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Local convergence: Baden 1829–1847

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This paper investigates whether internal institutional homogenisation during nation-state formation led to internal local convergence. We use the case of Baden with a new economic measure based on tax revenues derived from archival records. Our measure of local economic activity shows no evidence for convergence, unconditional or conditional, for the period 1829–1847. However, looking at sub-periods the six year interval after Baden’s 1836 entry into the Zollverein customs union exhibits an adjustment effect resembling absolute convergence. Rejecting urbanisation as the reason behind this pattern we discuss alternative mechanisms in particular the reallocation of labour.

Keywords: Baden; local growth; convergence; urbanisation

Subject classification codes: N13; N93; O47

Introduction

Germany experienced an economic, political and institutional unification during the nineteenth century. During the first half of the century this modernisation process predominantly happened within individual German states, some of which were right at the start of the Industrial Revolution. This paper investigates with the case of Baden whether such an economy experienced internal convergence following this process. This is connected with an analysis whether external institutional shocks such as joining the Zollverein customs union affected the relative internal growth process.

Solow’s seminal growth model has been extensively used to investigate the convergence of economic activity within distinct economies. Focusing on regions within the same country convergence has been shown in a historic context for US states during the nineteenth century and in other countries for the twentieth century. Recently, this result has also been demonstrated for economies on a county level. These studies, however, presuppose the existence of established nation states and modern economic growth. Here I analyse the existence of convergence between local economies within a state that was developing into a nation state and entering industrialisation, improving our knowledge about the onset of modern economic growth, its regional characteristics and the consequences of institutional change.

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2See Barro/Sala-i-Martin, Economic Growth (1995) for a discussion of this literature.
4For example, see Persson, ‘Convergence’ (1997) and DeJuan/Tomljanovich, ‘Income’ (2005).
Baden was a midsized German state with about 1.2 million inhabitants in 1834 and a size of 15,070 sqkm, similar to its neighbour Wuerttemberg, located on the eastern banks of the Rhine between Switzerland, France and the German states of Wuerttemberg and Bavaria. Elevated to a Grand-duchy in 1806 the state was governed as a hereditary monarchy by the Grand Duke in combination with the Landtag, a representative assembly, and was consolidating institutionally during the years following the territorial changes of the Napoleonic wars, including the creation of a unified tax system and the later on participation in the Zollverein, the 1834 customs union between German states.

The new tax system included administrative districts delineating local economies and as part of the newly instituted commercial tax a number of income-related tax components. Based on archival records of these tax components an annual measure of economic activity for each district is derived for the period 1829-1847. This time frame sets the analysis just after the institutional homogenisation and right at the beginning of Baden’s industrialisation. Additionally, it contains Baden’s 1836 entry into the Zollverein, which allows the comparison of regional growth paths before and after.

The convergence analysis using these data finds no absolute convergence, nor divergence, for the whole time period between 1829 and 1847. This result does not change by including additional district characteristics and testing for conditional convergence. Separating the time period into three equal blocks, one before and two after the Zollverein, shows only the period right after the entry had a growth pattern resembling convergence, while the other two showed no distinctive differential growth paths.

Additionally, the role of changes in urbanisation is explored. Such changes can be a mechanism through which either the differential rates of return underlying the convergence idea or the Zollverein impact could work. However, the results show that increases in urbanisation can explain substantial parts of total growth but not the observed local patterns, especially those of the adjustment effect after the Zollverein.

**Historical background**

A number of German states, including Baden, gained substantial territories during the secularisation and mediatisation process at the turn of the nineteenth century and some were able to hold on to their gains during the congress of Vienna. As such one of the immediate tasks was to harmonise the administrative structures within the new states. Baden was no exception and although some of its economic regulations were and remained locally splintered for quite some time, the tax and customs systems represented examples of newly introduced, uniform policies.

6Wuerttemberg had about 1.6 Million inhabitants and a size of 19,508 sqkm; Henderson, Zollverein (1984) also provides information about other German states.
7See Müller, Zolleinigung (1984), Fischer, Staat und Anfaenge (1962), and Regenauer, Staatshaushalt (1863).
8Records are taken from Generallandesarchiv Karlsruhe, Nr 237/13929.
10Fischer, Staat und Anfaenge (1962).
During this process in the first half of the nineteenth century the state’s economy was lagging the development of a few German regions, which had entered the industrialisation process in the wake of the Napoleonic wars. Nevertheless its agriculture, substantial crafts sector and the trading activity in a number of locations meant that the gap was not too substantial.\textsuperscript{11} As similar gap existed with its direct foreign neighbours, Switzerland and the French district of Alsace had especially with regard to textile production a substantial advantage over Baden.\textsuperscript{12}

