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To what extent did Austria-Hungary experience sectoral specialization from 1867 to 1910?

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Abstract: Austria-Hungary was from 1867 to the beginning of the first world war, one of Europe's largest countries and also a monetary and customs union exhibiting features common in recent debates on economic integration. The role of economic integration on growth, development and industrialisation are central themes in today's debates. The effects of economic integration have been debated thus this thesis will illustrate changes in the size of employment in three different sectors answering: Was there convergence in sectoral employment in Austria-Hungary from 1867-1910? Using the idea of optimum currency areas and Krugman's idea of increasing specialization caused by monetary unions is discussed on the backdrop of specialization found in Austria-Hungary. The specialization is investigated using the Theil indexes of dissimilarity. The result of the study show that the total dissimilarities increased however the differences in the sizes of the industry sector in Austria-Hungary showed decreasing values from 1890 to 1910. To further investigate the regions in Austria-Hungary, a hierarchical algorithm is applied to dissimilarity matrices to cluster regions creating macro-regions. These macro-regions show similar results as for the smaller regions, confirming that the results found were indeed macro-trends, were increased dissimilarity in agriculture was found and decreased dissimilarity in the size of industry employment.

Key words: economic integration, specialization, optimum currency area, Austria-Hungary

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Acronyms
EMU - European monetary union
LMU – Latin monetary union
SMU – Scandinavian monetary union
OCA – Optimum Currency Area
Gulden/Forint – Currency Austria-Hungary
Krone/Korona – Currency Austria-Hungary

1 Introduction

This paper aims at understanding market integration and specialization in three sectors in Austria-Hungary, the agricultural, industrial and service sectors using employment data and its changes over time. As a result of this study there will give greater understanding of changes of the size of sector employment during a period of monetary integration in the context of Austria-Hungary. This is of interest as there is an ongoing debate of the causes of monetary unions on economies, connected to EU enlargement especially, however also for the debates and discussions on convergence and divergence in the economic history of Europe. It can be seen that the work is also of interest in a comparative sense, between the regional difference within Austria-Hungary, how these developed over time. The knowledge of what happened during this period, was the cause of the monetary union, the greater integration of the economies or the industrialisation of a backward economy. Thus the study can be related as well to a larger debate on economies and their course of development. Austria-Hungary is also an interesting subject of study because of its diversity, it is of interest to know the effect economic integration has upon regions, if there are increasing differences or not over time. The differences across Austria-Hungary can also to some extent, act as a proxy, for greater projects of economic integration, for example similar studies have been pursued on the subject of EMU integration. Compared to other monetary-unions and subjects of economic integration the subject of Austria-Hungary and specialization within it, provides uncharted area of investigation as to the knowledge of the author a similar study has not been pursued.

In this paper the main study will be within three sectors agriculture, industry and the services. The changes of employee concentration and sectoral change will be shown using dissimilarity indexes to evaluate the development in Austria-Hungary from 1867 to 1910, however the focus will be on the period 1890 to 1910. Using these indices, it will be possible to illustrate whether a country or a region experienced an increase of specialization or not during this period, allowing to contribute to the discussion of specialization. The period 1867 to 1914, Austria-Hungary was a monetary union, this adds a second layer of analysis, as the idea of convergence or specialization within monetary unions persist today. Theories of monetary unions are in turn related to theories of Optimum Currency Area (OCA) which is a subject

relevant in world economy today when it comes to determine the effects of monetary union and economic integration upon its members. Thus OCA criteria and its theories will be central in determining the effect of the monetary union upon Austria-Hungary. It is also evident that there are different theories of what causes industrialisation and different aspects apart from monetary unions can have an effect on the specialization. That specialization is not purely caused by monetary unions, Rudolph highlights the importance of the banks for Austrian industrialisation to take place (Rudolph, 1976). However, I have chosen to limit the interpretations of the results to rest on the backdrop of monetary unions and the theory of OCA and what effect it ought to have on monetary unions. Thus there are other explanations to why there could be regional specialization and industrialisation, however those aspects will not be investigated in this thesis.

Austria-Hungary shared a common currency and foreign policy with a conjoined military force and a common market, with two separate parliaments one in Vienna, the other in Budapest (Flandreau and Maurel, 2005). Since the emergence of Austria-Hungary there was the monetary union, with the currency called the Gulden (Forint in Hungary) and then the Krone (Korona in Hungary). The central bank was the National Bank, which in 1877 changed to the Austro-Hungarian bank, was the issuer of bank notes during the period (Rudolph, 1976). This makes Austria-Hungary a relevant case to study as it shares features similar to other monetary unions, both past and present.

The specialization is defined as a share of population related to a sector compared to the total population in the region (Kuroiwa, 2012, p. 31). To investigate if there is specialization , dissimilarity indexes of will be used as a method, this is as it is a method used by Krugman and proposed by Kuriowa to illustrate specialization (Krugman and Eklöf, 1996, Krugman, 1993, Kuroiwa, 2012, p. 34-37). The Theil index will also be calculated in order to determine the dissimilarity on a regional level comparing both sectors on a country level but also across regions. The use of regional data is also complemented by clustering regions based on dissimilarities, in order to produce macro-regions used for comparison. To the knowledge of the author no previous study has performed these analyses upon Austria-Hungary, this leaves a gap in what can be learned from historical monetary unions. With the availability of sectoral employment data recorded in censuses and statistical yearbooks published decennially these questions can be investigated. Using these methods, the causality of specialization and localization to the monetary union itself cannot be drawn directly, one must therefore see this as a descriptive work based upon these theories. The dissimilarities calculated in this work can be used in future works regarding agglomeration, trade and development.

1.1 History of Austria-Hungary

To trace the history of Austria-Hungary one finds its root in the Holy Roman Empire which was to become the Habsburg dynasty. The Habsburgs had its accession to power through King Leopold I and the victory over the Turks in the late 1600s and the conquering Hungary (Evans, 2008a, p. 7-12). Continuing further into the beginning of the 1800s the Habsburg empire was one of largest countries in Europe, consisting of one seventh of the total European population and contained a wide range of different nationalities and faiths (Gross, 1966, Zentralkommission, 1912). The Habsburg empire, which had Hungary under Austrian rule, started to meet national resistance among the different cultural groups in the beginning of 1840's (Evans, 2008b). This cumulated into the revolution of 1848, at the time Austria was successful in war against Italy and the Hungarian revolution was also overthrown (Colquhoun, 1914). The revolution was not completely resultless as it caused the abdication of the Kaiser of Austria and King of Hungary, Ferdinand I, giving the throne to Francis Joseph (Colquhoun, 1914). The revolution was also essential in increasing agricultural output, this is as there was an emancipation of the peasantry, that increased production (Komlos, 1983, p. 216). It can be argued that the emancipation of the peasantry is essential in order for there to be any industrialisation (Gerschenkron, 1962, p. 19).

The state of industrialisation in Austria-Hungary was seen as somewhat retarded already in the 1840s this is as a customs union between the Habsburg and Germany was proposed. The customs union was refuted by Austrian industrialists, with the argument that the development of Germany and its industries were far more advanced thus they believed in the protection of Austrian industry (Gross, 1966). Furthermore, it is found that the then contemporary statements about the market ought to be taken with caution, this is as statements of this nature are often qualitative, making them unreliable (ibid). Thus there is uncertainty of the Austrian development compared to the other western powers.

In 1860 a law was passed in which the Austrian power over Hungary was considered unconstitutional (Colquhoun, 1914). This resulted in a lack of tax payments to Austria, at the same time Austria had been defeated in the Prussian wars, thus the compromise was created under pressure from the Hungarians (Colquhoun, 1914, Flandreau, 2006). The emperor was then crowned as a Hungarian monarch, creating the dual-monarchy (Colquhoun, 1914). This resulted in a period of joint monetary policy however fiscal independence (Flandreau, 2006). The monetary policy during the dual monarchy can be seen in three parts, first until 1879 had

a currency bound to silver. After this period Austria-Hungary were attempting to join the gold standard, not having enough gold an artificial exchange rate was created and thirdly by 1902 it was on the gold standard (Tullio and Wolters, 2007). The length of the period 1879 to 1902 was because Austria-Hungary had collected enough physical gold to be able to join the gold standard (ibid).

The union was to break down completely after the first world war and the signing of the treaty of Trianon on 4th of June, 1920 and treaty of Saint Germain signed on 10th of September 1919 – dividing the countries and people by 11 different national borders (Encyclopedia, 2016, Schulze and Wolf, 2012). It has been found that the breaking up of the union was not something natural or predictable, as its been shown that Austria was favourable in its monetary policy towards Hungary giving incentives for Austria-Hungary to remain (Flandreau, 2006). Along these lines Komlos findings can be interpreted, showing that Hungary was not being exploited by Austria and that there were mutual benefits from being in the monetary union (Komlos, 1983, p. 215-219).

1.1.1 Previous research on Austria-Hungary

The beginnings of industrialisation in Austria-Hungary can be traced back to the beginning of the 1800s, as the blockades of the Napoleonic wars had an effect on creating demand for produced manufactured goods (Gross, 1966). During this period, it has come to attention that Austria-Hungary was considered relatively undeveloped compared to other western European countries. Gross finds that the use of steam power and coal consumption was not as large as ought to be expected from a developing and industrialising economies (Gross, 1966).

Research on the dual monarchy has been quite poor in general, however there has been significant research by Schulze (2000, 2007 and 2012) who covers different aspects of the dual monarchy. The paper *Economic nationalism and economic integration: the Austro-Hungarian Empire in the late nineteenth century*, finds with the use of prices and linguistic similarities that there was discrimination based on ethnicity within the empire (Schulze and Wolf, 2012). Here the diversity of Austria-Hungary is focused upon as a determinant for regional growth, the asymmetry of the integration of the economy is found by investigating transport costs and grain prices (ibid). Through a gravity model specification, the subject is investigated, finding that the ethno-linguistic variable can explain the asymmetry of Austro-Hungarian economic integration (ibid). One important fact is also pointed out by Schulze, that is of high value for this thesis, is

that there were no administrative barriers within the union or currency differences that could cause this asymmetry in prices Schulze finds. The lack of administrative barriers for trade is essential when applying the theories of the monetary union and regional specialization.

In further works by Schulze a shift-share analysis is done in order to measure labour productivity and growth in Austria and Hungary, which is then compared to Germany (Schulze, 2007). Finding that the Austrian economy did not grow as fast as the Hungarian or the German (ibid). The period 1895 to 1912, the estimated GDP growth in sectors are found to be larger in Hungary in primary and secondary sectors than in Austria (ibid). It is stated that the decrease of employment in the agricultural sector was slow due to protectionists measures, whilst it is also given that Hungary has a comparative advantage in agriculture compared to Austria (ibid). There is also a comparison between the human capital levels in Austro-Hungary being lower than in Germany, showing that there is less accumulated human capital in Austria-Hungary (ibid).

Further Schulze also finds using new GDP estimates for Austria and Hungary, finding that the GDP growth in Hungary declined (Schulze, 2000). The period of the highest growth is found to be that between 1870 to 1895, after that growth had declined, in Hungary it was the agricultural industry that was being modernised (ibid). Schulze also finds that Austria did not exhibit characteristics of those countries that were beginning to industrialise. Furthermore, research done by Sandgruber focusing on agricultural development in Austria, finds that there were variation in the development of Austrian, regions, finding that some experienced reduced modernisation and that some regions lost in productivity over time (Sandgruber, 1978, p. 15-17). Illustrating that Austria was relatively unmodernised as most of the population was involved in agricultural employment. There is also a mention that regions in western Austria was at a disadvantage in agricultural production compared to those in eastern Austria. The regions of Galizien, Bukowina, Dalmatien and the Küstenlände, were found to be particularly underdeveloped compared to the rest of Austria (Sandgruber, 1978, p. 112-113).

Business cycles could have an effect on Austria-Hungarian developments in industry and employment in sectors, also affecting the suitability of an optimum currency area. Previous research has found that business cycles in Hungary correlated with Austria with a one up to a two year delay, meaning that the cycles were indeed very similar (Komlos, 1983, p. 19). Finding that there is synchronization between Austria and Hungary is of value to this essay as sectoral development is influenced by this and essential for the suitability of a monetary union. Komlos focuses on the industrial development in Austria-Hungary, showing that it was because of the conjoined financial markets the Hungarian government was able to finance investments through

state securities (Komlos, 1983, p. 217-218). It is also found that Austria and Hungary was profiting from one another, the agricultural goods from Hungary to Austria and Hungary also provided a market for Austria's industrial goods. Komlos work is also filled with reworked tables showing statistics of production, values and trade, it can be seen that in 1870, the imports from Austria, 76.7% consisted of manufactured goods in value (Komlos, 1983, p. 125). Komlos also finds that Austria-Hungary, with regard to Hungary, reflects to some degree the ideas of Gerschenkron with regard to industrialisation in a backward country (Komlos, 1983, p. 113). Gerschenkron stated that the development of a more backward country needed the support of banks and that the more backward countries could not rely on stock markets and capital markets (Miwa and Ramseyer, 2002). Komlos illustrates that the Hungarian state had an important role in the development of Hungarian industrialisation, thus replacing the need for private capital markets, therefore somewhat different to Gerschenkron's idea (Komlos, 1983, p. 113).

