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The Productivity Slowdown Puzzle in European Countries

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Abstract

Productivity growth is slowing around the world and this is one of the most disturbing and, no doubt, worrying phenomenon affecting the world economy in the new millennium. The productivity slowdown may appear alarming in relation to the fact that weak productivity growth usually means a lower trend of the whole economy, as well as a lower level of profits, wage and a less public and private debt sustainability.

In this project, our aim is to study the causes of this fall and, in particular, how much and in which manner labour market regulation, and its changes, may affect productivity of labour, capital and the technological progress.

We start our analysis from some stylized facts. Specifically, we use the growth accounting methodology. We collect data for a large group of European and non-European countries and we refer to models related to the economic growth theory. In particular, the exogenous growth theory of Solow (1954) attributes the economic growth to technical progress, and it claim, in its standard formulation, that it does not depend on other economic variables.

In 1963, Nicholas Kaldor listed some stylized facts which seemed to be, with sufficiently widespread, the general empirical regularities of the growth process. Starting from Kaldor model, we will attempt to build an "exogenous" and then an "endogenous" growth model, related to the labour market regulation, which would be coherent especially with the current characteristics of the economic cycle, characterized by a phase of post-crisis and mild economic recovery. Then, with the use of Structural VAR model, we will analyse the responses of three driver variables to three shocks. We will discuss these responses in order to understand the macroeconomic implications. Mainly, the empirical evidence provide support to our view of the complex relationship linking productivity, investment and technological progress with labour regulation in the long run.

Summary

First Chapter

Productivity Slowdown

1.1 Introduction

Productivity growth is slowing around the world, and this is one of the most disturbing and, no doubt, worrying phenomenon, that is affecting the world economy in these first years of the new millennium. The productivity slowdown may appear very alarming in relation to the fact that, as it is well known, its weak growth usually means a lower trend growth of the economy, as well as a lower level of firms' profits, a lack of wage trends and less debt sustainability.

In this project, our aim is to understand how much and in which way labour flexibility, introduced since the early 90's in Italy and in the most Western European countries has affected the productivity of capital, the productivity of labour and the technological progress. Our intent is also to try to find and to understand the causes of this fall. The evidence shows that in the last fifteen years, so since the early Nineties, most of the European countries, and especially among them Italy, are going through a period of clear economic decline. They have recorded the worst economic performance from the end of the Second World War accompanied, paradoxically, by increased employment, until the last few years. The symptom more evident of this stagnation has been the slowdown in the growth rate of labour productivity. Until the late eighties, instead, although in a context of a general reduction in the growth, the productivity of European countries remained higher than the US. It is therefore necessary to understand the roots of this negative situation, investigating the functioning of the labour market and the model adopted by these countries, in particular the role played by flexibility, in order to understand which variables are more or less involved.

The project is divided into seven chapters and it is organized as follows. In the first one, we will present the problem of the productivity slowdown, trying to find out the possible causes and to understand the variables involved in this kind of phenomenon. We will start describing the economic situation of Europe, to make an idea of which is the general economic trend of the countries, with a detailed description of the variables involved, in order to have a clearer picture about the trends of innovation, technological progress, investment, capital accumulation and productivity, which are the drivers of the economic growth.

In the second chapter, we will describe the theory of Growth Accounting, in order to reach the definition of Total Factor Productivity (TFP), a key element of the analysis. To make a clear and complete analysis, however, it is fundamental collecting specific data. We will use the Ameco database of the European Commission for both European countries and for USA and Australia, so that it will be possible to make comparisons among them.

Our intent is to go more in deep, analysing which is the economic situation of a specific country, so the third chapter focus on the Italian case. Italy, indeed, has gone and it is still going through a moment of decisive changes, due to several structural reforms and to different European economic policy measures. Despite being among the most industrialized countries and between the world powers, it has shown in the last twenty years strong weaknesses both in the real economy and in the financial economy.

The fourth chapter makes an overview of all the most important labour market models, that over the years have been developed by the leading economists and by the

main schools of thought, until arrive to the most recent dynamic growth models. It is from these last models, in particular focusing on Solow and Kaldor model, that we lie the foundations for the construction of a new model with similar characteristics but more near the current economic situation and business cycle.

Our goal in the fifth chapter is to build a theoretical exogenous growth model, which can involve all the key variables necessary to describe the condition of the labour market. We construct a Price – setting and Wage - setting model and we test what happen to the system if we introduced shocks.

We will make, moreover, in the sixth chapter, an empirical verification with the construction of a micro-founded model. We will estimate, with the use of Structural VAR, the responses given by three driver variables (capital intensity, Total Factor Productivity and GDP Price Deflator) to three shocks (two supply shocks, capital and technological shocks, and a demand shock). These responses permit us to understand the macroeconomic implications for the system that lies behind supply and demand shocks.

In the seventh chapter, we summarize the work done along the project, the variables involved, in order to analyze the productivity slowdown phenomenon, the literature contribution studied to construct our model, the results obtained. Our aim is to have a desirable confirmation of the initial hypotheses presented, and, hopefully, the possibility to make forecasts and prevention for the future.

1.2 The State of Art: The Productivity Slowdown Puzzle

Let us start seeing more in depth, which is nowadays and which has been in the last years the situation of the economies on the world and especially the European countries' economies, in order to focus on our main problem. With the end of the twentieth century and the beginning of the new millennium in European countries and especially in developing countries, like Italy, experience a structural change in the trend of economic growth. This change is reflected in an increasingly marked slowdown in the GDP growth rate and in the deterioration of labour productivity, real investment and international competitiveness. Interpreting this Long-Term phenomenon is not easy. Between the late eighties and the first years of the new Millennium, the organization of European labour markets changes profoundly towards increasingly deregulated, flexible and precarious forms and contracts. Parallel it is revolutionizing the organization of international financial markets, expanding with ever experienced before capital mobility modes. New emerging countries such as China and India entering the global stage, they change, but in a direction still to be defined, the balance in Middle East, with the inevitable tensions in the markets of oil products and the Mediterranean geopolitics.

In short, the process of globalization and liberalization of markets pushes the world economy, and especially the European economies, along a ridge unprecedented growth path of new unknowns and with a predominantly liberal character, both economic and social, that had sustained European economic development from the post-World War II onwards. In seeking to understand this problem, it is tempting to invoke the global financial crisis that erupted in 2008. It disrupted the availability of credit, which is important for innovation, and it slowed the growth of international trade, with which increases in productivity and technical efficiency are associated historically. There seems to be substantial agreement among scholars that the productivity slowdown level is only partly attributable to the crisis of 2008 and that it refers to deeper economic problems.

Among other things, the phenomenon began to manifest itself in the early years of the new millennium, although it has since worsened. The crisis has reduced, however, the flow of credit for firms' investment by the banking system, which had to keep locked resources in firms in difficulty, not so able to direct funding towards new sectors with higher productivity. Firms are parallel become more cautious, preferring to maintain high liquidity rather than embarking on risky projects. On the other hand, the crisis has helped keep wages low, thus reducing the incentives of firms to substitute capital for labour. Meanwhile, in the public sector austerity policies and other difficulties they have led to the reduction in the various countries also increased government investment.

A common explanation of the productivity slowdown phenomenon refers to some changes in the structure of economies. Therefore, the argument is that rich countries, which have already recorded a strong level of automation in industry, are developing their activities in the service sector, which has fewer spaces for rapid gains in efficiency and that has not been invested in massively from automation processes.

Simon Taylor (2016) has recently advanced a new hypothesis. In the last period, says the author, the degree of concentration of many sectors is increasing significantly, from telecommunications, social media, to internet search engines, pharmaceuticals, electronic commerce, etc. On the other hand, he notes that the anti-trust authorities have

slowed their pressure on firms. The scholar concludes that this trend can be explained at least in part the productivity slowdown, because in a monopolistic situation, the undertakings, having less need to generate adequate profits, have incentives to invest less in innovation.

Another important explanation relates to the field of high technologies refers to the finding that the innovations are no longer passing quickly from the few progressive firms in the rest of the economy, as happened once; the diffusive machine is jammed (O'Connor, 2016), perhaps, again, to increase the monopoly power of a few large firms.

Another possible evaluation would have to do with the quality of work. While employees with high qualifications are retiring, a workforce that is less competent and efficient, because studied less gradually replaces them. Of course, the segment of the population that is less educated today is that of the poorest and weakest.

A more technical consideration, finally, has to do with institutional factors, such as education and vocational training quality, the public infrastructure, the organizations that promote entrepreneurship, etc. All these activities in the last times are suffering a lot due to lack of resources.

Nevertheless, the slump in the Total Factor Productivity, which is the driver for the growth, as we will demonstrate ahead in the research, is widespread. It is not limited to or even differentially evident in countries most directly affected by the financial crisis. In the advanced countries, where the deceleration in productivity growth predates the financial crisis, some observers have invoked the hypothesis of secular stagnation, suggesting that productivity growth has slowed because of a decline in innovation or, possibly, inadequate spending on the demand side. For this reason, there will be the technical progress and the trend of the aggregate demand the variables involved in our studies, in order to get some results that could explain the problem of productivity slowdown. We will describe in the next paragraphs the general economic situation of European Countries, to go then more in depth to the causes of our problem.

1.2.1 The European Framework

The economic crisis, the demographic challenge, migration, youth unemployment and the Transatlantic Treaty: a synthetic analysis of the field of problems across the Union in the recent years. What is most alarming, however, is that in the last fifteen years, European countries have recorded the worst economic performance since the end of the Second World War. This disappointing evolution has been the subject of increasing scrutiny over recent years.

We can distinguish, at a glance, two revolutionary facts, which have struck Europe in recent years: one from a “real” point of view, the deregulation of the labour market, resulting in a greater flexibility within the same and the other one that interest the “monetary” sphere, the introduction of the *Euro,* the single currency. These two phenomena, combined together, have generated significant consequences, both on the side of the real economy and on the side of the financial economy, which are synthesized in the fall in productivity of both labour and capital and in serious consequences on employment and investments.

Starting from the real side, since the launch of the Lisbon agenda in 2000, about ten million labours have been created in the EU. This strategy has provided a satisfactory answer to the problem of the rising European unemployment of the 1980s, but many countries have seen labour productivity decline over the same period. Thus, after the labourless growth of the 1980s and early 1990s. One first possible explanation to this phenomenon is that the rise in employment itself has caused the productivity slowdown. A short-run trade-off between employment and productivity may indeed emerge if the rising employment entails a lower capital per worker, and if more workers with relatively low skills are employed. Most of the recent literature has focused to shocks to labour supply, such as changes in real-wage aspirations and labour market institutions, to explain differences in economic performance among countries. In this perspective, the productivity slowdown in the EU15 is only a short run effect of the increase in the employment rate, with productivity recovery in the long run. However, in principle, any number of causes can explain the current trade-off between employment and productivity, including a deceleration of the technological progress, a decrease in the ratio of capital stock per worker, an adverse effect of the composition of labour supply due to recent immigration, changes in labour market policies and institutions, variations in the distribution of income with unfavourable consequences on profits and investments, or any combination of these. We address the question of whether the shift in the labour supply curve is the only fundamental change capturing the negative correlation between the growth rates of productivity and employment. If this explanation is correct then the labour demand curve did not shift in recent times, keeping other features of the production function unchanged. This problem of identification may account for the mixed empirical results found by several authors on the relationship between productivity and employment.

1.2.2 European Monetary Policy

As we have already said before, from a monetary aspect, the introduction of the single currency has determine some consequences in the real economies of the countries involved. Let us analyse the situation.