The administrative reforms in Baden and other German states, combined with the need to repay war debts, led to the resurgence of tariff barriers between German states after the war, although especially larger states moved from internal customs lines to a unified, external border system. The failure of the Deutsche Bund, the German federation, to fulfil the economic policy mandate it was given in Vienna led to trade negotiations between groups of German states in the next two decades. In 1828, Bavaria and Wuerttemberg as well as Prussia and Hesse-Darmstadt concluded separate customs union agreements. Those two unions and a number of other states agreed to form a common customs union, the first step to Germany’s eventual economic unification. The resulting customs union came into existence on 1 January 1834 and was commonly referred to as the Zollverein.\textsuperscript{13}

Although Baden was involved in the early phase of the negotiations, economic, political and geographic differences led to the state not being included in the creation of the customs union. Deciding to end its isolated position it joined in the first round of expansion in 1836. The Zollverein influenced its member states’ economies, and therefore Baden’s, by abolishing all tariff barriers between and within its member states, and by reducing transaction costs through measurement and currency coordination. Furthermore, it severely restricted possible state monopolies, harmonised some producer taxes and led to equal treatment of all Zollverein citizens under the respective commercial laws.\textsuperscript{14}

As a state that had a quite liberal view with regard to economic policy, the main impact of the Zollverein was the change in tariff law. The state had very low rates prior to accession and now had to introduce the substantially higher tariff rates versus foreign neighbours, namely Switzerland and France.\textsuperscript{15}

Data
Baden’s tax system combined like most comparable tax structures a number of direct and indirect taxes. The following description centres on direct taxes as these are utilised as the central data sources\textsuperscript{16} in the empirical analysis.

\textsuperscript{12}For a discussion see Eusterbrock, ‘Industrielle Entwicklung’ (1968).
\textsuperscript{13}For an extended discussion of these negotiations see Hahn, \textit{Geschichte} (1984), Henderson, \textit{Zollverein} (1984), Ploeckl, ‘Formation’ (2010).
\textsuperscript{14}For economic impact see Shiue, ‘Political Fragmentation’ (2005) and Ploeckl, ‘Borders’ (2010).
\textsuperscript{15}For an extended discussion about Baden’s economic policies see Fischer, \textit{Staat und Anfaenge} (1962) and Müller, \textit{Zolleinigung} (1984).
\textsuperscript{16}Utilized local tax data is taken from Generallandesarchiv Karlsruhe, Nr 237/13929.
Baden’s system of direct taxation was an *Ertragsteuer*-system, following the French tax system at the time. Such an approach does not use actual income as a basis for taxation, but rather the potential income which could be derived from the underlying source. These sources are then assessed with a specific capital value such that the potential income can be interpreted as the return to an explicit capital value. These capital values can be assessed for a number of possible sources, ranging from physical capital, for example land and buildings, to immaterial values, in particular labour as well as concessions and privileges.  

The choice of such a system was motivated by a number of concerns, in particular the low volatility of revenues and the equal taxation of capital and labour. Another potential advantage is of administrative nature, potential income is easier to be standardised and calculated with a number of simple characteristics, for example, occupation or location and size of a plot of land, that do not change from year to year, while actual income requires more extensive accounting practices.  

Baden’s system of direct taxation consisted of a number of taxes covering different income sources. The relevant ones in this context are the *Gewerbesteuer*, the commercial tax covering predominantly labour income, the *Land- und Gebaeudesteuer*, the tax on land and buildings, and the *Klassensteuer*, another tax on income levied on a small number of specific occupations. In 1850, all direct taxes had combined revenues of 3,120,276fl., while indirect taxes contributed 5,028,890fl. The tax on land and buildings constitutes the largest direct tax with revenues of 1,933,352fl., while the commercial tax raised 652,825fl. The tax on liberal occupations saw revenues of 192,027fl.  

**Administration**

The general administration of the tax system rested with the ministry of finance, situated in Karlsruhe. The ministry organised the regional tax administration by creating a number of regional tax districts. Each district was supervised by a tax official, who collaborated with local municipal authorities to organise and update the relevant tax rolls, in particular those for land, buildings and the commercial taxes. These tax officials reported annually to the ministry, detailing the actual revenues of the different taxes.  

The tax assessment was based on self-reported information by households and enterprises; however, the tax official had the right to make his own determination if he doubted the self-reported values. The final instance of appeal of an assessment was then the ministry itself. More importantly this also implied that the tax registers

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19Aggregate tax revenue numbers are taken from Finanzministerium Baden, *Amtliche Beitraege* (1851).  
21The quality of the self-reporting was also enhanced through the local knowledge of the village or town administrators that served as a reporting conduit to the tax officials.
were updated at least annually\textsuperscript{22} and there existed additional mechanisms to deal with substantial changes during the year.\textsuperscript{23}

These tax districts serve as the basic unit of observation. There existed about 30 of them and each was labelled according to the residence location of the responsible tax official. These districts were in general based on smaller administrative districts, though were occasionally reorganised through a reassignment of the smaller administrative districts. Based on official announcements,\textsuperscript{24} and changes in the recorded district population, I combine them into a set of 20 time-consistent districts. Summary characteristics are provided in Table 1.

