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Have the average wages of the Eurozone countries converged?

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Abstract

This thesis analyses the progression of the average wages of the countries in the Eurozone between 1996 and 2017. The purpose of this study is to examine if the wages in those countries have converged during this period and the impact of adopting the Euro had. To answer that question, data has been collected for every country and expose the progression of the average wages relatively to the Eurozone's average. Furthermore, the thesis employs an econometrical model to conclude if the average wages are statistically different from the Eurozone's average.

With the above process, this paper concludes that there is no significant indication of wage convergence between all countries during the analysed period. However, by omitting Luxembourg, Finland, France, Ireland, Greece and Portugal there are trends of convergence in the remaining countries, both above and below the Eurozone average wage throughout the period. The econometrical model concludes that Finland and France are the only countries whose average wages are not statistically different from the Eurozone average throughout the analysed period. Finally, the adoption of the Euro does not appear to have an impact in terms of wage convergence.

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1 Introduction

This paper tests for wage equalisation on the members of the Eurozone in the period of 1996-2017. In a monetary union every country uses the same currency. In such a scenario, trade among the countries of the union is expected to be greater than if countries used different currencies (Glick & Rose, 2002). All the members of the monetary union are also in the Schengen area[1] which entitles all citizens to travel, work and live in any European Union (EU) member state without being exposed to border checks or special formalities (European Commission, 2019a).

The research made by Samuelson (1948) and Ohlin (1978) concludes that free trade between two countries should lead to factor-price equalisation. This is commonly known as the Heckscher-Ohlin model and has been empirically tested in previous literature related to trade (see section 2.1.1). This paper does not perform such a test, instead it employs the Heckscher-Ohlin model as to why average wages are expected to converge in the Eurozone countries.

We expect to see a convergence towards a similar value in the average wages of all member states due to the policies free movement of labour, free trade and a common currency. The methodology used in the paper enables an examination of the convergence patterns in individual member states rather than only examining the overall average wage convergence. Furthermore, there are several countries interested in joining the EU and later the Eurozone (European Commission, 2019b). This paper aims at providing information for these potential future members, so that they have realistic expectations of the impact of joining the Eurozone in terms of average wages. This paper limits the population to the Eurozone[2] as there has been extensive studies on the EU and other groups of European countries (See section 2.2).

[1] With the exception of Ireland and Cyprus (European Commission, 2019a)

[2] Andorra, Kosovo, Monaco, Montenegro. San Marino and the Vatican City are part of the Eurozone, however they are not part of the European Single Market. As such, these are not considered. (European Commission, 2019d)

1.1 Methodology

In order to assess whether the Eurozone members have been converging towards a similar mean value the study includes different approaches which will strengthen the results. In this paper the average wage data from each member state is transformed into what is addressed as the convergence quotient. This makes it easier to interpret the changes in averages wages, this is further explained in section *3.2 The Convergence Quotient*.

The transformed data is used in visually appealing maps and graphs. The maps will show the differences in average wages between 1996 and 2017, whilst the graphs are used to inspect the convergence process of each country above and below the Eurozone average wage. Lastly, the study presents an econometrical model and analyses its results.

One limitation of the approach is that it takes conclusions and interpretations based on visual results rather than solely econometrical ones. However, this is a value in that it is easier to identify countries with similar trends as well as countries behaving against the assumptions.

We find it important to include a broad range of literature about convergence, both in Europe and elsewhere, since the results are heavily relying on visual representations rather than econometrical results. The graphs and the broad literature included allow for an interesting discussion regarding the wage convergence in Europe. By comparing them to previous findings, this paper can discuss if the different approaches (data, time period and countries included) yielded drastically different results regarding wage convergence. Lastly, some articles are included in the discussion as to why convergence would not occur.

2 Theory & Literature Review

In this section, the study presents previous literature that explains the reasoning as to why trade should result in wage convergence and why being member of a monetary union should accelerate this process. Some of these articles will be further explored and discussed once the results have been presented.

2.1 Trade leading to wage convergence

The Heckscher-Ohlin model can be used to show how trade leads to factor-price equalisation. In this model it is assumed that there are only two countries. Those two countries produce two different goods, food and cloth, for instance. Said goods are produced with two types of inputs: labour and capital-the factors of production. In order to

produce a unit (or a kilogram) of the good, it requires different amounts of the above inputs. A good will require relatively more of a factor of production than the other. That good is referred to as intensive in that factor of production. Similarly, if a country possesses more of a factor of production relative to the other, that country is abundant in that factor (Samuelson, 1948). This is exemplified with the labour-intensive good of cloth and the capital intensive good of food, as well as the labour-abundant country A and the capital-abundant country B. Nevertheless, the Heckscher-Ohlin model has two idealistic assumptions. Firstly, there should be perfect competition and secondly free trade.

The relative abundance of a factor of production leads to a good being relatively more produced than the other. Country A will produce more cloth relative to food than country B since it is abundant in labour. In other words, the supply of cloth is high in A, but it also has a shortage of food. The opposite scenario is true for country B. That being the case, the price of food relative to cloth will be greater in country A than in country B. Assuming that there is no trade between the two countries (autarky). If the two countries open up for trade however, food will flow into country A (as well as cloth will flow into country B) and due to this increase in supply, the relative prices of the goods will be equalised in both countries (Stiglitz, 1970). Due to perfect competition, relative prices are tied to wages. This is a positive occurrence for labourers in country A since the relative price of what they produce has been augmented, so their wages became higher. Conversely, it is also bad tidings for the labourers of country B since what they produce became relatively cheaper. Overall, free trade led to the convergence of wages.

How do the institutions of the EU fit into this? The European single market is what allows for free trade to exist (European Union, 2019a). It lets goods from any European country into the other without tariffs which would stand as a transportation cost or trade barrier. Without the existence of these, one can say that there is free trade in the Eurozone which according to the Heckscher-Ohlin model, will set in motion a factor-price equalisation process.

To corroborate this theory, several studies are presented which argue that trade leads to the equalisation of wages.

2.1.1 Articles Supporting Factor-Price Equalisation

Under the hypothetical scenario of a free-trade agreement between the United States and Mexico, Leamer (1992) analyses the effects of this agreement on the wages of both countries. He describes Mexico as a country that is abundant in low-skill labour and as

such it will export goods that are intensive in that factor of production. This poses a problem to American low-skilled workers, since they cannot compete with the Mexican products in theory.

One of the questions that the author rises has to do with the size of Mexico. Is Mexico big enough to impact the prices of American labour-intensive products and consequently the wages of its workers? The author reaches the conclusion that Mexico will eventually dominate some labour-abundant markets.

Finally, the author speculates about the actual effects of a free-trade agreement between the two countries through the Stolper-Samuelson theorem and the Rybczynski effects. According to him, real wages in the U.S. would decrease for low-skilled workers but increase for high-skilled ones. This effect is accentuated if the real prices are more elastic.

Mokhtari & Rassekh (1989) tested for factor-price convergence in the period of 1961-1984 among OECD members with manufacturing wages. They conclude that wages do indeed converge as trade among countries increases.

2.2 Articles testing wage convergence in Europe

Tovias (1982) found that manufacturing wages were converging for 12 years among the original six countries of the European Economic Community. The trend began towards the end of the 1950s prior to the trade union's creation, but he found a diverging trend after 1968 throughout 1977. Erickson and Kuruvilla (1994) concluded that there was no convergence of wages amongst 12 European countries during the 1980s in the manufacturing industry. When using a longer time period and more extensive data, Doroodian and Jung (2000) found that labour costs were converging among the Netherlands, UK, France, Belgium, Germany, Italy and Denmark in the period of 1961-1991.

Mora, López-Tamayo and Suriñach (2005) found evidence of convergence in the period of 1981-2001 with nominal wages and unit labout cost in the Eurozone, but the results were insignificant regarding real wages and productivity. The convergence of productivity is not something which will be adressed, but as they mention themselves it poses a problem for less wealthy countries joining the eurozone as they no longer can change their exchange rate to compensate for a lacking productivity.They further found that convergence remained more or less the same from 1997 and forward, suggesting that the monetary union have had insignificant effects on convergence.