As it is known, the European Union has experienced a very important and fundamental event. In 1999, indeed, the European Union decided to go one-step further and started the process of replacing national currencies with one common currency, called the *Euro*. Only eleven countries participated at the beginning; since then, six more have joined. Some countries, in particular the United Kingdom, have decided not to join, at least for the time being. The official name for the group of member countries is the *Euro Area*. The transition took place in steps. On the first January, 1999, each of the eleven countries fixed the value of its currency to the Euro. For example, a Euro was set equal to 6.56 French francs, to 166 Spanish pesetas, and so on. From 1999 to 2002, prices were quoted both in national currency units and in Euro, but the Euro was not yet used as currency. This happened in 2002, when the Euro notes and coins replaced national currencies. Seventeen countries now belong to this common currency area. So nowadays, the European Central Bank (ECB) and the European System of Central Banks (ESCB),

which are independent from other EU institutions and from national governments, manage the monetary policy. The primary objective of the European monetary policy is the price stability, defined as "a situation in which the 12-month increase in the consumer prices for the euro area is less than the 2% over the medium term time horizon". Therefore, the first target of the EBC is the inflation.

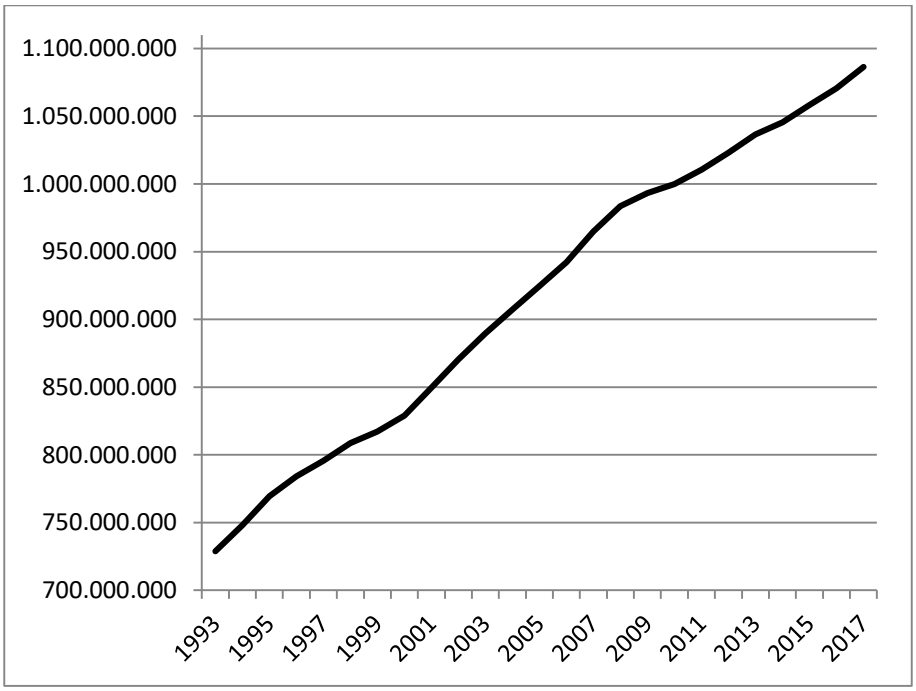


Figure 1. Euro Area Price Deflator Gross Domestic Product
Sources: AMECO - Annual macro-economic database – European Commission

Figure 1 shows the trend of the Price Deflator of Gross Domestic Product for the Euro Area from 1993 until 2017. This variable is a driver for the inflation. It is easy to see that the line is stably increasing, reflecting the limit of 2% imposed by the monetary authority. This goal, the monetary stability, is essential in order to ensure the maintenance of price stability in the euro area and to preserve the international value of the euro, i.e. its purchasing power.

However, there are other secondary objectives as much important, such as the economic development, the employment, the social and the environment protection. The ECB's strategy, therefore, is based on two pillars: the control of the money and the maintenance of stable inflation in the medium term. The instruments used are the official rates, the reserve requirements for financial intermediaries, the open market operations, direct controls (supervision); through channels such as the interest rate, the exchange rate, financial asset prices, bank lending channel, financial credit channel. A restrictive monetary policy implies a reduction in aggregate and an increase in the monetary interest rate (on deposits), conversely an expansionary policy entails an increase of the currency and a reduction in the rate. With the creation of the European Monetary Union, through the Maastricht Agreement of 1992, in any case, the changes were not only institutional with the transfer of responsibility for monetary policy from national central banks to the

ECB, but also economic and share with the entry into circulation since 2002 of the single European currency, the Euro. This event, in fact, has brought with it a series of above all financial consequences, but undoubtedly linked to the real economy, which generated in the majority of acceding countries to the union, a lot of internal imbalances that need a reorganization through economic policies adequate. Anyway, a monetary union not accompanied by a fiscal and political union, as we will see in the following paragraphs from the data that describe the recent European situation, hardly can stand.

1.2.3 Euro or not?

Since its entry into force, the single currency was seen as a new problem for the European Union. Economists and citizens are divided between those who are in favour of its circulation and those who are against it.

Supporters of the euro point out first to its enormous symbolic importance. In light of the many past wars among European countries, what better proof of the permanent end to military conflict than the adoption of a common currency? They also point out to the economic advantages of having a common currency: no more changes in the relative price of currencies for European firms to worry about, no more need to change currencies when crossing borders. Together with the removal of other obstacles to trade among European countries, the euro contributes, they argue, to the creation of a large economic power in the world.

Others worry that the symbolism of the euro may come with substantial economic costs. They point out that a common currency means a common monetary policy, which means the same interest rate across the euro countries. What if one country plunges into recession, while another is in the middle of an economic boom? The first country needs lower interest rates to increase spending and output; the second country needs higher interest rates to slow down its economy. If interest rates have to be the same in both countries, what will happen? Is not there the risk that one country will remain in recession for a long time or that the other will not be able to slow down its booming economy?

Until the first years of the adoption of Euro, the debate was somewhat abstract. It no longer is. A number of euro members, from Ireland, to Portugal, to Greece, are going through deep recessions. If they had their own currency, they likely would have decreased their interest rate or depreciated their currency so that they would see to increase the demand for their exports. Because they share a currency with their neighbours, this is not possible. Thus, some economists argue that they should drop out of the euro. Others argue that such an exit would be both unwise, as it would give up on the other advantages of being in the euro, and extremely disruptive, leading to even deeper problems for the country that has existed. This issue is likely to remain a hot one for some time to come. (Blanchard, 2012).

1.2.4 Exchange Rate and Competition

In 2013, the Italian President of the ECB, Mario Draghi, said that the euro exchange rate has very much appreciated against all the major currencies, indicating a return of the confidence in Europe. No doubt, it was an affirmation to encourage the exit from the crisis and from the economic pessimism climate that was present in the operators early as the 2008 outbreak. Nevertheless, a strong national currency against foreign ones, is really a good thing and to be happy about? If we look at foreign and international context, the productivity of a state must necessarily be related to the competitiveness and the economy of that country is able to support than the others. This aspect is more significant for Italy, if we consider that it as well as one of the world state is inserted in the complicated and ever-changing European context. Intuitively, the notion of competitiveness can be immediately linked to the relative comparison between the growth rates of different countries but also to the evolution of a commercial nature, and international agreements with the related benefits that may ensue.

We can distinguish two main meanings of competitiveness, a short-term price competitiveness, linked to changes in the real exchange rate and the consequent change in unit production costs; and a long-term competitiveness of technological character. Whereas the nominal exchange rate is defined as the price of foreign currency in terms of national currency, while the real exchange rate is the ratio between the prices of domestically produced good, expressed in local currency, and the price of foreign production good, which is also expressed in local currency. Therefore, we can consider the following relationship:

$$R = P_1/EP_2 \tag{1}$$

where:

P_1 : price of domestically produced expressed in domestic currency (e.g. €)
P_2 : price of foreign production expressed in foreign currency (e.g. $)
R : the real exchange rate
E : the nominal exchange rate (e.g. € / $)

If R is increasing, it has an appreciation and it determines a decrease in the price of international competitiveness for the local producer, while if R is descending, it has a depreciation with a consequent increase in the price of international competitiveness for the local producer. Price competitiveness can be obtained with a devaluation of the nominal exchange rate, i.e. an increase of E, or by a decrease in the price of locally produced goods (P_1) obtained by reduction of unit costs. The depreciation of the real exchange rate can be achieved with a reduction of the debt, as lower debt implies lower interest rate, possibility of more investment abroad, decrease in national currency value. This, however, is not a sustainable strategy in the long run, in fact if the price of imported goods increases, the inflation increases, causing a fall in domestic investment and consequently in productivity. The long-term technological competitiveness is determined by innovation, which implies higher productivity and exports, it is compatible with products of the highest prices (higher quality indicators) and a higher value of the national

currency. It implies the idea that relations between countries can be characterized as a positive sum game rather than a game to zero sum. How to increase the long-term competitiveness is the main question that arises the theory of growth.

The introduction of the single currency in Europe, determined, with no doubt, major changes in the international monetary environment. They were born new relations of exchange rate between the Euro and other major currencies like the US dollar, the British pound and the Japanese yen. The euro-dollar relationship, especially, it is significant to have a comparison between the performance of the European economy and the American economy. The historian of the euro-dollar exchange rate was established, as opposed to many those who think, already in 1999, and not in 2002, the official year when the euro was introduced into people's pockets. For accounting purposes, and within the financial markets, the euro was born in the past millennium, namely the first January 1999, when it began to be traded within such financial transactions. It is on that date that is born historian of the euro-dollar exchange rate, along with historical graphs of exchange rates between the euro and other currencies. From the birth of the historian of the euro-dollar exchange rate it has been 3 years before the euro began to circulate in the pockets of the Europeans, or rather, in the countries of Europe who have agreed to use the euro as their single currency.

Therefore, if the 1999 was the date when our currency has started to be used for financial and accounting transactions, the euro-dollar exchange rate (EUR USD) came in 2016 in his eighteenth year of age. It is considered nowadays the most famous exchange rate in the world, the most absolute liquid and the most chosen by investors, because it allows earning money by investing both in the long and in the short-term. How was the euro-dollar exchange rate trend during these years? What were the peaks and the minimum of this relationship? In what way can we use the historical data to invest in the future and to make forecasts? Let us see more in depth, which has been the trend of the euro-dollar exchange rate over the years in the graph below, in order to answer our questions.

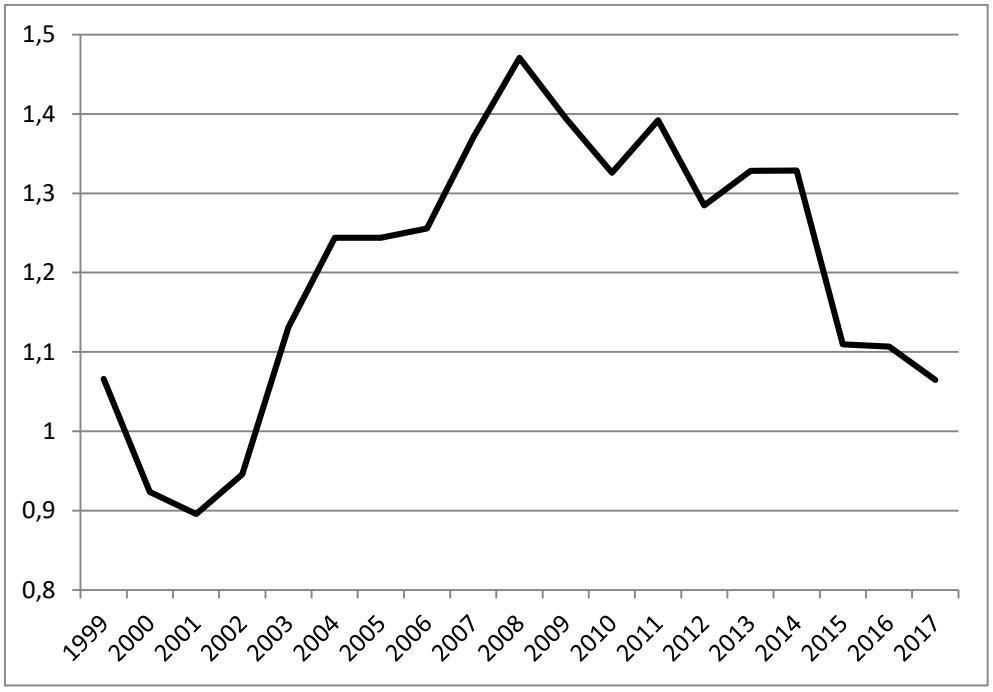


Figure 2. Annual EUR USD Exchange Rate.
Source: FRED- Federal Reserve Economic Data

From an historical graph of euro-dollar exchange rate, in Figure 2, we can note what the initial effects on the economy were. At birth, in 1999, the euro-dollar was quoted at 1.18, meaning that for 1 euro corresponded as much as 1.18 US dollars. The euro dollar moved a lot over the years and it is precisely for this reason that it has earned the nickname of "couple of more volatile currencies in the world". Something that could has been expected if we consider that the US is the first economy in the world and Europe is just behind. The minimum value of all time was 0.83, reached in 2001, while the maximum was 1.60 US dollars, reached in October 2008, with explosion of the financial crisis. Between one and the other of these intervals of time, we have seen a trend variable and very volatile, often linked to the logic of supply and demand. Macro-economic issues and fundamental analysis, such as Quantitative Easing by the Fed before and by the ECB then, or the movements of interest rates, but also the trend of unemployment, influence it. After 2008, the trend continue to be quite variable and a bit decreasing. Between 2015 and 2016, cause of the outbreak of the crisis in Greece and the launch of Quantitative Easing by Mario Draghi, the euro-dollar exchange rate comes to a level around the value of one. So much that many investors thought that it would find the equality (one euro for one US dollar) in 2016, but this has not happened yet.