The construction of the tax districts from underlying administrative districts guarantees that the created districts resemble economically determined local economies quite well. This implies that they are good candidates for an analysis

\begin{table}[h]
\centering
\begin{tabular}{lccc}
\hline
District & Region & Population 1835 & Commercial tax 1835 & Urbanization 1835 \\
\hline
Bischofsheim & N & 29,754 & 103.27 & 0.27 \\
Bonndorf & S & 74,445 & 92.68 & 0.21 \\
Boxberg & N & 71,297 & 109.9 & 0.21 \\
Bruchsal & C & 124,897 & 106.07 & 0.24 \\
Emmendingen & W & 46,900 & 103.51 & 0.21 \\
Freiburg & W & 42,854 & 107.96 & 0.31 \\
Gengenbach & C & 226,618 & 96.42 & 0.18 \\
Heidelberg & N & 46,736 & 123.15 & 0.32 \\
Karlsruhe & C & 72,234 & 115.93 & 0.4 \\
Konstanz & S & 57,310 & 105.01 & 0.19 \\
Lahr & N & 46,188 & 95.08 & 0.2 \\
Loerrach & N & 39,103 & 99.65 & 0.12 \\
Mannheim & N & 67,087 & 128.14 & 0.45 \\
Mosbach & N & 39,962 & 113.59 & 0.17 \\
Muellheim & W & 62,609 & 104.12 & 0.18 \\
Pforzheim & C & 41,881 & 111.2 & 0.15 \\
Pfullendorf & S & 43,258 & 89.72 & 0.18 \\
St.Blasien & W & 24,728 & 96.03 & 0.15 \\
Thiengen & W & 51,421 & 79.79 & 0.08 \\
Waldkirch & W & 20,512 & 84.15 & 0.17 \\
\hline
\end{tabular}
\caption{Summary statistics about local economies.}
\end{table}

Note: Region indicates a district's location in one of the four major administrative regions, tax measure is the per capita level of the central component of the utilised tax measure, namely the Earned Income capital.
Source: Own calculations based on archival records.

\textsuperscript{22}Ploeckl ‘Internal Impact’ (2012) uses the data to derive a number of employment series that demonstrate the annual nature of the updating process.
\textsuperscript{23}For details, including the pro-rata mechanisms for death or substantial fluctuations of employees, see Staatsregierung Baden, ‘Gewerb-Steuer-Ordnung’ (1815). Schremmer, ‘Gewerbesteuer’ (1987) gives a more detailed discussion about the whole process.
\textsuperscript{24}Tax district boundaries are determined based on Steuerdirektion, ‘Einteilung’ (1837) and Kommission, \textit{Historischer Atlas} (1979).
focusing on the relative development of regional economies within Baden. A graphical representation of the districts is given in Figure 1.

**Commercial tax**

The main tax utilised in the analysis is the commercial tax, whose code was newly introduced in 1815.\(^{25}\) It provided a consolidated tax for all of Baden’s territory, which had a multiplicity of tax systems due to substantial territorial increases during the Napoleonic wars. After some minor revisions in 1816, the tax code stayed essentially the same until a major revision in 1854. The tax was designed to extend tax coverage beyond the existing taxes on land and buildings and did so by identifying and taxing additional income sources, most importantly labour. In particular, this tax recognised three income sources: *Verdienstkapital*, Earned Income capital which covered a person’s own work, *Betriebskapital*, Operating capital which covered the value of his tools, and *Gehilfenkapital*, Employee capital which represented a tax on the work of employees.\(^{26}\)

Figure 1. Map of derived local economies in Baden.


\(^{25}\)For the legal text see Staatsregierung Baden, ‘Gewerb-Steuer-Ordnung’ (1815) and ‘Aenderungen’ (1816).

\(^{26}\)For a discussion see Schremmer, ‘Gewerbesteuer’ (1987).
This commercial tax had far-reaching coverage, making its name slightly misleading. The tax covered almost all occupations, resembling, therefore, a general income or occupational poll tax. There was one systematic exception though, namely liberal occupations such as civil servants, lawyers, doctors, clergy or teachers, who were instead covered by a separate tax, the *Klassensteuer*. A second issue concerns the tax obligation regarding *Gehilfgesellen*, employees in crafts shops. The tax differed in the treatment of employees in agriculture versus crafts and manufacturing. Agricultural employees were taxed as individuals and were, therefore, responsible for the tax obligations themselves. In crafts, manufacturing and trade the individual employee was not assessed directly but the tax had to be paid by the employer. There were also a few exemptions based on the personal situation of an individual, for example, for widows, seniors, veterans or notorious poor.

Quantitatively, the total population in 1829 was assumed to be 1,171,294 inhabitants, which represented, according to tax statistics, 236,265 families, the unit used for the tax assessment. Of these families, at least 197,416 were classified as working in agriculture, crafts, trade or manufacturing. Of those, only 23,216 families, about 11.8%, were tax exempt, which demonstrates the far-reaching coverage of the commercial tax with regard to economic activity in Baden. Additionally, the statistics listed 33,269 *Gewerbsgehilfen*, employees in crafts, trade and manufacturing, which were covered through their employers.