Egger & Pfeffermayr (2004) analysed this topic from the perspective of outsourcing. As they define it in their paper, outsourcing constitutes the trading of intermediate goods between countries. In their paper they analysed the EU in 1995 (EU-15) and the Central and Eastern European Countries (CEEC)[3]. They distinguished between conditional and unconditional convergence. The former describes a pattern where wages in several countries converge towards a long-term level with a certain factor as its condition whilst the latter stands for a scenario where every country's wages move to a mutual steady state without a particular factor. Regarding convergence, they found no evidence of unconditional convergence, only for conditional convergence where the condition was international outsourcing, in other words, the trade of intermediate goods. As such, the exporting/importing of intermediate goods leads to factor-price equalisation. Naz, Ahmad & Naveed (2017) published an article where they examined wage convergence in the EU. In their study, they define unconditional convergence to be the tendency towards the same steady state regardless of population, growth rates, saving rates, factor endowments and infrastructure. On the other hand, conditional convergence depends on the aforementioned factors. Their results conclude that there is convergence within the borders of a country, however there is no evidence of cross-border convergence. In other words, there is evidence for conditional convergence, but not for unconditional convergence.

Finally, a paper by Head & Mayer (2006) is considered. They check for the home-market effect (an increase in the demand for a home product leading to a more than proportional increase in its production Head & Mayer (2004)) in several EU countries. More relevantly, they investigate the effects of the real market potential on factor prices (wages/rental rates) in the same countries. They introduce the concept of real market power of a region i, RMP_i. Its calculation is given by how easy it is for consumers in region j to reach goods produced in region i. It also takes into account what is the consumption expenditure in region j adjusted for the level of competition in that region. In other words, it measures how well the domestic market reaches a foreign region. According to their findings, wages do interact with RMP. In fact, if RMP_i increases by 10%, wages in i will increase on average by 1.2%. Hence, increasing the real market potential will tend to increase wages. It is also worth mentioning that this adjustment takes on average four years to complete, due to wage rigidity. The most important takeaway is that making it easy for

[3] (Hungary, Slovenia, Czechia, Slovakia & Poland)

domestic products to reach a foreign market helps with the convergence of the factor prices.

2.3 Monetary Union Leading to Higher Trade

Empirically speaking, (Glick & Rose, 2002) found proof of the impact a monetary union has on trade. They used the gravity model to calculate how much each factor that they included affects trade between two countries. Their sample includes 217 countries. According to them, when two countries join a currency union, the trade volume between each other doubles. Furthermore, they also show the opposite: when a country leaves the monetary union, the size of its trade with the countries inside the union falls.

To test if this holds true for the Eurozone, this paper refers to (Faruqee, 2004) who also designed a gravity model. His sample includes only the countries that were in the Eurozone in 2003[4]. According to his study, the adoption of the Euro has boosted the trade between the member countries by 10%. Whilst it is much less than what expected by Glick & Rose (2002) who argued that it would double, it is still a positive relationship between same currency and trade. It is also worth mentioning that Faruqee's study concludes that the rise in trade due to the same currency is increasing and that the 10% that he found was reported fifteen years ago. Assuming that he is correct and that the share of trade among countries in the Eurozone is still rising, it is expected that said share to be much greater by now.

Thus, trade among countries leads to factor-price equalisation and, moreover, a monetary union increases the volume of trade between the countries that are in it. As such the hypothesis is that wages in the Eurozone should converge towards a similar value as the Euro is implemented.

[4] Austria; Belgium; France; Finland; Germany; Ireland; Italy; Netherlands; Portugal; Spain

3 Data

The data was collected from the OECD. It shows the average real wages in the countries that today are members of the Eurozone[5] (See Appendix 4, Table 1). The time period of 1996-2017 was chosen to show how wages flowed before any country adopted the Euro. This date period also allows for an analysis that includes the countries that joined the Euro at a later date, giving the possibility to examine the before and after of every nation as well as two decades of economic activity. Hereinafter, the mention of average wages refers to the average real wages (prices of 2016), rather than the nominal wages.

This data period also allows this paper to see the effects of several occurrences that might have an effect on the Eurozone's average wages. For instance, it was in the first of January of 1999 that the countries that would join the Eurozone[6] in 2002 fixed their exchange rates against each other (European Commission, 2019c). The effects of this policy will be analysed in a later section. It is also worthy of analysis the year on which every country *de facto* joined the Eurozone. Since that year is different for some countries the graphs include a mark to clarify in which year the Euro started flowing into a country.

3.1 Absolute values

This paper mainly refers to the transformed data which is further explained in the next section "The Convergence Quotient". However, to expand the discussion of the transformed data results, some interesting observations regarding the changes of the absolute values in the Eurozone countries are presented. Overall colour changes (See Appendix 4, Table 1) show that the average real wages have been increasing in most countries in the period 1996-2017 as there is a general pattern from dark red (low) towards dark green (high), but after 2009 a few countries experience noticeable decreases of their average wages. The most noticeable outliers between 2010-2017 are Portugal (-1560 USD) and Greece (-5130 USD). The second greatest change in this period belongs to Ireland (-4207 USD) whilst Spain (-1511) and Italy (-1329 USD) have similar values to Portugal.

Regarding the Eurozone's average wages, they steadily increase until 2010. After that year they slightly decrease for two years, which is likely due to the financial crisis of

[5] Except for Malta and Cyprus due to data availability

[6] Austria; Belgium; France; Finland; Germany; Ireland; Italy; Netherlands; Portugal; Spain

2008. After the impact of the crisis dissipates, the average wages continue increasing from 2013 until the end of the analysed period.

3.2 The Convergence Quotient

Beyond the table with the absolute values, another table with the average national wages relative to the Eurozone average is presented (See Appendix 4, Table 2). This number is referred to as the convergence quotient, however, note that the decision of this name relies only on simplicity and convenience rather than on the claim that there is convergence between the average national wages and the Eurozone average.

$$convergence\ quotient = \frac{W_i}{W_{eu}}$$

W_i stands for the average real wage of country i and W_{eu} stands for the average wage of the Eurozone. Thus, if the convergence quotient is less than one, country i has an average wage below the Eurozone's average. The opposite is true if the quotient is greater than one. According to the hypothesis, this paper expects to see the countries' convergence quotient approaching the value of one.

