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**Labor Productivity Convergence Dynamics
within the Euro Zone:
A Theoretical and Empirical Examination**

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Abstract

Twelve years ago, eleven European countries voluntarily abandoned their home currencies and joined the Euro. The founding fathers of the Euro believed that creation of the common currency would strengthen integration among the members and catalyze economic convergence progress within the common currency area. This study examines this issue in detail. I focus on labor productivity convergence and study it at sectoral level in order to figure out dynamics of different industries which are subject to different economic fundamentals. The sectors under study are electrical and optical machines (ELECOM), which denotes the IT industry in a specific country, goods production excluding electrical machinery, and market services excluding post and telecommunication. The empirical results reveal the fact that in the Euro era, there is no labor productivity convergence within the first wave Euro zone countries in any of three sectoral categories. This result largely stems from two facts. First, the initial integration level among the Euro zone countries prior to joining the Euro was not developed enough to catalyze labor productivity convergence progress. On top of that, the creation of the Euro has not improved economic integration among the members to the extent estimated at its launch.

Key Words: Productivity Convergence, Neo-Classical Growth Theory, Economic Integration

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List of Abbreviations

ELECOM Electrical and Optical Machines

EMU European Monetary Union

EU European Union

IATA International Air Transport Association

IT Information Technology

GDP Gross Domestic Product

GPT General Purpose Technologies

PPP Purchasing Power Parity

ULC Unit Labor Cost

USA United States of America

1. Introduction

More than a decade ago, after exhaustive negotiations, eleven European countries voluntarily abandoned their home currencies in order to join a common currency area which is called the Euro zone. Creating a common currency was the climax for the economic integration among the European countries following the developments in the free movement of goods, capital and labor. Thus, this final decisive step completed the establishment of an economic union.

In the article 2 of the EU Treaty, it is stated that the convergence of economic performance should be achieved by establishing a common market, economic and monetary union. The masterminds of the Euro strongly believed the idea that, though some academic economists were skeptic, the creation of the Euro would eventually lead to the increase in economic convergence.

In this study, I aim to examine this assumption by various aspects. First, I theoretically analyze how joining a common currency may benefit the relatively backward countries of the union in terms of the labor productivity. This analysis is done by employing parameters related with labor productivity growth which are extensively discussed in the growth and international trade literature. Secondly, I investigate convergence dynamics within the Euro zone countries. For this purpose, I apply the well-known beta and sigma convergence tests which are developed by Sala-i-Martin and Barro (1991) and Sala-i-Martin and Barro (1992). My focus will be on the labor productivity convergence because productivity is the long-run source of growth according to both neo-classical and endogenous growth theories. If Euro zone really aims to increase the cohesion within the union, one of the key aspects is to having small dispersions in labor productivity which would close income gap and indicate the similarity of production processes and technological degree among the members.

I will investigate labor productivity convergence within the Euro zone economies at sectoral level. The sectors under study are electrical and optical machines (ELECOM), which denotes the IT-industry in a specific country, goods production excluding electrical machinery, and market services excluding post and telecommunications. This kind of sectoral division uncovers the convergence dynamics of different sectors which are subject to the different economic fundamentals. The division between market services and goods production sector is beneficial because of two main reasons. First, the factor intensity differs a lot in these two sectors. Services are much more labor oriented than goods production industries. Second, it has been a general belief that productivity improvements are less likely to appear in services

than in the goods production due to the nature of market services (see Baumol (1967)). And the share of services to GDP has been rising since couple of decades in Euro zone countries as in all other developed countries. It is 60% at least. A further disaggregation of the goods production as the IT production and traditional goods production is motivated by the two main reasons. The first is greater opportunities in the IT industry compared to the traditional goods production. The second is the widespread spillovers from the IT industry to all other industries including market services. This fact stems from the General Purpose Technology (GPT) feature of the IT industry. For instance, an e-ticket costs 1\$ but a paper ticket costs 10 \$ according to the International Air Transport Association (IATA). And the annual saving from using e-ticket instead of paper ticket is \$3 billion.

Van Ark et al (2007) underlines the productivity gap between the US and Europe for the post mid 1990's period. As the sources of this gap, they emphasize the underdevelopment of the knowledge economy in Europe compared to the US and higher productivity growth of market services in the USA. This study alone necessitates a separate investigation of the IT industry, traditional goods industry and market services.

The countries under study are the founding members of the Euro excluding Luxembourg. Accordingly, they are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain. This study covers the period from 1999 to 2007 for the Euro era. The data is available until 2007 for the Euro era at the latest.

The ultimate result of this study reveals the fact that there is no labor productivity convergence in the Euro era while it can be firmly observed when the longer periods of time are studied. And that result holds for all three sectoral categories. This fact disproves arguments of the article 2.

The organization of the paper is like the following. Section 2 reviews the relevant literature. Section 3 discusses the labor productivity developments in the Euro zone countries during the Euro era. Section 4 touches upon the current account balance effects of the labor productivity differentials within the Euro zone which is currently one of the most popular topics in the public sphere. Section 5 suggests a theoretical analysis for the labor productivity gains from the joining a currency union and its implications for the case of Euro. Section 6 presents the results of the both beta and sigma convergence tests. Section 7 extends the theoretical analysis including the distance to the frontier parameter. Section 8 concludes.

2. Literature Review

The study consists of two main parts, the theoretical relation between economic integration and labor productivity convergence and empirical convergence tests. Accordingly, this section presents a brief review of literature which covers these two topics.

2.1 Theories regarding the relation between economic integration and convergence

Although recent discussions have given much emphasis on the integration of institutional structure and policy choices, increase in economic integration is largely described as the increase in trade and increase in the mobility of factor inputs like capital, labor, ideas etc. by the literature. I stick to the literature's definition of economic integration.

There are two famous branches of growth theories, neo-classical growth models, and endogenous growth models. Both models provide arguments which support the positive relation between integration and convergence. Neo-classical growth models assume that the increase in mobility of input factors would equalize the marginal product of each input factors which leads to convergence. Barro and Sala-i-Martin (2003, Ch.3) provides a brief examination for the capital mobility and Barro and Sala-i-Martin (2003, Ch.9) for the labor mobility. Endogenous growth theories focus on other mechanisms. Grossman and Helpman (1995) emphasizes that further integration leads to expand the range of intermediate goods which are used by backward countries. In the case of perfect mobility, any invented intermediate good would be available to all producers in the world. And the increasing similarity in the usage of intermediate goods leads to faster convergence of the backward countries to the frontiers. Rivera-Batiz and Romer (1991) underlines the importance of ideas. With the increase in mobility, the ideas flow more easily in the form of the designs, management techniques etc. And these ideas lead to convergence by boosting the productivity of the producers of the backward countries.

Theories of growth generally analyze the impact of the integration on the convergence from the factor inputs perspective instead of the trade volume. The only exception is another branch of the endogenous growth theory that is the learning-by-doing approach which is first developed by Arrow (1962). According to this theory, the increase in production volumes causes more repetition of same tasks which creates innovations and efficiency improvements as the by-products. The increase in trade volumes triggers these by-products by increasing the markets size. In addition, backward countries can benefit from the increase in trade with the

frontiers by adopting their techniques through reverse engineering, imitation etc. However, this point resembles Rivera-Batiz and Romer (1991)'s flow of ideas approach.

Trade theories give more elaborate analysis for the productivity and convergence effects of the increase in trade. However, their findings are more controversial compared to the analysis of the theories of growth. Krugman (1993) argues that increasing trade among EMU countries would lead divergence instead of convergence due to scale economies, externalities and agglomeration effects. These effects result in the increased specialization and asymmetric developments and divergence among the EMU members. These arguments largely base on new trade theories (for extensive discussion see Krugman and Helpman (1987)). The new trade theories work under the assumption of the representative firm. However, the more recent theoretical studies take into account the firm heterogeneity in exporting decisions which is called new new trade theory. Melitz (2003) indicates that the least productive firms in a country are non-traders. Exporting firms are more productive than non-traders. And the most productive ones are the multi-nationals which are able to invest abroad. Thus, he emphasizes a kind of self-selection in exporting decisions. This view assumes that as trade volumes increase more productive foreign firm penetrate into the domestic market and cut off the less productive non-traders which results in the increase in the average productivity. Thus, the assumptions of the new new trade theory regarding the effect of integration on productivity and convergence differ from the new trade theory ones.

2.2 Empirical Convergence Tests

This sub-section is devoted to a brief review of the empirical convergence tests. Although convergence is implied by the neo-classical growth theories and tested empirically by various studies, (for an example see Baumol (1986)), the speed of convergence concept was first developed and used by Sala-i-Martin and Barro (1991), Sala-i-Martin and Barro (1992). They employed their own method in order determine the speed of income convergence among the US states and found out around 2% speed of convergence. The 2% result holds both longer term study from 1880 to 1988 and shorter term study from 1963 and 1986.

Sala-i-Martin (1996) used the same technique in order to find out the speed of convergence among the regions of the five European countries, Germany, UK, France, Italy and Spain. The results range from 1% to 3% which correspond to the results of US states. The period of time under study is 1950-1990 for Germany, UK, France, Italy and 1955-1987 for Spain.

The studies regarding the Euro zone are quite limited. Probably, the reason is that the euro has been circulating since 1999 which implies a short time span. Marelli (2007) is an empirical study of convergence dynamics within the EU and EMU. According to his results, the speed of convergence is 4,4% for the 161 regions in the EMU. The period of time under study is 1999-2005.

The aforementioned empirical studies aim to measure the speed of convergence in income. The studies are quite limited for the labor productivity convergence. It becomes much scarcer if one tries to find the benchmark studies for the sectoral level labor productivity convergence rates. Barro and Sala-i-Martin (1991) is a unique example. They extensively investigated the convergence dynamics within the U.S states for the period between 1963 and 1986. They also delve into the sectoral labor productivity convergence. They found that the convergence rate ranges between 0,93 % and 1,5% for the market services and between 1,7 % and 4,6% for the goods production. 4,6% is for the manufacturing which comprises the largest part of the goods production. Marelli (2007) also measures the labor productivity convergence rate of the 161 EMU regions for the period 1999-2005. And the result is 1,4% but it is significant at 10% in contrast to the 1% significance of all other convergence rates which are mentioned until now. It is very important to note that these two studies used product per labor as the description of the labor productivity.

To the author's knowledge, there is no study which examines the sectoral labor productivity convergence rate within the Euro zone countries.