As mentioned above, the tax assessment covers three components, the work itself, operating capital and the work of employees. The tax was assessed on a household or family level, therefore, secondary sources of income, in particular some form of agriculture, were not taxed if they did not represent the main occupation.

The first component was the Earned Income capital, which covers the income from the main occupation. Each liable family was assigned to a specific occupation, of which there were over 200. Some of these were very specific, for example, in 1829 there was a listing for a *Mausfallenmacher*, a producer of mouse traps. There was a single *Meister* active in this occupation in the whole of Baden at that time. Once the occupation had been determined, the next step was to use the size of the location in terms of population. Each settlement was classified either as a village, a town below 3000 inhabitants, a town with 3000–6000 inhabitants, or as a town larger than 6000.

The tax code contained a matrix of occupation and location size combinations, which listed a tax class value for each combination. This class value was then turned into a fixed capital value. For example, a smith in a village was assigned to class II, which implies a capital value of 625fl, while a book printer in a town with over 6000 inhabitants was slotted into class VIII, implying a value of 4000fl. There were two main exceptions – first, a few occupations were assigned values without regard to the location, for example, bankers and most notably farmers. Second, the occupational classification of trade and manufacturing depended on the level of operating capital and the organisation of the business. For example, a trade establishment without a public store was assigned based on its level of operating capital, while those with an open store were assessed according to operating capital as well as location size.

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2723,801 widows are separately listed without reference to income or occupation.
28Statistics and examples are taken from Volz, *Gewerbstaschenbuch* (1835), and Dietz, *Bericht* (1847).
The second component was the Operating capital. It assessed the value of any mobile physical capital, therefore, it covered assets like tools, equipment, inventory, certain licenses and operating funds. This mobile capital stock measure is complementary to the fixed capital stock, which was covered by the tax on land and buildings. The value was estimated and then slotted into value bands, each of which had a corresponding actual capital value assigned to it. For example, if the estimated value was 700fl, the person would be assigned into band 2, which had a range from 600fl to 800fl and resulted in a tax capital value of 500fl. The highest category, over 22,000fl, was open-ended and assigned the actual estimate as tax capital. These examples show that the capital values had a slight progression, which was due to the intended exemption of a subsistence level of capital. Any value below 400fl was tax exempt, while above that the band capital values reflected some of this exemption. The subsistence value was actually fairly generous – about 81% of families in 1829 did not have to pay any taxes on operating capital. The existence of an exempt subsistence capital level and the systematic exemption of agricultural capital29 implies that the aggregate operating capital values represent particularly operating capital employed in manufacturing, crafts and trading beyond subsistence pretty well.

The third component was the Employee capital. It assessed a capital value on the income an employer derived from its employees. As noted above, this did not apply to agriculture, where employees were taxed directly. Employees were classified into two categories, category I covered the first five employees, category II covered any employee beyond the fifth. So an enterprise with ten employees had five category I employees and five category II employees, while an enterprise with two employees had only two category I employees. This distinction had then consequences for the assessed value, each category I employee was assessed with 1/5 of the Earned Income capital of the employer, while each category II employee was assessed a fixed amount, 100fl for a male employee, 50fl for a female one.

The actual tax obligation was then a small, fixed percentage of this capital value. The resulting tax payments were relatively small in comparison to actual income, which also explains why the revenues of this tax were substantially smaller than especially the land tax.

Further data sources

Land tax

Baden introduced in 1810 a new land and buildings tax, which remained the most important direct tax for the next decades. It covered the fixed capital stock, land used for agriculture, mining or forestry and buildings used for any purpose. The building tax component also covered any fixed installations within or attached to buildings. Similar to the commercial tax, the actual return from land or buildings, for example harvest results or rents, did not matter for the tax assessment. In contrast to the commercial tax, where changes in occupation or operating capital led to a change in the annual assessment, the land and buildings tax was annually assessed but not fully

29Agricultural capital was specifically taxed through the land and building taxes.
updated. Renovations, improvements to the land and similar changes did not affect the assessment; only major changes like a new building triggered such an update.

*Klassensteuer*

Another direct tax was the *Klassensteuer*, covering liberal professions that were not included under the commercial tax. The included occupations were either directly public or closely related, for example civil servants, teachers, clergy, lawyers or artists. These occupations also usually required a certain degree of higher education. The assessment procedure was similar to the commercial tax, in particular the Employee capital component, each occupation was assigned a certain tax class, though without regard to the urbanisation level of the location, and thereby a specific capital value. This value was then again the basis for the actual tax obligation.

*Urbanisation*

The description of the tax system shows that the degree of urbanisation matters for the tax obligation of enterprises and households. The classification scheme mixes a combination of size, the different thresholds for towns, with a legal characteristic, the status as a village or town. The assessment procedure classified locations into four categories, villages, towns below 3000 inhabitants, towns between 3000 and 6000, and towns with a population of more than 6000. Data for urbanisation is only available for 1835 and 1852, which allow the calculation for the respective rates of urbanisation in each district at those time points.