The work *Banking and Industrialization in Austria-Hungary* by Rudolph shows a comparison of banking and industry in Austria and the Czech regions, focused on the institutional role on industrialisation. The role of the banks is illustrated as being crucial for development of Austria, similar to the industrialisation of Germany, a similar statement was produced by Gross (Gross, 1966, Rudolph, 1976). The Czech Lands of Austria, are also found to be of large importance in industrialisation, this is shown by Rudolph, who finds that Böhmen, Mähren and Schlesien were very industrialised (Rudolph, 1976). The findings also show that the industry was controlled by Germans through German banks, whilst the Czech population had difficulties to engage in investment activities and as they were at a disadvantage when facing the German banks. Later Czech banks were also founded and at the turn of the 1900s, the Czech were also involved in the industrialisation (ibid). It becomes clear that nationalism played a central role in the industrialisation of these areas, as both banking and industry was a conflicted area where the possibilities were limited based on ethnicity, similar to what Schulze finds.

Further research has been done on the currency which was called the Gulden in Austria and Forint in Hungary and legal tender in Austria-Hungary and is by Yeager described as very free floating and not requiring government stabilisation until the year of 1889 (Swoboda and Mundell, 1966, p. 62, Flandreau and Komlos, 2006). Another aspect of the Gulden is that it was worth more than its part in silver it was backed by. The average fluctuation of the exchange rate 1879 to 1891 of the Gulden was also seen to be similar to those of US and Canada during the 1950s (Swoboda and Mundell, 1966, p. 67). It can however be seen that the Gulden was subject to some speculation, although these fluctuations remained small and rare events, however the

issue of what a large change actually is in exchange rates remains (ibid). In 1892 the move towards gold was completed, however full convertibility was not reached until 10 years later, however the transition was completed smoothly without any shocks to the currency (ibid). This shows that there was stability in the monetary markets of Austria-Hungary, thus this ought not to have any shock effects on the economy.

1.1.2 Previous research on Optimum Currency Area

This part will show the work that has been pursued on Optimum Currency Areas (OCA), this will incorporate other monetary unions, not Austria-Hungary as the research on this topic has been on more recent unions. The role of the monetary union in development was raised to attention with Mundell's theory of OCA in 1963, which has been an important topic since then (Cesarano, 2013). There are four fundamental aspects of the success of a monetary union, according to the OCA criteria which are the following; extensive trade between members, labour mobility, similar business cycles and risk sharing (Frankel and Rose, 1998). Frankel and Rose in their paper focus on business cycles and trade in the EMU (ibid). Finding that increased trade does create increased similarities in business cycles thus they call for some endogenic features of monetary unions, which this paper will return to (ibid).

Addressing the integrational aspect of monetary unions is the work of Bordo, comparing the United States with the EU (Bordo, 2004). Apart from the definition that a monetary union is an area were the common payment is accepted throughout and is under common control (Bordo, 2004). Bordo also puts an emphasis on *real integration* which is the conjoining of business cycles, labour markets and mobility of goods (Bordo, 2004). Bordo argues that the United Sates is much more integrated than the European market and that labour mobility is the United Sates is extensive compared to Europe. In Europe the institutions, language and culture prohibit complete mobility (Bordo, 2004).

Two outcomes of OCA are reviewed by Akiba and Iida, who show that previous research this far have shown that the specialization hypothesis has gathered the most empiric evidence (Akiba and Iida, 2009). They argue that if indeed, monetary unions were subject of production specialization, this ought to be visible and seen by the asymmetric shocks in the economy, targeting one country or sector (ibid).

A gravity model is used by Flandreau in order to investigate the Latin Monetary Union (LMU) and Scandinavian Monetary Union (SMU) during 1860 to 1880 (Flandreau, 2000). The

results found by Flandreau show that there is no significant advantage of the monetary unions in the case of the LMU and SMU (ibid). Flandreau finds that the Latin Monetary Union was the result of an already increased economic integration and the cause was not the monetary union itself and therefore it did not have the intended effect (Flandreau, 2000).

Endogenous OCA effects

The *Rose effect* entails the thought that currency unions increase trade between countries, who are members of the union but also causes an increase in the intra-industrial trade (Havránek, 2010, Akiba and Iida, 2009). In turn the increase in intra-industrial trade increases the synchronisation effects of the monetary union reducing internal differences, creating increased similarities (Akiba and Iida, 2009). However this has been critiqued by Baldwin and others for not being able to explain the causality by the sudden increase in trade volumes (Havránek, 2010). The Rose effect can be measured using a gravity model, in which the variables GDP of both countries, distance and the currency union is a dummy variable.

The gravity model is commonly used to evaluate if there is an increase in trade as a result of the currency union. This is an example of a model by Harvánek, with some changes.

$$logTrade_{abt} = C_0 + XMonetaryUnion_{abt} + X_2 logGDP_{abt} + X_3 Distance_{ab} + X_n Controlvariables_{abt} + \varepsilon_i$$

The model takes distance and size of the country into account assuming these would draw the most trade.

This endogenous theory of OCA insinuates that by having institutions in place, a currency union will by itself cause convergence, that the optimality of the currency area is created from within. This suggests that even if a country does not fulfil the criteria of OCA, the criteria can be created once the monetary union is in place. Akiba and Iida identify the assumptions of why this is and summarize it in four steps combining ideas and theories of previous research (Akiba and Iida, 2009). Firstly, there is a lowering of transaction costs, then this in turn creates better allocations of resources, followed by capital and market integration, finally a decrease in exchange rate volatility combined with more flexible wage and goods pricing (ibid). This is also supported by the research of Coe and Helpman who find that countries that are open for trade are more likely to develop and the link between research and development and productivity is strengthened (Coe and Helpman, 1993). Initially this is done by researching the relationship of total factor production (TFP) and R&D investments finding that foreign

investments are having a significant effect upon the increase of TFP (ibid). That it's not only the country itself but the countries that it trades with that allow a country to benefit from R&D spill overs, thus meaning a more integrated economy ought to lead to increased technological development (ibid).

Trade

Specialization in trade can also be related to the Heckscher-Ohlin model, according to which, countries would specialise and trade according to the gravity model (Jakab et al., 2001). Schön uses the Heckscher-Ohlin model to evaluate Swedish development from 1870 to 1930, a very similar time period as for this study, using Heckscher-Ohlin's theory centred around trade. Schön finds that in the beginning of the period, trade was important for Swedish development. Which then changed and the development of Sweden was caused by structural changes within Sweden (Schön, 2006). This idea of specialization can therefore be related to a national level with the Heckscher-Ohlin model as well as regional transformation, therefore the size of regions can also be discussed and will also be investigated in this study.

Specialization and Localization

The cause of localization of industries have been given three reasons according to Marshall, Krugman explains these; the first being that people with the skills sought after will move into areas were their skills are demanded, as a result companies will also do this (Krugman and Eklöf, 1996). Secondly another reason found for this this is that having a localised industry becomes cheaper for a producer as supplier also move to the area (Krugman and Eklöf, 1996). Thirdly, when localization of companies occurs, the exchange of ideas will give these companies the possibility to develop faster as they can make use of these new ideas (ibid).

In the work by Wren and Taylor the method of using coefficients of regional specialization based on sectoral employment data to measure differences in specialization, the regions in England are compared with Scotland and Northern Ireland (Wren and Taylor, 1999). However, some of their focus lies on the effect of regional policy's and grants given to research in order to promote technological development (ibid). Arguably this method is similar to the one used in this thesis however this thesis is in a historical context of Austria-Hungary.

An increase in regional specialization allows for a greater regional exports, which in turn allows for regional shocks to occur, were regions can be affected negatively from a change in demand or a change in technology (Krugman, 1993). The growth in one regions exports, also brings with it a growth in investment, this in turn enforces higher growth and specialization,

when a change in production or technology happens, these regions will remain in their previous production methods, instead cutting costs (ibid). The cutting of costs and labour is what Krugman argues will cause long run economic divergence across regions, were an adoption of newer technology does not take place.

1.1.3 Theories of Industrialisation

What can be seen is that it is the industrial sector that it is central in the development of Austria, therefore it is also essential to understand the cause of the industrialisation. This is not the aim of the paper, however an important addition. Developing the ideas of why the differences of regions existed and the cause of these. England can be seen as the first industrialisation, were different theories exist on why it industrialised. In the case for Austria-Hungary, Gerschenkron uses the case of Germany to argue the importance of banks for later industrialisers, arguing that the reason for Germany's industrialisation was not caused by the capital markets but the financing from banks (Miwa and Ramseyer, 2002). That it was the heavy industries that attracted the banks interests in Germany, that it was not the textiles, but the coal, iron and engineering that found the support of the banks in the case of the German industrialisation (Gerschenkron, 1962, p. 15). Most importantly these results shown of German industrialisation can be applied to other countries and has been argued to be a path for backward countries to industrialise (Gerschenkron, 1962). There are a range of ideas of what brought about economic growth and industrialisation, these are ideas of human capital, the role of imperialism, natural recourses for instance coal and the Darwinist ideas of Clark then also the idea of virtues by McCloskey (Mokyr, 2012). With this in mind this thesis will in its entirety focus upon the effects of the Austria-Hungarian monetary union and the effect of them, not the causes of the underlying industrialisation.

1.1.4 Theories of Agglomeration

Two main concepts of economic geography have to be introduced; these are the core-periphery (CP), that there is a core in production, a physical location were production factor are located. When specialization has taken place a large producer chooses to place themselves in areas, were transport costs can be reduced and there is a local market available (Krugman and Eklöf, 1996). The efficiency of transportation must also be recognized, the role of the railway network was

prominent in creating growth in industries, however this was happening jointly together with increased population concentrations (Krugman and Eklöf, 1996). The theory of the core-periphery model is based around two regions and the idea of equilibria being created from the migration and different technical levels (Baldwin, 2001). The model presented by Baldwin, shows two goods in two different industries with two different type of people will migrate in order to gain the highest possible real wage (Baldwin, 2001). Although some state that migration of labour is substituted by movements in capital and trade within services (Nayyar, 1994).

On the other hand this has been criticized by theories of evolutionary geography which bases its ideas upon the newly and still developing theory of evolutionary economics (Boschma and Martin, 2010). It can be seen that evolutionary economics is not one single theory, thus there is still an element of uncertainty of how the subjects and methods used should be approached. However three key elements are found to be of importance, *dynamic changes*, *irreversible* changes and *novelty* (Boschma and Martin, 2010, p. 5). This means that a broad range of theories can be applied in accordance to these idea, with parallels drawn to sciences and evolutionary biology. It is also found that these theories can be drawn into parallels with many other existing theories in order to promote a view of change from within (Boschma and Martin, 2010). A question in the field is about the spatial allocation of production factors, this is somewhat this paper has been referring to partly as regional specialization. Three main lines in research can be drawn, Darwinist evolutionary theory is the most common which draws parallels to science and evolution, then there is the ideas of path dependency and thirdly complexity theories(8, Boschma and Martin, 2010). Finding what actually causes clusters to form *a priori* and not the advantages that can be seen afterwards, is also an aspect that has been seen in the field. Further it has been found that clusters have a positive effect for the starting of a new company and the existing companies in a cluster have an advantage, although here the role of transport costs or natural resources is also seen as possible explanation of clustering for some industries (Boschma and Martin, 2010). An institutional view can also be taken to explain the phenomena of clustering and furthermore a network approach, were business connections can be viewed from a network perspective. Overall in relation to this paper it can be seen that the starting point of the regions in Austria-Hungary effects the outcome, thus according to these theories, the outcome will be path dependent upon their starting point limiting the specialization that can occur in the regions, also as its found that specialization on a firm level, only tends happen in a related field. This would therefore speak against the effect of monetary unions and

the effect of OCA's of regions over time and instead a predisposition path of development in each region.