1.2.5 More in depth: Is the Euro Area an optimal currency area?

The theory of Optimum Currency Areas (OCA) investigates the costs and the benefits that might arise for countries that choose to join a monetary union. It builds its

foundations on the school of thought called neoclassical synthesis, according to which the level of aggregate demand in the long run, will match the level of production by the change in relative prices of goods and inputs. Aggregate demand determines the level of production only in the short term, thereby taking up the Keynesian idea of the centrality of the question.

The main criterion that should satisfy optimum currency area lies in the full capabilities of money wages and prices from falling down. Because of asymmetric shocks hitting one of the region which result in a drop in production and employment in the affected region, flexible money wages down would lead to a decrease in prices, an increase in the affected region and therefore exports to increased production and employment, thanks to a change in consumer preferences. Another way by which the reduction of money wages leads to an increase in output and employment it is the most complicated Keynes effect, focused on domestic demand.

The theory of optimum currency areas argues that the single currency favours the mobility of factors of production (capital and labour) and greater financial integration between countries outside the currency. The mobility of the work allows, in the idea of Mundell, to be able to deal with an asymmetric shock by a region that undergoes the shock. The mobility of capital, virtually the same thing in financial integration, allows the convergence of interest rates in the countries belonging to the area (we showed in an article here as in the euro convergence in interest rates on bonds public has been allowed thanks to the ECB's monetary policy) due to the absence of exchange rate risk.

The main problem that is taken into consideration when it comes to understanding the advantages inherent in creating an area of fixed exchange rates or a monetary union is the possible occurrence of asymmetric shocks in the exogenous variables of the countries involved. An example is given by an asymmetrical variation (which occurs in one or more countries, but not in all) produced in a country (country A) may increase, while it might decrease the demand for goods produced in another country (country B). In the absence of a system of fixed exchange rates, the increased demand for goods in the country should to change the exchange rate. This leads to the depreciation of the currency of country B and the appreciation of the currency of country A. The increase in unemployment (or the deterioration of the trade balance) is avoided in country B. Clearly, this adjustment cannot take place in the presence of fixed exchange rates, or even of a monetary union regime. The adjustment could be achieved by a change in wage and price, should they be flexible. In the absence of this flexibility, the only solution to avoid the consequences of the shock would be the shift of production factors.

As regards price changes, then hire them, as possible (flexibility of prices and wages) is not enough to consider them a remedy. In fact, it would be necessary that the economies of the two countries were closely integrated from the commercial point of view: in this way, a small decline in prices of goods produced in country B would lead to a sharp increase of their demand. Another element that may facilitate optimum currency area is the actual presence of a fiscal federalism system, useful in mobilizing resources from the most advantaged areas to the most disadvantaged. A result of these considerations is that currency (or monetary) area is optimal if asymmetric shocks are rare or absent, or if prices and wages in the various countries are very flexible, or if the

economies of the two countries are highly integrated. Alternatively, an efficient fiscal federalism system could make more desirable monetary integration.

Theorists of OCA point out that because a currency area can be defined as optimal, it is necessary the existence of a both monetary and fiscal union. This means the existence of a common public budget to the entire area, so that any asymmetric shocks can be addressed with appropriate automatic stabilizers, i.e. fiscal transfers in favour of the regions that show a loss of production and employment. This is a delicate point of the question, as the Eurozone, unlike what happens in the US, is not a fiscal union. With the Euro, monetary policy has become common, but the fiscal policy decisions are taken individually by each country (though bound by the Maastricht Treaty). It lacks a centralized transfer system, able to support the spending capacity of the countries in difficulty. We can then also respond, as they have done, however, in many, that the Eurozone is not an optimal currency area. The bottom line, however, remains one regarding a review of a policy that, at the base, is very little founded.

1.3 European Prospective

The recovery seen in recent quarters in Europe is still modest and fragile. The weakening external demand and uncertainties in the global outlook have increased the risks of a global economic slowdown. An extended period exceptionally low inflation and slow recovery are affecting negatively the growth potential and weakening expectations about future economic prospects. Critical indicators such as investment, industrial output and employment are still far below pre-crisis levels in several Member States. Imbalances have expanded further, with negative consequences on the overall sustainability and the resilience of the euro area.

The signs of disaffection with the European project are much more widespread than we could fear at the height of the crisis, whose exceptional durability powered consent for populist proposals. These are favored also by the difficulty to perceive the added value of EU membership. On the contrary, especially in some countries the response to the crisis was regarded as likely to exacerbate divisions between the center and periphery of the Union. Overall, the mix of policies implemented in the Euro zone has proved inadequate to address the crisis and stimulate a sustained recovery. To prevent that significant and persistent loss of the product influence in a permanent way the potential growth, further convergence, acceleration of structural reforms and strong domestic demand are necessary. Beyond the current policy mix and the positive contribution made by the orientation of the ECB, serve coordinated and decisive actions to address urgently the challenges of restoring growth sustained and positive expectations.

Europe is also facing new exceptional systemic challenges: the influx of migrants and asylum seekers. These challenges require a coordinated policy for provide immediate help and to plan joint initiatives that facilitate the integration. Any tightening of controls at internal borders to the Union would be detrimental to the free movement of workers and goods, with negative consequences from the impact unpredictable. Adequate policies in this field can only be adopted following a integrated approach, in which the implementation of short term initiatives is part a more ambitious strategy.

Although in most countries production has picked up again, in many member states of Eastern Europe and South it remains below the level of 2007. We need a strong macroeconomic stimulus, boosting growth and employment. Monetary policy has been strengthened in the expansive way through quantitative easing. However, in the current macroeconomic context marked by low expectations and weak demand, this will not encourage them to return. The so-called Juncker Plan, for the same reasons, will not provide the necessary stimulus to the economy, while the new interpretation of the Stability and Growth Pact, which leads despite some progress, will result only in reducing the tax burden in countries in crisis, instead of generating a substantial fiscal stimulus. It requires coordinated economic expansion, focused on boosting employment through the realization of investments that promote the environment, conscious gender optics; the attack on social spending has to stop. The single currency should be supplemented with an active fiscal policy at the federal level, which is able to operate effectively in stabilizing countercyclical key regional, national and federal and, at the same time, to operate the transfer of resources between the richest regions and the poorest. Fiscal policy should be highly progressive and integrated by European unemployment insurance, acting as a key automatic stabilizer. Of the structural and regional policies of the EU should be strengthened and extended, especially through a large program of public and private investment, financed by the European Investment Bank, and focuses in particular on countries in deficit, and on those with low income.

1.4 The stylized facts

Summing up all the considerations made in the previous paragraphs, we can outline four conflicting stylized facts, which characterizes the economic decline in Europe and especially in Italy in the last two decades:

1. *The increase in employment*. Much of the literature about the issue of the recent Italian and European stagnation has placed at the core of the functioning of the labour market, with an emphasis on the mechanisms that regulate the labour supply. The models based on labour explain the productivity slowdown in European countries because of the downward shift of the supply curve: the low productivity growth is just a short-term effect due to growing employment, with productivity that will recover in the long run due to higher activity levels. The increase in employment rate is due to important reforms and changes in labour market, connected to a strong wage flexibility especially over the course of the 1990s.

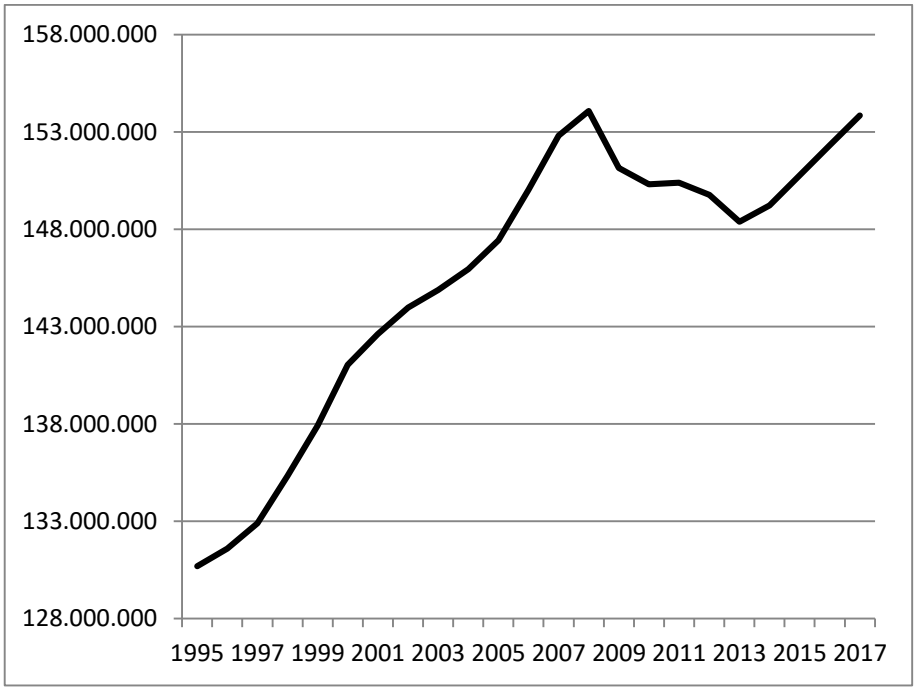


Figure 3. Employment, persons: total economy, Euro Area
Sources: AMECO - Annual macro-economic database – European Commission

Figure 3 shows the trend of the employment in the Euro Area from 1995 until now. From the first years until 2009 the values increase considerably, starting from a value of 130.000.000 persons employed to almost 155.000.000 persons. From 2009, in the peak of the financial crises, the trend start to decreases slightly and the number of persons employed was less than 150.000.000 in 2013. In the last few years, however, the values seem to rise again reaching more or less the same value of 2009.

2. *The productivity slowdown.* There is a negative correlation between the growth rates of employment and the growth rate of productivity; in particular, there is a slower growth of output per worker, connected to a slower capital stock per worker. There is also a change in the composition of labour supply due to recent immigration, with negative effects on productivity.