4 Results

4.1 The Eurozone in 1996

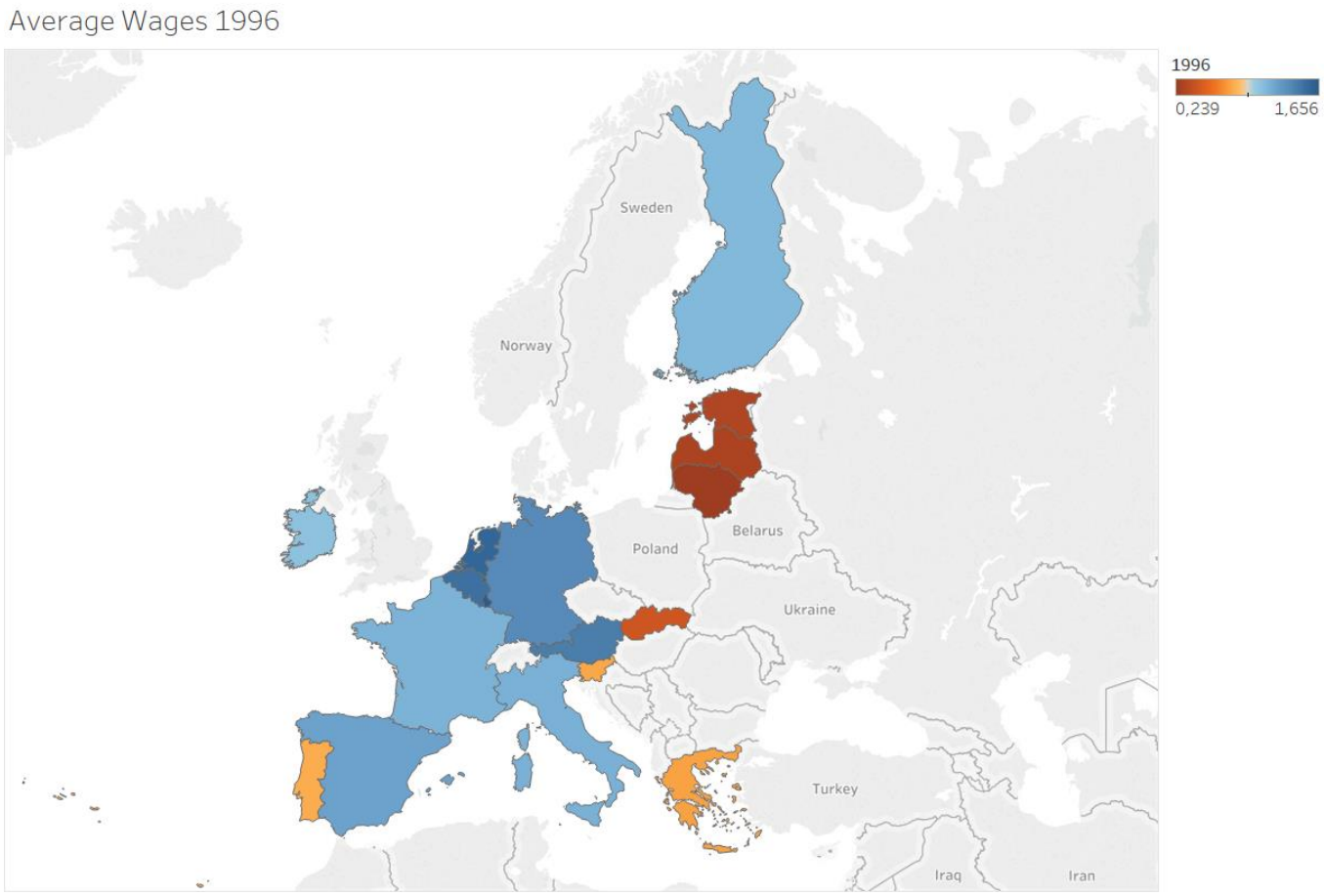

Figure 1: The convergence quotient of the countries in the Eurozone in 1996.
Source: The author's processing the data from OECD (2019)

We begin by assessing the situation at the beginning of the analysed period. Figure 1 shows the convergence quotient in 1996 for every country that is analysed. This was three years before the countries that would join the Eurozone in 2002 fixed their currencies (European Commission, 2019c). As such, in 1996, most countries had their own currency floating against each other. Furthermore, it is important to remember that not every country mapped was in the EU by this date[7].

[7] Slovenia; Slovakia; Lithuania; Latvia; Estonia would only join the European Union in 2004

In the beginning of the period that is analysed, the Benelux[8] region distinguishes itself by showing the highest wages relatively to the Eurozone's average. Austria and Germany follow next with wages closer to the average. Even closer there is Spain, France, Italy, Finland and, the closest, Ireland. All these countries were already in the EU by this date. It is also worth mentioning that every founding member[9] of the European Communities[10] is above the Eurozone's average in 1996. Geographically speaking, the countries of Western Europe have wages above the average, the outliers being Portugal, whose average wage is below the Eurozone's average, and Finland, which has the opposite scenario.

Below the Eurozone's average the situation is more diverse. Greece and Portugal are countries that, just like the countries that are above the Eurozone average, were already in the EU before 1996 (European Union, 2019b). Slovenia had just declared independence five years ago (Government of the Republic of Slovenia, 2019). Not only was it a new country but it was also still shifting from a communist economy to a market economy. Despite these challenges, its wages are on par with Portugal and Greece. The rest of the countries in this group are countries that were in the eastern bloc during the Cold War. They were either satellite states[11] (Encyclopaedia Britannica, 2019a) of, or republics[12] (Encyclopaedia Britannica, 2019b) in the Soviet Union (Encyclopaedia Britannica, 2019a). Although with a small difference, Slovakia's wages were closer to the Eurozone's average than the Baltic countries' which have roughly the same value.

4.2 The Convergence Quotient throughout the years

To better visualise the information provided by the Convergence Quotient, the data is plotted on a line diagram. For better digestion, the countries are separated into three groups: the countries that had average wages below the Eurozone average in 1996; the countries that were above the average and whose convergence quotient tended towards the Eurozone average. The final graph includes countries that do not fall in either category. The graphs that follow show the convergence quotient for every country throughout the

[8] Belgium, the Netherlands & Luxembourg

[9] The Netherlands; Belgium; Luxembourg; France; West Germany; Italy

[10] European Coal and Steel Community; European Atomic Energy Community; European Economic Community

[11] Slovakia (as Czekoslovakia)

[12] Estonia; Latvia; Lithuania

years. They also include the Eurozone average represented by the red line. Further will the first graph (the plot of the countries below the Eurozone's average) include a mark to point out in which year did that country adopt the Euro as well as, if applicable, when did it join the EU. If no mark representing the entry to the EU is included it means that the country was already part of the union before the considered period. Lastly, these marks or notations are omitted in the second and third graphs since all the countries that have an average wage above the Eurozone's average were all part of the EU before 1996 and all adopted the Euro as their currency in 2002. Thus, the marks do not add any value and risk making the graph messier.

4.3 Countries below the Eurozone's Average

Figure 2 illustrates that the countries that had average wages below the Eurozone's average have, in general, their wages increasing, however they also seem to tend towards 0,65. The countries that are exceptions to this are Greece and Portugal, whose convergence quotient has, in fact, diverged from the value of one. Slovenia is the country that shows wages closest to the Eurozone mean and Latvia is the country that remains farther away from an average wage equal to the one from the Eurozone. In 1996 two groups of countries can be distinguished: those that have a convergence quotient around 0.8 and those that have it below 0.5.

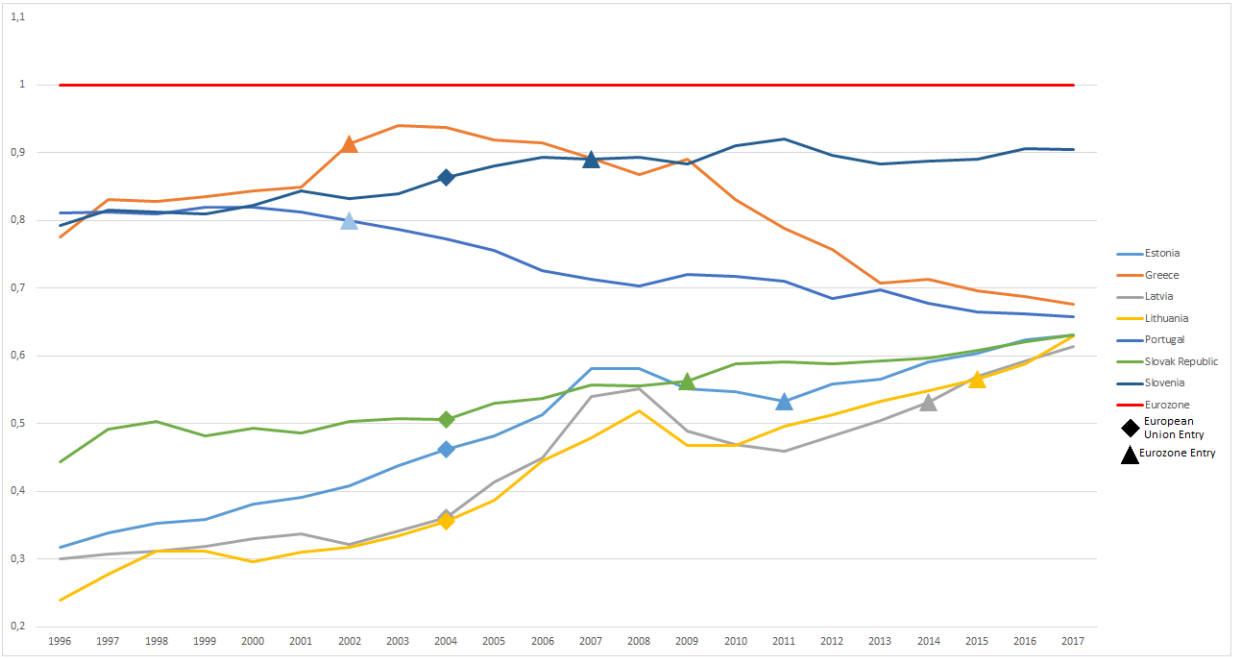

Figure 2: Evolution of the convergence quotient for the years 1996-2017 for the countries that were below the average in 1996.