3. Sectoral Labor Productivity Growth Developments in the Euro Zone Countries

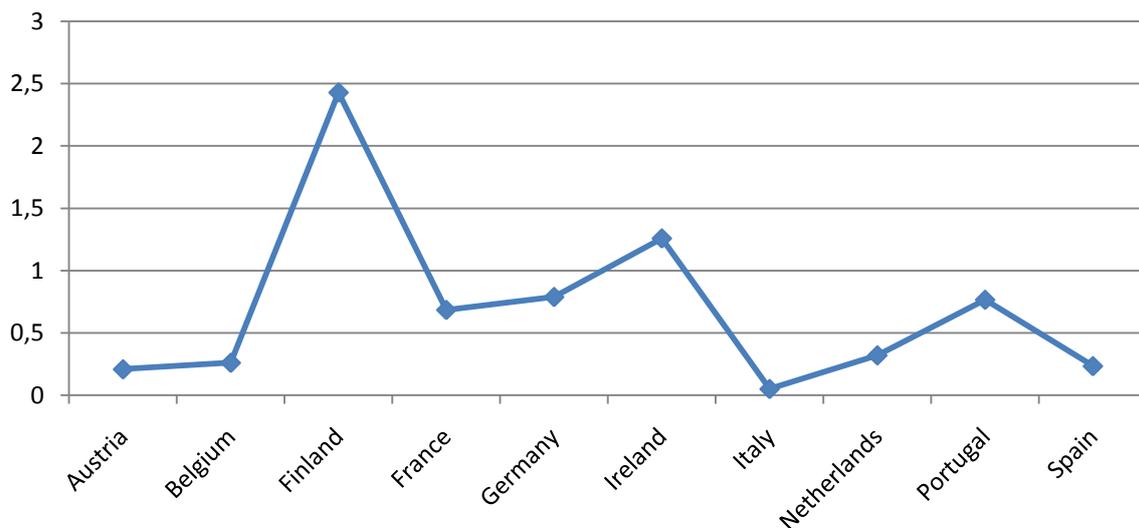
In this section, I will present and discuss sectoral labor productivity developments in the Euro zone countries. I aim to shed some light on the different trends in different countries. That also gives opportunities to compare the productivity performances of different countries and different sectors within a common currency area.

Throughout this study, labor productivity is identified as output per hour worked. Output values are Purchasing Power Parity (PPP) adjusted. And PPP values are sector-specific. I obtained output and working hour values from the vast EU KLEMS database.

3.1. ELECOM

The figure 1 clearly depicts the productivity improvements in the first wave of Euro zone countries. The unit of measurement is the labor productivity level in 2007 minus the labor productivity level in 1999 divided by the labor productivity level in 1999 which gives labor productivity growth rate from 1999 to 2007.

Figure.1 ELECOM LABOR PRODUCTIVITY GROWTH RATE 1999-2007



The unweighted average growth rate is 70% for these ten Euro zone countries.

The productivity growth rate performance of the IT firms in Finland significantly outpaced their Euro zone counterparts. The productivity growth rate of the ELECOM industry was approximately 250% from 1999 to 2007. It is approximately 3,5 times bigger than the average growth rate. This is a remarkable performance by any means. The second best performance belongs to Ireland. The growth rate was 125% which is significantly higher than the average but just half of the productivity growth rate performance of the Finland. These results are not surprising at all because these two countries have been known as the most IT-intense countries in Europe since the last couple of decades. Germany comes after these two countries with 79% growth rate. The real surprise is Portugal. The productivity growth rate was 77% which is above average and the fourth best result. This result necessitates a case study for the IT industry in Portugal that may give some insights about this performance. France follows Portugal with 68 % growth rate which is around average. After France, there is significant drop in the productivity growth rates as it can be seen from the Figure 1. The next best

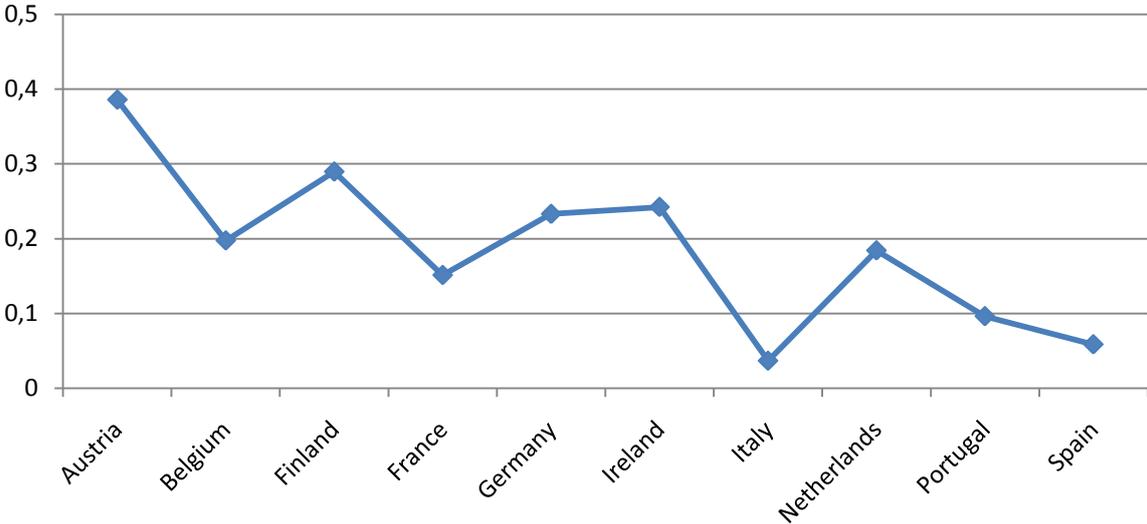
performance belongs to Netherland with 32 % growth rate which is less than the half of the average growth rate. The following countries are Belgium, Spain and Austria with 26%, 23% and 21% growth rates, respectively. These values are significantly low compared to the average and around one third of it. However, the most awful performance comes from Italy with just 5 % growth rate. It means that in Italy, the labor productivity in the IT industry had grown fourteen times less than the average and fifty times less than the Finland’s labor productivity growth during the first eight years of the Euro.

This examination proves that some countries were able to keep up with the latest developments in the IT industries and some were not. Finland and Ireland are the expected success stories. Portugal is the surprising one. Meanwhile, Austria, Belgium, Spain and Italy are the stories of failure. And the special emphasis should be on the extremely bad performance of the Italian IT industry.

3.2 Goods Production

In Figure 2, the labor productivity growth rates of the goods production excluding IT can be seen for the first wave of the Euro zone countries for the period 1999-2007.

Figure.2 GOODS PRODUCTION LABOR PRODUCTIVITY GROWTH RATE 1999-2007



The unweighted average growth rate is 19% for these ten Euro zone countries. The best performance belongs to Austria with 39% which is the double of the average. It is followed by Finland, Ireland and Germany, respectively, with 29%, 24% and 23% growth rates. These values are higher than the average but lower than the best performance. These countries have

been known as the industrial power horse of Europe since the last couple of decades. In this regard, results do not deviate much from the common expectations. Next best performances come from Belgium and Netherland, respectively, with 20% and 18% growth rates. These values are around average. The next place belongs to France with 15% growth rate which is slightly lower than the average. The last three places are taken by the Mediterranean countries. Portugal, Spain and Italy had the lowest labor productivity growth rates with 10%, 6% and 4%, respectively. The performances of Spain and Italy are especially disappointing because the growth rates are lower than the one third of the average.

This examination confirms that Northern European countries could better accommodate their industrial structure for the new century which is largely defined by the transformation of production processes and raising competition from the emerging countries.

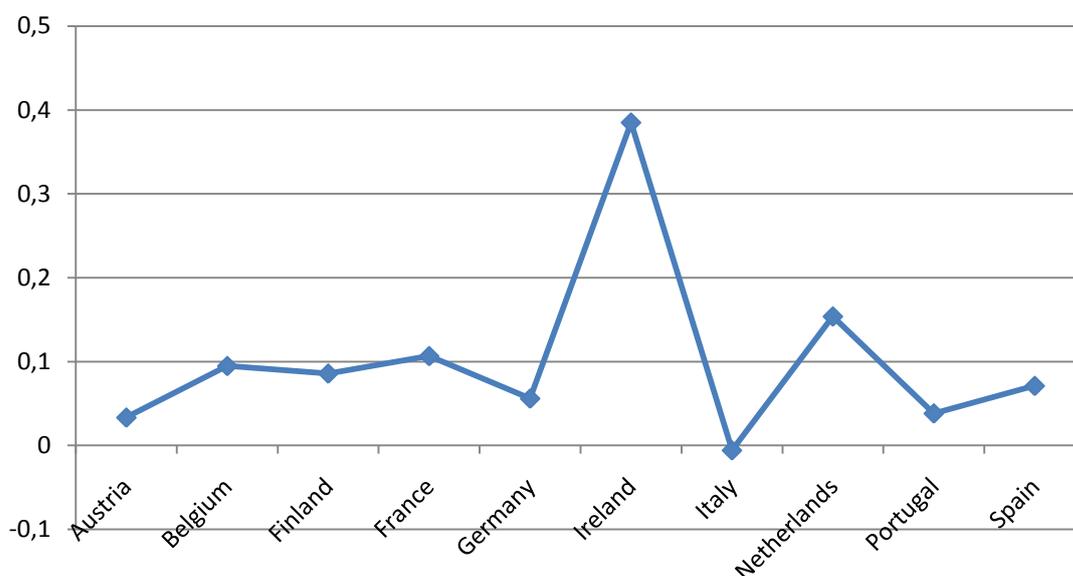
Another result which can be deduced from sectoral level investigation is the comparison of the developments in different sectors as a whole. For example, the unweighted average labor productivity growth rate of the IT industries in the Euro zone countries is approximately 3,5 times higher than the average labor productivity growth rate of the traditional goods production sector. This result largely stems from the fact that IT production offers a wide range opportunities compared to the traditional production industries. Another interesting result is that the dispersion in the labor productivity growth rates is significantly smaller in the traditional goods production industries compared to the IT production industry. The interval is 39% - 4% for the traditional goods production and 250% -5% for the IT production. It seems that this fact is also caused by the great opportunities in the IT industry compared to the limited ones in the traditional goods production industries.

It is very interesting to observe that some countries such as Finland, Ireland and Germany had shown good performance both in the traditional goods production and IT production. Some countries such as Italy and Spain had poorly performed both in the traditional goods production and IT production. The special emphasis should be put on the case of Italy which takes the last place in both categories. The other countries achieved above average performance either in the traditional goods production or IT production.

3.3 Market Services

Figure 3 presents the labor productivity growth rates of market services in the first wave of the Euro zone countries. The period of time under study is 1999-2007.

Figure.3 MARKET SERVICES LABOR PRODUCTIVITY GROWTH RATE 1999-2007



The unweighted average growth rate is 10% for these ten Euro zone countries. The first impression is the extraordinary performance of Ireland. The productivity growth rate from 1999 to 2007 was 38% which is almost four times higher than the average. The second best performance belongs to Netherland with 15% growth rate which is above average but significantly lower than the growth rate of Ireland. Following these countries, France, Belgium and Ireland come with 11%, 9% and 9% growth rates, respectively. These values are around average. The next three places are taken by Spain, Germany and Portugal, respectively, with 7%, 6% and 4% growth rates which are lower than the average. The worst performance comes from Italy as in the all cases. The labor productivity growth rate from 1999 to 2007 was -0,006% in Italy. This negative growth rate means that during the Euro era under study, market services had become less productive in Italy in contrast to the labor productivity increases in all other Euro zone countries.