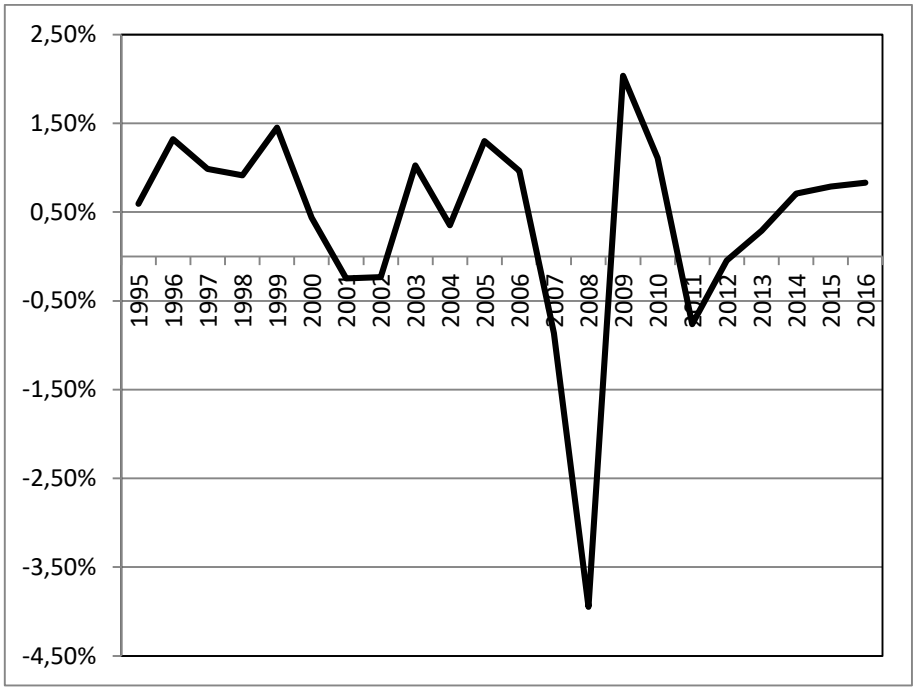


Figure 4. Annual logarithmic differences of Euro Area TFP
Sources: AMECO - Annual macro-economic database – European Commission

Figure 4 shows the trend of the annual logarithmic differences of TFP in the Euro Area from 1995 until 2016. The curve is not linear there are a lot of peaks and minimum. In particular it evident to see the minimum peak in 2008, with a negative difference of 5% from the previous year. In 2009, the difference is recovered, but in 2011, it falls again of about 3%. In the last few years, the trend seems to be more stable and slightly increasing.

3. *The rise of profits.* There has been a shift in income distribution with different consequences on profits and accumulation.

4. *The fall of capital intensity*. The growth rate of the capital deepening (the rate of investment per worker) has decreased, signalling that firms invested in capital saving production and they prefer low quality work, generating a low level of technological progress.

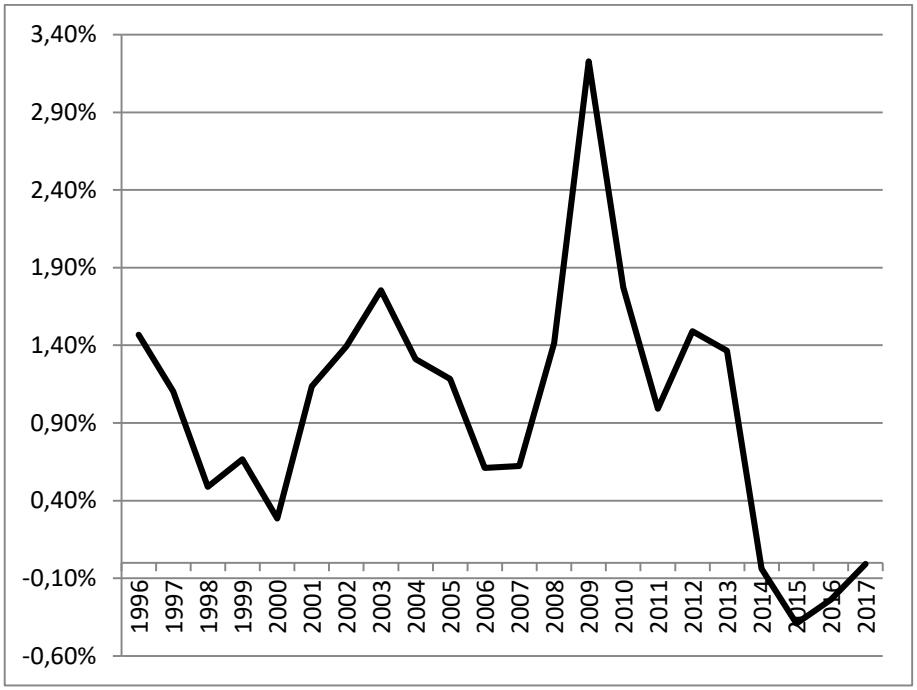


Figure 5. Annual logarithmic differences of Euro Area Capital Intensity
Sources: AMECO - Annual macro-economic database – European Commission

Figure 5 shows the trend of the annual logarithmic differences of Capital Intensity in the Euro Area from 1995 until 2017. The curve is not linear. It is evident the increase from 2007 to 2009 for about 3% and the consequent slowdown until 2011 with a negative different of more than 2%. Until 2013, the gap seem to recover but there is a reduction of about 2%. In the last few years, the trend seems to increase slightly.

These changes in the capital-labour ratio may reflect that the adoption of technologies is not neutral, with consequences on growth and income distribution. Moreover, we can distinguish two types of shocks that hit the Europe and the Italian economy in the last fifteen years, causing the so-called "Productivity Slowdown Puzzle":

1. *Non-Technological (or Institutional) Shocks*

2. *Technological Shocks*

These shocks have shown their effects in the labour market affecting employment, productivity, wages, profits and growth. The Non Technological Shock are all shocks that increase the supply of labour (moving the supply curve of labour) such as the introduction of reforms in the labour market. We can consider, among them, also the wage moderation, the reorganization of the legislation in the labour market (in Italy the reforms of Treu and Biagi), the double-level wage bargaining, the immigration of low quality labour (human capital): they have all changed the characteristics of the labour market and employment. Adverse Technological Shocks, instead, are all shocks that affect the labour demand (shift of the labour demand curve). Therefore, we have the reduction of the Total Factor

Productivity growth (which we will analyse in the next paragraphs), with consequences on the productivity slowdown, in the accumulation slowdown and in a slowing economic growth.

1.5 Production, Production Function and GDP: a macroeconomic overview

The focus of this research project is certainly the issue of productivity, in the light of the most recent economic and historical facts that we have mentioned, with all the variables and relationships that are involved. Before discussing the problem of the fall in productivity, over the last fifteen years in most European countries, let us see more in detail what it is productivity and which is the function of the production process, the typical and essential activity of any kind of firm.

The productivity measures the efficiency of the production process, the ratio between input and output. More particularly, the productivity of the labour indicates the unit of product per worker (or hour worked); capital productivity is measured, instead, by calculating the ratio between output and capital used in the production process. Productivity growth is one of the variables studied in both theoretical and applied economics, as it represents one of the most important factors in explaining output growth of a firm and, in aggregate, of a sector and of a country. The economic analysis has identified a number of determinants of productivity growth.

The production in economy is the set of operations through which goods and primary resources are processed or modified, with the use of material and intangible (e.g. energy, machines and human labour) in final goods and value-added products, in order to make them useful, and, after their distribution on the market, to satisfy the demand for consumption of final consumers. This definition is applicable to almost human activity and not, in any discipline, even non-technical. At the macroeconomic level the production, which represents the offer, it is connected with the level of consumption, so of demand and employment. Production and consumption tend to the equilibrium, in response to the balance between demand and supply of goods and services. The production function indicates the maximum amount producible of a product *(Q)*, the data inputs available capital *(K)* and labour *(L)*. Typically the simplest expression is:

$$Q = f(K, L) \tag{2}$$

The technology determines the amount of output that can be achieved, given a set of inputs. The firm that seeks to obtain the greatest amount of production, given the inputs, operates in a technically efficiency. The typical short-run production function, as we can see in Figure 1, initially grows more than proportionately, and then continues to grow but less than proportionately. This trend reflects the law of diminishing returns, which establishes that if you add more units of a productive factor (taking fixed all the others), in a first phase the product increases more than proportionally respect to the input, beyond a certain point, the product continues to grow but less than proportional.

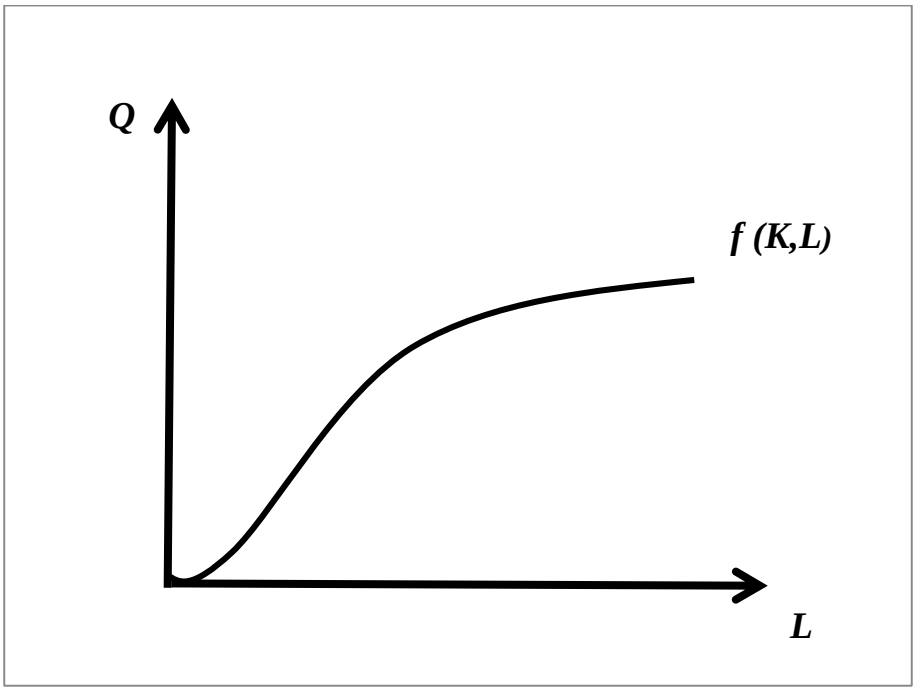


Figure 6. Production Function

Technical progress influences the curve of the production. If the variation of technology is positive, the curve shifts upward, as shown in the picture below (Figure 2), so that the value of output is higher. Vice versa, with a negative variation of technology the curve would move downward determining a lower amount of production.

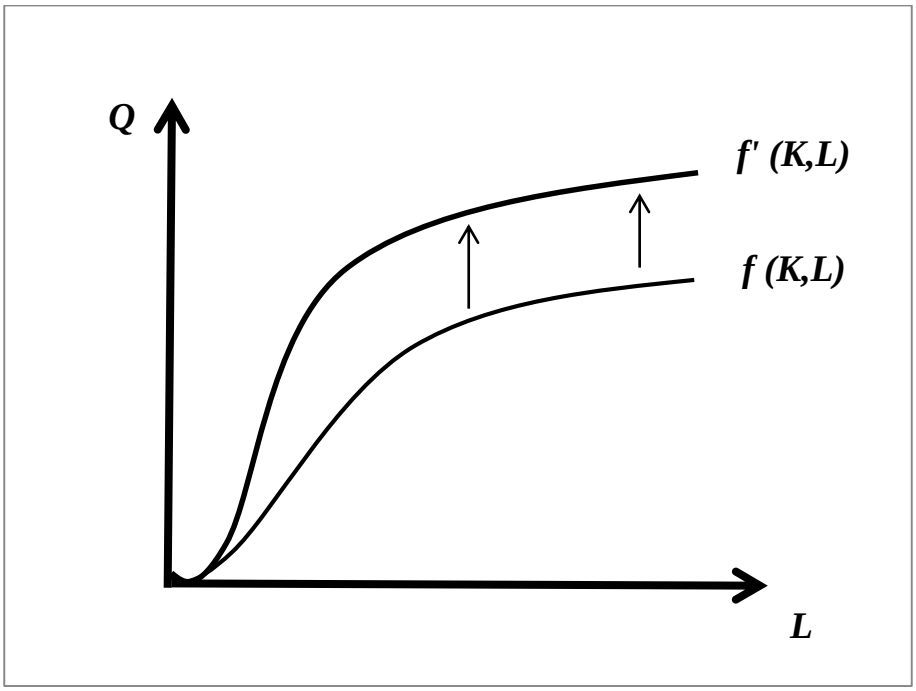


Figure 7. Variation of Technology

The marginal product *(MP)* of a factor is determined by the change in output from a small input variation, holding constant the use of all the other production factors:

$$MP_L = \frac{\Delta Q}{\Delta L} \tag{3}$$

If we look with a broader perspective and a longer time horizon, the considerations on the production and change its function. In the long run, in fact, all inputs are variable. The combinations of inputs that guarantee the same level of output represents an isoquant. A map of isoquants represents a set of isoquants curves, each of which corresponds to a constant level of product. Moving from the intersection of the axis the output increases, as we can see in the picture below.