1.1.5 Results of research on Monetary Unions

Moving away from specific research on OCA and Austria-Hungary , the Latin Monetary union was created in 1865 and its main area was to standardize methods of coinage, using bimetallism, were the value of coins were synchronized, countries involved were France, Italy, Belgium, Switzerland and Greece (Fendel and Maurer, 2015, Flandreau, 2000). The monetary policy was bimetallic meaning a gold and silver base, the standard was set by the French, although it lacked a central authority to control members of union to stop them from misusing the currency (Flandreau, 2000). The effect of the LMU is estimated and also compared to the Scandinavian Monetary union which was introduced in 1873 and is chosen as a control variable. This is evaluated using a gravity model in order to determine whether there is a bias towards trade with partners in the union. Flandreau finds that the Latin Monetary Union was the result of an already increased economic integration and the cause was not the monetary union itself (Flandreau, 2000). The results showing the union was not significant, could therefore mean that the monetary union itself was not having a positive effect. Furthermore the comparison and contrasting of the Latin Monetary union and EMU can be seen in the work of Fendel and Maurer, the problems can be seen to be similar to those existing today in monetary unions (Fendel and Maurer, 2015). What can be seen is that the main issues relating to the monetary union stem from the use of bimetallism, were there was a fixed conversion ratio between gold and silver, this meant that as long as prices are kept constant and in the metal prices move in unison the conversion is possible. However it can be seen that when one metal decreases or increases relative to the other, opens up options of arbitrage, but also enforces the issue of Gresham's Law, which states that coins with lesser value will be forced out of the market (Fendel and Maurer, 2015).

Komlos and Flandreau illustrate the use of target zones in convertibility and exchange rates for monetary unions using Austria-Hungary, that were to some degree fixed to the German mark (Flandreau and Komlos, 2006). Then from 1900, whilst on the gold-standard, with a band allowing for compensation of transport cost for gold, the Austria-Hungarian currency functioned according to models (Flandreau and Komlos, 2006). It is also found that the

monetary markets during the period could be seen as efficient and well-functioning (Flandreau and Komlos, 2006).

Bayoumi and Eichengreen analyse the EMU before its existence (1965 to 1988) and compares it to the US, also taking a core-periphery approach into account, with the framework based on demand and supply and with the use of data on growth and inflation variances and correlations are calculated (Bayoumi and Eichengreen, 1992). Finding that the US has a higher correlation when it comes to prices all across the US, further this is also analysed using a core-periphery approach, were the periphery countries are excluded and vice-versa. It is shown that the differences across the US core-periphery are smaller than those of the EMU. It is also found that the effect of being a neighbouring country (France, Netherlands, Belgium and Denmark) produced much higher correlations, however for those that were not, the correlation in supply and demand chocks was very small.

The comparison of the EMU and the LMU show that there are both similarities, but also quite different, for example in the LMU, there was no central banks, whilst the EMU has the ECB (Fendel and Maurer, 2015). But most importantly Fendel and Maurer argue that a monetary union only based upon OCA criteria, is not enough to last through an economic downturn, this is as there ought also to be a political motive behind the unification in order to hold it together (Fendel and Maurer, 2015). Whereas also unions were there is a dominant member involved with smaller less powerful states, this can also create well-functioning and long-lasting unions (ibid). Finally concluding that political unity needs to exist in order to make the monetary union a stabilising and stable solution for monetary policy (ibid).

The EMU is the most recent example of economic integration in the Europe. This is commented on by Krugman however the empirical findings are quite rough and show only show that there is a higher degree of specialization in the US, this was before the implementation of the euro (Krugman and Eklöf, 1996). There are however studies which have investigated what has happened within the monetary union with the euro. An example of this is the use of is the paper by Marelli who uses regional data of 250 regions in order find if there has been convergence or not, the years studied are 1980, 1992, 1999 and 2005 (Marelli, 2007). It is found that the convergence has increased, that initially Europe was highly specialized (ibid). Furthermore, evidence of increased business cycle correlation can be found were it is argued that the euro has had a converging effect on regions in the euro-area (ibid). The paper by Meiliciani and Savona uses the framework of agglomeration economies to explain sectoral specialization (Meliciani and Savona, 2015) The EU is investigated on a regional level (NUTS2) using the proxy of business-services to find regional specialization (Meliciani and

Savona, 2015). What is found is that metropolitan areas can experience convergence, however previous areas of manufacturing are falling behind (ibid). Showing that areas which are more technologically advanced will be more prone to increase specialization within business services areas than those that are considered “old regions” (ibid).

2 Method

2.1 Specialization and dissimilarity indexes to show sectoral change

Based on Krugman's theory, that with falling trade costs and reduced risk, industries of that are high in cost will specialize within areas, it is this specialization that it aimed to be captured using the indexes. Causing enlarged differences between regions, this can be measured using various dissimilarity indexes, one of these being the Krugman index (Longhi et al., 2014). Below is an example of how a Krugman index is calculated, the *Vi* value is the share of the industry employment compared to total employment. This is then subtracted against the comparison region, the absolute numbers are added, resulting in values ranging from 0 and up. No specialization in industries would give the number 0, however there is no maximum value that could be achieved from this method which has been up for critique because of this.

$$Krugman\ index = \sum_{k=1}^{n} abs(\ v_{iH} - v_{iA})$$

However, there are several variations of these types of indexes, for example the Theil index, shown by Cutrini, that uses this index to measure divergence among regions, either across countries or within (Cutrini, 2010). These are somewhat similar to the index proposed by Krugman, as the rely on employment in regions and sectors, however here the index also gives the possibility of an aggregate but also the possibility to decompose, showing sectoral or regional differences. The Krugman index is however the most useful in the creation of a matrix showing dissimilarities against different regions.

The following Theil index is proposed by Cutrini to calculate differences between regions:

$$\mathrm{T} = \sum_{i=1}^{m} \sum_{j=1}^{r} \frac{x_{ijk}}{x_k} ln \left(\frac{x_{ijk}/x_{ik}}{x_{ij}/x_i} \right)$$

This method is used in the context of the European Union to measure specialization by Cutrini and the index is also suggested (Cutrini, 2010). Therefore, it ought also to be applicable for the Austria-Hungarian case, as similar data are also accessible for this case. The indexes can also be checked using bootstrapping method with which the changes of the index can be checked if they are significant (Cutrini, 2010). This allows the testing of results created using an index, showing that a change actually is significant or not. The values of the different regions and sectors are all added together, this allows for the Theil value to be deconstructed, in order to show what sectors and regions were the most different. The calculations of the Theil index produces values that vary from 0 to 1, were 1 is the most unequal and 0 is the most equal.

The Lilien index can be used to measure sectoral changes as shown, however more recent development show these changes being possible to quantify on regional levels (Lilien, 1982, Robson, 2006). The problem with the use of this index is that observations are lost, as the Δ means that the change from the previous year has to be taken into account, this removes one point of observation, thus decreasing an already small sample. This also ranges from 0 being the most similar, however in the case of this thesis taking the decennial changes in employment and population change into account.

$$S_t = \left[\sum_{r=1}^{N} \left(\frac{X_{it}}{X_t}\right)(\Delta \log X_{it} - \Delta \log X_t)\right]^{1/2}$$

(Robson, 2006)

2.2 Clustering using Hierarchical algorithm

Macro-regions are created through the use of hierarchical algorithm, however solely based on the size of dissimilarity between regions. A dissimilarity matrix based on the Krugman index matrices, given these results they can be applied in order to calculate dissimilarities using hierarchical algorithms as done by (Ciccarelli and Missiaia, 2014). This method does not incorporate any form of geographical agglomeration, simply relying on dissimilarity in agriculture, industry and services. Using this method larger regions can be created, form areas that are similar but are not in the proximity of the region as has been previously shown by Ciccarelli and Missiaia. The dissimilarity matrix is calculated using Krugman Indexed based upon sectoral data in 1900. This allows for a macro-region to be decided upon by the use of

algorithms finding which regions are the most similar regardless of their geographic location. This method should produce unbiased results, as it only incorporates the data given, this is also suggested by Kaufman and Rosseeuw that a direct application of dissimilarity data gives the most successful results (Kaufman and Rousseeuw, 2008). The clusters are calculated using the Johnson hierarchical clustering algorithm in UCINET (Borgatti Steve, 2002). The results that are produced show the clustering at different levels of dissimilarity, where those with the lowest level of dissimilarity cluster first, then the size and number of clusters increase as the level of dissimilarity increases and in the final cluster all regions are incorporated. These results can be illustrated in dendrograms that illustrate first the most similar two regions are paired at a very low level of dissimilarity, where the level of dissimilarity increases going right in the figure. The dendrograms do not themselves show what sort of clustering is the optimal solutions or how big the clusters are, these are up to the author to make, where there are multiple possibilities for clusters and sub-clusters to be specified

3 Data

Statistical yearbooks published by the Hungarian and Austrian government will be the main source of information. These yearbooks contain population data, but also data from different sectors and their employment. These censuses were carried out every 10 years, this means that there will be population data for the years (1870, 1880, 1890, 1900, 1910). For the data on Austria the book *Östereichische Agrarstaistik* 1759 to 1918 by Sandgruber is also used from which the regions are merged (Sandgruber, 1978). Sandgruber mentions issues in the statisics, collected by the government, as family members helping or working were first included in the 1890 then included until 1910 (Sandgruber, 1978, p. 112). However, there are also limits to the data accuracy, the use of counting machines, limits the numbers of occupation, occupations do also change over time, in the 1910 census there were 197 changes in occupations (Zentralkommission, 1912, p. 25). When trying to find the data for 1880, there are sections of the census that were found to be incomplete at least those that were scanned and accessible through the internet. The same issue was found by Komlos on the use of 1880-85 data, thus this year can unfortunately not be used in this study (Komlos, 1983, p. 238).

The data for Austria is divided in 14 regions, the same regions used by Sandgruber in Österreischise Agrarstatistik , in which five regions have been merged (Sandgruber, 1978). The first new region created is Küstenland, which include the data from *Triest und Gebiet, Görcz und Gradisca* and *Istrien* in the statistical data. The second region is Tirol/Voralberg, were the data from *Tirol* and *Voralberg* are merged into one region. There are 31 sectors found in Austria, however for the specific regions these sectors are merged into three different categories. These being Agricultural, Industrial and Services, similar classification of occupational sectors can also be seen in Gross (Gross, 1966, p. 57). Although because of changes within sectors and for making comparison across Austria-Hungary possible it was decided to limit the study to three sectors, agriculture, industry and services. The agricultural sector contains, agricultural works as well as fishing and forestry. The industry sector contains all industries from textile, food processing, metal works, these can be seen in Appendix 7.1.7. The services include, banking as well as transportation, sales and employment in households, it does not contain public servants, education and those in the military.

For Hungary the country is divided into 63 Hungarian counties and 8 Croatian and Slavic counties, a total of 71. However, 8 larger regions are created, which were also used in the census data, Croatia and the Slavic counties become one region, the Hungarian regions are divided based on geography, their relation to the rivers of Danube and Tisza. For the year 1870, the employment in absolute numbers had to be extrapolated from percentages of population within county. This means that the population data for 1869, was used to calculate amount of people involved in agriculture and industry. For the first census in 1869 to 70, Hungary consisted of 78 counties, some of which were merged later by 1880, creating the 63 counties. A central distinction must also be made, the Hungarian Kingdom in 1870 to 1910, contains 71 counties, including Croatia. However, when only referring to Hungary, the 63 counties of Hungary are intended. The censuses for Austria, since the one of 1869 could be considered reliable, during the period 1817 to 1910, it can be seen that the Austria experienced a population increase of an average of 0.81 % growth (Gross, 1966, p. 43-46).

Table 1 Regions recorded from census.