In this point, it is worth comparing labor productivity growth performances of different countries in different sectors. The only country, which had performed above average in all three categories, is Ireland. In this regard, it won't be an exaggeration to call Ireland labor productivity growth champion of the Euro zone in the Euro era. Finland and Germany are the countries which had performed above average both in the IT production and traditional goods production but below average in the market services. Austria and Belgium had shown above average performance in the traditional goods production sector, in fact Austria is the number

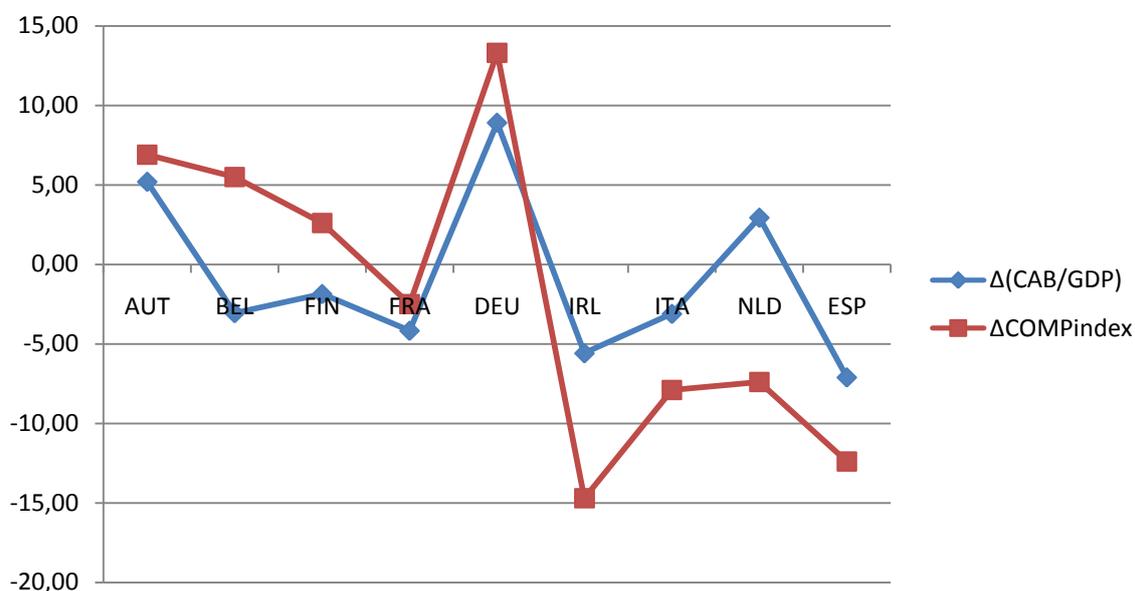
one in this category, but below average performance both in the IT industry and market services. Interestingly, in France, the labor productivity growth rates of all three categories are close to the average. Netherland and Portugal had achieved above average growth rates just in one category. It is market services for the former and IT industry for the latter which is quite surprising. Spain and Italy were not able to show above average performance in any of these three categories. The growth rates are anemic especially for Italy which takes the last place in all three categories.

4. Labor Productivity Growth Rates and External Imbalances within the Euro Zone

After discussing sectoral labor productivity developments, it is worthwhile to argue some macroeconomic effects of these labor productivity differentials within the Euro zone. The most favorite topic of the recent macroeconomic debates is the global external imbalances without any doubt. Although much emphasis has been put on the external imbalances between the USA and China, the external imbalances within the Euro zone have attracted considerable interest.

The crucial point is that exchange rate changes are ruled out as a tool of improving competitiveness and, accordingly, external balances when the Euro zone countries joined the common currency area. The only remaining tool for competitiveness became the unit labor cost (ULC) which is the labor cost per output. ULC can be measured as the ratio of wages to labor productivity. If wages go up, ULC increases as well. And if labor productivity goes up, ULC decreases. If ULC increases, competitiveness diminishes and current account balance deteriorates. In this respect, coupling with the changes in wage level, labor productivity growth rates determine current account balance of the Euro zone countries.

Figure.4 CHANGES in the COMPETITIVENESS INDEX and CURRENT ACCOUNT BALANCE to GDP RATIOS in the EURO ERA



Sources: ECB and World Development Indicators

Figure 4 confirms the argument. During the Euro era, the changes in competitiveness index, based on ULC, and current account balance to GDP ratios had shown very close relationship.

Four countries were able to increase their competitiveness. These countries are Germany, Austria, Belgium and Finland. The common feature of these countries is their above average performance at the labor productivity growth rate of the goods production sector. And the competitiveness decreased in five countries. Four of them had below average goods production labor productivity growth rate. The only exception is Ireland. Although Ireland is the only country which was able to achieve above average labor productivity growth rates in all three categories, the biggest competitiveness loss appeared in Ireland which is very surprising. Apart from the case of Ireland, these results indicate that the developments in competitiveness are in lieu with the developments in goods production labor productivity growth. Therefore, it can be argued that wages do not quickly respond to the labor productivity changes. It seems that Keynesian wage rigidities dominate the European labor market with a single exception. The case of Ireland requires in depth analysis. The future labor productivity growth expectations coupling with the flexible labor market may have fuelled the wage level increases in Ireland. If we set aside Ireland, we can assume for all other

Euro zone countries that more productive countries become more competitive, due to labor market rigidities, and current account improved in these countries. In extreme cases like Germany, in which labor unions and management agreed upon wage moderation as Sabbatini and Zollino (2010) put it, any increase in the goods production labor productivity would lead to the competitiveness increase and result in the improvement of current account balance. On the contrary, less productive countries became less competitive, due to labor market rigidities again, and current account deteriorated.

Another conclusion is that the decrease in nominal wages may be required, due to low inflation in the Euro zone, in countries which had very low productivity growth rates in goods production sector. This point was emphasized by Blanchard (2007) for Portugal. In my opinion, this option is much more relevant for Italy and Spain because in the Euro era, goods production labor productivity growth rates, 4% and 6% respectively, were substantially lower in these countries compared to the 10% goods production labor productivity growth rate of Portugal. However, any decrease in nominal wages has been always assumed inapplicable due to various political and economic reasons. If we add the inflexible labor markets and powerful labor unions of the Mediterranean countries on top of this general inapplicability, any decrease in nominal wages becomes very unlikely. If these countries won't be able to boost their labor productivity growth in a miraculous way and (or) if the decrease in wage levels won't occur, they will be trapped in the low competitiveness. And the external imbalances within the Euro zone will be persistent.

5. A Theoretical Analysis for the Labor Productivity Gains from the Joining a Currency Union

In this section, I try to develop a theoretical analysis for the labor productivity gains of the laggards from the joining a common currency area.

I inspired from the analysis of Krugman and Obstfeld (2008) for the gains (and losses) from the joining the Euro. Specifically, I rearranged their analysis for the labor productivity gains (and losses) by employing parameters which are related with the labor productivity. These parameters are discussed in detail in the Literature Review section.

5.1. Labor Productivity Gains

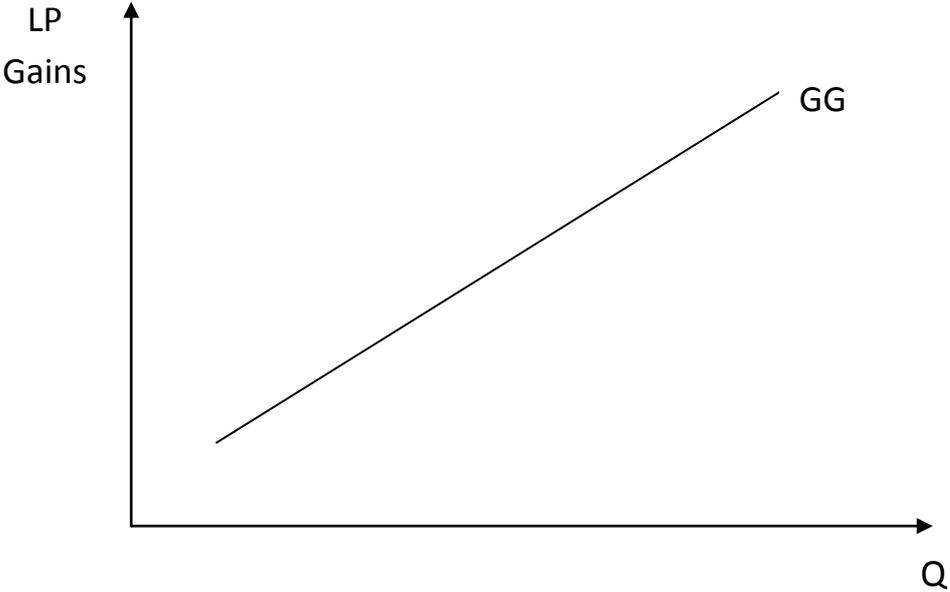
My first task is focusing on gains. It is general belief that joining a common currency boosts trade and factor input mobility within the currency union because of the decrease in the

uncertainty, transaction costs, risks associated with the exchange rate volatility, cost of calculation of the effective exchange rate etc. In a study, Rose and Frankel (2002) estimated that joining a currency union triples the trade among the members. In this point, it is necessary to argue through which mechanisms the increase in trade and factor mobility may boost the labor productivity growth in the laggards and pave the way for the convergence. There are four pillars on which labor productivity gains and convergence of the laggards lie.

- Learning by exporting: As the trade increases the exporting firms of the backward countries may learn more and more from their frontier counterparts through reverse engineering, copying the production processes, imitating the management techniques etc.
- Cut-off of the less productive domestic firms: Some of the recent empirical, Pavcnik (2002), Ottaviano and Mayer (2008), Greenaway and Kneller (2007), and theoretical, Melitz (2003), studies underline the firm heterogeneity in exporting decisions. They have found that the least productive firms in a country are non-traders. Exporting firms are more productive than non-traders. And the most productive ones are the multi-nationals which are able to invest abroad. Thus, they emphasize a kind of self-selection in exporting decisions. In this respect, they generally dismiss the idea that exporting firms become more productive as they do more export. However, they don't ignore the idea that the increase in trade volumes leads to increase in labor productivity. They frame a different channel. As the trade increases more foreign firms penetrate into the domestic market and cut-off some of the least productive non-traders which would increase the average labor productivity. In addition, the freed sources of the non-traders will be channeled to the more productive exporting firms which would accelerate the increase in labor productivity.
- Technology Transfer: The capital embodies the existing technology. As the mobility of the capital eases, the intermediate goods of technological leaders would be more available for the laggards. This flow would improve the adoption and utilization of the best existing technology in the relatively backwards countries of the union which triggers the labor productivity and improves the convergence progress.
- Human Capital Transfer: As the mobility of the labor eases, ideas, embodied by the human capital of the labor, flow more easily from the leaders to the laggards.

The all aforementioned pillars are the positive function of the integration. The more trade and input mobility take place, the more the positive effects of the learning-by-exporting, cut-off of the least productive domestic firms, technology transfer and human capital transfer can be enjoyed.

Figure.5 LABOR PRODUCTIVITY GAINS from the JOINING a COMMON CURRENCY AREA



The figure above depicts that the labor productivity gains of the laggards are the positive function of integration.