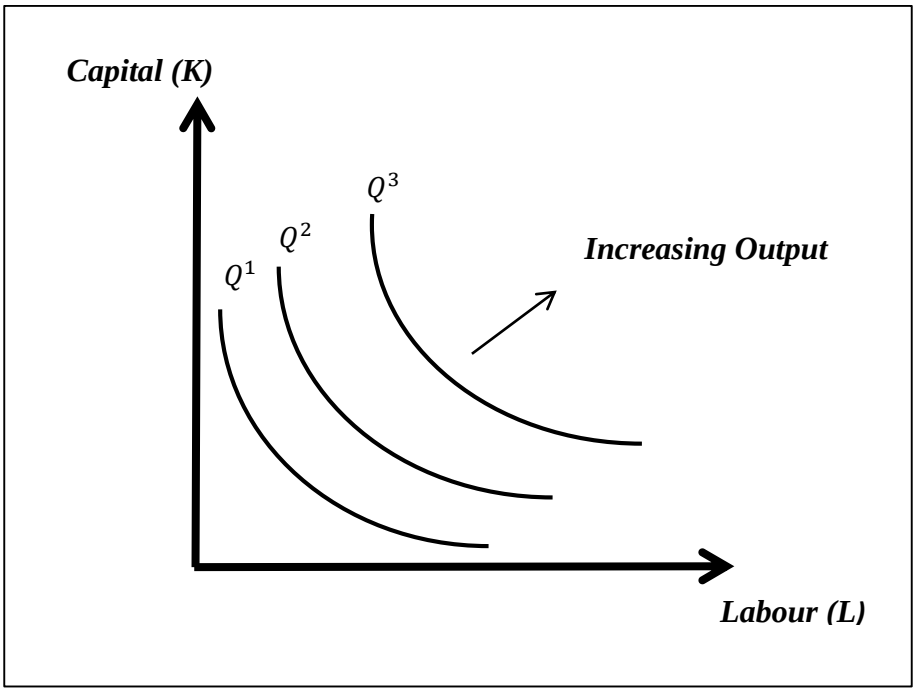


Figure 8. Map of Isoquants

In the long run we can introduce an important ratio, which is the marginal rate of technical substitution, that measures the additional quantity of a production factor required by the firm to continue to produce the same amount of output, as a result of the reduction of the second production factor. In other words, you can replace a factor with another, without changing the production at the rate.

The marginal rate of technical substitution is equal to the ratio of the marginal productivity of factors of production or the absolute value of the slope of the isoquant:

$$MRST = \frac{MP_L}{MP_K} = \left|\frac{\Delta K}{\Delta L}\right| \tag{4}$$

In the long run it is useful to introduce also the concept of returns to scale. They are tied to changes in proportion of all production factors, which take place simultaneously. The returns to scale are a key factor in determining the structure of a firm. Following an increase of production factors, the returns to scale can be increasing, constant or decreasing. It is observed that the decreasing returns to scale have nothing to do with the law of decreasing marginal returns. The marginal product of the individual factors should be decreasing, but the production function can have decreasing, constant or increasing returns to scale.

Speaking of production and productive system of a country inevitably, we have to introduce the concept of *GDP*, or gross domestic product, a key variable of macroeconomics. GDP is the market value of all final goods and services produced in a country in a given period. We can clarify the various terms that come into this definition:

- Gross: indicates the value of production before amortization, i.e. the natural depreciation of the physical capital stock occurred during the period.

- Market value: goods and services entering GDP are valuated at market (current) prices, i.e. the prices at which they are effectively sold.

- All: less than those produced and sold illegally; less than those produced and consumed within households.

- Final: the flour is a final good if sold as flour; it is an intermediated good if it is sold to the baker to make bread. In this case, the value of the flour is incorporated in the value of the bread.

- Product: GDP measures the value of goods and services produced in a year, not the transactions in a year; so new cars that are bought and sold are part of GDP, as produced in the year, while the used car market is not recorded in the GDP.

- In a country: GDP measures what is produced in Italy, not what is produced by Italians. Italians can produce abroad; while in Italy can also produce foreign people. GDP includes what is produced by foreign people in Italy and excludes that which is produced abroad by Italian.

- Period: the time horizon taken in consideration is the year.

There are different ways to calculate GDP, such as the value-added method, the income approach and the expenditure method. Although GDP has more specific characteristics, we give the following synthetic formulation:

$$Y = C + I + G + X \tag{5}$$

With *Y* we indicate the GDP, *C* is the private consumption, *I* is the expenditure for private investment in durable goods including changes in stocks, *G* is the public expenditure and *X* are the net exports (*E – Z*, where *E* are the exports and *Z* the imports). GDP has a leading position about his ability to express or symbolize the well-being of a national community and its level of development or progress. However, GDP is not the only macroeconomic measure of product or income. As already mentioned it includes income earned in a country (Italy, for example) by foreign residents but excludes the incomes of Italian citizens but earned abroad. If we add to GDP the net income from abroad, that is, the balance between incomes of Italian citizens abroad and foreign income in Italy, we get the Gross National Product or GNP:

GNP = GDP + net income from abroad

In large countries, like the US or the European Union the difference between GDP and GNP is minimal (3% - 4%), because the incomes of residents abroad are very similar to that of the foreign income dimension to inside of these countries. For smaller countries, the two values can be very different. Consider the case of countries with high emigration and low immigration, where there are few foreign firms, which establish their facilities there. For similar countries will have a larger GNP than GDP. Conversely, countries with significant immigration and a strong ability to attract foreign companies will have a much greater GDP of GNP.

There are many other indices and measures of well-being and production for a country, but none of them has been so far able to be absolute and irreplaceable, so in the general common accounting of the countries, nowadays, it usually speaks of GDP. The production and the GDP are fundamental to give us information about the output growth of a country. From a macroeconomic point of view, the three main dimensions of aggregate economic activity are output growth, the unemployment rate, and the inflation rate. Clearly, they are not independent, so in the following paragraphs we will analyze the latter two in order to have a complete scheme of study.

When economists want to dig deeper and to look at the state of health of a country, they look at three basic variables. The output growth, which is the rate of change of output. The unemployment rate, which is the proportion of workers in the economy who are not employed and are looking for a job. The inflation rate, the rate at which the average price of the goods in the economy is increasing over time. Therefore, we will analyse separately also the last two variables.

1.6 The Unemployment Rate

Because it is a measure of aggregate activity, GDP is obviously the most important macroeconomic variable. However, two other variables, which are unemployment and inflation, tell us about other important aspects of how an economy is performing. We will use these variables, together with the technological progress to

construct our model in the last chapter of this project. This paragraph focuses on the unemployment rate.

We start with two definitions. Employment is the number of people who have a job. Unemployment is the number of people who do not have a job but are looking for one. The labour force is the sum of employment and unemployment:

$$L = N + U \tag{6}$$

where L is the labour force, N is the employment and U is the unemployment. The unemployment rate is the ratio of the number of people who are unemployed to the number of people in the labor force:

$$u = \frac{U}{L} \tag{7}$$

where u is the unemployment rate. Determining whether somebody is unemployed is harder. Recall from the definition that, to be classified as unemployed, a person must meet two conditions: that he or she does not have a job, and he or she is looking for one; this second condition is harder to assess.

Until the 1940s in the United States, and until more recently in most other countries, the only available source of data on unemployment was the number of people registered at unemployment offices, and so only those workers who were registered in unemployment offices were counted as unemployed. This system led to a poor measure of unemployment. How many of those looking for jobs actually registered at the unemployment office varied both across countries and across time. Those who had no incentive to register, for example, those who had exhausted their unemployment benefits, were unlikely to take the time to come to the unemployment office, so they were not counted. Countries with less generous benefit systems were likely to have fewer unemployed registering, and therefore smaller measured unemployment rates. Today, most rich countries rely on large surveys of households to compute the unemployment rate. In the United States, this survey is called the Current Population Survey (CPS). It relies on interviews of 50,000 households every month. The survey classifies a person as employed if he or she has a job at the time of the interview; it classifies a person as unemployed if he or she does not have a job and has been looking for a job in the last four weeks. Most other countries use a similar definition of unemployment. Note that only those looking for a job are counted as unemployed; those who do not have a job and are not looking for one are counted as not in the labor force. When unemployment is high, some of the unemployed give up looking for a job and therefore are no longer counted as unemployed. These people are known as discouraged workers. Take an extreme example: if all workers without a job gave up looking for one, the unemployment rate would equal zero. This would make the unemployment rate a very poor indicator of what is happening in the labor market. This example is too extreme; in practice, when the economy slows down, we typically observe both an increase in unemployment and an increase in the number of people who drop out of the labor force. Equivalently, a higher unemployment

rate is typically associated with a lower participation rate, defined as the ratio of the labor force to the total population of working age.

Economists care about unemployment for two reasons. First, they care about unemployment because of its direct effect on the welfare of the unemployed. Although unemployment benefits are more generous today than they were during the Great Depression, unemployment is still often associated with financial and psychological suffering. How much suffering depends on the nature of the unemployment. One image of unemployment is that of a stagnant pool, of people remaining unemployed for long periods. In normal times, in the United States, this image is not right. Every month, many people become unemployed, and many of the unemployed find jobs. When unemployment increases, however, as is the case now, the image becomes more accurate. Not only are more people unemployed, but also many of them are unemployed for a long time. In short, when the unemployment increases, not only does unemployment become both more widespread, but it also becomes more painful. Second, economists also care about the unemployment rate because it provides a signal that the economy may not be using some of its resources efficiently. Many workers who want to work do not find jobs; the economy is not utilizing its human resources efficiently. From this viewpoint, can very low unemployment also be a problem? The answer is yes. Like an engine running at too high a speed, an economy in which unemployment is very low may be over utilizing its resources and run into labor shortages. How low is "too low"? This is a difficult question. The question came up at the beginning of the new millennium in the United States. At the end of 2000, some economists worried that the unemployment rate, 4% at the time, was indeed too low. So, while they did not advocate triggering a recession, they favored lower (but positive) output growth for some time, to allow the unemployment rate to increase to a somewhat higher level. It turned out that they got more than they had asked for a recession rather than a slowdown.

Let us see what has been the trend of unemployment in Europe, in order to understand also the other economic phenomena, which are correlated.