Source: The author's processing the data from OECD (2019)

The first group is composed by Greece, Portugal and Slovenia. These countries are distinguished from the others since they have a higher convergence quotient in 1996, but also a slower convergence. Out of these nations, Portugal is the one that has the lowest convergence speed. In fact, between 1999 and 2002, the period in which it the Portuguese Escudo had a fixed exchange rate with the other European currencies (as mentioned in the data section), is when the Portuguese convergence quotient starts to diverge from the other two countries in this initial group. Greece had a "bumpier" evolution. In 2002, when the Euro is introduced in Greece, the convergence quotient increases substantially to 0.9128 which indicates that Greek wages are just 8.71% less than the Eurozone's average. This convergence, however, slows down and after two years a process of divergence initiates. This process will continue for the rest of the analysed period and will be exacerbated by the 2008 financial crisis. Greece is harshly impacted by said crisis in 2009 as seen by their public debt as a percentage of the GDP going from 109.4% in 2009 to 172.1% two years after (Country Economy, 2019). As such their averages wages also fall relatively to the Eurozone. The fall will slow down after four years (in 2013), but they will not recover from it before the analysed period is over. Unlike the other two countries in this group, Slovenia's convergence quotient never falters. Rather, the year in which they join the EU, their wages slightly increase relatively to the Eurozone. On the other hand, adopting the

Euro does not seem to have had any impact on the convergence quotient which, in 2012 stagnates at around 0.9. Possible reasons for these patterns are

The second group starts below a score of 0.5. These countries have in common that they are former communist states that switched into market economies in the nineties (Encyclopaedia Britannica, 2019a) (Encyclopaedia Britannica, 2019b). Unlike the countries on the first group that begin with a similar convergence quotient, the countries on this group have values that are more separated and range from 0.24 (Lithuania) to 0.44 (Slovakia). In this group Slovakia had the highest wages relatively to the Eurozone and their evolution is rather linear. Their average wages slowly increase and tend towards the value of 0.65. Their wages seem to be unaffected by the 2008 financial crisis. The Baltic countries (Estonia, Latvia and Lithuania) have a similar convergence process. However, Estonia stands out as they have the highest wages (relatively to the Eurozone) of the three countries for every year in the considered period. The second country by convergence quotient (out of these three) alternates between Latvia and Lithuania throughout the years. Neither of the two has decisively a higher score. As mentioned all three countries have a similar process so they will be analysed together. All three countries' convergence quotient grows at a pace higher than any other country that has an average wage below the Eurozone's average. The pace is accelerated in 2002 for Estonia and 2004 (the year when they gained membership in the EU (European Union, 2019b)) for Latvia and Lithuania. This growth is accelerated in 2006 for all three countries. In 2009 the three countries' growth stagnates until 2011. This stagnation might be related to the financial crisis of 2008. After 2011 the Baltic states' wages continue to increase. Notably, Estonia entered the Eurozone in that year (European Commission, 2019c). However, it cannot be claimed that it was the adoption of the Euro that led to the increase in the convergence quotient because Latvia and Lithuania had a similar pattern and only joined the Eurozone years later. Instead it could have been gravity factors, like distance to trading partners and the size of their economies that are aiding trade in the Baltic countries (Bergstrand, 1989). As the years near 2017, Latvia and Lithuania's convergence quotient get closer to Estonia's and in the final year, Estonia no longer has average wages notably higher than the other two nations.

Figure 2 shows an interesting pattern. Aside from Slovenia which keeps approaching the Eurozone's average wage, the remaining countries seem to converge to 0.65. Portugal and Greece from above and the Baltic countries and Slovakia from below.

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4.4 Countries above the Eurozone's Average

The countries with a convergence quotient above the Eurozone average can be divided into two groups. The first group shows signs of convergence as the value has a significant decrease between 1996 and 2017 (Figure 3). Belgium, the Netherlands and Austria have a similar trend of steadily converging average wages. We can tie this similar progress between Belgium and the Netherlands by applying gravity theory. These countries have the same language and share a border, meaning that they are going to trade more (Fratianni, 2007), thus their wages converge together as predicted by the Heckscher-Ohlin model. Germany follows the same trend until 2010 where it starts to diverge, but the value in 2017 is still lower than that of 1996. Despite the fact that Germany and Austria have a common language, which according to Fratianni (2007) should lead to a higher volume of trade between the two countries (and thus converging prices and wages), we do not see an approximation of the wages of the German speaking countries. The two countries with the lowest values in 1996, Spain and Italy, also have steadily converging trends towards the Eurozone average.

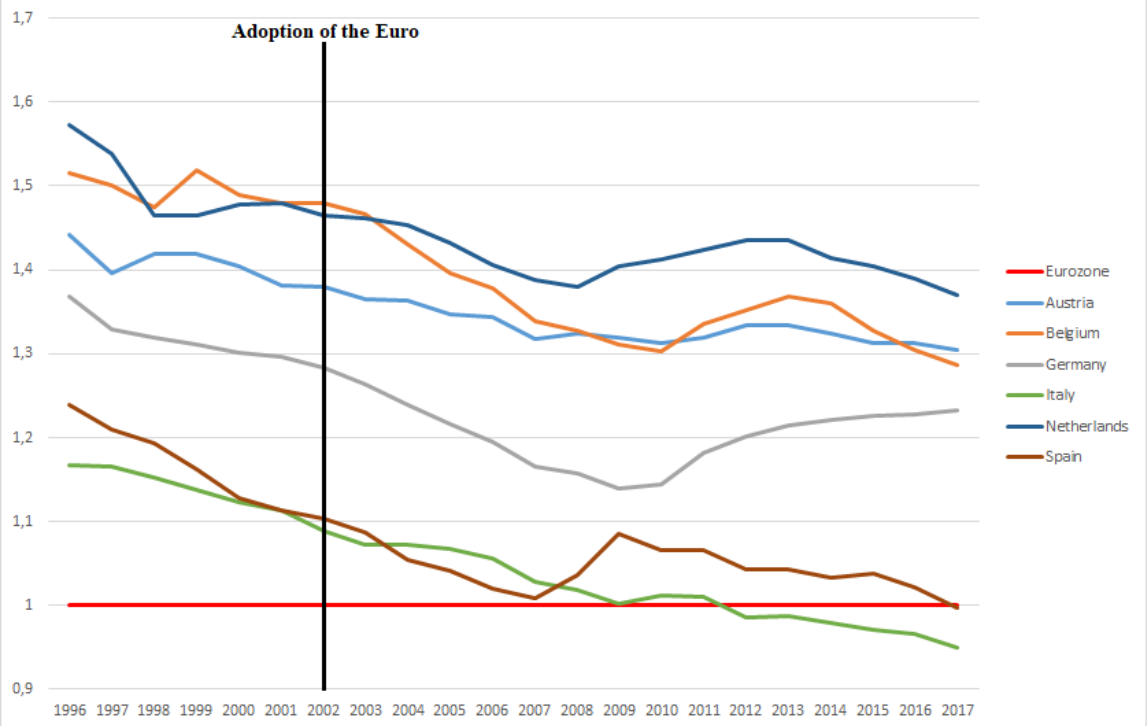

Figure 3. Evolution of the convergence quotient for the years 1996-2017 for the countries that were above the average in 1996 with a significantly decreasing value.
Source: The author's processing the data from OECD (2019)

Spain has a diverging trend between 2007 and 2009, but, after that, it continues to converge until 2017 to a value once again of the Eurozone average. Unlike the other converging countries, Spain's convergence 1996-2006 can be traced to the decreasing average real wages 1996-2006 (See Appendix 4, Table 1).