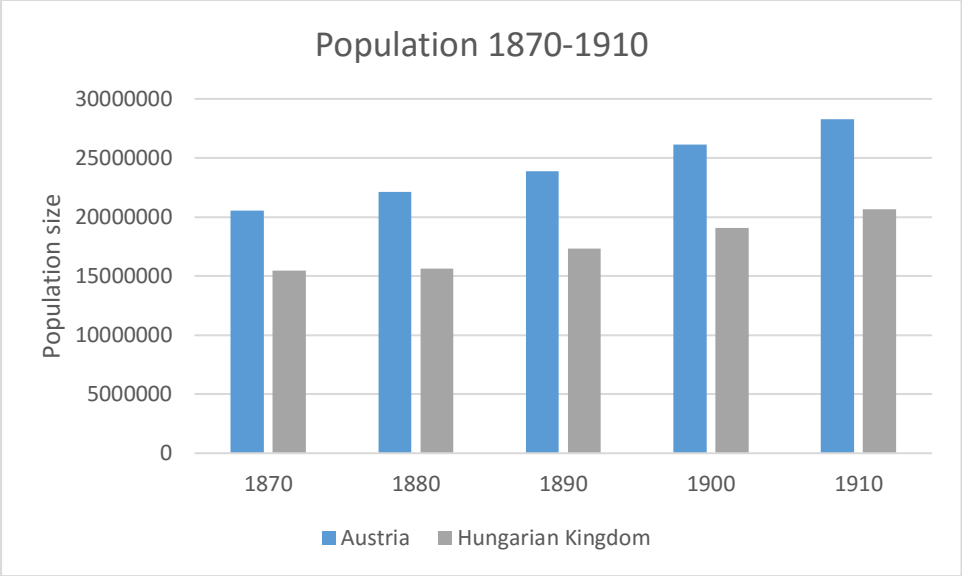
Hungarian Kingdom 1900		Austria 1900	
Region	Population	Region	Population
Duna bal partja	1341628	Niederösterreich	3100493
Duna jobb partja	2012123	Oberösterreich	810246
Duna-Tisza köze	1738615	Salzburg	192763
Tisza jobb partja	1084401	Steiermark	1356491
Tisza bal partja	1710517	Käntern	367324
Tisza-Maros	1475857	Tirol/Vorarlberg	981949
Kiralyhágon túl	1873844	Böhmen	6318697
Horvát -Szlavonország	1981276	Mähren	2437706
		Schlesien	680422
		Galizien	7315989
		Bukowina	730195
		Krain	508150
		Küstenland	756546
		Dalmatien	593784

Source: Statistischen Zentralkommission-1912, and Központi Sztatistikai Hivatal from 1912 (Központi-Sztatisztika-Hivatal, 1905, Zentralkommission, 1912)

From the regions seen above those in Hungary are approximately the same size when it comes to population, whereas the regions of Austria, has larger differenced populations. This could be argued to be a weakness of these regions and make them less suitable for comparison. These Austrian regions have been used in comparative studies by other authors, with success in Sandgruber and Rudolph (Sandgruber, 1978, Rudolph, 1976). Two methods of looking at

regions are suggested by Ciccarelli and Missiaia that is the exogenous and the endogenous, the exogenous is creating macro-regions out of existing regions based on geography, the other is by using cluster analysis to determine which regions are more similar to each other (Ciccarelli and Missiaia, 2014). Four possible macro regions in Austria are suggested in their work, however this leaves questions of how the Hungarian Kingdom ought to be regionalised into comparable parts (ibid).

Figure 1- Populations of Austria-Hungary 1870-1910



Source:(Statistischen Zentralkommission, 1912, Központi-Sztatisztika-Hivatal, 1905, Központi-Sztatisztika-Hivatal, 1912, Orszagos Magyar Sztatistikai Hivatal, 1871, Central-Commission, 1882)

Figure 1. shows the increase of the population over time, it also illustrates the population size differences between the Austrian and the Hungarian kingdom. It recognisable that the Austrian population was much larger compared to Hungary, the population is constantly increasing in both regions. With a population in Austria at 28,2 million and 20,6 million in Hungarian Kingdom in the year 1910, whilst in 1870 the population in the Hungarian Kingdom was 15,4 million and in Austria 20,5 million.

4 Results

It can be seen that the results of this thesis can be divided into two parts. The first part of results, show differences based on established regions within countries, the calculations are done for Austria-Hungary as a whole, but also only for Austria and only for Hungary. The second part of the results are similar calculations however now with macro-regions in order to capture differences across regions to see if the same tendencies of exist.

4.1 Results Austria-Hungarian specialization

Table 2 - Decomposed Theil Index in Austria-Hungary in three sectors

	Agriculture	Industry	Services
1910	0.072	0.140	0.102
Share of inequality	23%	45%	33%
Total Theil		**0.314**	
1900	0.0535	0.1389	0.1154
Share of inequality	17%	45%	37%
Total Theil		**0.308**	
1890	0.0354	0.1858	0.0693
Share of inequality	12%	64%	24%
Total Theil		**0.2905**	

Source: own calculations on data from (Statistischen Központi-Sztatisztika-Hivatal, 1905, Központi-Sztatisztika-Hivatal, 1912, Statistischen Zentralkommission, 1912, Central-Commission, 1892)

The above result in Table 2 is based on all regions in Austria and Hungary and shows that the dissimilarity Austria-Hungary stems to a large extent from industry. Meaning that the highest part of the dissimilarity was seen in the industry sector, showing that this was the largest cause of dissimilarity between the regions. The share of the industry sector is also shown to not be changed from 1900 to 1910. It can be seen that the specialization of the services can be seen to decreases, however the agriculture sector shows increasing specialization. It can also be seen

that the role of the Services, has increased from 0.0693 in Theil to 0.102 from 1890 to 1910, were the share of the dissimilarity was also seen to be increased.

Table 3- Theil Index on Agriculture, in Austria-Hungary

Years	Theil Index Agriculture
1910	0.072
1900	0.054
1890	0.035

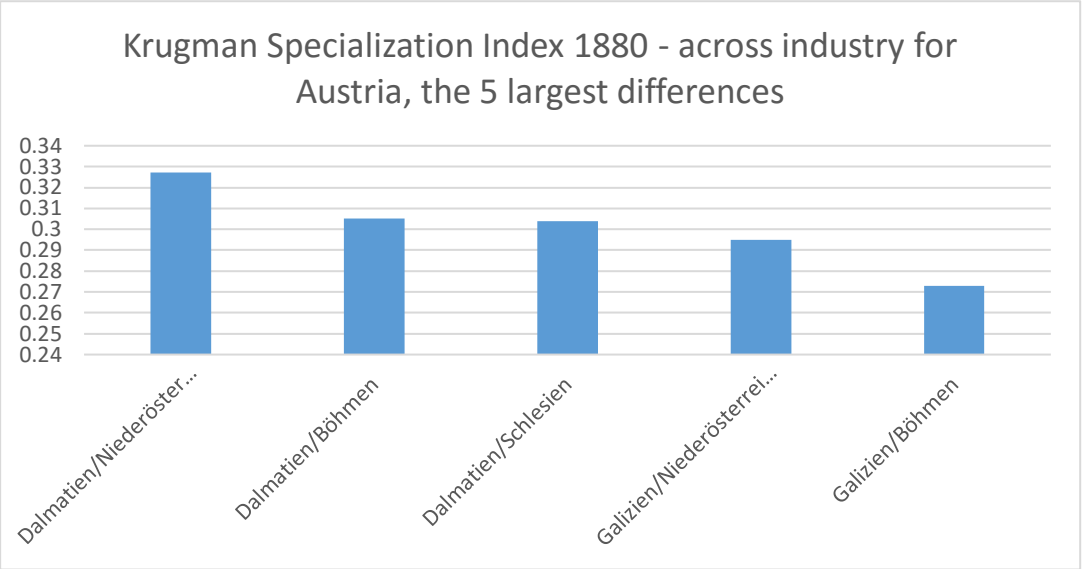
Source: Table 3

Table 3 highlights the agricultural sector from Table 2 showing the increase of agriculture dissimilarity. The agricultural sector and the specialization of it can be seen to be constantly increasing from 1890 to 1910. This show an increasing specialization of agriculture in the regions of Austria-Hungary, it must however be seen that the initial dissimilarity of 0.035 show that the size of agricultural employment in regions initially is very similar, close to zero Theil value. This is very different to dissimilarity of industry seen in Table 3, its value of 0.18 in Theil dissimilarity, meaning that the differences of the size of employment are much larger in the industry sector than in the agricultural.

4.1.1 Results only with Austria

These results show the changes of sectoral employment only for Austria.

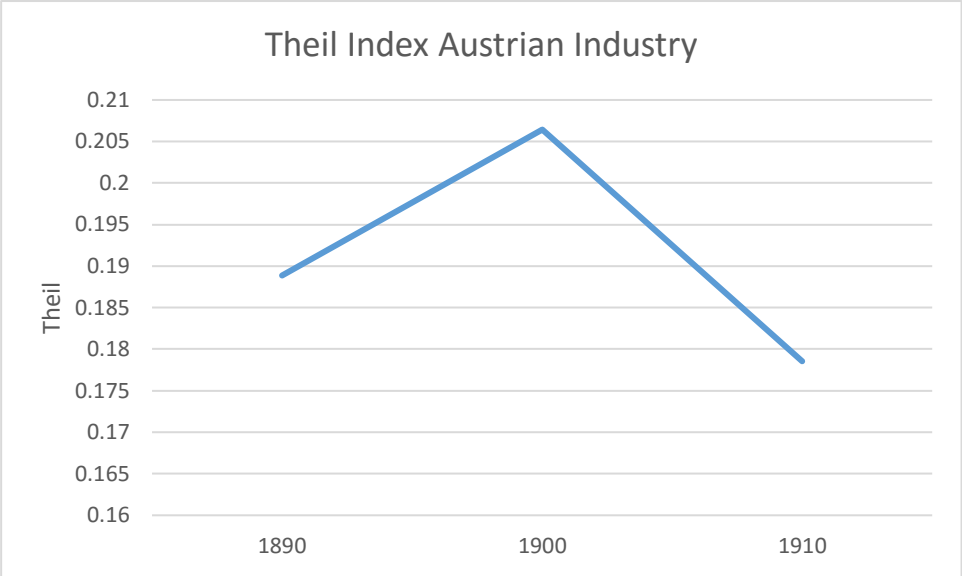
Figure 2 - Krugman difference Austria



Source: own calculations on data from (Statistischen Central-Commission, 1882)

Figure 2. illustrates and confirms results by Sandgruber and Rudolph, showing that the largest differences in Austria, were between the industrial parts Niederösterreich, Böhmen and Schlesien and the areas of Dalmatien and Galizien (Rudolph, 1976, Sandgruber, 1978). This shows what was being explained in his work, that there were large differences in industrialisation within Austria and the different regions of Austria.

Figure 3 - Theil Index Austria



Source: own calculations on data from (Statistischen Zentralkommission, 1912, Statistischen Central-Commission, 1892)

The diagram above shows the worker specialization in industry across the regions of Austria. It displays an increase from 1890 to 1900, followed by a decrease. This indicates no clear trend in the movement of the specialization of industry in Austria, however one can see that there is an overall decrease in the specialization, from 0.2 to 0.17.

Table 4 - Sector specialization in Austria, 1890-1910

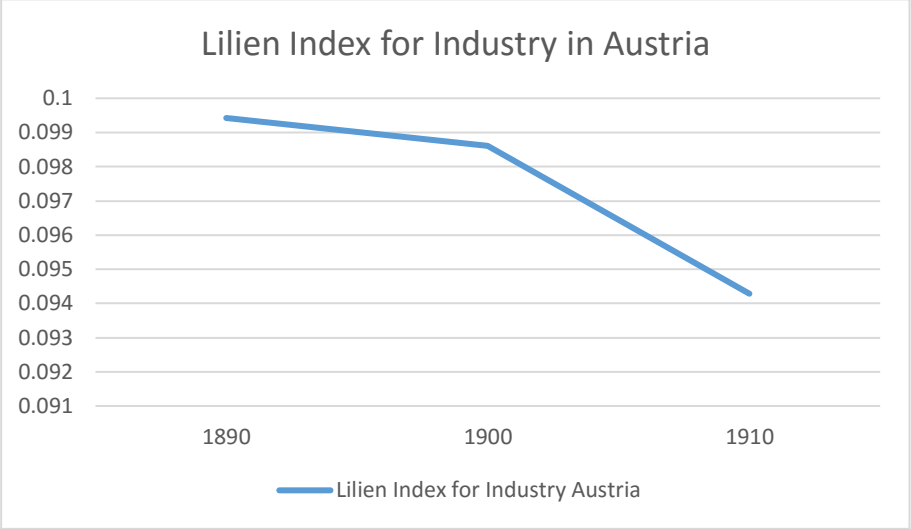
	1890	**1900**	**1910**
Machine-industry	0.70	0.66	0.59
Textile	1.06	0.88	0.82
Clothing	1.81	1.40	1.49
Total Industry dissimilarities	**12.21**	**11.54**	**11.21**

Source: own calculations on data from (Statistischen Zentralkommission, 1912)

The results above were calculated in Austria using Krugman indexes and compares the industrial sub-sectors to each other, a total of 14 sub sectors. In Table 4 three of these sub-sectors of importance were selected and are the same that were used by Krugman in a sample from the United States, this shows the decrease of specialization in machine industry, textile

and also in clothing, looking at the period from 1890 to 1910 (Krugman and Eklöf, 1996). It can be seen that the within the industrial sectors the total, the specialization was also decreasing, from 12.21 to 11.21 during the years from 1890 to 1910.