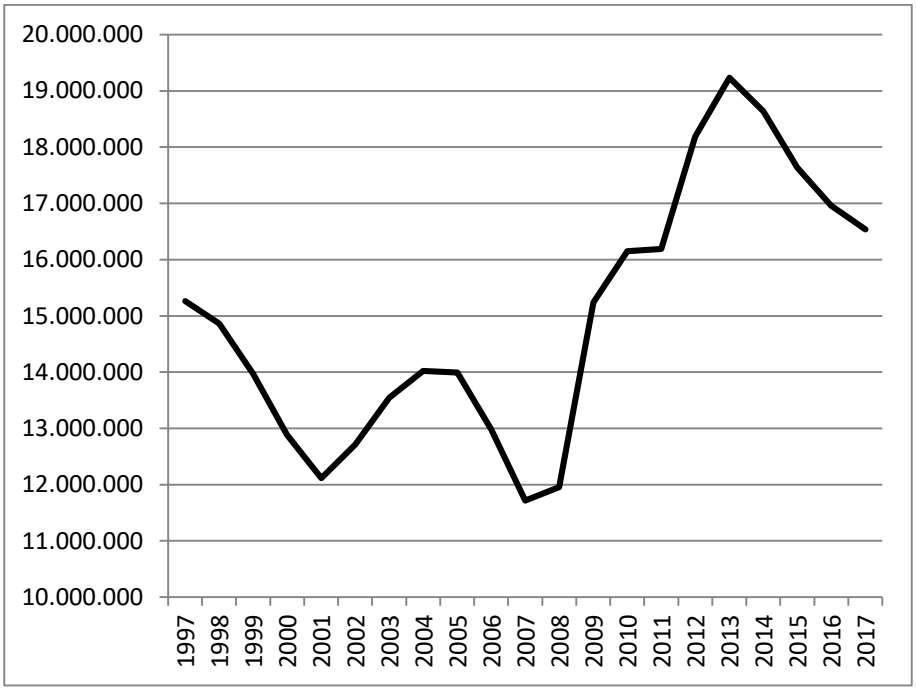


Figure 9. Euro-Area Total Unemployment, Member States
Sources: AMECO - Annual macro-economic database – European Commission

Figure 9 shows the trend of the Total Unemployment in the Euro Area in a period from 1997 until nowadays. The values are always above eleven millions of persons and under fifteen millions from the beginning until 2009. In 2008, indeed, with the outbreak of the global financial crisis, they begin to rise sharply. From 2010 to 2011, the trend seems to be quite stable around a value of sixteen millions, but from 2011, it increases again until the highest value of more than nineteen millions in 2014. In the last three years, the trend is decreasing, even if the values are always high and far from the values of the pre-crisis period.

1.7 The Inflation Rate

As we said before the other important variable for an economy is the Inflation Rate, let us see what are its main features.

Inflation is a sustained rise in the general level of prices, the price level. The inflation rate is the rate at which the price level increases (symmetrically, deflation is a sustained decline in the price level; it corresponds to a negative inflation rate). The practical issue is how to define the price level so that the inflation rate can be measured. Macroeconomists typically look at two measures of the price level, at two price indexes: the GDP deflator and the Consumer Price Index. If a higher inflation rate meant just a faster but proportional increase in all prices and wages, a case called pure inflation, inflation would be only a minor inconvenience, as relative prices would be unaffected. Take, for example, the workers' real wage, the wage measured in terms of goods rather than in dollars. In an economy with 10% more inflation, prices would increase by 10% more a year. However, wages would also increase by 10% more a year, so real wages

would be unaffected by inflation. Inflation would not be entirely irrelevant; people would have to keep track of the increase in prices and wages when making decisions. This, however, would be a small burden, hardly justifying making control of the inflation rate one of the major goals of macroeconomic policy. So why do economists care about inflation? Precisely because there is no such thing as pure inflation. First, during periods of inflation, not all prices and wages rise proportionately. Because they do not, inflation affects income distribution. For example, retirees in many countries receive payments that do not keep up with the price level, so they lose in relation to other groups when inflation is high. Variations in relative prices also lead to more uncertainty, making it harder for firms to make decisions about the future, such as investment decisions. Some prices, which are fixed by law or by regulation, lag behind the others, leading to changes in relative prices.

Taxation interacts with inflation to create more distortions. If tax brackets are not adjusted for inflation, for example, people move into higher and higher tax brackets as their nominal income increases, even if their real income remains the same. If inflation is so bad, does this imply that deflation (negative inflation) is good? The answer is no. First, high deflation (a large negative rate of inflation) would create many of the same problems as high inflation, from distortions to increased uncertainty. Second, as we shall see later in the book, even a low rate of deflation limits the ability of monetary policy to affect output. So what is the “best” rate of inflation? Most macroeconomists believe that the best rate of inflation is a low and stable rate of inflation, somewhere between 1 and 4%. (Blanchard, 2012).

As we said before, the primary objective of the European monetary policy is the price stability, defined as "a situation in which the 12-month increase in the consumer prices for the euro area is less than the 2% over the medium term time horizon”. Therefore, the first target of the EBC is the inflation. We have seen in figure 1, with the trend of the Euro Area Price Deflator Gross Domestic Product, that this purpose has been maintained from the beginning of the EU until now.

1.8 The Key Words: Innovation, Investment, Flexibility and Productivity

After describing and analysing the macroeconomic fundamental variables connected, in particular, with the production system in the previous paragraph, we can now discuss the topic of this research in more clear and depth way.

The issue about how labour flexibility affects innovation, investment and productivity in the long run is not new in the economic literature. The Solow growth model has taught us that the growth of labour productivity depends on technological progress. The question that we ask now is: what determines the level of employment in the long run? Is it influenced by technological progress and institutional changes that regulate the relations in the labour market? In addition, if the answer is positive, in what direction? Technical progress increases or decreases the employment? Do institutional reforms only affect the level of employment? Or even that of productivity? May

technological progress be affected by the changes occurring in the labour market institutions? Most economists believe, indeed, that the source of the productivity problem is not the macroeconomic policy, but the labour market institutions. Too tight a monetary policy, they concede, can indeed lead to high unemployment for some time, but surely not for twenty years. The fact that unemployment has been so high for so long points to problems in the labour market. The challenge is to identify exactly what these problems are. Some economists believe the main problem is that European states protect workers too much. To prevent workers from losing their jobs, they make it expensive for firms to lay off workers. One of the unintended results of this policy is to deter firms from hiring workers in the first place, and this increases unemployment. To protect workers who become unemployed, European governments provide generous unemployment insurance. However, by doing so, they decrease the incentives for the unemployed to look for jobs; this also increases unemployment. The solution, they argue, is to be less protective, to eliminate these labour market rigidities, and to adopt U.S.-style labour-market institutions. This is what the United Kingdom has largely done, and, until the crisis, its unemployment rate was low. Others are more sceptical. They point to the fact that, before the crisis, unemployment was not high everywhere in Europe. It was low in a number of smaller countries, for example, the Netherlands or Denmark, where the unemployment rate was under 4%. Yet these countries are very different from the United States and provide generous social insurance to workers. This suggests that the problem may lie not so much with the degree of protection but with the way in which it is implemented. The challenge, these economists argue, is to understand what the Netherlands or Denmark have done right. Resolving these questions is one of the major tasks facing European macroeconomists and policy makers today. (Blanchard, 2012).

The key issue is how to keep a balance between the need for firms to adapt to ever-changing market conditions on the one hand, and workers' employment security on the other. We know from the study of the labour market functioning that labour flexibility is the theoretical concept according to which a worker does not remain constantly at his labour indefinitely, but changes, several times in his lifetime, his own position and/or the employer. In evolutionary perspective and growth, flexibility should allow a constant improvement of the worker's knowledge and consequently the level of employment achieved both in the economic sphere and as regards the professional skills. The introduction of tools to facilitate flexibility in the labour market can be considered as one of the best way to increase employment. According to this vision, firms, facilitated by the existence of just binding contracts and less costly social security levels, would have an incentive to seek constantly in the labour market all those professionals they need at a given time, without being forced to keep them signed overdue. In this way, the demand for employment in the labour market would be released and would produce a virtuous circle intended to boost demand. In fact, the true extent of such an evaluation is questionable: often-flexible contracts are used only as means of saving by firms, which is often considered a tool for growth of precarious positions.

Actually, the effects of changes in labour regulation are ambiguous and a lot of question arise from the literature. Have employment protection regulations an impact on firms hiring and firing decisions? In addition, is this impact different across demographic groups? Do such regulations explain the high incidence of temporary work recorded in

certain countries? How to instil labour market dynamism while also protecting workers against labour and income loss? The literature identifies two main opposite effects. On the one hand, when a higher labour flexibility rises the number of workers, but not innovation, productivity may decrease. On the other hand, when innovation is radically new and requires new skills, a higher labour flexibility may reduce the cost of such innovation, easing the adoption of new technologies and the raise of productivity. On the theoretical ground, labour regulation affects innovation and investment through several channels. As said above, the literature identifies two main different response patterns. A more flexible labour market contributes to reduce the adjustment cost of labour demand, and this process may have a positive impact on investment and innovation (Nickell, 1986; Saint-Paul, 1997, 2002; Samaniego, 2006; Cuñat and Melitz, 2010). In the longrun, however, labour flexibility may result in lower innovation due to lower incentives for firms to invest in new technology and human capital, determining a reduction in innovation and productivity (Kleinknecht, 1998; Bastgen and Holzner, 2015). To discuss in detail these different relationships, it is useful to divide the literature in two main groups: those economists that argue a positive correlation between labour flexibility and innovation and those who defend the cause of a negative correlation between the two.

1.8.1 Positive Correlation

Four types of arguments are usually advanced to argue in favour of a positive correlation. Firstly, labour market rigidity reduces the capacity of the firm to reallocate workers aftershocks from old and declining sectors to new and more dynamic ones (Bentolila and Bertola, 1990; Hopenhayn and Rogerson, 1993; Nickell and Layard, 1999). Further, this stickiness negatively can affect capital accumulation (Calcagnini et al. 2009). Interestingly, some recent estimates indicate that stricter employment protection legislation led to significantly lower innovation intensity in industries with a higher labour reallocation propensity, and that the use of temporary contracts have a stronger impact on innovation intensity than the strictness of employment protection for regular contracts (Griffith and Macartney, 2009; Murphy et al., 2013). Second, the explicit and implicit firing costs faced by the firms can hamper their decision to invest in new labour-saving innovations, pushing either an industry or an economy toward sectors where technology progress slowly and demand is stable (Bassanini and Ernest, 2002; Scarpetta and Tressel, 2004; Samaniego, 2006; Saint-Paul, 2002; Calcagnini et al. 2009; Bartelsman et al., 2010). Theoretical models on labour market regulations and international specialization also suggest that countries with lower labour flexibility specialize in incremental innovation while new products are first produced in countries with higher labour flexibility (Saint-Paul, 1997; 2002). Third, there is the possibility that in rigid labour market workers tend to appropriate rents generated by innovative process, thus reducing the incentive of firms to adopt new technology and take new investment risks (Malcolmson, 1997; Metcalf, 2002; Zhou et al, 2011). Among these, Jacob (2010) and Ichino and Riphahn (2005) show that a lower employment protection legislation can positively affect labour productivity, but not innovation, through the reduction of absenteeism. Finally, labour market rigidity can reduce, at country level, the skill

premium of workers, and, if innovations are labour saving, economies with more stringent labour regulation, which are binding for low skilled workers, become less technologically advanced in their high-skilled sectors, and more technologically advanced in their low-skilled sectors (Alesina et al. 2014).

1.8.2 Negative Correlation

Altogether, the previous contributions assert that higher flexibility, innovation and productivity can move in the same direction. This outcome, however, is not conclusive. Indeed, many other contributions, based on different economic mechanisms, suggest that a higher labour flexibility reduce innovation and often investment in the long run. In addition, in this case a broad literature exists.