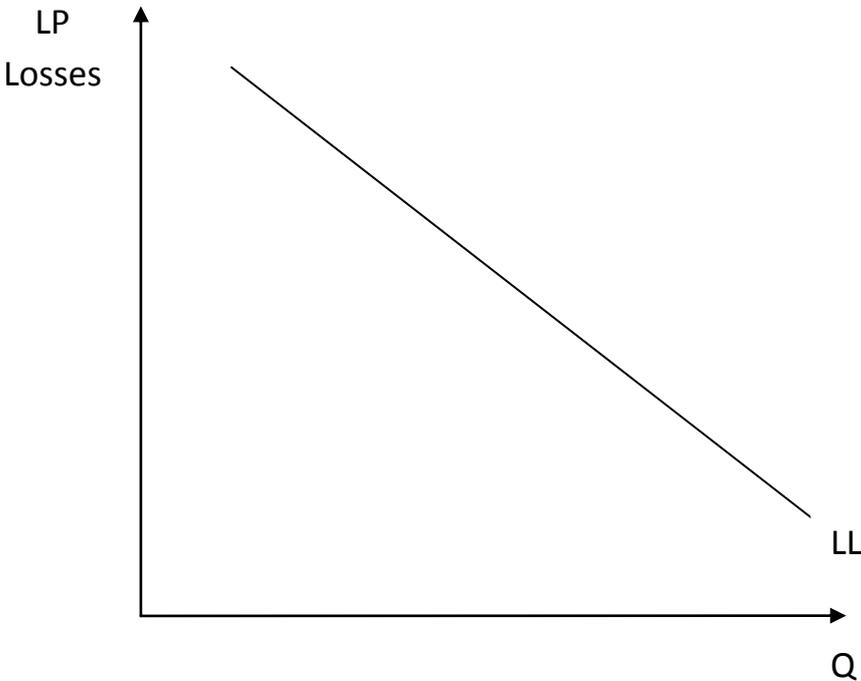
5.2. Labor Productivity Losses

Although the previous discussion about the labor productivity gains of the laggards provides clear-cut arguments, the benefits can be reaped in the long-run according to the nature of mechanisms. In the short-run, the loss of the effective demand management, due to the loss of the monetary autonomy, may harm the labor productivity. If a negative shock hits the aggregate demand, countries can not use the interest rate or exchange rate tools in order to outweigh the fall in the aggregate demand. Therefore, the remaining tools for combating against the fall in aggregate demand are real wages and real prices. If inflation levels and

labor productivity levels are too low, the increase in competitiveness may even require the decrease in nominal wages and prices as it is discussed in the previous sections. However, the empirical evidences indicate the Keynesian wage and price rigidities. On top of this natural limited responsiveness of the markets, one should also add the inflexibility of the European labor market and the strong presence of the labor unions which makes the adjustment of the wages and prices more sluggish. These factors combine and create the idle capacity in the economy which lowers the average labor productivity.

However, it should be noted that the short-term losses are the negative function of integration level. As the integration increases, other countries in the common currency union would respond more quickly to the price decreases in the countries of which a negative demand shock hits. That would significantly tame the degree and shorten the duration of the price and wage adjustments in these countries. As a result, the idle capacity would be much lesser and the decrease in average labor productivity would be milder. Another point is that the higher the integration level is, the easier the idle capacity in terms of the both capital and labor can move to other countries in the currency union. That would also soften the decrease in labor productivity losses.

Figure.6 LABOR PRODUCTIVITY LOSSES from the JOINING a COMMON CURRENCY AREA



The figure above depicts that the labor productivity loss is the negative function of integration.

5.3 Combining the Gains and the Losses Curves

The long-run gains and the short-run costs combine and determine the labor productivity gains (or losses) of the relatively backward countries from the joining a common currency.

Figure.7 LABOR PRODUCTIVITY GAINS & LOSSES from the JOINING a COMMON CURRENCY AREA

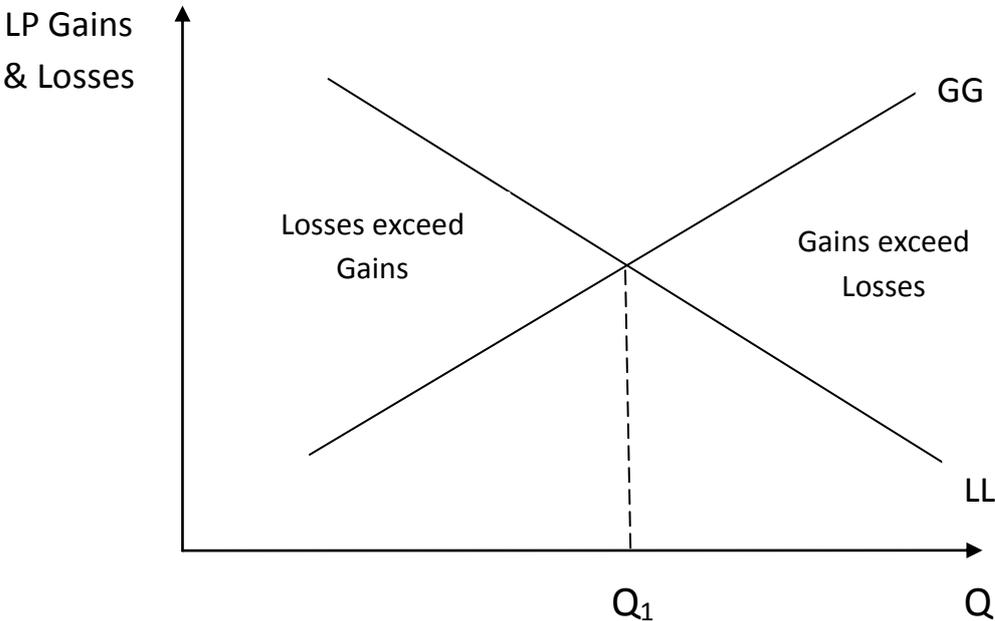


Figure 7 indicates that Q₁ level integration should be reached if relatively backward countries want to gain from the joining a common currency union in terms of the labor productivity. As the integration level increases (decreases), the labor productivity gains (losses) exceed the labor productivity losses (gains) more and the likelihood of convergence (divergence) goes up ceteris paribus. In this respect, again ceteris paribus, the labor productivity convergence is a positive function of the integration within the partial equilibrium framework.

Figure.8 LABOR PRODUCTIVITY CONVERGENCE and INTEGRATION

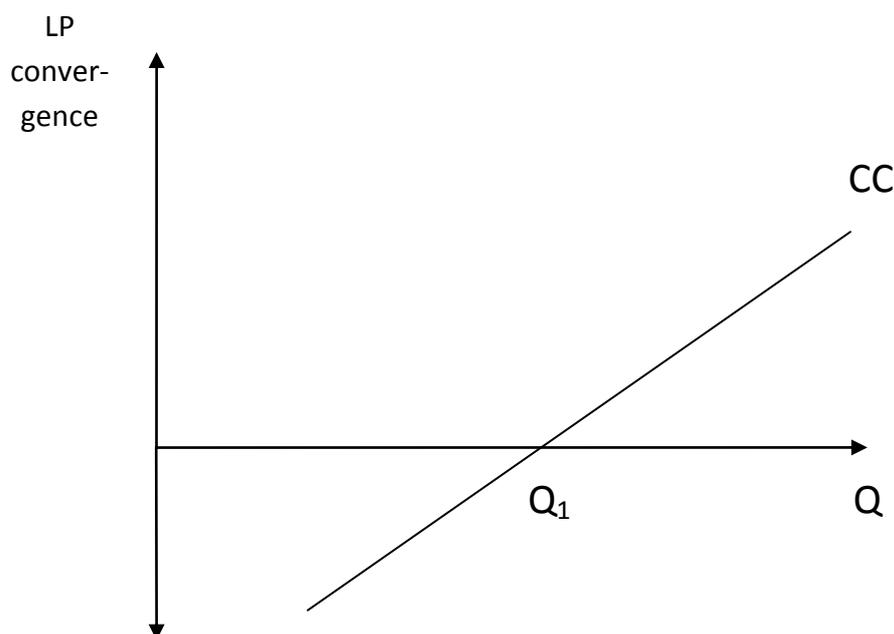


Figure 8 depicts a possible convergence curve which is based on the previous partial equilibrium analysis. According to the figure, at the Q_1 level integration, the relative labor productivity of the laggard country to the frontier remains same. As the integration increases (decreases) beyond Q_1 , the backward countries converge (diverge) to (from) the frontier more.

Although this kind of partial equilibrium analysis grossly simplifies the analytical reasoning of the developments in labor productivity convergence, I aim to shed some light on the mechanisms how joining a common currency union may strengthen the convergence progress of the laggards to the frontiers within the common currency area. This goal requires the isolation of other variables which may also affect the convergence progress that justifies the usage of the partial equilibrium analysis framework.

5.4 Evidences for Integration until now

Evidences until now points the idea that introduction of the Euro has not led to the further integration to the extent what was expected by the authorities. Frankel (2010) estimates that the effect of the Euro had been 15% increase in the intra-Euroland trade for the period 1999-2006. That is incomparable with the results of the earlier studies which found that joining a common currency triples the trade among the member states. Petroulas (2007) estimates that the introduction of the Euro increased the intra-Euroland foreign direct investments just 16 %.

Another issue is the labor mobility. Table 1 presents the emigration from the least productive Mediterranean Euro zone countries, Spain, Italy and Portugal, to the most productive Northern Euro zone countries, Finland, Ireland and Germany.

Table.1 EMIGRATION from the MEDITERRENEAN to the NORTHERN EUROPE

	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	
Spain	Germany	7,442	8,14	8,185	10,345	8,992	9,194	9,004	:	9,541	8,413
	Ireland	:	:	:	:	:	:	:	:	:	:
	Finland	37	33	50	105	53	39	27	56	40	16
Italy	Germany	23,591	25,72	27,118	35,056	32,485	34,179	33,164	:	37,205	37,851
	Ireland	:	:	:	:	:	:	:	:	:	:
	Finland	55	64	41	73	39	46	48	72	26	21
Portugal	Germany	6,452	6,729	6,912	8,772	8,508	10,771	10,968	:	16,376	22,116
	Ireland	:	:	:	:	:	:	:	:	:	:
	Finland	7	9	10	17	5	5	6	9	3	1

Source : Eurostat

The table indicates the emigration to Ireland and Finland had been negligible during the Euro era. Meanwhile, the emigration to Germany, the industrial power horse of the EU, had slowed in Italy and Portugal and had been flat in Spain during the Euro era.

To sum up, developments in the Euro era in terms of the integration are the slight increases in trade and capital mobility but the decrease in labor mobility. These results are very discouraging and raise some skepticism about the labor productivity gains of the relatively backward countries of the Euro zone from the joining the common currency area. Accordingly, that leads to question whether initial integration level among the Euro zone countries prior to joining the Euro was at the level which can boost the labor productivity convergence. In the following section, this issue will be addressed in detail.

6. Convergence Dynamics in Different Sectors within the Euro Zone

One of the natural questions, which may arise from the investigation of the labor productivity developments in the Euro zone, is what has been the convergence dynamics during the Euro era.

As the condition of the joining the Euro, countries were required to converge in nominal terms. Nominal convergence criteria were set in four different macroeconomic variables:

- An inflation rate not exceeding the rate of the best three performing countries plus an allowance of 1,5%
- A nominal interest rate not exceeding the interest rate of the best three performing countries (in terms of inflation) plus an allowance of 2%
- A public deficit to GDP ratio not exceeding 3%
- A debt to GDP ratio not exceeding 60%

Generally, the Euro zone countries had fulfilled the nominal convergence criteria during the Euro era until the recent financial crisis.