As Italian wages decrease and reach the Eurozone average in 2008, they have a 2-year period of stagnation, and continue to decrease, even going below the Eurozone average afterwards. Just as for Spain, the average real wages had a big impact on the convergence quotient. After 2010 the pattern of the average real wages in Italy does not follow the pattern of the most other countries (other countries have general pattern of increasing wages).

It is tempting to suggest that reaching the Eurozone average causes divergence, but as figure 3 shows, there are several countries diverging in the period 2007-2012. Germany continues to diverge even after this period is over. As seen from Italy and Spain whose wages go below the average, there is an interesting question: what will happen once a country reaches the Eurozone average. Will it continue to tend below the threshold, or will it fluctuate?

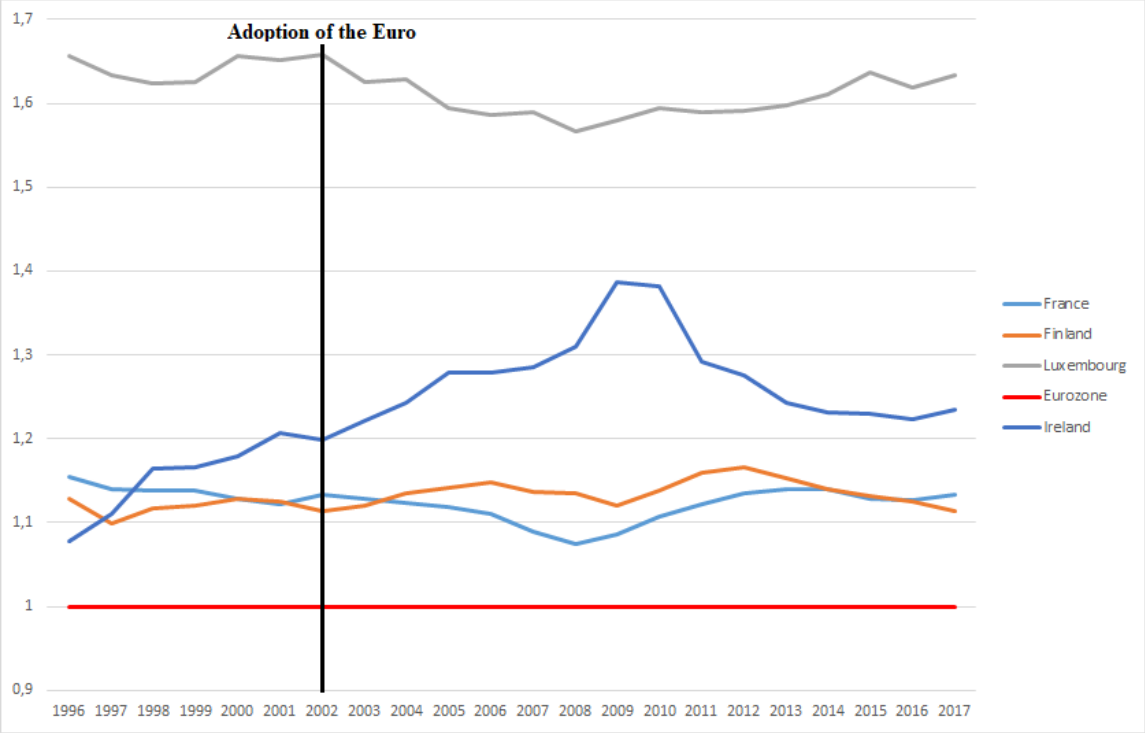

Figure 4. Evolution of the convergence quotient for the years 1996-2017 for the countries that were above the average in 1996 with a significantly stable or increasing value.

Source: The author's processing the data from OECD (2019)

The second group consists of the countries above the Eurozone average that are not showing significant signs of convergence (Figure 4). Luxembourg, France and Finland all have relatively unchanged values in the period which is measured. Similar to the first group there are some signs of divergence after 2007, but the 1996 value and 2017 remain relatively unchanged. Ireland is the big outlier among the countries above the Eurozone average since there is a clear trend of divergence until 2009. The convergence starting after 2009 is due to the decreasing average real wages in Ireland which was previously mentioned.

4.5 The Eurozone in 2017

To finalise the analysis of the data, a heat-map of the last year of the analysed period is presented in figure 5.

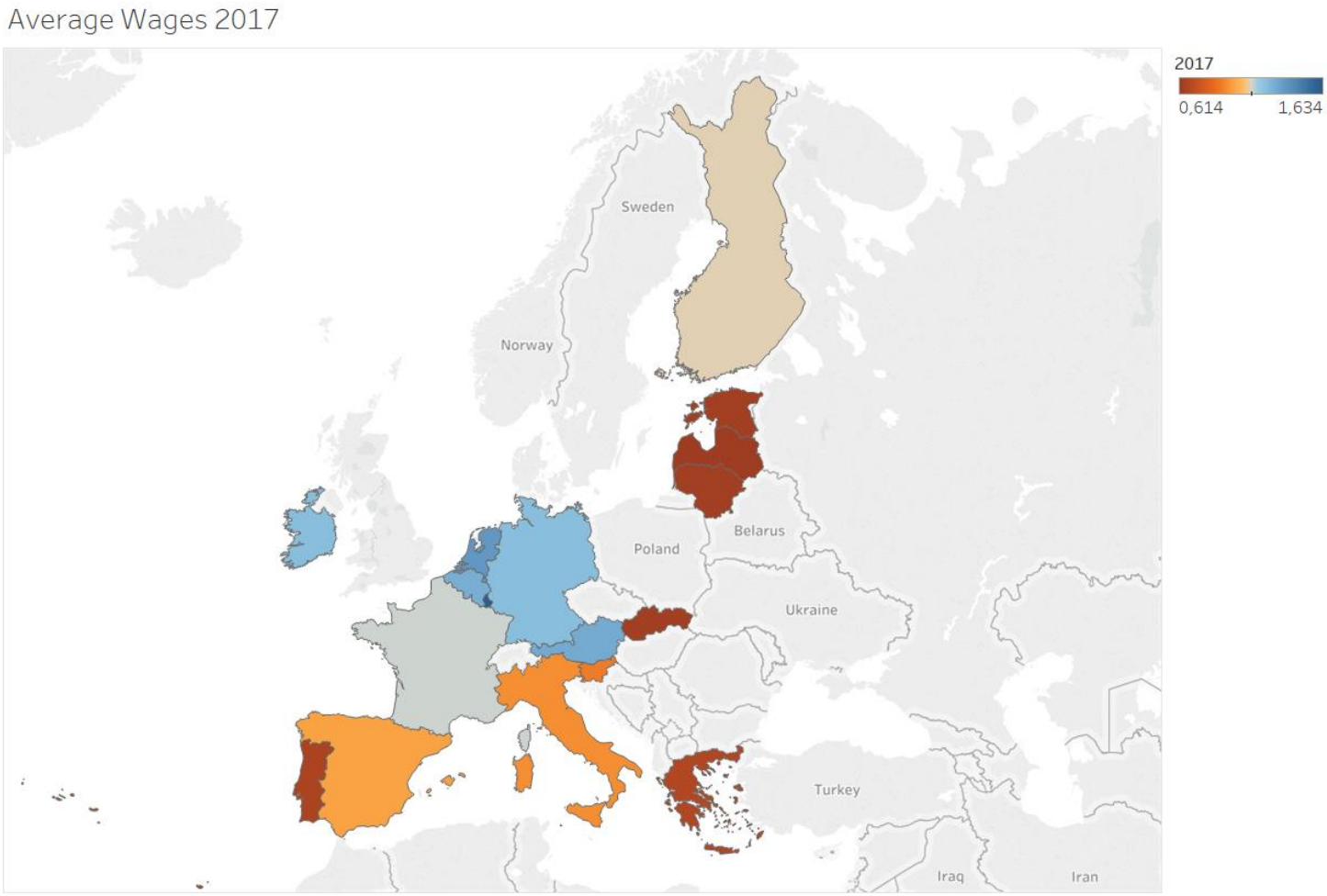

Figure 5: The convergence quotient of the countries in the Eurozone in 2017.
Source: The author's processing the data from OECD (2019)

In 2017, there is a bigger difference between the countries that were above the average in 1996. Whilst the Benelux, Germany, Austria are still notably above the average, the other countries whose convergence quotient was closer to the value of one in 1996[13] are even closer to it (Ireland being the exception since it shows a convergence quotient similar to Germany). Furthermore, Spain and Italy have crossed the line and have, in 2017, wages below the Eurozone's average.