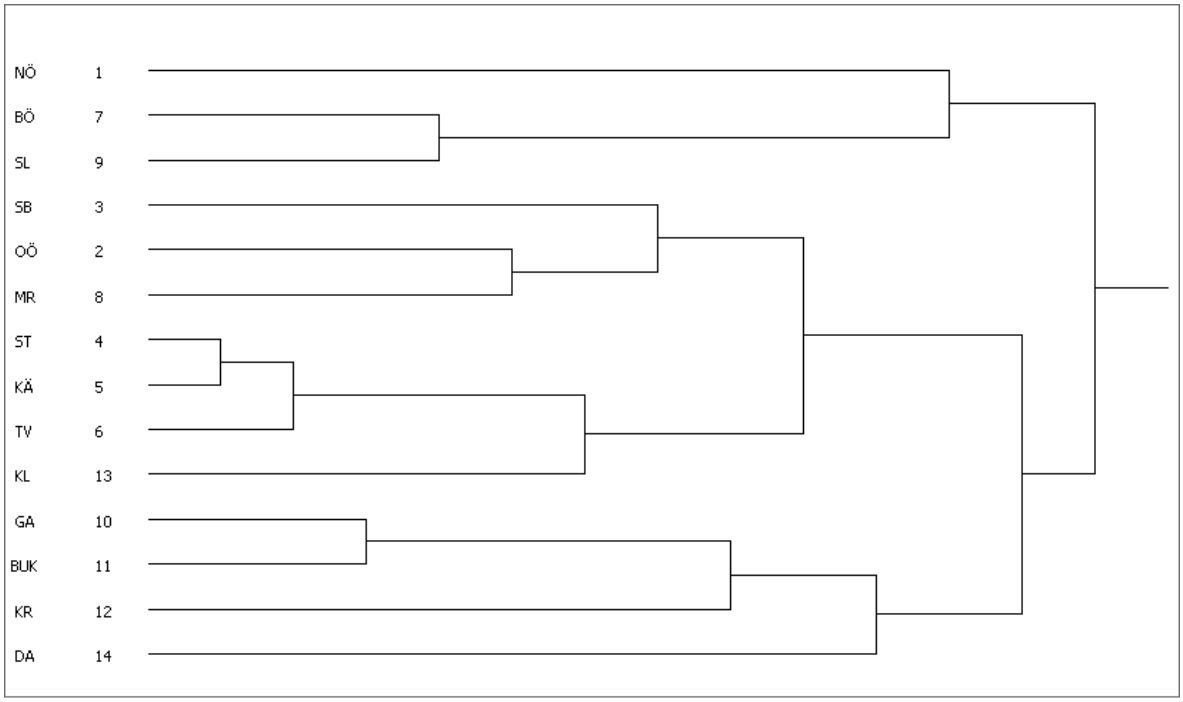
Figure 4- Lilien Index on workers in industry 1890-1910



Source: own calculations on data from (Statistischen Zentralkommission, 1912, Statistischen Central-Commission, 1892)

The above figure shows the Lilien index calculated for Austria, using data on employees in industry. This shows a decline in the regional specialization of industries within Austria, a constant decrease from 0.99 to 0.094. Different from what can be seen in the total change in the Theil index, showing that the choice of index does have an effect on the results displayed. It can also be seen that these are values close to 0, meaning that its showing that the industrial sector and the regions in Austria, could be considered to be close the average industry when also taking yearly changes into account.

Figure 5 - Clustering for Austria



Source: own calculations on data from (Statistischen Zentralkommission, 1912)

Dendrogram above shows the Johnson's hierarchal results of Austria in 1900 see Appendix 7.1.5 for the Krugman dissimilarity matrix the regions are based upon. The region of Niederösterreich was seen to be the most different region, this is as the region contains Vienna, the most industrialized and developed region. Followed by the region of Dalmatia, the coastal region of the Austria, thus it can be seen that the method has correctly identified the differences of the regions. It can be seen that clusters can be identified, the level of dissimilarity between Steiermark (ST) and Käntern (KÄ) is 0.0069, meaning that they are in fact very similar in their employment structure compare to the other regions.

Table 5 Macro-regions Austria

New region	Name of region members
1	Niederösterreich
2	Oberösterreich
2	Salzburg
3	Steiermark
3	Käntern
3	Tirol/Vorarlberg
4	Böhmen
4	Mähren
4	Schlesien
4	Galizien
5	Bukowina
5	Krain
5	Küstenland
6	Dalmatien

Source: own grouping based on Figure 5

These are the 6 new regions that will be the macro-regions of Austria as it can be argued to illustrate the different areas of Austria. The level of dissimilarity of the regions above is 0.1426, thus showing a grouping of regions that are similar. It can be seen that region 3 shows alp regions, region number 2 shows the regions that are somewhat more developed and urbanised. It can also be seen that Bukowina, Krain and Küstenland is one region, that show that the less industrialised regions.

Table 6 Macro-regions Theil index results within Austria

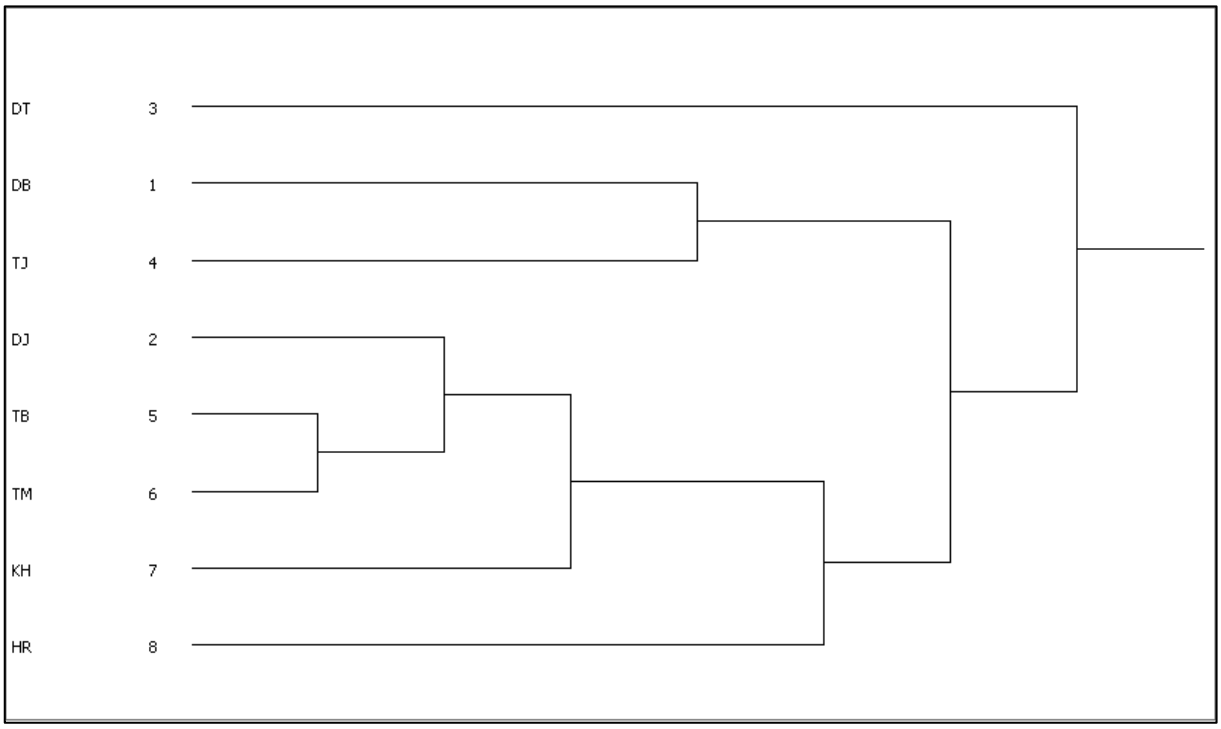
1910	**Agriculture**	**Industry**	**Services**
Theil	0.0416	0.0323	0.0379
Share	37%	29%	34%
Total Theil		**0.1117**	
1900	**Agriculture**	**Industry**	**Services**
Theil	0.0355	0.0373	0.0521
Share	28%	30%	42%
Total Theil		**0.125**	
1890	**Agriculture**	**Industry**	**Services**
Theil	0.0276	0.0404	0.0533
Share	23%	33%	44%
Total Theil		**0.121**	

Source: own calculations on data from Source: own calculations on data from (Statistischen Zentralkommission, 1912, Statistischen Central-Commission, 1892)

It can be seen that the total Theil index change first shows an increase, then a decrease in dissimilarity. Overall for the period from 1890 to 1910 it can be seen that there was a decrease. Among the Agriculture, agricultural sector there was a continuous increase in dissimilarity. In both industry and services, it can be seen that there was a decrease in the dissimilarity, thus showing that the regions were experiencing more similar employments in industrial and service sectors in 1910 than in 1890.

4.1.2 Results only including Hungary

Figure 6 - Clusters within Hungary



Source: own calculations on data from (Központi-Sztatisztika-Hivatal, 1905)

The results for Hungary show that there is level of dissimilarity of 0.0259 between TB and TM, giving the first cluster. It can be seen that the DT (Duna-Tisza köze) is the most different region, compared to the rest, this can be explained by that Budapest is included in this region, the region with little agriculture and plenty of industry and services. It can also be identified that the difference HR- Horvátország is also different, this is the now a day Croatia, region next to the Mediterranean. The regions that were found with the least dissimilarity was TB- Tisza

bal partja and TM – Tisza Maros, these regions are geographically also in the same area, both along the river Tisza in Eastern Hungary.

Table 7 New Region Hungary

Macro Region	Regions included
1	Duna bal partja
2	Duna jobb parja
2	Duna-Tisza köze
3	Tisza jobb partja
3	Tisza bal partja
3	Tisza-Maros
3	Kiralyhágon túl
4	Horvátország

Source: own clustering based on figure 7

It can be seen in the table above the regions that were used for an analysis of the changes within Hungary, it can be seen that this clustering is effective with an eta value of -0.581, thus the regions created are effective. The sectoral change between these regions can be seen in the table below.

Table 8 Theil Index with new Hungarian regions

1910	Agriculture	Industry	Services
Theil	0.0145	0.0393	0.0687
Share	12%	32%	56%
Total Theil		**0.1225**	
1900	Agriculture	Industry	Services
Theil	0.0080	0.1358	0.0711
Share	4%	63%	33%
Total Theil		**0.215**	
1890	Agriculture	Industry	Services
Theil	0.0054	0.1618	0.0543
Share	2%	73%	25%
Total Theil		**0.221**	

Source: own calculations on data from (Központi-Sztatisztika-Hivatal, 1905, Központi-Sztatisztika-Hivatal, 1912)

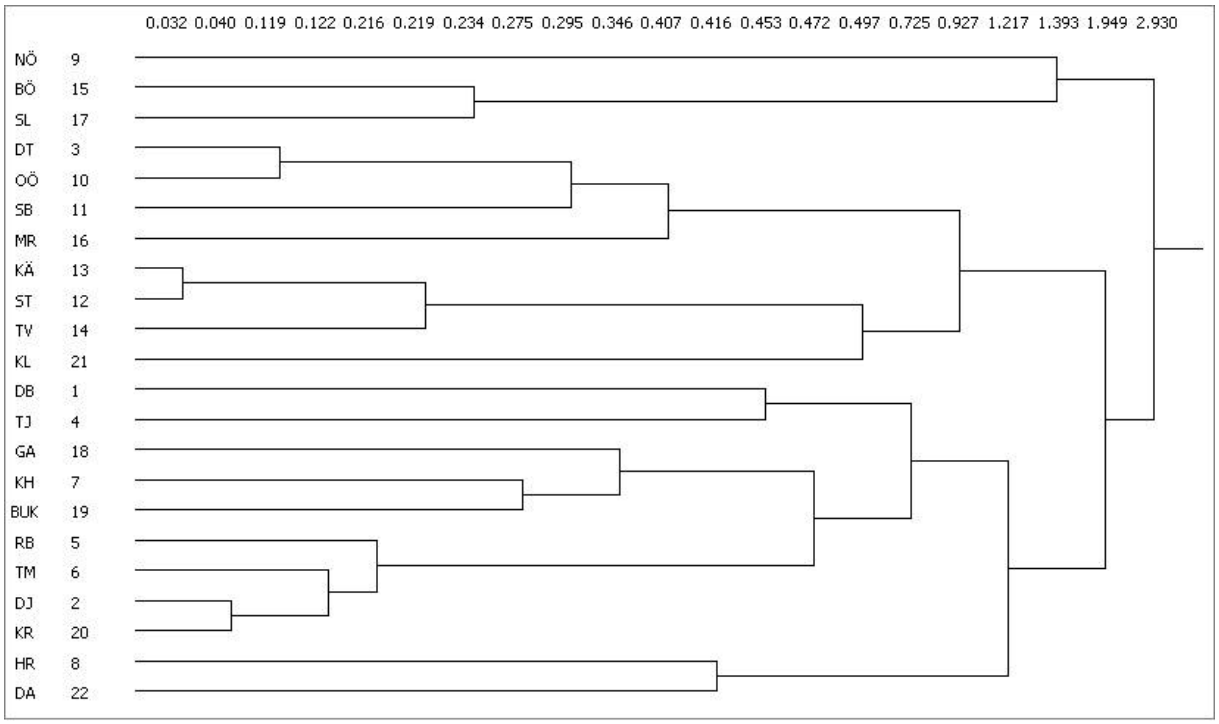
The table above shows that the changes within Hungary according to the 4 regions created from 1890 to 1910. This shows that there was a decrease in dissimilarity among these regions, decreasing from 0.22 in 1890 to 0.12 in 1910. There is are also changes within sectors, that are causing these changes. In 1890 it can be seen that the in their allocation of agriculture the

regions were very similar, however it can be seen that they are becoming more dissimilar until 1910. The largest dissimilarity is seen in the year 1890, for the industrial sector were the dissimilarity is 0.1618 with a share of the total Theil index of 73% meaning that that it was by large the cause of dissimilarity between the regions in 1890. However, it can be seen to decrease until the year 1910, were it in 1910 it was a share of 32%. At the same time it can be seen that the share of the cause of inequality between regions can be seen to be largely increased from 1890 with a share of 25%, in 1900 it was 33% and by 1910 it was 56%.