It was general belief that the convergence in nominal terms would pave the way for the real convergences such as the convergence in labor productivity. In the following sections, I will test labor productivity convergence dynamics within the Euro zone.

6.1 Beta Convergence

The first method I employ targets to measure the speed of convergence to the steady state value. This technique was introduced by Sala-i-Martin and Barro (1991), Sala-i-Martin and Barro (1992). Their empirical method is based on the convergence concept which is developed by neo-classical growth theories. They assume that the more the countries are away from their steady state income levels, the higher the growth rates should be. Accordingly, there should be an inverse relation between the initial income level and the growth rate of income. In this respect, Sala-i-Martin and Barro (1991) and Sala-i-Martin and Barro (1992) regress the annual income growth rate on the initial income level. Here, the coefficient value of the initial income level determines the rate of convergence. The sign should be negative if the convergence takes place. The estimation equation is like the following.

$$\frac{1}{T} \cdot \ln \left(\frac{y_{i,t_0+T}}{y_{i,t_0}} \right) = B - \left(\frac{1-e^{-\beta T}}{T} \right) \cdot \ln(y_{i,t_0}) + u_{i,t_0,t_0+T} \quad (1)$$

I preferred non-linear equation to linear equation because of its superiority that is explained by Sala-i-Martin (1996). By putting minus sign in front of the β variable, I changed the sign of the rate of convergence from minus to plus in order to simplify interpretations of the results.

y is the labor productivity in terms of the product per hour worked. β denotes the speed of convergence. The error term is a distributed lag of the $u_{i,t}$ between dates t_0+T . The constant term is:

$$B = \left(\frac{1-e^{-\beta T}}{T} \right) \cdot [\ln(\hat{y}^*) + x \cdot t_0]$$

\hat{y}^* is the steady state value and x is the rate of the technological progress. If β is higher, the response of the average growth rate to the difference between $\log(\hat{y}^*)$ and $\log(y_0)$ would be higher. That can be shown more explicitly by rearranging the equation above.

$$\frac{1}{T} \cdot \ln \left(\frac{y_{i,t_0+T}}{y_{i,t_0}} \right) = \left(\frac{1-e^{-\beta T}}{T} \right) \cdot [\ln \left(\frac{\hat{y}^*}{y_{i,t_0}} \right) + x \cdot t_0] + u_{i,t_0,t_0+T} \quad (2)$$

The steady state labor productivity and the rate of the technological progress should be uncorrelated with the initial income if one aims to find the unconditional convergence rate. This proposition also assumes that steady state values and the rate of technological progress should be identical for all countries under study. If they differ from country to country, some outside variables affect both the initial labor productivity and the steady state labor productivity. In this case, the control variables, which may affect both the initial and steady state labor productivity, should be included in order to avoid any bias in the β values. However, this procedure implies the conditional convergence.

Sala-i-Martin (1996) argues that the convergence dynamics can be observed in the regional data sets without including the control variables but in the cross-country analysis, the control variables may be required in order to find out the convergence dynamics. The reason is that the structural variables, which determine the long-run values, deviate less among the regions within the same country in comparison with the deviations among different countries.

The goal of the Euro is to integrate the member countries to the extent that member countries are perceived as the regions within the Euro zone. In this respect, I prefer to employ unconditional convergence approach without including any control variable.

I separately run the first equation for all three different sectoral categories. I conducted the tests for three different periods of time, 1970-2007, 1970-1999 and 1999-2007. With this strategy, I primarily aim to uncover the convergence dynamics in the Euro era. In addition to that, it is enlightening to investigate the convergence dynamics from the longer run perspective and compare the results with the results in the Euro era. One extra point which is worth noting that how the long run convergence rates change with the inclusion of the Euro era.

6.1.1 ELECOM

Table 2 summarizes the results regarding the ELECOM industry.

Table.2 ELECOM BETA CONVERGENCE TEST RESULTS

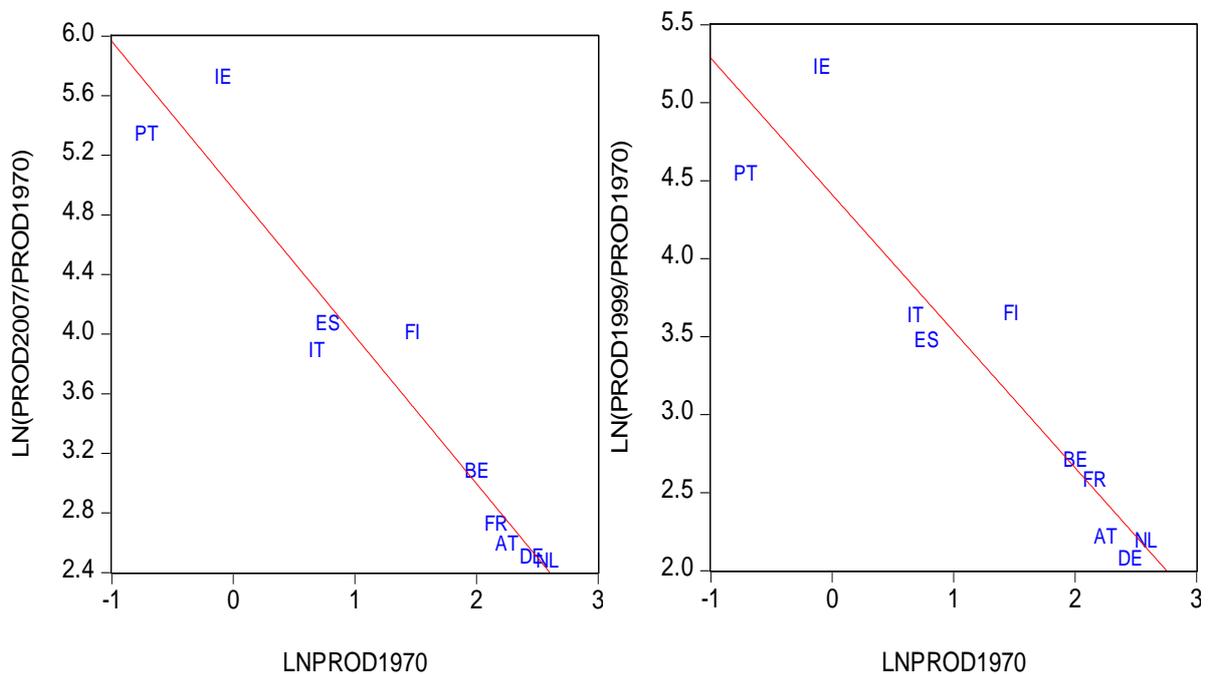
	1970-2007	1970-1999	1999-2007
β	0,0267***	0,0302***	0,0325
s.e	0,0028	0,0040	0,0180
Rsquare	0,9178	0,8774	0,2893

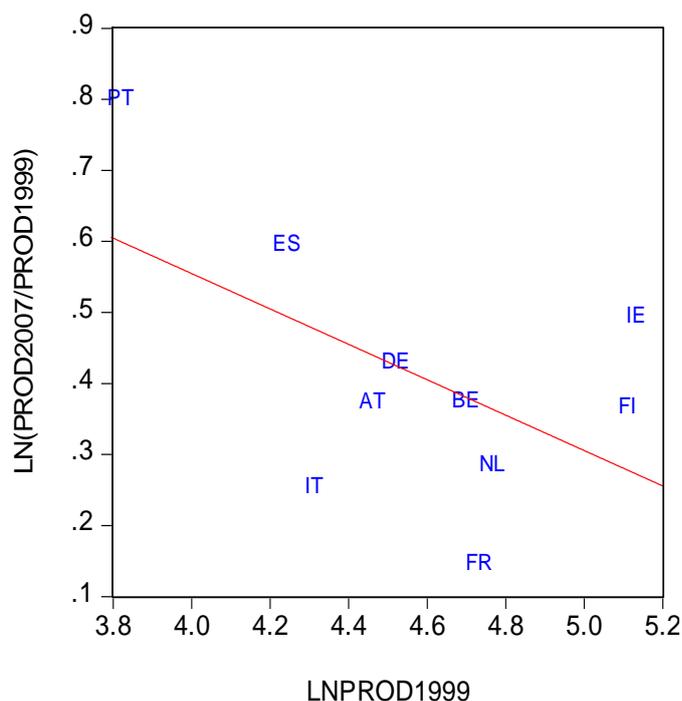
Note: ***significant at 1 %, ** significant at 5%,* significant at 10%

First of all, the β convergence rates have the positive sign in all periods of time under study but it becomes insignificant in the Euro era. β convergence rates from 1970 to 1999 and from 1970 to 2007 are significant at 1% level. The convergence rates are 3% and 2,7%, respectively. This result indicates that the inclusion of the Euro era decreases the speed of convergence from the long run perspective. Goodness-of-fit values are quite high for the longer run models but it is very low for the Euro era.

Figure 9 depicts the dynamics which are figured out by the regressions.

Figure.9 ELECOM LABOR PRODUCTIVITY GROWTH RATES vs. INITIAL LABOR PRODUCTIVITY LEVELS





The negative relation between the initial level of labor productivity and the labor productivity growth is very robust for the periods 1970-1999 and 1970-2007. However, this negative relation is less clear for the Euro era. Some countries, like Ireland and Finland, with high initial labor productivity achieved higher labor productivity growth rates than the initially less productive countries like Italy and France.

6.1.2 Goods Production

Table 3 summarizes the results regarding the aggregate goods production sector.