A traditional explanation regards the possibility that a higher labour cost will stimulate the firms to adopt new labour-saving innovations (Sylos Labini 1984, 1993, 1999). Notice that here dynamic substitution between capital and labour differs from static substitution and provides a way to explain how technology advancement passes through new capital goods (Saltari and Travaglini, 2009). Since higher flexibility reduces the adjustment cost of labour this theoretical scheme can be employed to explain the negative correlation between labour flexibility and innovation (Bastgen and Holzner, 2015). Second, in a Schumpeterian perspective "the flexibilitation of the wage formation process will give an extra competitive option to non-innovative firms" (Keleinknecht, 1998, p.394). Indeed, wage flexibility increases the chance of less productive and innovative firms to survive in a competitive market paying a lower wage (Antonucci and Pianta, 2002). However, while in the short run their survival is favourable for employment, it will depress productivity and technology in the long run (with eventually a negative impact even on employment). In addition, it can be shown that wage moderation policy tends to slowdown the replacement of old capital, depressing productivity as time passes (Naastepad and Kleinknecht, 2004). Further, flexible labour and wage moderation can depress aggregate demand and technology progress. This is the well-known Verdoon—Kaldor law which links demand growth to productivity growth (Verdoon 1949; Kaldor, 1957, 1966). However, not all these explanations exhaust the reasons of the negative link between labour flexibility and innovation. One of this regards the impact of flexible labour on training and human capital. When expected labour duration is short "firms have little incentives to invest in workforce training, simply because the payback period is too short" (Lucidi and Kleinknecht, 2009). Moreover, similar incentives render workers reluctant to acquire skills since they anticipate the absence of any commitment with the employers (Belòt et al, 2002). Therefore, a more flexible labour market may cause underinvestment in training with negative consequences on productivity growth and wage. According to this view, labour flexibility in the form of temporary workers display on average a lower level of general and firm specific human capital. Firms with a high labour turnover may lack of knowledge of markets (Zhou, 2011), and this could weaken their innovation. Similar phenomenon of lack in workplace cooperation, and subsequent non-cooperative relationship between workers and management, may negatively affect innovative activity

and firm performance (BucheleandChristiansen1999; Huselid, 1995; Lorenz, 1999; Naastepad and Storm, 2005). Asymmetric information can induce further problems. Let us suppose that the effort of workers is not observable. In this case, fixed term workers can be particularly prone to exert low level of effort if they expect to be fired at the end of their contract (Bentolila and Dolado, 1994). Acharya (2012) emphasizes a crucial aspect. In their empirical analysis on US firms, they show that the labour deregulation policy tends to reduce the efforts of workers and employers to undertake innovative activities and risky (profitable) projects. Taken together "these tests enable us to conclude that innovation and firm creation are indeed fostered by laws that limit firms' ability to ex post discharge their employees at will. Thus, we surmise that employment protection laws present a trade-off: while they may cause ex-post inefficiencies in the labour market [...], they can have positive ex-ante effects by fostering innovation and entrepreneurship" (Acharya et al 2012). Finally, they conclude, "laws affecting employment and dismissal are an important part of the policy toolkit for promoting innovation and possibly economic growth". Similar empirical outcomes, but for other countries, are find by Michie and Sheehan (2003), Pompei (2003), Boeri and Garibaldi (2007), Pieroni and Pompei (2008), Antonioli et al. (2010), Acharya (2012), Pini (2014).

1.9 A Productivity Driver: The Per Capita Income

In the last paragraph, we introduced the concept of labour flexibility in order to understand the possible connection with the problem of the productivity slowdown in the last two decades. However, there is an important macroeconomic variable, which can help us to analyse the trend of the productivity in a country. A way to form an idea of the current difficulties of the European economies, and, especially, of the Italian one, in fact, is to look at the per capita income. The per capita income can be defined as the amount of the gross domestic product, possessed hypothetically, in a certain period, by a group of people; it is usually reported in units of currency, for a year, relative to a country. It is the relationship between national income and the total population of a country. It indicates the average income of each individual of a country. Per capita income is often used to measure the level of welfare and well-being of the population of a country, compared to other countries. So that the various data can be comparable, it must be expressed in terms of a currency used internationally, as the euro or the dollar. It is emphasized, however, that this index does not always fairly represent the well-being of a country, especially when are compared countries economically and culturally very different. Not always the per capita income indicates the income distribution within a country, there could be, for example, an imbalance between the few people who own much of the income and the majority of the population that is, instead, very poor. Since 2000, the per capita Italian was constantly less than the European average (EU 15). In the period 2002-2007, the average growth rate of real GDP has been in Italy dell'0.8%. In the US was 2.7% while in France amounted to 1.7%. The gap growth of our country compared to the other economies is huge and has a negative impact on the living standards. Italy has lost, in terms of its lack of growth, a cumulative value of the GDP amounted to 13.3 % age points. Identify the causes of the slowdown in the growth rate should be a primary goal of the macroeconomic analysis, even if it has proved to be a game very difficult. But which active forces driving the change in GDP per capita? For accounting purposes, at any time t, it is identically true that:

$$\frac{Pil_t}{pop_t} = \left(\frac{pop_{15-64}}{pop}\right)_t \cdot \left(\frac{occ}{pop_{15-64}}\right)_t \cdot \left(\frac{Pil}{occ}\right)_t \tag{8}$$

$$Pil_t = pop_t \cdot \left(\frac{pop_{15-64}}{pop}\right)_t \cdot \left(\frac{occ}{pop_{15-64}}\right)_t \cdot \left(\frac{Pil}{occ}\right)_t \tag{9}$$

By taking the logarithm:

$$logPil_t = logPop_t + log\left(\frac{pop_{15-64}}{pop}\right)_t + log\left(\frac{occ}{pop_{15-64}}\right)_t + log\left(\frac{Pil}{occ}\right)_t \tag{10}$$

Delaying for a period, and calculating the difference:

$$g_y = logPil_t - logPil_{t-1} \tag{11}$$

We get the breakdown of the growth rate of GDP:

$$g_y = g_{pop} + g_{\frac{15-64}{pop}} + g_{\frac{occ}{15-64}} + g_{\frac{y}{occ}} \tag{12}$$

Thus, its growth rate can be broken down into four distinct contribution:

1. g_{pop}: the total population;

2. $g_{\frac{15-64}{pop}}$**:** the proportion of the population of working age (between 15 and 64 years of age);

3. $g_{\frac{occ}{15-64}}$**:** the activity rate, or the proportion of the population of working age which is actually used;

4. $g_{\frac{y}{occ}}$**:** the labour productivity measured by output per worker.

The first two contributions, g_{pop} and $g_{(15-64)/pop}$**,** capture the size demographic growth, that depends on the dynamics of the population, due to the death and the birth rate, to the greater longevity, but also to migration, which is facilitated by the increasing geographical mobility. The third contribution, the activity rate $g_{occ/15-64_t}$ depends on the operation of labour market and, therefore, both on the labour supply, of those who want to be employed, and on the labour demand, that is, the capacity of firms to create labours. In other words, it depends on the functioning of the labour market and the institutions that characterize it. Finally, the last contribution, that is, the output per worker, $g_{(y/occ)_t}$, is a measure of labour productivity and its efficiency. It depends not only on the quality and specialization of labour (human capital), but also on the level of technology, the size (large or small) of firms and on their internal and external organization. Thus, the labour productivity is an index of the synthetic ability to produce wealth.

1.9.1 Some Data

The growth rate of GDP per capita depends on the percentage changes of the four factors described in the previous paragraph. The decomposition helps us to understand which demographic and economic forces promote or hamper growth in a country.

The table below summarizes the annual percentage changes relative to Population, GDP, GDP per capita and the rates that make it up, calculated for the main European countries, the USA, Australia and the Euro Area. In this analysis I have used data from the official database of the European Commission, AMECO, I have used a

period of observation, which starts in 1960 and ends in 2016 (with forecast data) and I divided the periods of observation into time spans of ten years, by calculating the average of the observed values within each of them.

	1960 - 69	1970 - 79	1980 - 89	1990 - 99	2000 - 2009	2010 - 2016
				Germany		
GDP	-	-	-	-	0,79%	1,89%
Pop	0,75%	0,03%	0,08%	0,42%	-0,02%	0,33%
Pop(15-64)/Pop	-0,68%	0,32%	0,58%	-0,15%	-0,33%	0,09%
Employment, persons/Pop(15-64)	-	-	-	-	0,84%	0,41%
GDP/Employment, persons	-	-	-	-	0,31%	1,05%
GDP/Pop	-	-	-	-	0,81%	1,56%
				Spain		
GDP	7,41%	3,76%	2,65%	2,61%	2,71%	0,54%
Pop	1,11%	1,07%	0,42%	0,29%	1,49%	-0,02%
Pop(15-64)/Pop	-0,28%	-0,02%	0,53%	0,33%	0,01%	-0,46%
Employment, persons/Pop(15-64)	-	-	-	-	0,80%	0,16%
GDP/Employment, persons	-	-	-	-	0,40%	0,86%
GDP/Pop	6,30%	2,69%	2,23%	2,32%	1,21%	0,56%
				Italy		
GDP	5,59%	3,91%	2,51%	1,48%	0,51%	0,10%
Pop	0,72%	0,51%	0,06%	0,04%	0,45%	0,35%
Pop(15-64)/Pop	-0,20%	-0,09%	0,63%	-0,10%	-0,32%	-0,28%
Employment, persons/Pop(15-64)	-1,04%	0,41%	-0,11%	0,12%	0,91%	-0,30%
GDP/Employment, persons	6,12%	3,08%	1,93%	1,42%	-0,53%	0,33%
GDP/Pop	4,88%	3,41%	2,45%	1,43%	0,06%	-0,25%
				Greece		
GDP	8,10%	5,28%	0,75%	2,03%	2,69%	-2,92%
Pop	0,57%	0,85%	0,55%	0,76%	0,28%	-0,36%
Pop(15-64)/Pop	-	-0,18%	0,44%	0,20%	-0,20%	-0,46%
Employment, persons/Pop(15-64)	-	-	-	-	1,09%	-1,11%
GDP/Employment, persons	-	-	-	-	1,53%	-0,98%
GDP/Pop	7,53%	4,44%	0,20%	1,27%	2,41%	-2,56%
				France		

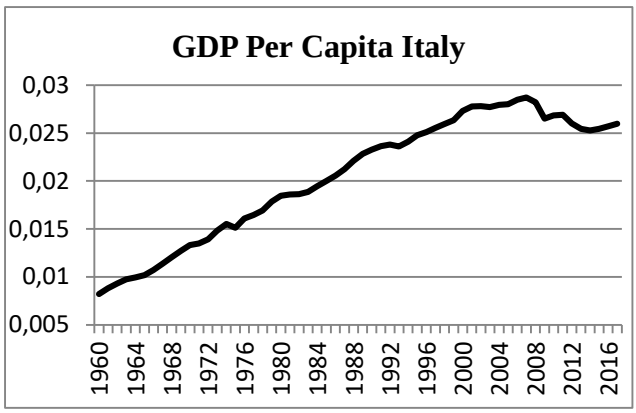
GDP	5,54%	3,99%	2,33%	1,98%	1,39%	1,13%
Pop	1,07%	0,63%	0,51%	0,42%	0,67%	0,49%
Pop(15-64)/Pop	0,05%	0,18%	0,41%	-0,13%	-0,04%	-0,54%
Employment, persons/Pop(15-64)	-0,66%	-0,02%	-0,55%	0,58%	0,10%	0,47%
GDP/Employment, persons	5,07%	3,21%	1,95%	1,11%	0,66%	0,71%
GDP/Pop	4,46%	3,36%	1,81%	1,56%	0,72%	0,64%
			UK			
GDP	3,07%	2,57%	2,62%	2,08%	1,80%	2,02%
Pop	0,64%	0,14%	0,15%	0,28%	0,59%	0,76%
Pop(15-64)/Pop	-0,31%	0,09%	0,25%	-0,06%	0,18%	-0,15%
Employment, persons/Pop(15-64)	-	-	-	-	-0,07%	0,52%
GDP/Employment, persons	-	-	-	-	1,10%	0,90%
GDP/Pop	2,43%	2,42%	2,47%	1,81%	1,21%	1,26%
			USA			
GDP	-	-	-	-	-1,88%	4,06%
Pop	1,28%	1,05%	0,92%	1,23%	0,95%	0,77%
Pop(15-64)/Pop	0,33%	0,69%	0,01%	0,01%	0,17%	-0,32%
Employment, persons/Pop(15-64)	0,39%	0,34%	0,77%	-0,05%	-0,66%	0,64%
GDP/Employment, persons	-	-	-	-	-2,34%	2,97%
GDP/Pop	-	-	-	-	-2,83%	3,30%
			Australia			
GDP	5,22%	2,96%	3,34%	3,25%	1,94%	2,63%
Pop	2,00%	1,56%	1,46%	1,21%	1,21%	1,11%
Pop(15-64)/Pop	0,26%	0,34%	0,29%	0,06%	0,12%	-0,35%
Employment, persons/Pop(15-64)	0,51%	-0,30%	0,48%	-0,05%	0,86%	0,57%
GDP/Employment, persons	2,46%	1,37%	1,11%	2,03%	0,80%	1,30%
GDP/Pop	3,23%	1,41%	1,88%	2,04%	1,78%	1,52%
			Euro Area			
GDP	-	-	-	-	0,10%	-0,45%
Pop	0,83%	0,51%	0,29%	0,32%	0,48%	0,27%
Pop(15-64)/Pop	-	-	-	-	-0,14%	-0,29%
Employment, persons/Pop(15-64)	-	-	-	-	0,57%	0,24%
GDP/Employment, persons	-	-	-	-	-0,81%	-1,00%
GDP/Pop	-	-	-	-	-0,24%	-0,77%