*Analysis*

*Unconditional convergence*

As mentioned above, the main data sources are based on Baden's tax system, in particular its commercial tax. One of the characteristics of this tax is the resemblance of some of its components to a general income tax. Generally speaking, the tax could be described as an occupational poll tax. Its fairly universal coverage, including agriculture, crafts, trade and manufacturing, makes it a suitable to create a measure for general economic activity.

To derive the measure the central components of this tax that covered income derived from work, in particular the Earned Income capital and the two Employee capital values, are utilised. More precisely the per-capita values of these three tax components are summed up as the applied measure of per-capita economic activity and thereby also its growth.

This measure has a number of similarities but also differences from the usual GDP measures used in growth regressions. This becomes visible in comparison with the income approach to calculate GDP. The measure represents labour income, which is a central, but not the only, component of GDP. The aforementioned assessment issues of land and building tax, which does represent in this setting the

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30 There is an intermediate categories, Flecken, which are treated by the tax code like towns.  
31 Data for urbanization rates are taken from Heunisch, *Beschreibung* (1833), Staatsregierung Baden, *Hof- und Staatshandbuch* (1836) and Ministerium des Inneren, *Gemeinden* (1855).
major second component of the income approach to GDP, make a combination with the labour-based commercial tax component misleading and is therefore not pursued. This, nevertheless, implies that the measure exhibits a strong correlation with GDP. The assessment procedures also lead to another important distinction from GDP. The underlying conceptual idea behind the commercial tax makes this measure resemble more of a full capacity measure rather than an actual one, at least with regard to the output from employed factors. This implies that the measure is more in line with the original approach outlined by Solov and the results are less sensitive to business cycles than the usual GDP. Growth paths found through these tax returns are therefore revealing the structural developments of the local economies within Baden.

Utilising this measure, the first specification tests the existence of convergence between local economies in Baden over the whole time period of 18 years. Formally the following specification is tested:

$$g_t = \alpha + \beta y_t + \epsilon_t$$

where $g_t$ is the annualised growth rate of the derived measure between 1829 and 1847, $y_t$ is the level of the measure in 1829, $\alpha$ a constant, $\beta$ the regression coefficient to be estimated and $\epsilon$ is the error term. The inclusion of this level characteristic, which tests whether poorer regions grew faster than richer regions follows the convention for an unconditional convergence regression.\(^{32}\)

Table 2 shows the results in columns 1 and 2, first for the estimation with regular OLS and then with a median regression for robustness reasons.

The negative sign of the coefficient on the level of activity indicates that the direction of the effect follows the prediction of the standard growth models, namely the convergence between poorer and richer states. However, the two methods differ regarding the statistical significance of the effect. The insignificance of the effect in the estimation with the median regression, which is less sensitive to outliers, implies that the effect is not particularly robust and further investigation is necessary to draw a clearer conclusion.

The underlying nature of the observed convergence will be investigated in connection with the central, discrete economic event during this time period, namely Baden’s entry into the Zollverein, the customs union between German states. This is

<table>
<thead>
<tr>
<th>Measure (level)</th>
<th>OLS</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$-0.00011^{**}$</td>
<td>$-0.00008$</td>
</tr>
<tr>
<td></td>
<td>$-0.00004$</td>
<td>$-0.00007$</td>
</tr>
<tr>
<td>Intercept</td>
<td>$0.01310^{***}$</td>
<td>$0.00998$</td>
</tr>
<tr>
<td></td>
<td>$-0.00443$</td>
<td>$-0.00745$</td>
</tr>
<tr>
<td>Observations</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>(Pseudo-) $R^2$</td>
<td>0.25</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Significance levels ***0.01, **0.05, *0.1.
Note: Second row for each variable reports standard errors, which are robust (OLS) and bootstrapped (Median).
Dependent variable is annualised growth rate of the derived measure.

accomplished by focusing the analysis on three time periods around this change to the whole state. The first is 1829 through 1835, the years before Zollverein entry, the second lasts from 1835 through 1841, the first years immediately after Zollverein entry, and third from 1841 through 1847, when the adjustments to the Zollverein were potentially already made. The split into these periods is also made to create periods with a length long enough to avoid short-term fluctuations, furthermore, the relevant years 1829, 1835, 1841 and 1847 are all years for which actual rather than interpolated population numbers exist.

Utilising the same specification as above, Table 3 shows the results for the three periods. Again I conduct an OLS and a median regression for each of the periods.

The results exhibit a clear, robust pattern over the three periods, namely no convergence before the Zollverein, a distinct convergence effect in the period right after the entry, and no convergence afterwards again. This pattern indicates that during the early days of the industrial revolution there was no general convergence between local economies unless some external impact caused an effect that was differentiated along the existing level of activity. The convergence effect is also visible in Figure 2, which plots Earned Income capital level and growth from 1835 to 1841.