Table.3 GOODS PRODUCTION BETA CONVERGENCE TEST RESULTS

	1970-2007	1970-1999	1999-2007
β	0.0171***	0.0242***	-0.0102
s.e	0.0015	0.0022	0.0074
Rsquare	0.9383	0.9333	0.1892

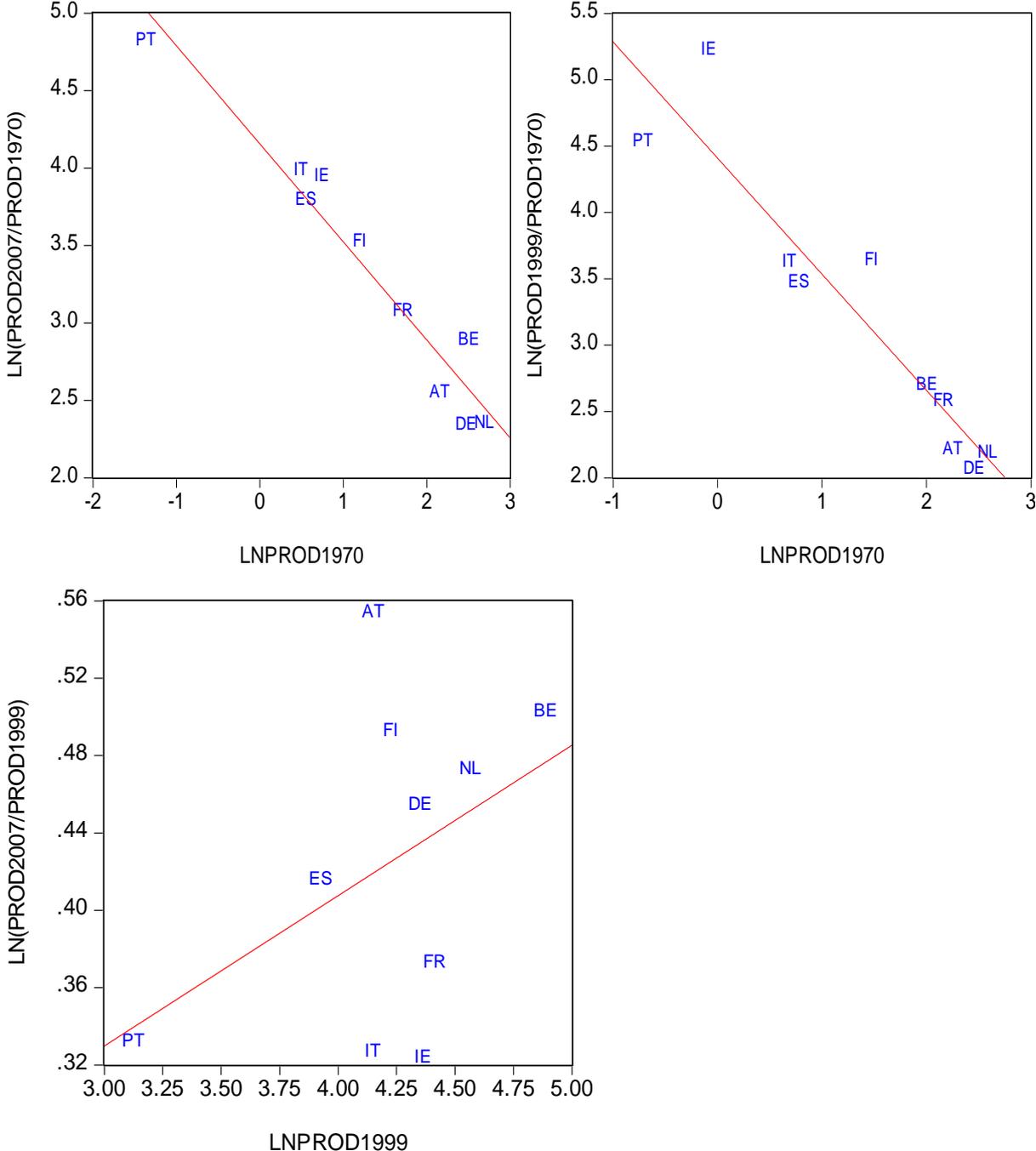
Note: ***significant at 1 %, ** significant at 5%, * significant at 10%

β convergence rates have the positive sign for the longer periods but it appears with the wrong sign for the Euro era. This result means that we can observe divergence rather than the convergence in the Euro era. However, this divergence is statistically insignificant. The convergence rates are 1,7% from 1970 to 2007 and 2,4% from 1970 to 1999. These rates are statistically significant at 1% level. Table 3 shows that the inclusion of the Euro era

diminishes the rate of convergence as in the ELECOM industry. Goodness-of-fit values are quite high for the longer run models but it is very low for the Euro era.

Figure 10 depicts the dynamics which are figured out by the regressions.

Figure.10 GOODS PRODUCTION LABOR PRODUCTIVITY GROWTH RATES vs. INITIAL LABOR PRODUCTIVITY LEVELS



The negative relation between the initial level of labor productivity and the labor productivity growth is very robust for the periods 1970-1999 and 1970-2007 as in the ELECOM industry.

However, in the Euro era, a positive relation can be observed that implies divergence. This development simply contradicts with the convergence argument of the Neo-Classical Growth Theory. Apparently, most of the initially productive countries achieved higher labor productivity growth rates than the initially less productive countries. This fact can be easily seen that labor productivity growth rates of Belgium, Netherland, Germany, Finland and Austria exceeded the rates of Portugal, Spain and Italy.

In this point, it is worth comparing the convergence dynamics in the IT industry and traditional goods production. First of all, the convergence rates are higher in the IT production industry compared to the traditional goods sector in the longer term examination. Secondly, we can observe insignificant convergence in the IT industry for the Euro era but insignificant divergence in the traditional goods production sector. That lowers more the long-term convergence rate of the traditional goods sector.

There are two main points which should be emphasized while explaining the asymmetry in the results of the IT production and traditional goods production. The first is the micro-structural differences between these two sectoral categories. In the IT production industry, the fixed costs are high but the variable costs are low. This discrepancy in the cost structure does not exist in the traditional goods sector to the extent which exists in the IT industry. The flow of technology from leaders to the laggards significantly eases the burden of the high fixed costs in the IT production and firms bear just the relatively low variable costs. The second point is the macro-structural differences between these two categories. Traditional goods production sector has been always subject to tougher competition than the IT production. The global competition in the traditional goods production sector has reached to its peak level in the Euro era in which emerging countries like China, India, and Brazil have become major players in this sector. However, European countries like all other developed countries are relatively more immune from the competition in the IT industry.

In my opinion, these micro- and macro-structural variations combine and create the differences in the convergence dynamics between the traditional goods and IT production sectors both in the longer-term and in the Euro era.

6.1.3 Market Services

Table 4 summarizes the results regarding the market services.

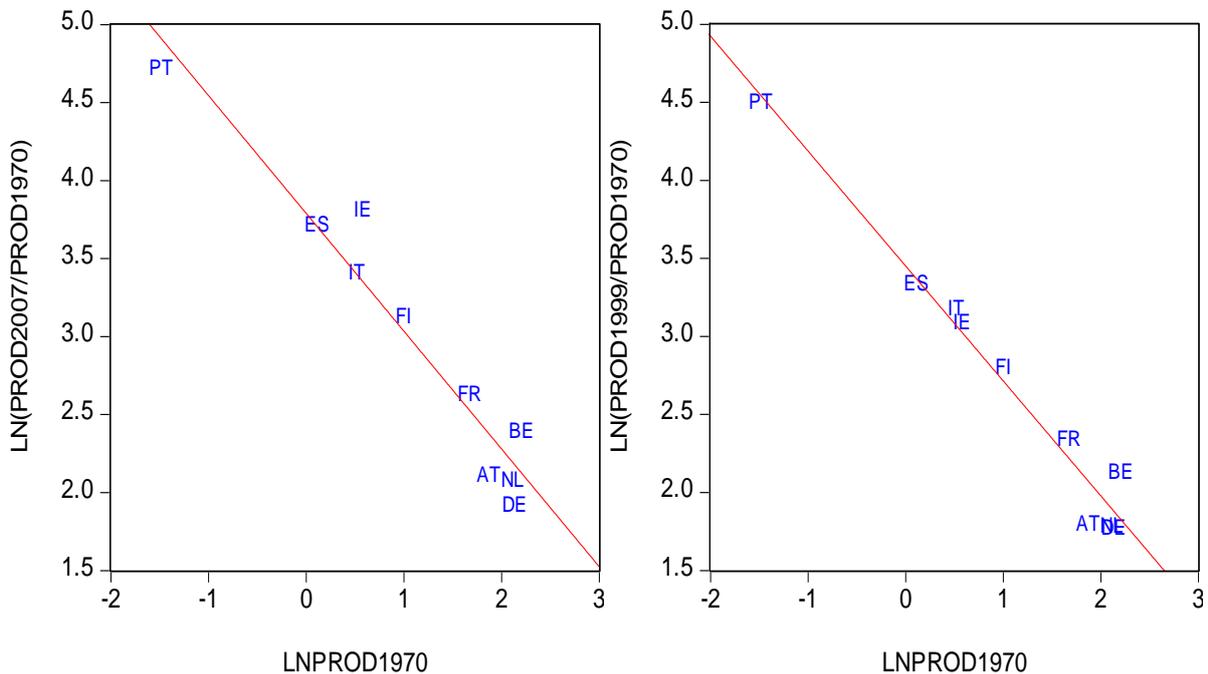
Table.4 MARKET SERVICES BETA CONVERGENCE TEST RESULTS

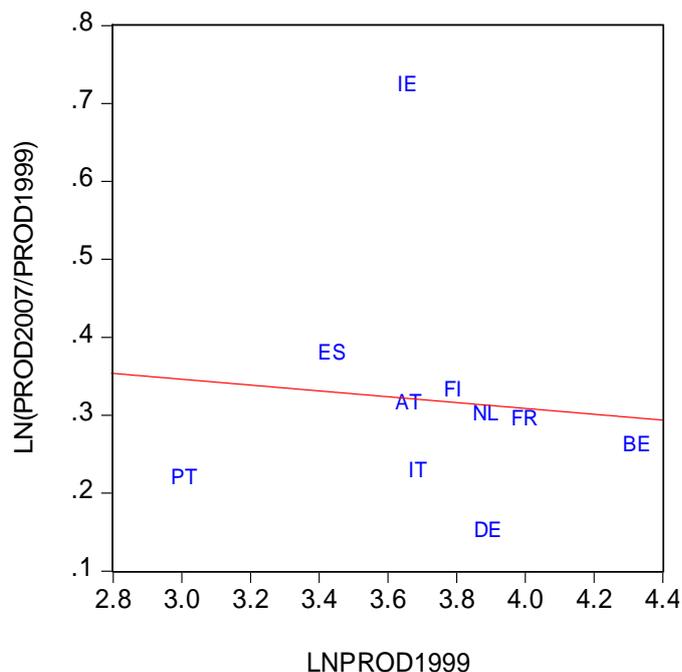
	1970-2007	1970-1999	1999-2007
β	0.0206***	0.0263***	0.0075
s.e	0.0018	0.0017	0.0204
Rsquare	0.9387	0.9671	0.0169

Note: ***significant at 1 %, ** significant at 5%, * significant at 10%

β convergence rates are positive and significant for longer time periods as in the production sectors. The values are 2,6% from 1970 to 1999 and 2,1% from 1970 to 2007. However, it is close to zero and insignificant for the Euro era. The Goodness-of-fit values are quite high for the longer periods of time but it is very low for the Euro era. The inclusion of the Euro era diminishes the convergence rate in this case as well. Figure 11 depicts the dynamics which are figured out by the regressions.

Figure.11 MARKET SERVICES LABOR PRODUCTIVITY GROWTH RATES vs. INITIAL LABOR PRODUCTIVITY LEVELS





It can be easily seen from the Figure 11 that the negative relation between the initial labor productivity and labor productivity is very firm for the longer periods of time but very unclear in the Euro era. Some countries, like Belgium, Netherland and Finland, with high initial labor productivity achieved higher labor productivity growth rates than the initially less productive countries like Portugal and Italy.

It is very unfortunate that the literature is quite limited for the labor productivity convergence that may give some opportunities to compare the results. And the sources become much scarcer when it comes to sectoral level convergence analysis. Barro and Sala-i-Martin (1991) is a unique example for the sectoral level convergence analysis. They extensively investigated the convergence dynamics within the U.S states for the period between 1963 and 1986. They also delve into the sectoral labor productivity convergence. They found that the convergence rate ranges between 0,93 % and 1,5% for the market services which are lower than the values of the Euro zone countries for the longer periods of time. They also found that the convergence rate ranges between 1,7 % and 4,6% for the goods production. And 4,6% is for the manufacturing which comprises the largest part of the goods production. Thus, the labor productivity convergence in goods production is larger in the U.S. states than in the Euro zone. This is very interesting result and requires a more detailed analysis. The weighted average convergence rate is 2,13% for the US states for all industries. That is very close to the weighted average convergence rate of the Euro zone countries for the period 1970-2007. The value for the period 1970-1999 slightly exceeds the value of the US states.

