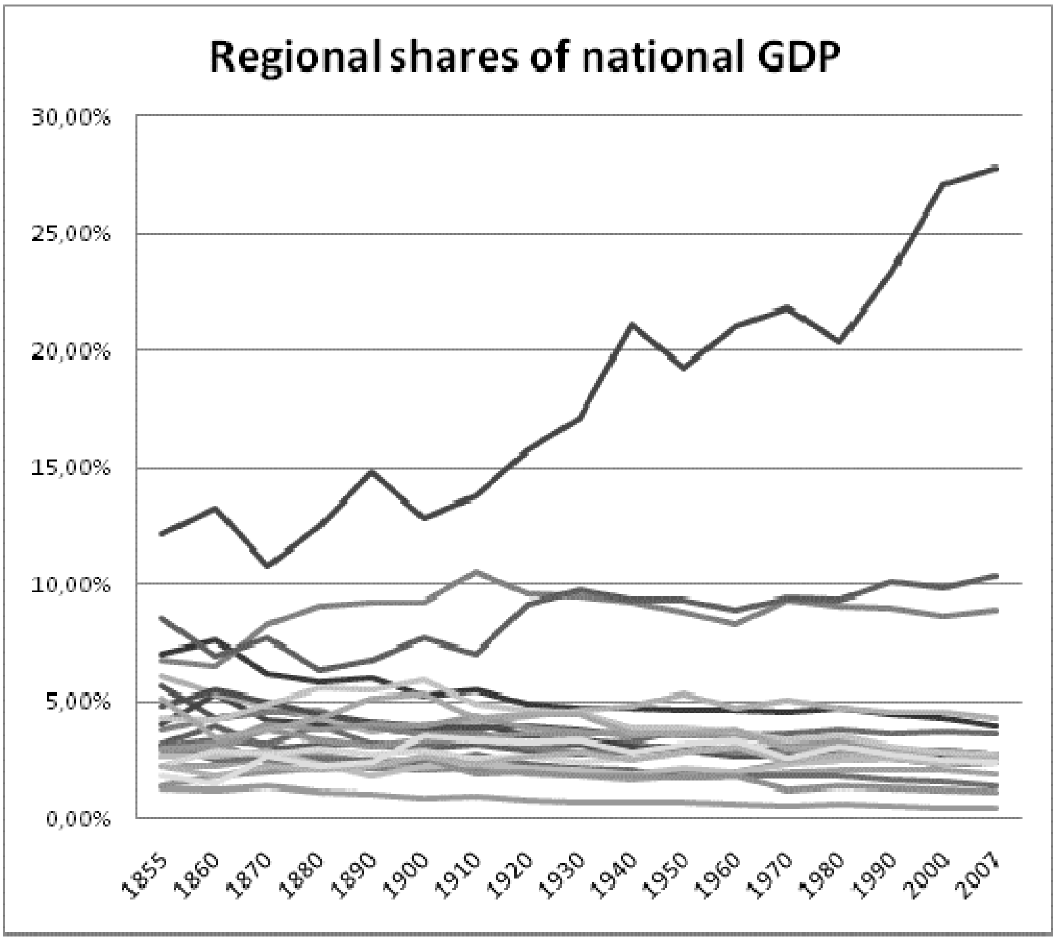

Figure 4. Percentage of national GDP per province.

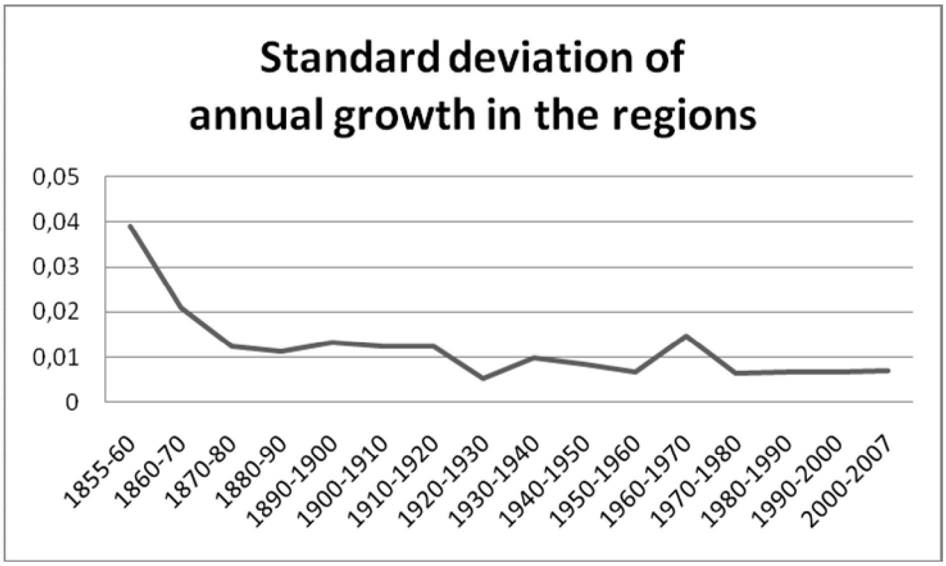

Figure 5. Yearly standard deviation of the annual growth of regions (fixed process, annual compound growth rates).