**Conditional convergence**

The next step in the analysis is to test for conditional convergence. While the first section assumes that all regions will eventually convergence to the same steady state this assumption can be relaxed to account for structural differences between the different economies. Certain local characteristics might sort the local economies into groups such that all members of such a category converge to a group specific steady state. This approach is usually labelled conditional convergence.33

The empirical test includes a number of potential coordinating characteristics, in particular capital stock measures based on commercial, land and building tax values, human capital values as seen in the tax on liberal occupations, the rate of urbanisation and a regional grouping.

Table 3. Unconditional convergence regression for sub-periods.

<table>
<thead>
<tr>
<th></th>
<th>OLS Base year</th>
<th>Median Base year</th>
<th>OLS Base year</th>
<th>Median Base year</th>
<th>OLS Base year</th>
<th>Median Base year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure (level)</td>
<td>-0.0001</td>
<td>-0.0001</td>
<td>-0.0002**</td>
<td>-0.0003*</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intercepts</td>
<td>0.0108</td>
<td>0.0156</td>
<td>0.0293***</td>
<td>0.0323**</td>
<td>0.0008</td>
<td>-0.0061</td>
</tr>
<tr>
<td>Observations</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>(Pseudo-) R²</td>
<td>0.02</td>
<td>0.02</td>
<td>0.34</td>
<td>0.27</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Note: Identical methods and reporting convention as in Table 2
Dependent variable is annualised growth rate of the derived measure.

33See Barro/Sala-i-Martin, Economic Growth (1995) for an extended discussion.
The first group of characteristics included are capital stock measures, which are based on three different taxes. The first is operating capital, which was part of the commercial tax. It comprised a tax on any mobile capital, therefore, it covered capital items like tools, equipment, inventory, certain licenses and operating funds. This mobile capital stock measure is complemented by two fixed capital stock measures, which are based on Baden’s taxes on land and buildings introduced above.

The next factor looks at the influence of human capital. Again I utilise a tax measure, in this case the per-capita value of the *Klassensteuer*, the tax on liberal occupations. This tax was complementary to the commercial tax and covered a number of occupations which were exempted by the commercial code. In particular these were predominantly public professionals like civil servants, teachers, clergy, but also lawyers and artists. All of these occupations require further education beyond basic literacy skills. Higher per-capita revenues, therefore, imply a stronger presence of highly educated professionals. Their general presence, which also implies more professionals in educational occupations, indicates a higher general level of education in the region. Although this was an annual tax the archival records only provide a district level breakdown for the year 1838.

Another characteristic included is the degree of urbanisation in each district. Urban areas differed in their economic structures from rural areas; an observation that led Baden’s government to use this characteristic in the tax assessment process, as outlined above. Due to the limited availability of detailed urbanisation data I only use the urbanisation rates of 1835.
The final characteristic is a regional dummy for the four administrative regions. This tests whether Baden's main regions formed internal convergence clubs independent of other characteristics or whether any effect is state-wide.\textsuperscript{34}

The results obtained above indicate that the relative growth paths of Baden's local economies varied before and after the Zollverein. This leads me to use the three six-year periods introduced above also in this case. This leads to the following specification, which is estimated with a pooled OLS regression\textsuperscript{35}

\[ g_{it} = x + \beta y_{it} + \sum c \gamma_c K_{cit} + \theta H_i t + \mu_i U_i t + r_i + t_i + \epsilon_{it} \]

where \( g_{it} \) is the annualised growth of the measure for the local economy \( i \) in period \( t \), while \( y_{it} \) is the level of the measure at the beginning of the time period \( t \) and zero otherwise. \( K_{cit} \) are the three capital measures, namely operating capital, land and building values. \( H_i \) is the fixed proxy for human capital level, which is interacted with a time dummy \( t \) and included separately for each time period. Similar the rate of urbanisation, \( U_i \), is included separately for each time period. Additionally regional dummies, \( r_i \), and time dummies, \( t_i \), for each period are included. \( x \) is a constant, \( \beta, \gamma, \kappa \) and \( \mu \) are respective regression coefficients and \( \epsilon \) is the error term.

The results, shown in Table 4, are consistent with the main result of the unconditional convergence regression above. There is no general convergence but only an adjustment effect after Baden’s entry into the Zollverein. In those few years after this event poorer regions grew faster than their richer counterparts, leading to a small closing of the gap between them.

Furthermore, the level of income is the main variable with a significant coefficient, while essentially none of the remaining characteristics appear to have had an influence over the whole time period. This has two implications, first the absence of an impact of the various capital measures corroborates that the observed effect does not provide evidence for general convergence. The absence of different capital levels to explain growth patterns implies that the predictions of the growth model do not hold and there was no local convergence in the early years of the industrial revolution. This is compounded by the second implication, namely the absence of convergence clubs. The insignificance of other covariates as explanatory factor for the growth patterns implies that there is also no conditional convergence within subgroups of regions. The results for urbanisation provide weak evidence that this influenced the particular growth pattern, I investigate this, therefore, in more detail in the following section.