The results of my study for the Euro period correspond to the results of Marelli (2007) to a certain extent. He found convergence at a very low rate and significant just at 10%. This difference can be caused by several reasons. He used regional data instead of country-level data. Thus, the number of variables differs. Secondly he used product per worker as the indicator of labor productivity instead of the product per hour worked. With this method, the countries with higher working hours can have relatively better productivity values compared to the product per hour worked method.

6.2 Sigma Convergence

Sigma convergence is a concept which aims to indicate the evolution of the distribution of a specific variable. The more disperse the distribution of the variable gets, the higher the deviation from the mean is. As dispersion increases, sigma convergence values increase. The opposite case is that as dispersion decreases, sigma convergence values decrease and the distribution of the variable becomes more equal. Some debaters have argued that the sigma convergence is more relevant concept than the beta convergence. Quah (1993) underlines the methodological problems in the calculation techniques of the beta convergence. Durlauf et al. (2005) noted that there is no real theoretical connection between beta convergence and the concept of economic convergence. On the contrary, Sala-i-Martin (1996) supports the idea that beta convergence is a necessary condition for the sigma convergence.

I measured labor productivity dispersion within the Euro zone according to the following equation.

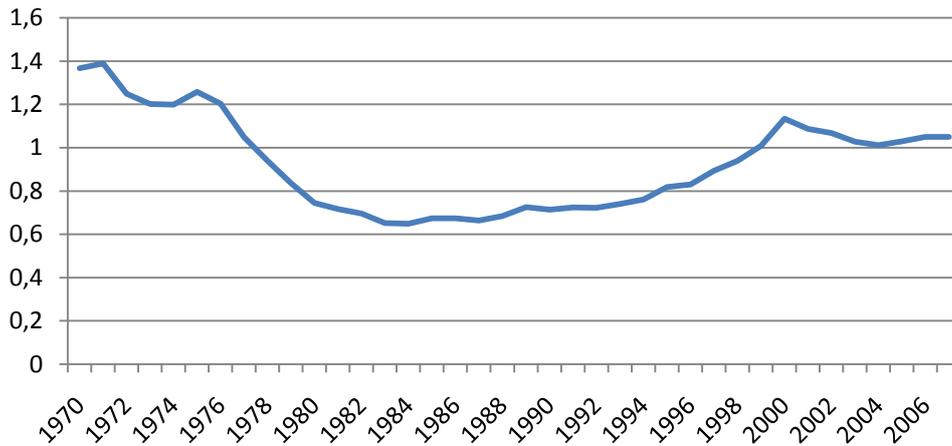
$$\sigma_t^2 = \frac{1}{N} \sum_{i=1}^N (\log(y_{it}) - \mu_t)^2 \quad (3)$$

where y_{it} is the labor productivity level and μ_t is the sample mean of $\log(y_{it})$. N is the number of countries under study and equal to 10 in this case.

6.2.1 ELECOM

The figure below depicts the evolution of the labor productivity dispersion in the ELECOM industry.

Figure.12 ELECOM LABOR PRODUCTIVITY DISPERSION within the EURO ZONE



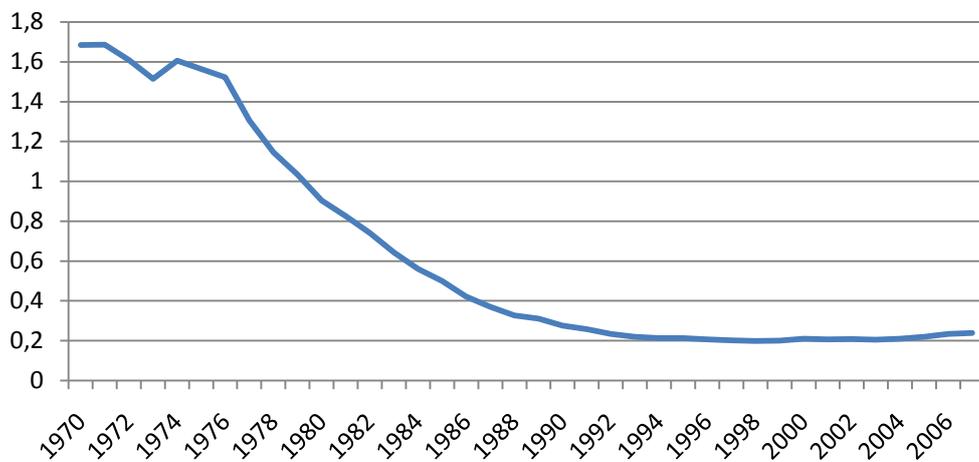
The labor productivity dispersion within the Euro zone countries in the ELECOM industry diminished abruptly from 1970 to the mid 80's. Thereafter, the downward trend reversed and the dispersion had increased until around 2000 but not reached to the levels in the 70's. The upward trend lasted in the beginning of the 2000's. A slight decrease in dispersion can be observed for the following years.

It is very interesting to find out two break points of the ongoing trends. The mid 80's is the period of time at which the initial downward trend lasted. The characteristic of this period of time is being the starting period of the IT revolution which has shaped our near future. Apparently, some Euro zone countries missed the tipping point at the time. And the dispersion had widened without any break until the 2000's. This time was another turning point after which a downward trend started but not as steep as in the 1970's.

6.2.2 Goods Production

The figure below depicts the evolution of the labor productivity dispersion in the traditional goods production sector.

Figure.13 GOODS PRODUCTION LABOR PRODUCTIVITY DISPERSION within the EURO ZONE



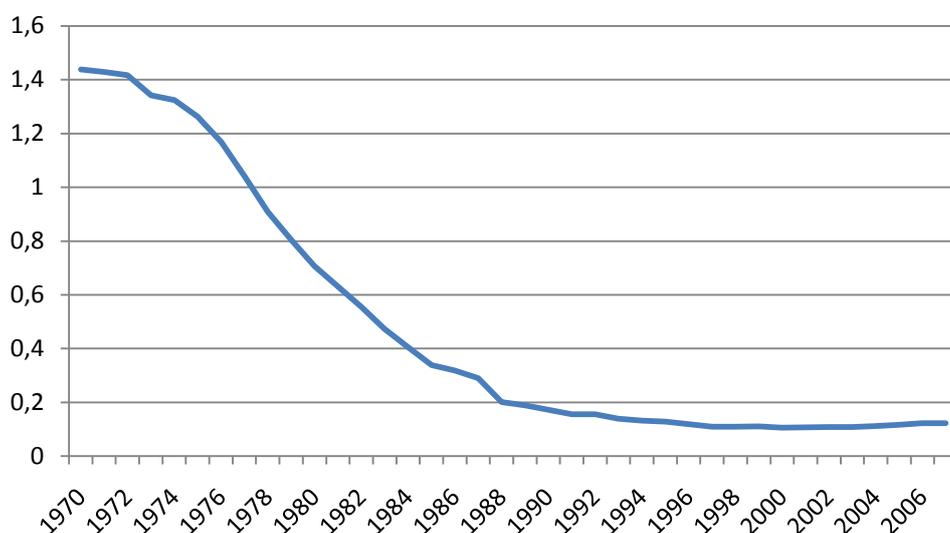
The dispersion had dramatically declined from 1970 to the early 90's. After the early 90's, it has remained constant.

At this point, it is worth comparing the results of the IT production and the traditional goods production. The dispersion level was almost same in 1970. After 1970, the dispersion had significantly decreased in both. However, after the mid 80's, trend in the IT industry differentiated from the trend in traditional goods production sector. The downward trend in the IT industry reversed and the dispersion started to increase. This upward trend lasted in the 2000's. Meanwhile, the downward trend in the traditional goods production sector had continued until the early 90's. Afterwards, the dispersion has remained constant. As a result of this differentiation in the trends, the current dispersion in the IT production considerably exceeds the current dispersion in the traditional goods production sector.

6.2.3 Market Services

The figure below depicts the evolution of the labor productivity dispersion in the market services.

Figure.14 MARKET SERVICES LABOR PRODUCTIVITY DISPERSION within the EURO ZONE



This graph resembles the previous one. The dispersion had dramatically declined from 1970 to the 90's. Afterwards, it has remained constant.

Although the debaters can't agree upon the most relevant convergence concept, the results of these two different techniques are consistent from my study's point of view. There is no further convergence in the Euro era but convergence dynamics are very firm if the examination is conducted with longer periods of time. And this result holds for all three sectoral categories.

The results regarding the Euro era are different from what was estimated but consistent with my theoretical reasoning. Since the economic integration among the Euro zone countries hasn't changed very dramatically during the Euro era, it can be suggested that the initial integration among Euro zone countries prior to joining the common currency was close to Q_1 level which was depicted in Figure 8 and Figure 7. Thus, the laggards couldn't benefit from the joining the Euro in terms of the labor productivity with given integration level. As a result, the convergence progress halted.

7. Convergence, Distance to the Frontier and the Integration within the Euro

Another interesting observation is that although the integration among the Euro zone countries had been much lower in the 70's, 80's and 90's than today, we can observe very firm convergence dynamics from 1970 to 2007 but not in the recent Euro era in which the

integration level is the highest. In the first sight, it may seem as the contradictory evidence to my theoretical framework but the inclusion of one variable will dramatically change the picture.

Some of the recent works on the economic growth theory, Aghion and Howitt (1992) and Aghion and Howitt (1998), are based on the quality-improving innovations. This branch of the theory put the emphasis on productivity growth as the source of long-run growth as in all other neo-classical or endogenous growth theories. However, they split the sources of the technological growth into two different inputs: leading-edge innovation and implementation of the best existing innovations. A simplified version of the model can be described as the following one:

$$A_{t+1} - A_t = \mu_n(\gamma - 1)A_t + \mu_m(\bar{A}_t - A_t) \quad (4)$$

A_t denotes the aggregate productivity parameter. \bar{A}_t is the aggregate productivity parameter of the technological leader. And γ describes the technological advancement on the previous technological level.

μ_n stands for the frequency of the cutting edge innovations and μ_m stands for the frequency of the imitations.