The countries which were below the average in 1996 remain below it. In fact, both Greece and Portugal have distanced themselves from a convergence quotient of one and have, in 2017, values closer to the others that were below the line in 1996. Slovenia, on the other hand, whilst not surpassing the value of one, it distances itself from said countries and shows a quotient similar to the Italian or the Spanish.

4.6 Econometric Analysis

After extracting the above information from the graphs and charts, to get a more statistical interpretation of the data, it is regressed on the convergence quotient. A significance level of 0.05 is used for the tests. Lastly, the following expression is used:

$$CQ_i = \beta_0 + D_i\beta_i$$

The dependent variable CQ_i stands for the convergence quotient of country i, D_i is a dummy variable that adopts the value of 1 when considering each respective country. In order not to fall in the dummy variable trap, the country of Finland is dropped. This decision falls upon the reason that Finland is the country that is steadily closest to the Eurozone's average. The coefficients (β_i) shows how statistically close the countries' convergence quotients are to the dropped country. An extensive version of the regression above can be observed in the appendix (See Appendix 1, Equation 1). In a later section, Finland's convergence quotient is tested if significantly different from the value of one, that is to say, the Eurozone's average. In the case that a coefficient is statistically insignificant (if the p-value is greater than the significance level of 0.05) will conclude that the convergence quotient of the country it represents is statistically the same as Finland. Thus, the average wage of the country it represents will be statistically close to the base country (Finland) and, depending on the result of the test, to the Eurozone's Average. In

[13] France; Finland; Spain; Ireland and Italy

other words, that country has converged to the Eurozone's average. Running the aforementioned regression gives the following output:

Table 3: Descriptive statistics analysis of results

Country	Number of observations	Coefficient	Minimum	Mean	Maximum	Std. Error	p-value
Finland (c)	22	1.131743	1,099613	1,131743	1,166865	0.014698	0.0000
Austria	22	0.221936	1,304611	1,353679	1,442667	0.020786	0.0000
Belgium	22	0.265766	1,287147	1,397510	1,519608	0.020786	0.0000
Estonia	22	-0.640580	0,316726	0,491163	0,630579	0.020786	0.0000
France	22	-0.008060	1,074083	1,123684	1,154777	0.020786	0.6984
Germany	22	0.106389	1,139897	1,238133	1,368350	0.020786	0.0000
Greece	22	-0.309561	0,675354	0,822182	0,939958	0.020786	0.0000
Ireland	22	0.105487	1,077646	1,237230	1,387600	0.020786	0.0000
Italy	22	-0.080453	0,949858	1,051291	1,166566	0.020786	0.0001
Latvia	22	-0.695667	0,300584	0,436077	0,613659	0.020786	0.0000
Lithuania	22	-0.704965	0,239194	0,426779	0,629309	0.020786	0.0000
Luxembourg	22	0.484296	1,567374	1,616039	1,658031	0.020786	0.0000
Netherlands	22	0.307984	1,370115	1,439728	1,572981	0.020786	0.0000
Portugal	22	-0.389488	0,657293	0,742256	0,819499	0.020786	0.0000
Slovakia	22	-0.587656	0,442720	0,544088	0,630371	0.020786	0.0000
Slovenia	22	-0.264889	0,792000	0,866855	0,920535	0.020786	0.0000
Spain	22	-0.050179	0,997769	1,081564	1,238706	0.020786	0.0163

Firstly, a t-test is performed to see if Finland's convergence quotient is significantly different from the Eurozone's average. These are the null and alternative hypothesis:

H_0: $\beta_0=1$

H_1: $\beta_0\neq1$

If the null hypothesis is correct, Finland's convergence quotient is not significantly different from the Eurozone's average. If such is true, this paper will be able to take conclusions regarding the proximity of a country's convergence quotient to the monetary union's average. Otherwise, this paper will have to limit the analysis to relating every country's coefficient to Finland.

Firstly, the t value is calculated (See Appendix 3). It has the value of 1,09. With 22 observation, and a level of significance of 5% (or 2,5% since the test is double tailed), the critical value is approximately 2,07. The null hypothesis is accepted since 2,07>1,09. Concluding that Finland's convergence quotient is not statistically different from the Eurozone's average, as such this paper is able to make inferences and compare every country's wage to the Eurozone's average, rather than to Finland.

Table 3 shows how far away the average wages of each country are from the Eurozone average for the analysed period. To interpret table 3, the country's coefficient is considered. The coefficient shown is, on average, how far the convergence quotient is from the monetary union's average. For instance, Germany has a coefficient of 0,11, so it has, on average and throughout the analysed period, a convergence quotient higher than the mean of the monetary union by 0,11. Similarly, Spain has a coefficient of -0,05. This means that Spain has a convergence quotient lower than the Eurozone by 0.05. The country that is the furthest from the base country is Lithuania whose convergence quotient is 0,70 less than the mean on average.

France is the only country whose coefficient is not significantly different from zero. This concludes that Finland and France are the only countries whose average wages are not statistically different from the Eurozone average throughout the analysed period. This corroborates the graphical analysis since these two countries have a convergence quotient that does not vary and is close to the value of one.

5 Discussion

5.1 Results and previous literature

One must be careful when making direct comparisons between the results of previous literature and what is presented in this paper. The differences in wage data, countries included and time periods limits how well the different conclusions can be compared next to each other. However, the different conclusions of wage convergence offer an interesting discussion once the methods are acknowledged as well.

Mora et al. (2005) did find convergence between the Eurozone countries (omitting Estonia, Latvia, Lithuania, Luxembourg, Slovakia, Slovenia) between 1981-2001 in nominal wages[14] and unit labour costs. However, like the results there was no significant signs of convergence in real wages. The results include several more years since the euro had been established, as well as more countries who joined the monetary union at a later date, but like Mora et al. (2005), the results in this paper show no significant impact of the common currency on wage convergence.

[14] When performing this analysis using nominal wages, we see a pattern that is similar to the real wages'. However, Irish wages increase at a higher rate until 2007, they then remain constant for three years and in 2011 they start to decline. All other countries have the same pattern with no notable differences.

Naz et al. (2017) did not either find significant evidence of cross-border convergence of average wages in the EU between 1996-2006, but did find evidence of convergence within the separate countries. Their results are like those of Egger & Pfeffermayr (2004) who used manufacturing industry-level data between EU-15 and CEEC[15] between 1993-2000.

The other studies use manufacturing wages and have similar trends of inconclusive or insignificant convergence. Tovias' (1982) results of a period of convergence followed by a period of divergence are especially interesting since, as he mentions himself, full trade liberalisation was achieved among the six members in July 1968 and the divergence begins after that year. The original six are Belgium, France, Italy, Luxembourg, Netherlands and West Germany.

Erickson & Kuruvilla (1994) included Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom. Compared to the research in this paper some countries were omitted while this paper does not include Denmark or United Kingdom. In their paper they mention that between 1977-1990 all countries experienced increases in compensation cost in the manufacturing industry except Spain and Italy. Furthermore in 1980 Portugal, Italy, Greece and Ireland were the countries with lowest compensation costs while Germany and Benelux had the highest ones. This is interesting since these are still the defined high wage and low wage countries. They did see a pattern of convergence, especially when Germany, Denmark and UK were compared with Portugal, Greece and Spain. This is interesting since another study has a similar result to us, that the low-wage countries of Portugal, Greece and Spain are not showing signs of convergence when measured in a different time period.