**Urbanisation**

The description of the tax details show that urbanisation was recognised by contemporaries as an important factor for economic activity. The incorporation of the level of urbanisation into the growth regressions show that the level of urbanisation seemingly did not really matter for a potential convergence between

\textsuperscript{34}The regional dummies follow the administrative structure of Baden, the Seekreis district is labelled South, the Oberheinkreis West, the Mittelheinkreis Central and the Unterrheinkreis North, following their relative geographic position.

\textsuperscript{35}Variations of this specification, especially also with Panel estimation approaches, essentially show no differential results and demonstrate the robustness of these numbers.
regions, especially after the Zollverein. Given the nature of the tax data this, however, does not preclude that changes in urbanisation independent of its level influenced the growth paths of regions. This section, therefore, utilises the available urbanisation data to analyse the differences in growth, and level, of the measure for local economic activity and the potential impact of the Zollverein.

As previously stressed, Baden’s commercial tax, in particular its Earned Income capital component, was strongly influenced by the location of the taxed economic activity. More precisely, the assessed tax was dependent on the status and population size of the location in question. Based on the belief of Baden’s government that work in towns and larger settlements was more profitable, the tax obligation of identical businesses was higher in towns than in villages.\(^{36}\) This implies that the level of income-related tax components were affected by the degree of urbanisation, while their growth was influenced by changes in the share of the population living in an urban environment.

Information about the degree of urbanisation in each district allows me to determine whether urbanisation explains the variation in Earned Income capital across districts, thereby explaining the difference in the level of activity. Second, it allows me to determine whether the increase in said capital was due to increases in urbanisation after the entry into the Zollverein. In a final step this information is then used to

\(^{36}\)See Regenauer, Staatshaushalt (1863).

### Table 4. Conditional convergence.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Coefficient</th>
<th>SE</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure 1829 (level)</td>
<td>-0.00026</td>
<td>0.00017</td>
<td>y</td>
</tr>
<tr>
<td>Measure 1835 (level)</td>
<td>-0.00036**</td>
<td>0.00014</td>
<td>y</td>
</tr>
<tr>
<td>Measure 1841 (level)</td>
<td>-0.00013</td>
<td>0.00018</td>
<td>y</td>
</tr>
<tr>
<td>Operating capital</td>
<td>0.00017</td>
<td>0.0002</td>
<td>K</td>
</tr>
<tr>
<td>Building capital</td>
<td>0</td>
<td>0</td>
<td>K</td>
</tr>
<tr>
<td>Land capital</td>
<td>0</td>
<td>0</td>
<td>K</td>
</tr>
<tr>
<td>Klassensteuer 1829</td>
<td>-0.00578</td>
<td>0.02546</td>
<td>H</td>
</tr>
<tr>
<td>Klassensteuer 1835</td>
<td>0.0008</td>
<td>0.01739</td>
<td>H</td>
</tr>
<tr>
<td>Klassensteuer 1841</td>
<td>-0.01367</td>
<td>0.01522</td>
<td>H</td>
</tr>
<tr>
<td>Urbanization 1829</td>
<td>0.02423*</td>
<td>0.01226</td>
<td>U</td>
</tr>
<tr>
<td>Urbanization 1829</td>
<td>0.00924</td>
<td>0.01315</td>
<td>U</td>
</tr>
<tr>
<td>Urbanization 1829</td>
<td>0.00476</td>
<td>0.0116</td>
<td>U</td>
</tr>
<tr>
<td>South</td>
<td>0.00064</td>
<td>0.00247</td>
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</tr>
<tr>
<td>West</td>
<td>-0.00307</td>
<td>0.00221</td>
<td>r</td>
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<tr>
<td>North</td>
<td>-0.00112</td>
<td>0.00195</td>
<td>r</td>
</tr>
<tr>
<td>Period 1835–1841</td>
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<td>0.01603</td>
<td>t</td>
</tr>
<tr>
<td>Period 1841–1847</td>
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<td>0.01579</td>
<td>t</td>
</tr>
<tr>
<td>Constant</td>
<td>0.02333</td>
<td>0.01469</td>
<td>z</td>
</tr>
</tbody>
</table>

Significance levels ***0.01, **0.05, *0.1.

Note: Pooled OLS regression with robust standard errors.
Dependent variable is annualised growth rate of the derived measure.
Notation column indicates the corresponding variable in the equation.
investigate the influence of these increases in urbanisation on the growth path of districts, demonstrating to what extent they explain the observed differential growth.

The first step is to calculate the average tax assessment per taxed household net of urbanisation, which requires a determination of the number of actual tax payers and the impact of urbanisation. Additionally, I correct for the influence of agriculture, since all farmers were classified into the same tax class, which was independent of location size. The resulting numbers indicate whether tax payers in the different districts had on average occupations with higher tax classifications or occupations with the same average tax assessment but exercised them in locations with a higher size classification.