4.1.3 Results Austria-Hungary with macro regions

Below are the results of Austria-Hungary showing the results based on macro-regions, based on clustering's which in turn were created using Krugman dissimilarities.

Figure 7- Clustered Results



Source: own calculations and using Ucinet (Borgatti Steve, 2002) on data from (Központi-Sztatisztika-Hivatal, 1905, Statistischen Zentralkommission, 1912)

Above is the dendrogram showing the strength of the dissimilarities between the different regions calculated using Johnson's hierarchical clustering, it is based upon agriculture, industry and services in Austria in 1900. It can be seen that the logic if these clustering are very

reasonable, for example is Croatia (HR) most similar to Dalmatia (DA) at a 0.0923 level, although these regions are belonging to different countries exhibit similarities. Similarly, Duna-Tisza között (DT) and Oberösterreich (OÖ) show low dissimilarities, this highlights the advantage of the hierarchical clustering as it creates cross border and not geographically based clusters. It can be seen that there are two distinct groups of those regions that are the most industrialised, therefore it would be of interest to see how these compare to the rest of the regions. This produces two large clusters, were one contains Niederösterreich, Böhmen and Schlesien, the second contained all other regions of Austria-Hungary. The regions in the first cluster can be identified as those that are the most industrialised regions compared which are then compared to the rest. A lower level of dissimilarity is however chosen to represent the macro regions. The adequacy of clusters can also be found using these calculations, finding the most relevant specification, the measures that are produced to measure the fit are: Eta, Q, Q-prime and E-I. These measures range from -1 to 1 were these show the best first, however a value of 0, shows no dissimilarity (Siems, 2016). Further visually looking at the dendrogram, the level of dissimilarity between groups can be seen on the top scale showing Krugman dissimilarities, however also a lower. (See Table 10 for the chosen configuration of clusters used in the thesis.)

Macro-regions in Austria-Hungary

Further clusters can be identified with a lower partition of 0.1358, these can be seen below. The suitability of these regions gave an eta value of -0.477 meaning that it is not an optimal clustering, however can still be considered to use in this case.

Table 9 New Regions of Austria-Hungary

	New macro region
Böhmen	1
Schlesien	1
Duna-Tisza köze	2
Oberösterreich	2
Salzburg	2
Mähren	2
Duna bal partja	3
Tisza jobb partja	3
Duna jobb parja	4
Tisza bal partja	4
Tisza-Maros	4
Kiralyhágon túl	4
Galizien	4
Bukowina	4
Krain	4
Horvátország	5
Dalmatien	5
Steiermark	6
Käntern	6
Tirol/Vorarlberg	6
Küstenland	6
Niederösterreich	7

Source: clustering based on figure 7

These results of table 9 show that seven macro regions that were identified using the algorithm with Niederösterreich being the 7th region also being the most different region. The largest macro-region is number 4, here Hungarian regions and more agricultural regions of Austria could be found to be similar. These macro regions will allow for calculations of dissimilarity showing larger regional effects, if there were any trends on a macro-level different to those seen previously. Potentially decreasing uncertainties caused by single small regions, now being able to identify larger trends in sectoral employments. This method also ignores cultural, geographic and linguistic effects that have been highlighted in previous works and only focuses on the employment size and its structure within the regions.

Table 10 Showing results from the 7 macro Regions Theil index

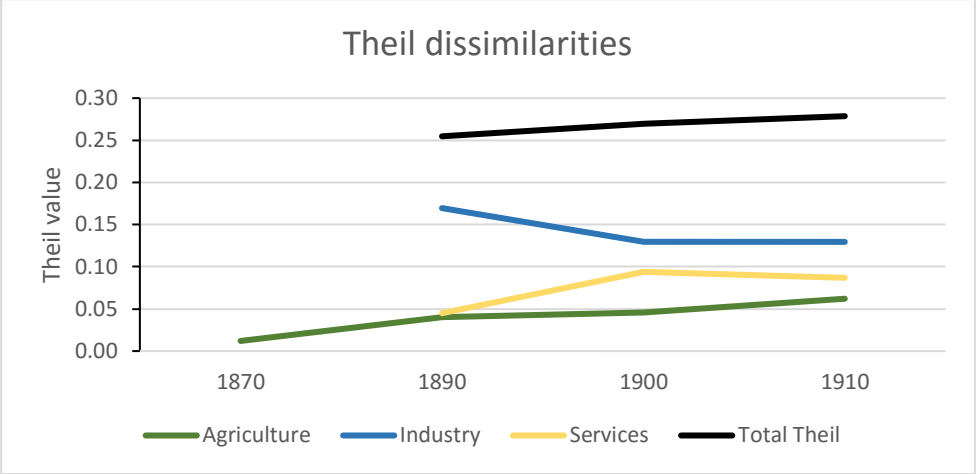
Year	Agriculture	Industry	Services	Total Theil	Percentage shares Agriculture	Percentage shares Industry	Percentage shares Services
1870	0.0120*						
1890	0.0402	0.1695	0.0450	**0.2547**	15.8%	66.6%	17.7%
1900	0.0456	0.1298	0.0939	**0.2693**	17.9%	50.9%	36.9%
1910	0.0621	0.1295	0.0870	**0.2786**	24.4%	50.8%	34.1%

*calculated using employment data not collected similarly as those of 1890

Source: own calculations on data from (Statistischen Zentralkommission, 1912, Központi-Sztatisztika-Hivatal, 1905, Központi-Sztatisztika-Hivatal, 1912, Orszagos Magyar Sztatistikai Hivatal, 1871, Central-Commission, 1882)

These above calculated indexes are created in order to show the dissimilarities for the longest period of time possible using data available and comparable. Although one must notice that there are changes in measurement from 1870 and 1890 compared to 1900 and 1910. The results show that the dissimilarities for the Agriculture- (agriculture, forestry and fishing) do show continuous increase from 1870 to 1910, showing a continual increase in dissimilarity in these regions. It can be seen that the overall industry, dissimilarity is decreasing from 1890 to 1910, however the years 1900 to 1910, show no change in the industry dissimilarity between the regions. Somewhat lower Theil-values are off-course produced now when there is less variation, however a similar pattern can be seen as produced by previous results.

Figure 8 - Theil dissimilarities



Source: graphical representation of table 11.

The Figure 8 Above is the graphic representation of the results produced in Table 10, showing the change over time for the different sectors measured in Theil indexes. It can be seen that the change in industry dissimilarity is marginal from year 1900 to 1910. The Figure does however highlight the rise of dissimilarity in the agricultural sector, that continuously increases throughout 1870 to 1910.

5 Discussion

It can be seen that the results of this study are neither complete nor fully explanatory, however show evidence of different theories. The results hare however successful in describing and giving an idea of the differences across regions and the development of these. Firstly, when looking at the countries it can be seen that Hungary shows a lower degree of dissimilarity across its regions than the Austrian. This is because of the industrial areas in Böhmen, Schlesien and Niederösterreich that were developed to a much larger degree than the most developed region in Hungary, Duna-Tisza köze. The use of clustering techniques has provided the macro-regions for testing, making these comparisons possible, although producing the same results of increased dissimilarity as the previous configurations. During the period from 1890 to 1910 it can also be seen that within the countries inequality between sectors increases in the agricultural sector and in some observations within the services.

Were the OCA criteria fulfilled?

This can be discussed in order, to argue that results are not to be interpreted as addition to any of the OCA-theories. One must see that there is a framework for what the OCA should entail and how it can be determined. The four criteria introduced will be commented on below in relation to previous research and findings on Austria-Hungary.

The first criteria is that there ought to be trade between the members, this can be seen when looking at the statistical yearbook of 1905, were Hungarians trade with Austria shows to be ranging from 69-76%, depending on measure (value or volume) (Magyar, 1907). This shows that trade between Austria-Hungary was flourishing and the Austria the biggest trading partner of Hungary by far.

The second criteria labour mobility can be seen in the census, were the amount of foreigners from other regions can be seen in the censuses, however it does not provide any information about labour migratory flows. The role of labour migration has been discussed, as capital movement are key aspect and can to some extent replace the movement of labour. This is shown by Nayyar who writes that the effect of capital movements and trade are having a substituting effect on migration (Nayyar, 1994). Thus the OCA criteria itself would be counterfactual if

relying on the work of Nayyar, when increasing the trade in goods would have the effect of limiting labour migration.

Thirdly, business cycle correlation has previously found to be similar in Austria-Hungary as given by Komlos with a one to two year lag (Komlos, 1983). This shows that there was cycle correlation between Hungary and Austria was strong, thus it must be seen that the criteria were fulfilled.

Fourthly, risk sharing an aspect of an OCA, this can be seen by the creation of the national bank, which can be seen as a central institution. However the national bank did not oversee any fiscal policy one of the fundamental aspects of the compromise was in fact sovereignty in fiscal matters (Flandreau, 2006). It is also found that the common currency decreased the risk associated with the exchange rate and the increase of lending from Austria to Hungary during the union (ibid). It can be argued that these are characteristics of risk sharing as they are lending, also describing the monetary union as a method of comprise. This can also be seen as vital to the union, this as the comprise was renegotiated continuously during its existence. The value of Austro-Hungarian currency being close to and traded in more markets also with debt being traded with a lower spreads, can all be evidence of lower risk associated with Austria-Hungary, thus there ought to be a risk mitigating effect in Austria-Hungary (Flandreau, 2006). It could therefore be argued that the risk-sharing aspect can be visualised in the pricing of currency in bonds, where Flandreau shows secession would have a negative effect. Komlos and Flandreau also finds that the monetary policy was flexible and "enabled monetary authorities to adjust monetary policy to domestic conditions (Flandreau and Komlos, 2006)". This shows that instead of pursuing one course in monetary policy it was adjusted in order to support domestic conditions.

With this in mind it can arguably be seen that it could be argued that Austria-Hungary in fact was an optimum currency area or that to some extent the background to what causes an OCA was there. It can be seen that the criteria regarding business cycle correlation can be considered to be the most important, this is as the effect of shocks should be minimalized (Babetskii, 2005). It can also be argued that if this was not to be true, the arguments of an endogenous OCA could be applied due to the extensive trade within Austria-Hungary satisfying OCA criteria ex post.

Was there convergence?