Previous literature struggles to find support of wage convergence among European countries. The one article that found wages (manufacturing) to be converging was Doroodian & Jung (2004) who measured a time period covering those of Tovias (1982) and Erickson & Kuruvilla (1994). By covering that time period, they omitted some countries (Portugal, Greece and Spain) which were critical in the conclusions Erickson & Kuruvilla made in 1994. Measuring the wage convergence over time in the EU becomes complex as countries joined at different points of time, this is one more reason why the results may differ, and one must be careful when comparing them. However, these older studies combined with those of Mora et al. (2005), Naz et al. (2017) and Egger &

[15] Hungary, Czechia, Slovakia & Poland

Pfeffermayr (2004) further support the results in this paper of no cross-border wage convergence when many European countries are included.

5.2 Why would not there be convergence?

So far, this paper has argued that, through the Heckscher-Ohlin model, trade leads to factor-price equalisation and that the common currency should accelerate this process since same-currency countries trade more with each other. In this section it is explained why wages would not converge despite the theories which are used.

Firstly, the assumption of perfect competition in the Heckscher-Ohlin model does not occur. In fact, Badinger (2007) shows that, whilst the mark-up of the building sector has been decreasing since the eighties, the mark-up for the services sector is on an increasing path (Badinger, 2007). Badinger highlights this as a problem since "[The services sector] accounts for some 70% of gross domestic product (GDP) and employment in most EU Member States" (Badinger, 2007). This infringement of one of the assumptions might have led this paper to the wrong conclusion once applied into practice.

Secondly, according to Walsh (2006), the most important factor to trade of services between two countries is the size of their economy (GDP) and a common language. He also denotes that being part of the EU does not increase the trade of services. This is a problem for the argument since this paper claims that the common currency should impulse trade between countries and whilst that is not false, it seems to affect mostly the trade of goods rather than of services. Because the services sector is the biggest sector of activity in the EU (Eurostat, 2018) and the trade of services is not occurring among the countries of the union there is no convergence of the salaries of the workers of the services sector. In order to keep our argument, the wages of the workers of the services sector would have to be separated from the wages of the workers of the goods sector and then conduct our analysis only on the latter.

5.3 Future Research

As mentioned in the "why would not there be convergence?" section, the reason for which there is no convergence might be due to the fact that services are not being traded enough and membership in the EU is not contributing to their trade. For future research, separating the wages of workers in the goods sector from the workers of the services sector would be recommended. This way, one could apply the theory on the salaries of services

and diagnose if there is convergence in the wages paid to those workers across the Eurozone.

Furthermore, further research could compare countries with similar trends and find the most important factor of it, other than free trade, rather than researching the overall impact of the Eurozone or EU. Such countries could be the Baltics, Slovakia, Greece and Portugal which seems to be converging towards a similar value below the Eurozone average, of course that could also just be a coincidence. However, if the countries are not converging towards the same average it might be because they are not as integrated in the internal market, and more integrated amongst themselves. Further research could look at if there are in fact different convergence levels among different groups of countries in the EU.

One further point is to include in one's analysis the countries that are not in the European Single Market[16], but that use the Euro as their currency and/or the opposite scenario (countries that are not in the Eurozone, but are in the European Single Market[17]). The objective is to isolate the two variables (the monetary union and the free trade agreement) to see which has a higher impact on wage convergence, or if they even lead to wage equalisation.

Finally, this thesis analyses how real wages progressed throughout the past two decades. It would be valuable to improve it by addressing the reason for which the wages flowed as they did, but especially for the countries that "go against the current" like Greece and Portugal whose wages grow farther way from the Eurozone mean.

6 Conclusion

The purpose of this paper was to test if the average wages in the Eurozone were converging towards the average between 1996 and 2017 due to factor-price equalisation and furthermore if the monetary union was an accelerating factor of this process.

This paper concludes that there is no significant indication of wage convergence between all countries during the analysed period, 1996-2017. However, by omitting Luxembourg, Finland, France, Ireland, Greece and Portugal there are trends of

[16] Andorra, Monaco, San Marino, Vatican City, Montenegro, Kosovo (European Commission, 2019d) (Government UK, 2019)

[17] Bulgaria, Croatia, Czechia, Denmark, Iceland, Hungary, Liechtenstein, Norway, Poland, Romania, Sweden, Switzerland, United Kingdom (Government UK, 2019)

convergence in the remaining countries, both above and below the Eurozone average wage throughout the period. The econometrical model concludes that Finland and France are the only countries whose average wages are not statistically different from the Eurozone average throughout the analysed period. This concludes that they neither converged or diverged, but remained at the Eurozone average. Luxembourg have a similar trend to France and Finland, but with average wages much higher than the Eurozone. Greece and Portugal were the only countries below the average that diverged.

The 2008 financial crisis decreased the average wages Ireland, Spain, Italy, Greece and Portugal notably more than the other countries. Further research could look at why other countries are not experiencing a decreasing trend of average wages after 2008, and what policies that might hinder such exposure of average wages.

Previous literature examining wage convergence in either Europe or the Eurozone have found similar results of no cross-border convergence. The exceptions that found signs of convergence in other literature tended to exclude several low-wage countries.

Finally, there are no clear signs of an accelerated process of convergence as the Euro is introduced in each country even when looking at the patterns of the graph 15 years after the monetary union was established in 2002. Neither could a pattern be observed among the newer members adopting the Euro after 2002.

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8 Appendix

8.1 Appendix 1: Non-simplified regression

Equation 1

$$CQ_i = \beta_0 + D_1\beta_1 + D_2\beta_2 + D_2\beta_2 + D_3\beta_3 + D_5\beta_5 + D_6\beta_6 + D_7\beta_7 + D_8\beta_8 + D_9\beta_9 + D_{10}\beta_{10} + D_{10}\beta_{10} + D_{11}\beta_{11} + D_{12}\beta_{12} + D_{13}\beta_{13} + D_{14}\beta_{14} + D_{15}\beta_{15} + D_{16}\beta_{16} + D_{17}\beta_{17} + \varepsilon_i$$

Where every country analysed is assigned a number (See appendix 2)

8.2 Appendix 2: Country-number correspondence

Number	Country
1	Austria
2	Belgium
3	Estonia
4	Finland
5	France
6	Germany
7	Greece
8	Ireland
9	Italy
10	Latvia
11	Lithuania
12	Luxembourg
13	Netherlands
14	Portugal
15	Slovakia
16	Slovenia
17	Spain

8.3 Appendix 3: Calculation of the t-value

Given the formula $t = \frac{\hat{\beta}_j - \beta_j}{\sqrt{se(\hat{\beta}_j)}}$

$\hat{\beta}_j$ stands for the coefficient estimated, $\hat{\beta}_j$ is the value for β that is tested, and $se(\beta_j)$ is the estimated standard error of $\hat{\beta}_j$.

Applying the formula: $t = \frac{1{,}131743 - 1}{\sqrt{0{,}014698}}$

We obtain the value of 1,086672.