Hence, growth rate can be described as;

$$g_t = (A_{t+1} - A_t) / A_t = \mu_n(\gamma - 1) + \mu_m(a_t^{-1} - 1) \quad (5)$$

where

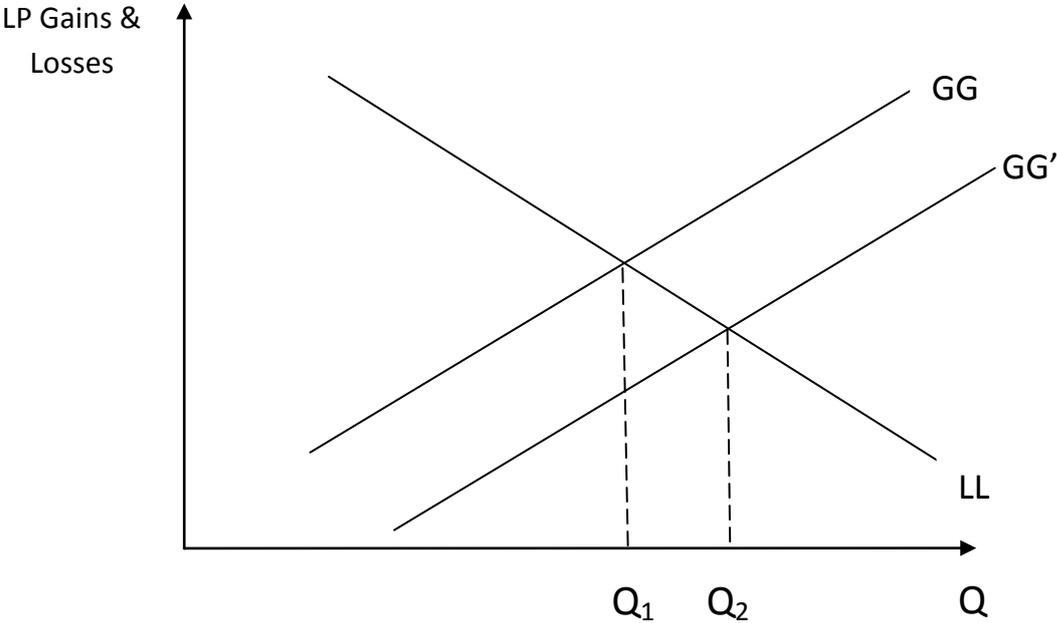
$$a_t = A_t / \bar{A}_t$$

a_t is the measure of the distance to the frontier. In this respect, as the backward countries approach the frontier, the productivity growth rate decreases other things being equal.

This analytical framework gives the reason behind the evidence that relatively backward Euro zone countries were able to converge to the frontiers in the longer periods of time even though they had been less integrated with the technological leaders. Before reaching the ultimate conclusion, it would be very beneficial to grasp how the change in distance to the frontier may affect the mechanisms which lead labor productivity gains (or losses) from the joining a common currency union. As the backward countries approach the frontier, the potentiality for the learning by exporting, technology transfer and human capital transfer diminishes because

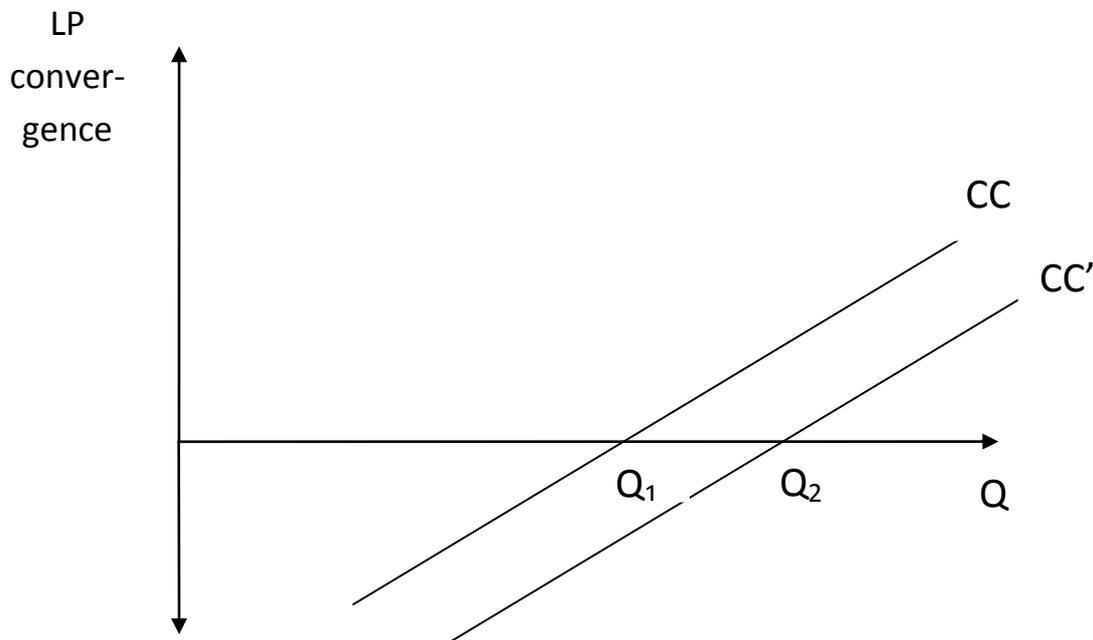
of the exploitation of the technological gaps with the frontiers. In this respect, as the backward countries approach the frontier, the labor productivity gains of the backward countries from the joining a common currency diminish with a given level of integration. In terms of the diagrammatic scheme, the GG curve shifts to the right. GG' becomes the new labor productivity gain curve. As a result of this shift, the necessary integration level for the labor productivity gains increases from Q_1 to Q_2 .

Figure.15 The IMPACT of DISTANCE to the FRONTIER on the LABOR PRODUCTIVITY GAINS & LOSSES FROM the JOINING a COMMON CURRENCY AREA



That shift in GG curve also causes a shift in CC curve which is presented in the Figure 15. As a result, the necessary integration level for the convergence to the frontier increases.

Figure.16 The IMPACT of DISTANCE to the FRONTIER on the LABOR PRODUCTIVITY CONVERGENCE and INTEGRATION



This analytical framework provides an explanation for the convergence and integration phenomena within the Euro zone countries that is consistent with the historical paths. In the past, the distance between the laggards and technological leaders of the Euro zone countries was high and the potentiality for the labor productivity gains was larger and the necessary integration level was lower. Any increase in integration had led to the productivity gains and the convergence to the frontier. However, as the laggards approach the frontier it had been getting harder to exploit the differences with the frontiers that necessitate higher level of the integration. As it was discussed in the previous sections, the effect of the Euro on the integration among the Euro zone countries has been quite limited. It seems that the integration within the Euro zone countries comes to its natural borders, i.e. steady state. As a result of this halt, the labor productivity gains from the joining the Euro have been quite limited for the laggards of the Euro zone like Italy, Spain and Portugal. A brief examination of the change in the distances to the frontiers can give some empirical evidences that support my theoretical framework.

Table.5 DISTANCE to the FRONTIERS in DIFFERENT SECTORS

	ELECOM		GOODS PRODUCTION		MARKET SERVICES	
	DtF1970	DtF1999	DtF1970	DtF1999	DtF1970	DtF1999
Austria	1,39	1,96	1,70	2,09	1,39	1,94
Belgium	1,79	1,54	1,20	1,00	1,00	1,00
Finland	3,04	1,02	4,45	1,94	3,32	1,71
France	1,53	1,49	2,67	1,61	1,70	1,39
Germany	1,14	1,84	1,25	1,71	1,07	1,54
Ireland	14,45	1,00	7,01	1,69	5,08	1,95
Italy	6,66	2,27	8,96	2,09	5,37	1,89
Netherlands	1,00	1,44	1,00	1,38	1,09	1,55
Portugal	26,98	3,71	57,35	5,82	39,82	3,73
Spain	6,10	2,44	8,48	2,62	8,11	2,43

Source: own calculation based on EU KLEMS database values

Table 5 indicates the distances between the laggards and the leaders in 1970 and in 1999. Distance to the frontier is calculated as the labor productivity level of the leader divided by the labor productivity level of individual countries. In this regard, the countries with the value of 1 are the labor productivity leaders.

The table shows that distances to the frontiers of the laggards, like Portugal, Italy and Spain, were dramatically greater in 1970 than in 1999.

8. Conclusion

This study documents that there is no further labor productivity convergence in the Euro era in none of the three sectoral categories. According to my theoretical framework, this result should stem from the fact that the initial integration among the Euro zone members should be close to Q_1 level since the creation of the Euro hasn't improved the economics integration among the members as it is shown by empirical studies. These limits on integration process damages convergence progress within the Euro zone.

I started with a brief study of developments in the labor productivity growth rates of Euro zone countries. My focus is on the Euro era from 1999 to 2007 and I cover developments in three different sectoral categories, IT production, traditional goods production and market services. The empirical evidences indicate that Ireland is the only country which showed above average performance in all three categories. Finland and Germany achieved above average labor productivity growth rates in the production sectors but below average in the

market services. Austria and Belgium performed above average in the traditional goods production sector but below average both in the IT industry and market services. France had growth rates around average in all three categories. Netherland achieved above average growth rates just in market services and Portugal just in the IT industry which is quite surprising. The last places belong to two Mediterranean countries, Spain and Italy. They had below average growth rates in all three sectoral categories. Italy's performance is especially disappointing by having the lowest labor productivity growth rates in all three sectoral categories.

Then, I touched upon the impact of the labor productivity growth differentials on the external imbalances within the Euro zone countries. The usage of common currency rules out the devaluation mechanism as a tool of sustaining competitiveness. Thus, ULC determines the degree of competitiveness. When this fact couples with the slow response of the wages to the changes in labor productivity, the labor productivity becomes the major determinant of the current account balance. Accordingly, countries, which had achieved high labor productivity growth rates in the goods production, had run current account surpluses. The only exception is the case of Ireland which requires a detailed study that should include the future expectations and labor market institutions. Unfortunately, this framework provides a gloomy future economic outlook for the less productive Mediterranean Euro zone countries. If these countries won't be able to boost their labor productivity growth in a miraculous way, the decrease in nominal wages may be necessary given the low inflation in the Euro zone. This resolution is generally accepted as inapplicable due to various economic and political reasons. I read this picture as low productive Mediterranean Euro zone countries are trapped in the low competitiveness and that led to the structural current account deficit in these countries. A real resolution requires reforms in the labor market which would increase responsiveness of the wages to the changes in the labor productivity growth. Secondly, these countries should revise their institutional framework in order to eliminate the structures that avoid the labor productivity increases. For example, Aghion et al. (2006) elaborates how the initially favorable institutions turn to be obstacles to the labor productivity increases as backward countries approach the frontier.

I provide a theoretical framework when backward countries benefits (or loses) from the joining a common currency in terms of the labor productivity. My ultimate result is that there

is an integration threshold for the labor productivity gains from the joining a common currency union. Accordingly, the convergence to the frontier is a positive function of the integration.

The labor productivity convergence tests uncover the fact that there had been no convergence in the Euro era from 1999 to 2007. However, the labor productivity convergence can be firmly observed if the period of time under study is changed to longer ones. This result holds for all three sectoral categories. .

In addition to the previous discussions, I noted by rearranging the theoretical framework that as the backward countries approach the frontier the threshold integration level goes up. The reason is that the potentiality for the exploitation of the gaps diminishes. Thus, it becomes harder to gain in terms of the labor productivity. Therefore, the labor productivity gains decrease from the joining a common currency with the given integration. That pushes up the minimum integration level which is necessary for the labor productivity gains. This rearrangement properly adapts analytical framework in order to explain why convergence can be observed in the longer periods but not in the Euro era although the integration level had been lower in the past.

As a concluding remark, the barriers, which hinder any extra integration, should be abolished in the Euro zone countries and reforms, which encourage further integration, should be imposed. Determining the barriers and identifying the necessary reforms require extensive research which should take place in the economists' and policy makers' agenda.

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