According to the endogenous OCA theory a monetary union should lead to convergence of the regions. One must also see that these calculations do not display the any form of causality

between monetary unions and dissimilarity, as it only illustrates their changes over time. When also looking at the sector specialization of Krugman indexes for Austria in table 4 it can be see that these show a continuous decline from 1890 to1910. Further Table 4, also shows the Krugman values for different industries and the differences within the industry sectors, showing the changes over time. The industries chosen here were the same as used by Krugman in his work, however it could be argued that these chosen are not applicable to Austria (Krugman and Eklöf, 1996). This is shown by Gerschenkron who finds, that the German industrialisation, was not within the soft industries of textile production (Gerschenkron, 1962). Thus it could be argued that the representation of table 4, could in fact not reflect a general trend within industrialisation of Austria. For further interest the entire table is available in appendix 7.1.7 showing the industrial dissimilarities, these also show that dissimilarity in employment was also decreasing within those industries that are heavy, for example metalwork's, chemical industry and mining. In the appendix 7.1.7 it can also be seen that the only increasing dissimilarity is in the building sector. This strengthens the idea that industrial employment did not experience any sort of industry specialization from 1890 to 1910, rather decreased specialization in the industry sector. This could therefore be evidence of convergence, however only for Austria and not the entire Austria-Hungary.

It could be argued that the period 1900 to 1910 ought to show the most converging effect, out of the time period, as by 1902 the gold standard was fully implemented with a physical reserve in gold. Suggested by those who argue for the endogeneity of the OCA criteria, a more stable and decreased variance and uncertainty in the currency ought to lead to higher integration, this in turn to more trade, thus convergence. It should therefore be more expected to see an increased convergence effect in the period 1900 to 1910. The years of 1903 to 1907 are also recognised to be a period of boom, investments were high and the expansion of the railway was prominent (Rudolph, 1976, p. 33-34).

Flandreau showed with the LMU an already well integrated economy should not be effected by increased monetary cooperation as trade was already present. According to this it could be argued as Hungary previously had been under Habsburg rule, the effect of the monetary union ought not to be the same as when or coordination had existed before. Thus this could be a possible explanation for the somewhat static and trendless changes in sectoral employment that was seen in Austria-Hungary. This is as Austria-Hungary has been under different forms of integration as Hungary has been under Austrian rule. It can be argued that the specialization and the integration was so far drawn, that the currency area has a limited effect.

It can also be seen that whilst for within Austria and also within Hungary the changes in of industry dissimilarity show a trend of decreasing dissimilarity. Whilst the agricultural differences are increasing, Komlos shows that large changes in the agriculture and its production started to happen already after the 1848 revolution (Komlos, 1983, p. 64-70).

The role of the service industry can be seen to be increasing as a source of dissimilarity, the share of the Theil index as seen in Table 10. This increases from 17% to 34% as a share of the total dissimilarity. The highest share is seen in the year 1900, with a Theil value of 0.0939 and a share of 36%, therefore a decrease can be seen from 1900 to 1910. The depiction of sectoral size and Theil index in Figure 8 of the results does show that it becomes very hard to see the U-shape mentioned in the work of Ciccarelli and Missiaia (Ciccarelli and Missiaia, 2014). Although those were based upon the GDP, it does show that these results are not in line with previous work, also for Austria in which the Theil index can be seen to be decreasing.

According to the Krugman idea, the greater integration ought to lead to specialization, Schulze showed that Hungary had a comparative advantage in agriculture (Schulze, 2007, Krugman and Eklöf, 1996). The findings of this research find a continuous increase in the agricultural sector from 1870 to 1910, thus it could be argued that this illustrates the specialization in Hungary, that there is this increase of dissimilarity due to the specialization of the integration. Therefore, if Krugman's findings and thoughts about monetary and economic integration ought to skew the production within agriculture towards Hungary. The increase of agricultural dissimilarity does also happen within Hungary looking at Table 8, illustrating that the heterogeneity of size of employment in agriculture was increasing. Akiba and Iida describe the specialization by Krugman they do this with commodity production being specialized, this is shown to be true as the dissimilarity in agriculture does increase in Table , (Akiba and Iida, 2009). In contrast the industrial dissimilarity is decreasing which is a feature of the synchronization thesis instead, that there are technology and knowledge spill overs in the economy created through the increased integration (Coe and Helpman, 1993). Thus the results are showing results allowing for both theories to be accepted to some extent. Whilst only within Austria, it can be seen that the Austrian regions show a decrease in both industry and services, also the total dissimilarity is decreasing, this can be seen in Table 6. The agricultural sector also shows the increase in dissimilarity from 1890 to 1910, similar to that seen in Austria-Hungary. What the increase in dissimilarity in Agriculture can also be found in the work of Komlos which describes, the increase of demand on grain and flour and that there were possibilities of rationalization in these sectors (Komlos, 1983). Further the measure of employment in three large sectors could be considered quite crude. This can be argued as what can be seen are

changes in the employment structure on a very large level. The work of Chapman uses employment in large sectors similar to those in this paper, however also dividing these into high and low skilled works or knowledge intensive (Chapman, 2013). In the case of Austria-Hungary, the essay is limited to these macro-sectors, thus there could be difficulties illustrating the specialization if it is happening within the industrial sector. Therefore, it could be argued that this is only showing the coordination of industrialisation within Austria-Hungary. Shown by Gerschenkron, industrialisation can take place in different industrial sectors, heavy industry in Germany, textiles in England, thus a more specific look at industry might not show specialization but a different path to development (Gerschenkron, 1962). Furthermore, it could also be argued that the macro-sectors are more effective, because an increase in a sub-sector ought not only reflect specialization, but could be a change in consumption pattern, meaning changes of local demand, not a result of regional advantages or specialization.

Comparing the macro-regions of Hungary Table 8 it can be seen that the changes of dissimilarity are much more prominent than what is seen in Austrian macro regions in Table 6. This can arguably show that Hungary experienced more changes in industrialisation and modernisation during this period than that of Austria. It could however be expected to see a greater divergence between Austria and Hungarian parts, if one sees the work of Nayyar, the divergence between them ought to continually increase from 1820 to 1920 (Nayyar, 2013). However, this is not evident from this case as the industrial dissimilarity is decreasing, not showing a clear divergence as supposed to be the differences between eastern and western Europe. However, knowing Hungary was profiting from the union and compromise could be seen as a possible explanation, that the divergence was not prominent because of the monetary union (Flandreau, 2006). Further the idea of exploitation of Hungary can not be found in this thesis. Furthermore, the decrease of industrial dissimilarity could therefore be evidence of the unnatural dismemberment of Austria-Hungary pursued after the first world war and evidence of advancement of Hungary as a result of the 1867 compromise.

With the decrease in industry dissimilarity in mind from Figure 8, the growth of the Hungarian industry was found by Komlos to be faster than that of Austria (Komlos, 1983, p. 113). This is argued to be because of the infantile state of Hungary's industry, whilst that of Austria being fully developed (ibid). Moreover, there were also comparative advantages in some industries in Hungary compared to Austria, these were visible in the food processing industry, were the processing of foods, more specifically flour production had gained international significance by 1879 and remained important until 1889 (Komlos, 1983, p. 132 - 141). The agricultural also increased, with the support of state financed land buying, land used

in the agricultural industry expanded during the late 1870s (Komlos, 1983, p. 149-151). The role of the state was not only seen in the financing of industry and agriculture however also in providing the infrastructure necessary for factory development (Komlos, 1983, p. 159-160). Thus the findings in Figure 8 can be argued to be in line with the previous research showing the faster paced changes in industrial development and the inherent advantages in agriculture for the Hungarian regions. However, the role of the monetary union in this can be questioned as it can be argued that the Hungarian state was active in the creation of industry, modernization. Which is to some extent similar to Gershchenkron's idea of development however there was also a large role of private capital as whereas in 1899 the state grants were approximately 16% of the private capital invested. This could also thwart the expected effects that the monetary union ought to have on the development as the state was involved in subsidising and developing in industry.

It could be seen that the study into services, ought to reveal more about potential specialization or the lack thereof. The work of Meliciani and Savona use business-services to find evidence of specialization (Meliciani and Savona, 2015). It has been chosen to not pursue this as the services are given in the censuses, as there is not difference between the high or low skilled services. Also the theories that the paper is based upon do not show not consider services, Krugman writes specifically about the location of industries in his comparison. The endogenous OCA, does in its work comment on the increase of the trade in goods and intra-industrial trade, not the existence of services. However as seen in Figure 8 the dissimilarity of increases from 1890 to 1910, the share in the total dissimilarity services can be seen to increase. Without any ability with the current data to determine the changes in the high-low skilled spectrum of services it could be not be possible to see a movement of high skilled specialization. Also the trading of services can be argued to be hard to specify according to the model proposed by Krugman as it some services can not be traded, especially not to the same extent as today. Thus the changes of services have to been left out of the current discussion. If the services where to be completely removed the total Theil index would be 0.20 in 1890 and 0.175 in 1900 and 0.19 in 1910 (subtracting services from the total in Table 10). This shows a different result – one where the total Theil is decreasing. Showing that there is less dissimilarity over the time period, contradicting the idea of increasing specialization.

Further it can be seen also from the dendrogram, that both in Austria and in Hungary, large differences could be seen in the regions containing Vienna and Budapest. This could in itself be related to Krugman's new economic geography in which the creation of large city centres are caused by poor infrastructure and concentrated political power in cities (Kuroiwa, 2012).

Whilst others point towards the geographical aspects, which to a large degree have an effect on trade, of how goods are transported.

Population change can also be seen to differentiate similarly across regions, were the regions of Duna-Tisza köze, containing Budapest and what was the most developed region of Hungary grew with 32% from 1890 to 1910 (see Appendix 7.1.1). Similarly, Niederösterreich had a population growth of 33% during the same period, this being the region containing Vienna. The region with the least population growth was found in Krain, a mountainous alpine region. It is by large the more developed regions that experience the highest growth in population, this could arguable also be the cause of growth. The role of demographic change for industrialisation and economic growth is discussed at length in the work of Gregory Clark – *A Farwell to Alms* (Clark, 2007). Thus the growth of these regions and the increase of dissimilarity could be drawn to that the average increase in population is seen to be higher in Austria than in Hungary. The role of population changes does also have an effect on the regions, this is as an asymmetric change in population would also have an effect upon the Theil index, Krugman and Lilien measurement used in this essay. The creation of the dissimilarities was based on the use of dissimilarity matrix, calculated using the Krugman index for the year of 1900. This can in turn effect these results as a base year for the calculation was in 1900, as seen in indexes, the choosing of year for a starting point can have a large effect on the changes seen. Thus 1900 was actively chosen as it was the middle observation, between 1890 and 1900.

6 Conclusion

It can be seen that the results can be divided into two parts, one the of the regional changes within countries and one of the larger commentary and discussion of the changes in Austria-Hungary at large. It could be argued that Austria-Hungary exhibited features of an OCA, however it is shown that the effect of the monetary union upon the results is up for interpretation.

The use of employment data is also a different approach taken to specialization and economic integration than what has previously been used, allowing for the creation of dissimilarities that has shown the differences in Austria-Hungarian sectoral employment and the changes over time. The essay has investigated the use of macro-regions, developed indexes on dissimilarities across regions in Austria-Hungary. It was found that the total dissimilarity between Austria-Hungary showed to be increasing from 1890 to 1910, in Austria alone it was decreasing whilst in Hungary alone it was increasing. The Theil index total results for Austria-Hungary is in line with Krugman's idea of greater specialization due to monetary integration, however the specialization is not seen within the industrial sector were the difference is actually decreasing. Which could be explained by technology spill overs from increased trade and economic integration, having a synchronizing effect upon industrialisation and development in Austria-Hungary. Thus no clear answer can currently be given regarding the effect of integration upon Austria-Hungary in relation to the monetary union using this method, however it facilitates further research into Austria-Hungary using the dissimilarities calculated. It does also show the industrialisation of Hungary compared to Austria, the move towards a more effective industry, however it can be argued that the growth of the Hungarian industry can be elusive compared to Austria as it does start from a backward state. The macro-regions created also highlight similarities and differences across the different regions of Austria-Hungary, the regions found using an endogenous method, does highlight that there were similarities between some Austrian and Hungarian regions. It can also be seen that when only taking Austria and Hungarian Kingdom with itself both countries showed decreasing total dissimilarities, which is an interesting finding.