8.4 Appendix 4

Table 1. Yearly Average Wages among Eurozone Countries between 1996-2017 (Total USD, 2016 as base year)

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Difference *
Luxembou	49447	49962	50491	51643	53337	53878	54941	54591	55827	55564	56294	57771	57660	59255	59860	58817	58486	58813	59928	61975	62091	63062	3202
Netherlan	46967	47057	45529	46516	47596	48232	48535	49060	49776	49939	49899	50457	50757	52734	53023	52668	52781	52808	52602	53171	53295	52877	-146
Belgium	45265	45900	45822	48270	47950	48222	49036	49231	48990	48688	48890	48659	48809	49227	48941	49382	49715	50363	50583	50259	50041	49675	734
Austria	43076	42715	44093	45060	45188	45069	45733	45855	46723	46963	47654	47895	48740	49521	49316	48809	49047	49120	49299	49695	50330	50349	1033
Germany	40857	40632	41025	41673	41873	42291	42513	42457	42454	42380	42415	42342	42610	42779	42970	43703	44202	44736	45421	46409	47097	47585	4615
Spain	36986	37010	37077	36945	36327	36320	36588	36489	36112	36322	36185	36659	38134	40717	40018	39451	38328	38416	38422	39339	39196	38507	-1511
Italy	34832	35661	35825	36161	36134	36313	36067	36029	36765	37181	37438	37401	37442	37627	37987	37394	36267	36324	36461	36770	37033	36658	-1329
France	34480	34866	35392	36152	36341	36593	37583	37899	38520	38983	39413	39578	39513	40732	41548	41472	41759	41986	42403	42731	43221	43755	2207
Finland	33713	33623	34722	35588	36308	36709	36917	37628	38886	39782	40707	41327	41728	42065	42725	42872	42902	42441	42425	42885	43139	42964	239
Ireland	32177	33942	36202	37031	37986	39347	39705	41043	42572	44557	45340	46734	48171	52075	51860	47806	46905	45735	45828	46561	46932	47653	-4207
Eurozone	29859	30577	31078	31765	32194	32608	33136	33581	34264	34853	35473	36349	36788	37529	37547	36986	36767	36806	37207	37874	38343	38593	1046
Portugal	24219	24852	25166	26021	26383	26498	26485	26416	26462	26310	25740	25921	25837	27031	26927	26287	25151	25668	25217	25164	25362	25367	-1560
Slovenia	23648	24930	25258	25727	26448	27513	27596	28176	29572	30689	31678	32368	32856	33166	34189	34047	32965	32506	33045	33699	34732	34933	744
Greece	23136	25413	25741	26527	27133	27682	30249	31565	32132	32034	32418	32411	31922	33423	31194	29149	27826	26026	26532	26336	26330	26064	-5130
Slovakia	13219	15020	15629	15300	15861	15850	16683	17046	17327	18451	19063	20235	20436	21125	22055	21859	21618	21782	22204	23026	23801	24328	2273
Estonia	9457	10346	10968	11389	12248	12727	13500	14719	15820	16771	18191	21125	21396	20673	20561	19715	20532	20824	21971	22840	23935	24336	3775
Latvia	8975	9392	9687	10098	10642	11002	10654	11446	12394	14425	15923	19642	20292	18321	17601	16988	17699	18546	19783	21587	22726	23683	6082
Lithuania	7142	8490	9693	9900	9544	10091	10532	11232	12157	13469	15788	17403	19087	17519	17530	18345	18854	19608	20393	21417	22562	24287	6757

Notes: The colour changes represent the changes within each country 1996-2017. The scale is dark red (lowest) to dark green (highest).

*Difference after 2017 value has been subtracted from 2010 value. The colour scale is relative to the column.

Data from OECD (2019)

Table 2: The convergence quotient of the countries of the Eurozone during 1996-2017

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Luxembourg	1,6560	1,6340	1,6247	1,6258	1,6567	1,6523	1,6580	1,6256	1,6293	1,5942	1,5870	1,5894	1,5674	1,5789	1,5943	1,5902	1,5907	1,5979	1,6107	1,6363	1,6194	1,6340
Netherlands	1,5730	1,5390	1,4650	1,4644	1,4784	1,4791	1,4647	1,4609	1,4527	1,4328	1,4067	1,3881	1,3797	1,4052	1,4122	1,4240	1,4356	1,4348	1,4138	1,4039	1,3900	1,3701
Belgium	1,5160	1,5011	1,4744	1,5196	1,4894	1,4788	1,4798	1,4660	1,4298	1,3969	1,3782	1,3387	1,3268	1,3117	1,3034	1,3351	1,3522	1,3683	1,3595	1,3270	1,3051	1,2871
Austria	1,4427	1,3970	1,4188	1,4186	1,4036	1,3821	1,3801	1,3655	1,3636	1,3474	1,3434	1,3177	1,3249	1,3195	1,3134	1,3197	1,3340	1,3346	1,3250	1,3121	1,3126	1,3046
Germany	1,3684	1,3288	1,3201	1,3119	1,3006	1,2969	1,2830	1,2643	1,2390	1,2159	1,1957	1,1649	1,1583	1,1399	1,1444	1,1816	1,2022	1,2155	1,2208	1,2253	1,2283	1,2330
Spain	1,2387	1,2104	1,1930	1,1631	1,1284	1,1138	1,1042	1,0866	1,0539	1,0421	1,0201	1,0085	1,0366	1,0850	1,0658	1,0666	1,0425	1,0437	1,0327	1,0387	1,0223	0,9978
Italy	1,1666	1,1663	1,1528	1,1384	1,1224	1,1136	1,0884	1,0729	1,0730	1,0668	1,0554	1,0289	1,0178	1,0026	1,0117	1,0110	0,9864	0,9869	0,9800	0,9708	0,9658	0,9499
France	1,1548	1,1403	1,1388	1,1381	1,1288	1,1222	1,1342	1,1286	1,1242	1,1185	1,1111	1,0888	1,0741	1,0854	1,1065	1,1213	1,1358	1,1407	1,1397	1,1282	1,1272	1,1338
Finland	1,1291	1,0996	1,1173	1,1204	1,1278	1,1258	1,1141	1,1205	1,1349	1,1414	1,1476	1,1370	1,1343	1,1209	1,1379	1,1591	1,1669	1,1531	1,1402	1,1323	1,1251	1,1133
Ireland	1,0776	1,1100	1,1649	1,1658	1,1799	1,2067	1,1982	1,2222	1,2425	1,2784	1,2782	1,2857	1,3094	1,3876	1,3812	1,2925	1,2757	1,2426	1,2317	1,2294	1,2240	1,2348
Eurozone	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Portugal	0,8111	0,8128	0,8098	0,8192	0,8195	0,8126	0,7993	0,7866	0,7723	0,7549	0,7256	0,7131	0,7023	0,7203	0,7171	0,7107	0,6841	0,6974	0,6778	0,6644	0,6615	0,6573
Slovenia	0,7920	0,8153	0,8127	0,8099	0,8215	0,8437	0,8328	0,8390	0,8631	0,8805	0,8930	0,8905	0,8931	0,8837	0,9106	0,9205	0,8966	0,8832	0,8881	0,8898	0,9058	0,9052
Greece	0,7749	0,8311	0,8283	0,8351	0,8428	0,8489	0,9129	0,9400	0,9378	0,9191	0,9139	0,8917	0,8677	0,8906	0,8308	0,7881	0,7568	0,7071	0,7131	0,6954	0,6867	0,6754
Slovakia	0,4427	0,4912	0,5029	0,4817	0,4927	0,4861	0,5035	0,5076	0,5057	0,5294	0,5374	0,5567	0,5555	0,5629	0,5874	0,5910	0,5880	0,5918	0,5968	0,6080	0,6207	0,6304
Estonia	0,3167	0,3384	0,3529	0,3585	0,3804	0,3903	0,4074	0,4383	0,4617	0,4812	0,5128	0,5812	0,5816	0,5509	0,5476	0,5330	0,5584	0,5658	0,5905	0,6030	0,6242	0,6306
Latvia	0,3006	0,3072	0,3117	0,3179	0,3306	0,3374	0,3215	0,3408	0,3617	0,4139	0,4489	0,5404	0,5516	0,4882	0,4688	0,4593	0,4814	0,5039	0,5317	0,5700	0,5927	0,6137
Lithuania	0,2392	0,2777	0,3119	0,3117	0,2965	0,3095	0,3178	0,3345	0,3548	0,3864	0,4451	0,4788	0,5188	0,4668	0,4669	0,4960	0,5128	0,5327	0,5481	0,5655	0,5884	0,6293

Notes: Transformed data from OECD (2019). See Appendix 4, Table 1.