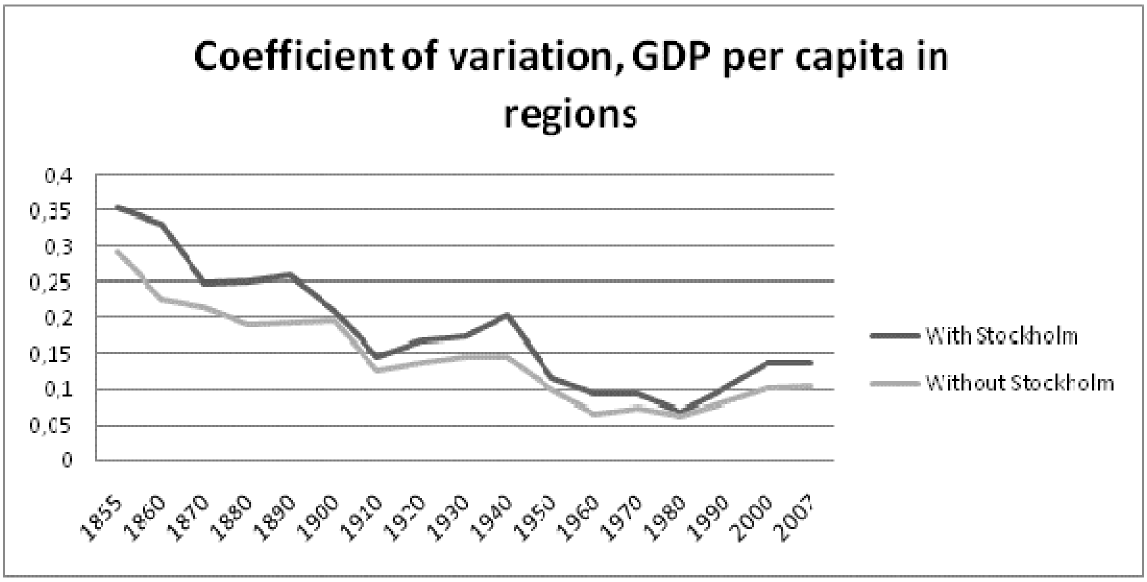

Figure 6. Coefficient of variation for GDP per capita in the Swedish regions.

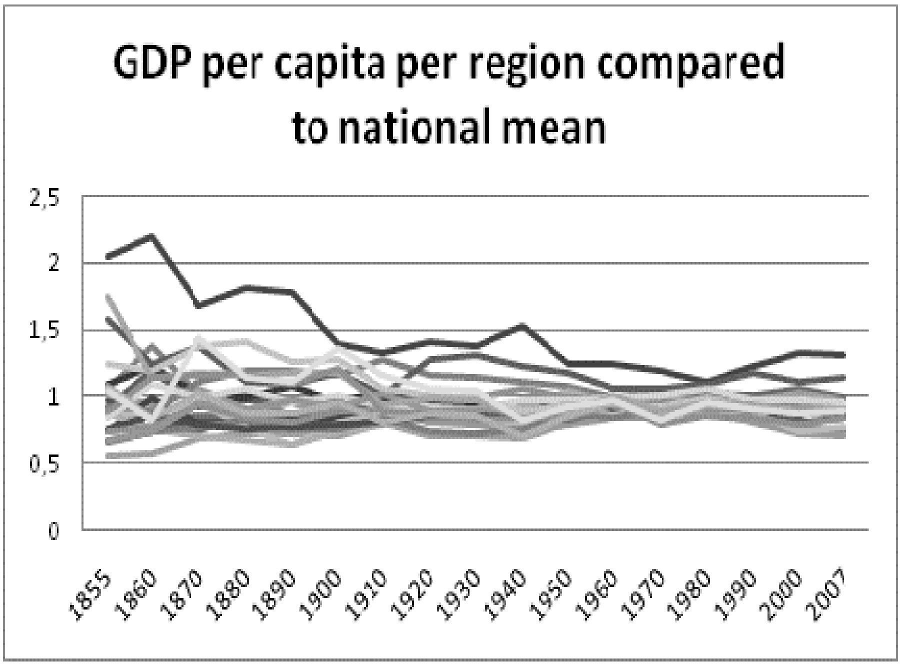

Figure 7. GDP per capita in the Swedish regions compared to the national mean GDP per capita.

Province	*Category*
Stockholms län	General above-average
Uppsala län	Early growers
Södermanlands län	General below-average
Östergötlands län	Early growers
Jönköpings län	General below-average
Kronobergs län	General below-average
Kalmar län	General below-average
Gotlands län	General below-average
Blekinge län	General below-average
Kristianstads län	General below-average
Malmöhus län	General above-average
Hallands län	General below-average
Göteborg och Bohus län	General above-average
Älvsborgs län	General below-average
Skaraborgs län	General below-average
Värmlands län	General below-average
Örebro län	General below-average
Västmanlands län	General below-average
Kopparbergs län	General below-average
Gävleborgs län	Early growers
Västernorrlands län	Early growers
Jämtlands län	Early growers
Västerbottens län	General below-average
Norrbottens län	Early growers

Table 8: provinces and their growth groups.