In conclusion the causality of the currency area and the effect upon the employment in sectors can not be shown using this method, however it does illustrate the changes over time

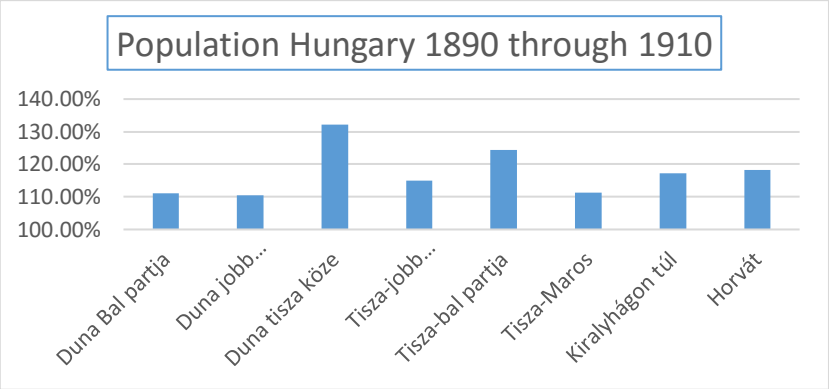
which could be argued to be affected by monetary policy and currency unions, the precise role of the monetary union is difficult to determine. To answer the question: to what extent Austria-Hungary experienced specialization? It can be seen that depending on the what sector is looked at the results are different, however the results do show that the extent of the changes in the size of sectoral employment were not large. It can also be seen that using these results, there is no support of any hampered industrialisation caused by the monetary union, as the dissimilarities are decreasing in the size of the industrial sector in Austria-Hungary. Suggesting that there is a limited effect or at least not measurable using this method for the size of the industry sector for Krugman's theory of specialization for the case of Austria-Hungary from 1890 to 1910. This is as there are only few sectors, but for only Austria sub-sectors of industry were found, that showed decreasing dissimilarity in the industry sector in its entirety. Therefore, this thesis should be viewed as an initial attempt at investigating the larger role of the monetary union in Austria-Hungary.

7 APPENDIX

7.1 Figures and tables

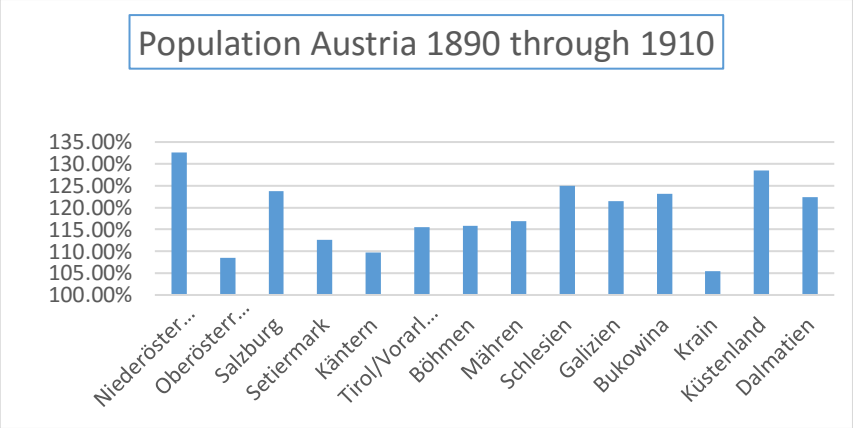
Below are selected calculations and figures and tables that are produced and are results of the thesis.

7.1.1 Hungarian population change



Source:(Központi-Sztatisztika-Hivatal, 1905, Hivatal, 1871, Központi-Sztatisztika-Hivatal, 1912)

7.1.2 Austrian population change



Source:(Statistischen Central-Commission, 1882, Statistischen Central-Commission, 1892, Statistischen Zentralkommission, 1912)

7.1.3 Clustering size – Austria-Hungary and measures of cluster suitability

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Eta	-0.097	-0.14	-0.16	-0.21	-0.273	-0.287	-0.298	-0.309	-0.348	-0.356	-0.365	-0.38	-0.4	-0.46	-0.477	-0.527	-0.557	-0.629	-0.633	-0.687
Q	-0.052	-0.06	-0.06	-0.06	-0.069	-0.072	-0.075	-0.083	-0.091	-0.097	-0.098	-0.103	-0.106	-0.124	-0.13	-0.161	-0.162	-0.17	-0.189	-0.091
Q-prime	-0.055	-0.06	-0.06	-0.06	-0.074	-0.077	-0.08	-0.089	-0.099	-0.105	-0.108	-0.114	-0.12	-0.141	-0.152	-0.193	-0.203	-0.227	-0.284	-0.182
E-I	1	0.999	0.999	0.997	0.993	0.991	0.99	0.988	0.98	0.977	0.975	0.97	0.961	0.93	0.92	0.858	0.821	0.693	0.68	-0.11

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	CL1	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.091	0.091	0.091	0.091	0.091	0.091	0.045	0.045	0.136	0.136	1
2	CL2	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.182	0.091	0.455	0.864	
3	CL3	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.091	0.045	0.045	0.045	0.182	0.182	0.091	0.455	0.409		
4	CL4	0.045	0.045	0.091	0.091	0.045	0.045	0.045	0.045	0.045	0.091	0.045	0.136	0.136	0.136	0.091	0.091	0.273	0.409			
5	CL5	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.091	0.045	0.136	0.136	0.091	0.091	0.318	0.182	0.409				
6	CL6	0.045	0.045	0.045	0.045	0.045	0.091	0.091	0.091	0.045	0.136	0.045	0.091	0.091	0.318	0.182	0.409					
7	CL7	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.136	0.045	0.091	0.091	0.227	0.182	0.091						
8	CL8	0.045	0.045	0.045	0.045	0.045	0.136	0.136	0.136	0.045	0.091	0.091	0.227	0.182	0.091							
9	CL9	0.045	0.045	0.045	0.045	0.136	0.045	0.045	0.045	0.091	0.091	0.227	0.045	0.091								
10	CL10	0.045	0.045	0.091	0.136	0.045	0.045	0.045	0.091	0.091	0.227	0.045	0.091									
11	CL11	0.045	0.091	0.045	0.045	0.045	0.045	0.045	0.091	0.227	0.045	0.091										
12	CL12	0.091	0.045	0.045	0.045	0.045	0.045	0.091	0.182	0.045	0.091											
13	CL13	0.045	0.045	0.045	0.045	0.045	0.045	0.182	0.045	0.045												
14	CL14	0.045	0.045	0.045	0.045	0.045	0.182	0.045	0.045													
15	CL15	0.045	0.045	0.045	0.045	0.182	0.045	0.045														
16	CL16	0.045	0.045	0.045	0.091	0.045	0.045															
17	CL17	0.045	0.045	0.091	0.045	0.045																
18	CL18	0.045	0.091	0.045	0.045																	
19	CL19	0.045	0.045	0.045																		
20	CL20	0.045	0.045																			
21	CL21	0.045																				

Source: results from Appendix 7.1.6 using UCINET (Borgatti Steve, 2002)

7.1.4 Clusters Austria measures of cluster suitability

	1	2	3	4	5	6	7	8	9	10	11	12
Eta	-0.167	-0.28	-0.311	-0.34	-0.37	-0.429	-0.468	-0.501	-0.626	-0.66	-0.673	-0.6
Q	-0.083	-0.09	-0.101	-0.11	-0.12	-0.124	-0.131	-0.144	-0.149	-0.18	-0.205	-0.1
Q-prime	-0.09	-0.1	-0.111	-0.13	-0.13	-0.142	-0.152	-0.173	-0.186	-0.24	-0.307	-0.3
E-I	1	0.995	0.991	0.987	0.981	0.962	0.948	0.932	0.798	0.76	0.734	0.09

Source: results from Appendix 7.1.6 using UCINET (Borgatti Steve, 2002)

7.1.5 Clusters within Hungary, suitability and size

	Adequacy							
		1	2	3	4	5	6	
1	Eta	-0.247	-0.417	-0.55	-0.586	-0.63	-0.75	
2	Q	-0.153	-0.169	-0.184	-0.194	-0.21	-0.11	
3	Q-prime	-0.178	-0.202	-0.23	-0.258	-0.31	-0.22	
4	E-I	0.99	0.957	0.871	0.837	0.622	-0.07	
	Size of clusters							
		1	2	3	4	5	6	7
1	CL1	0.125	0.125	0.125	0.125	0.125	0.125	1
2	CL2	0.125	0.125	0.125	0.25	0.25	0.875	
3	CL3	0.125	0.125	0.125	0.5	0.625		
4	CL4	0.125	0.375	0.5	0.125			
5	CL5	0.25	0.125	0.125				
6	CL6	0.125	0.125					
7	CL7	0.125						

Source: results from Appendix 7.1.6 using UCINET (Borgatti Steve, 2002)

7.1.6 Krugman dissimilarity matrix 1900

	Duna Bal partja	Duna jobb parja	Duna tisza köze	Tisza-jobb partja	Tisza-bal partja	Tisza-Maros	Kiralyhágon túl	Horvát	Niederösterreich	Oberösterreich	Salzburg	Setiermark	Käntern	Tirol/Vorarlberg	Böhmen	Mähren	Schlesien	Galizien	Bukowina	Krain	Küstenland	Dalmatien
Duna Bal partja																						
Duna jobb parja	0.16																					
Duna tisza köze	0.20	0.36																				
Tisza-jobb partja	0.10	0.11	0.28																			
Tisza-bal partja	0.20	0.04	0.40	0.12																		
Tisza-Maros	0.18	0.05	0.38	0.10	0.03																	
Kiralyhágon túl	0.26	0.10	0.46	0.18	0.06	0.08																
Horvát	0.35	0.19	0.55	0.27	0.15	0.17	0.09															
Niederösterreich	0.74	0.90	0.54	0.82	0.94	0.92	1.00	1.09														
Oberösterreich	0.21	0.37	0.06	0.30	0.42	0.39	0.47	0.57	0.53													
Salzburg	0.30	0.41	0.16	0.33	0.45	0.43	0.51	0.60	0.49	0.10												
Setiermark	0.14	0.19	0.17	0.15	0.23	0.21	0.29	0.38	0.71	0.18	0.22											
Käntern	0.15	0.18	0.17	0.16	0.23	0.21	0.29	0.38	0.71	0.19	0.22	0.01										
Tirol/Vorarlberg	0.17	0.23	0.13	0.18	0.27	0.25	0.33	0.42	0.67	0.15	0.18	0.04	0.04									
Böhmen	0.49	0.65	0.30	0.58	0.70	0.68	0.76	0.85	0.24	0.28	0.28	0.46	0.47	0.43								
Mähren	0.29	0.45	0.11	0.37	0.49	0.47	0.55	0.64	0.45	0.10	0.14	0.26	0.26	0.22	0.21							
Schlesien	0.51	0.67	0.35	0.59	0.71	0.69	0.77	0.86	0.29	0.34	0.36	0.48	0.48	0.45	0.08	0.24						
Galizien	0.33	0.18	0.47	0.23	0.13	0.16	0.11	0.12	1.01	0.49	0.52	0.32	0.32	0.34	0.77	0.56	0.79					
Bukowina	0.27	0.12	0.40	0.18	0.09	0.11	0.11	0.15	0.94	0.42	0.45	0.27	0.26	0.28	0.70	0.49	0.73	0.07				
Krain	0.16	0.02	0.36	0.10	0.04	0.03	0.10	0.19	0.90	0.38	0.41	0.19	0.19	0.23	0.66	0.45	0.67	0.17	0.11			
Küstenland	0.27	0.30	0.14	0.28	0.34	0.32	0.40	0.49	0.60	0.15	0.13	0.13	0.12	0.11	0.41	0.25	0.49	0.41	0.34	0.30		
Dalmatien	0.42	0.26	0.62	0.34	0.22	0.24	0.18	0.09	1.16	0.63	0.67	0.45	0.45	0.49	0.91	0.71	0.93	0.14	0.22	0.26	0.56	

Source: my own Krugman index calculations based on statistics from (Statistische Zentralkommission, 1912, Központi-Sztatisztika-Hivatal, 1905)

7.1.7 Krugman Dissimilarity Industries for entire Austria

	1890	1900	1910
Bergbau und Hüttenwesen	0.64835389	0.62883698	0.57448297
Steine und Erden	0.64835389	0.62883698	0.57394792
Metallverarbeitung	0.73015246	0.68726615	0.57394792
Maschinenindustrie	0.70104105	0.65717398	0.59160556
Chemische Industrie	0.87545376	0.82059197	0.79861076
Zentralanlagen	0.97781904	0.96890496	0.92095968
Baugewerbe	0.95546287	1.04430334	1.1284477
Polygraphische Gewerbe	0.890067	0.85582788	0.82810226
Textilindustrie	1.06252298	0.87965287	0.82441487
Papier Industrie	0.73503253	0.71936345	0.71040718
Holz und Schnitzhofe	0.68678584	0.63728909	0.62656286
Nahrungsmittel Getränke	0.81687602	0.75167792	0.70380709
Bekleidung	1.81032918	1.4038386	1.49338502
Zur Industrie gehörige	0.67163693	0.85771395	0.86165353
K	12.2098874	11.5412781	11.2103353

Source: my own Krugman index calculations based on statistics from (Statistische Zentralkommission, 1912)

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