A necessary assumption concerns the number of tax payers in agriculture as well as crafts and trade. Using information about the total number of agricultural and other tax payers in 1829 and 1844, I first interpolate numbers for 1835 and 1847 and then distribute the resulting number across the districts according to district population. This is based on data from 1844 which show that the variation across the four major regions in the relative share of agriculture and other tax payers is minor.\(^{37}\) All agricultural tax payers were assessed with tax class 1, which implies an assessed Earned Income capital of 500fl. Deducting the resulting agricultural capital from the total reported value and dividing by the number other tax payers, results in a first average tax capital assessment for each district. The values range between 502 and 960, with a mean of 749. These values have the right magnitude when compared to the listed values for the tax classes, which started at 500.

The next step is to correct for the influence of urbanisation. The information about the degrees in urbanisation within each district is combined with an assumption about the increase in tax capital through a higher location category. I use the differences between tax classes I, II, III and IV, the numerical values of the increases are 125, 250 and 375. This balances the higher increases for occupations which start out in a higher tax class with the downward effect of occupations that did not get reclassified. Using these numbers I calculate the underlying average tax assessment for each district. The magnitude of these values is still within the expected range close to the lower tax classes. The correlation between the average assessment without correcting for urbanisation and the average with such a correction is 0.75, still quite high but substantially reduced. Similar, regressing the average assessment before correction on the urban component shows that urbanisation explains about one-third of the variation between the districts.\(^{38}\)

The total increase in urbanisation after the Zollverein allows me to determine the influence of these changes on the average assessment after the Zollverein. To do this I calculate by how much the average assessment for 1835 changes when the urbanisation rates are replaced by those derived for 1847. The average of the district urbanisation rates increases from 22.0 to 23.5\%, while the state-wide average assessment increases from 751fl to 800fl in 1847. Applying the later urbanisation rates implies a state-wide assessment of 768fl. This shows that 35\% of the observed increase in the average assessment in the wake of the Zollverein can be explained by increases in urbanisation. This shows that urbanisation had a significant impact on observed growth within Baden.

\(^{37}\text{The shares are within 2\% for agriculture and within 4\% for other occupations.}\)

\(^{38}\text{Formal regression results available from the author by request.}\)
This leads to the final step, testing whether the increases in urbanisation in the wake of the Zollverein can explain the differential growth paths found above. There is only a small correlation between the increase in the urban component and the average assessment, regardless whether measured in absolute or relative terms.\textsuperscript{39} The correlation between the increase in urbanisation and the growth rate of the measure used above is similarly very small. These results lead to the conclusion that increases in urbanisation in the wake of the Zollverein did affect economic growth, but do not explain the observed short-term convergence growth pattern.

**Conclusion**

The Napoleonic wars triggered a reshaping of the political landscape in Germany and led to an institutional unification process within the new states. As shown with the case of Baden this institutional change, however, was not immediately followed by an economic convergence between local regions within states. This result indicates that institutional homogenisation alone was not sufficient to trigger convergence; further research is needed to clarify whether this is due to the absence of modern economic growth or whether convergence will only set in as a delayed response to a common institutional setting.

The main mechanism underlying the convergence process of Solow’s model is differential rates of return between economies which consequently lead to faster capital accumulation and consequently higher growth in poorer regions. The absence of convergence indicates that either differential rates did not lead to different accumulation behaviour or points towards structural differences in the underlying production process such that different capital levels did not lead to different rates of return. The close proximity and existing integration between local economies implies a level of factor mobility\textsuperscript{40} that would have seen capital accumulation respond to different returns, which points towards the link between capital level and growth as the reason behind the observed growth patterns.

The absence of an effect of different capital levels and relative urbanisation on the growth paths substantiates that this link did not work as postulated. The absence of a substantial industrial employment\textsuperscript{41} might be one contributing factor. The general growth impact of urbanisation and the impact of the Zollverein point towards an alternative explanation for the observed growth pattern. Increases in urbanisation imply a reallocation of labour towards more productive locations, which explains growth, but as long as those changes in urbanisation are not driven by underlying capital level differences no convergence effect will be observed. The tariff changes of the Zollverein led to a shift to more productive occupations in the southern, poorer regions close to Switzerland,\textsuperscript{42} which can explain the observed differential growth path after the Zollverein entry that resembled a convergence effect.

\textsuperscript{39}Formally the numbers are around 0.14.

\textsuperscript{40}Ploeckl, ‘Internal Impact’ (2012) documents investment by foreign entrepreneurs, which points towards substantial internal mobility.

\textsuperscript{41}See Ploeckl, ‘Internal Impact’ (2012).

\textsuperscript{42}See Ploeckl, ‘Internal Impact’ (2012) for a discussion of the impact of FDI and trade patterns on occupational structures in the wake of the Zollverein.
In summary the results show that institutional homogenisation was not enough to lead to a convergence between local economies within a state at the onset of the industrialisation and that relative growth paths appear to have been shaped by labour reallocation, triggered either by internal or external factors like Baden’s entry into the Zollverein.

Notes on contributor
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