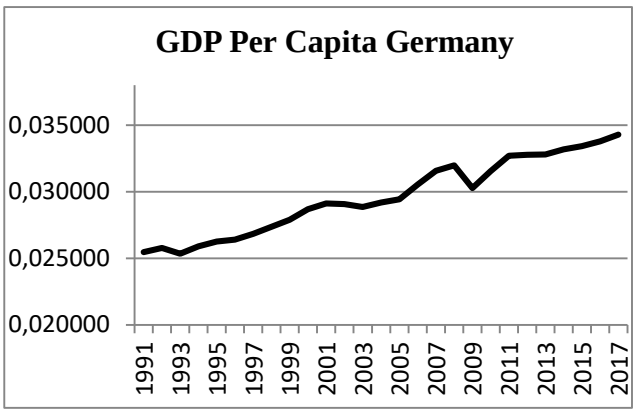
Table 1. Annual percentage Change Rates
Sources: AMECO - Annual macro-economic database – European Commission

Table 1 summarizes the data of the GDP Per Capita decomposition and shows what happened in the period from 1960 to 2016, providing a long-term perspective. In the first row of the table there are grouped the data of GDP growth rate in each country considered. In most European countries the GDP growth rate of the first period (1960-1969) is very high, around 5% in France and in Italy, even 7,41% in Spain and 8,01% in Greece. This trend, however, decreases since the next period considered and it keeps stable until the period 2000-2009. The period post crisis (2009-2016) recorders the worst performance for all European countries with growth rates near or even the zero. Italian GDP growth rate is nearly positive (0,10%), similar situation in Spain, while Greece shows a very negative GDP growth rate (-2,92%). Also the GDP growth rate of the Euro Area is negative, so we can deduce that there are more countries with negative GDP growth rates in recent years that those with positive GDP growth rate. Different is the case of UK, that maintains along all the period considered a GDP growth rate around 2%, only in the period 2000-2009 it falls at 1,80%, while it increases again in the last period. The English trend is quite similar to the Australian one: the Australian growth rate is quite high in the first period (5,22%) and it maintains the trend around 3%; it falls at 1,94% in the period 2000-2009 but it raises again in recent years. USA registers a negative GDP growth rate during the period 2000-2009. This means that the crisis has had its effects quite immediately on American economy. However it is quite surprising that in the next period, the GDP growth rate recovered a lot of percentage points standing at 4,06%, so this means an incisive and decisive response of the American economic system to the difficulties of the crisis. The next four rows of the table describe how it is formed the GDP per capita: the dynamics of the population, so the demographic growth rate (g_{pop}), the proportion of the population of working age ($g_{(15-64\,/pop)_t}$)**,** the activity in the labour market index ($g_{(occ/15-64)_t}$), and, finally, the output per worker or, in other words, the labour productivity ($g_{(y/occ)_t}$)**.** The growth rate of population is quite stable along the entire period considered in all the countries, with rates around zero. Only Australia shows higher population growth rates, which is 2% in the first period and it maintains around 1% in the others. The proportion of the population of working age has a similar trend of the demographic growth rates, however, in this case in most of European countries we register negative rate, in particular in the last two span of period considered. Also in USA and Australia, this kind of rate is very low, near the zero. The activity rate shows values near the zero, some of them also negative, in most of the countries and along the entire period considered. Particular is the case of Greece, where in the period 2000-2009 the rate is positive for more 1%, while the next one is quite negative (-1,11%), this, with no doubt, reflect the difficulties that the country faced as consequences of the crisis, with a lot of people unemployed. The last index in the third row is the labour productivity, which measures the output per worker. Looking at the data we can easily understand that it reflects in most of countries the trend of GDP, in fact, it is quite high in the first span of time considered, like in Italy which is 6,12% and in France 5,07%, while the trend fall in the rest of the period. In particular in the last two period the Euro Area shows a negative

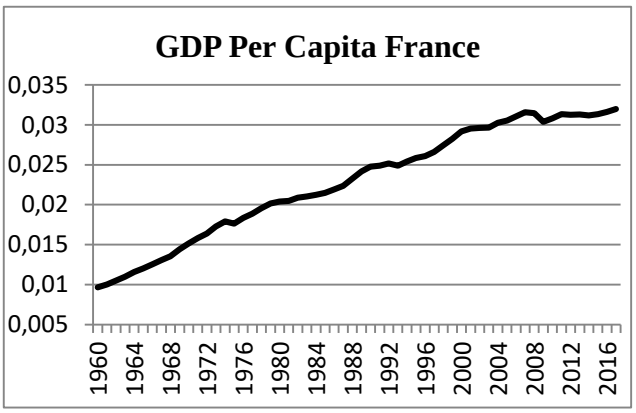
labour productivity growth rate, this confirm the state of art that we mentioned above, in the last fifteen years European countries faced a consistent productivity slowdown, both of labour and of capital. The last row shows the variable, on which we focus in this paragraph, the per capita income, expressed as the ratio between GDP and the total population. Analysing the data we can find high values of the GDP per capita growth rate in the first period, like in Spain (6,30%) and in Greece (7,53%). Moving on the values decrease in all the countries and in the last period there are also negative growth rates in Italy (-0,25%) and in Greece (-2,56%). Particular is the situation in USA, where the per capita income growth rate in quite negative (-2,83%) in the period 2000-2009, while it rise in the next period reaching the value of 3,30%.

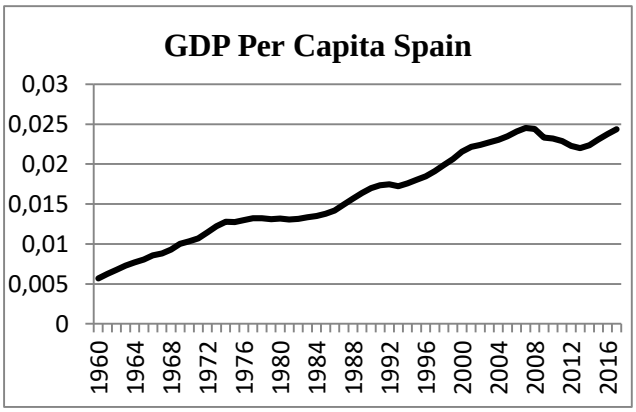
Below we reported the graph of the trend of GDP per capita for each countries analysed.

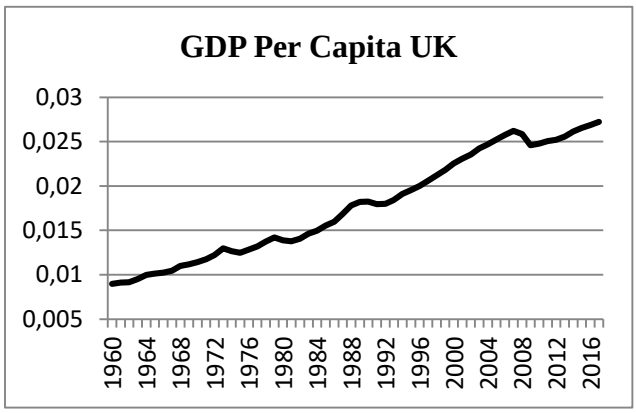

GDP Per Capita Italy
0,03
0,025
0,02
0,015
0,01
0,005
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

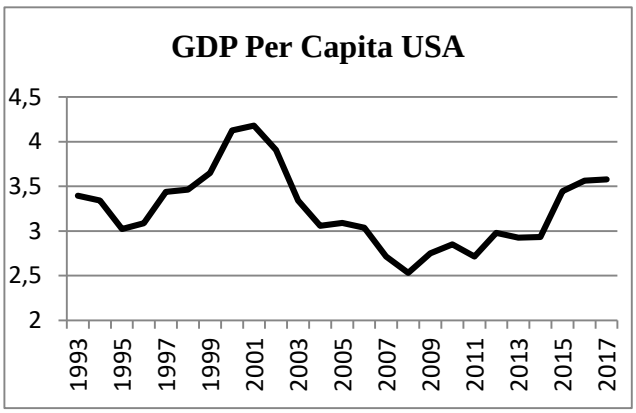

GDP Per Capita Germany
0,035000
0,030000
0,025000
0,020000
1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017

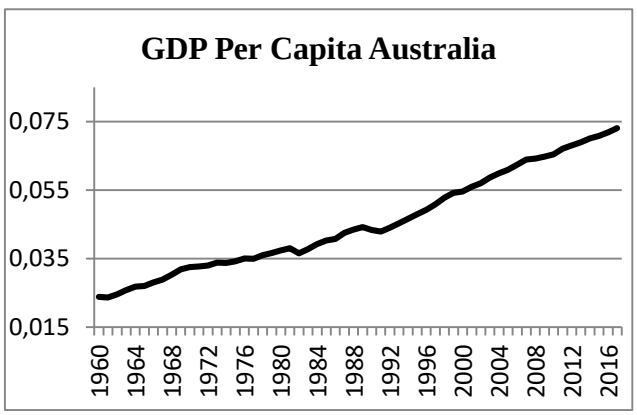

GDP Per Capita Greece
0,25
0,2
0,15
0,1
0,05
0
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016


GDP Per Capita France
0,035
0,03
0,025
0,02
0,015
0,01
0,005
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016


GDP Per Capita Spain
0,03
0,025
0,02
0,015
0,01
0,005
0
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016


GDP Per Capita UK
0,03
0,025
0,02
0,015
0,01
0,005
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016


GDP Per Capita USA
4,5
4
3,5
3
2,5
2
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017


GDP Per Capita Australia
0,075
0,055
0,035
0,015
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

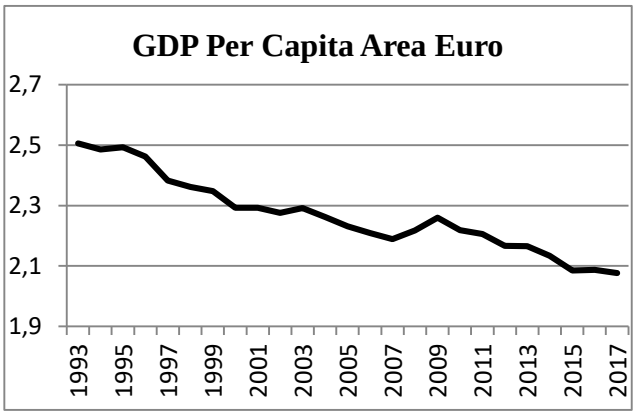


Figure 10. Trends of GDP per capita
Sources: AMECO - Annual macro-economic database – European Commission

The graphs are constructed with the value of GDP per capita, not considering the growth rate as in the data. The GDP per capita has in most of countries considered an increasing trend, until the recent fifteen years. It is easily to see like a reversal of trend starting around 2008, the year of financial crisis. The most evident falls are in Italy, Spain and Greece, even if from 2012 there seems to be a recover. Particular is the trend in Australia where there is no fall, while the Euro Area shows a decreasing trend from the born of the Union (1993) until now.

1.10 External Shock: The Financial Crisis of 2008

In order to have a complete picture of the current economic situation, which is characterized, as we have already mentioned, by the worrying productivity slowdown, it is essential to look also at the world global contest, outside the single country.

In recent years, we have assisted to a global economic phenomenon, that does not happen every day, but it is the result of a precise and dated economic cycle: the economic and financial crisis of 2008, whose depth and breadth is unprecedented in post-war economic history. A perfect storm. This is one metaphor used to describe the global crisis. No other economic downturn after World War II has been as severe as today's recession. Although a large number of crises have occurred in recent decades around the globe, almost all of them have remained national or regional events – without a global impact. To find a downturn of similar depth and extent, the record of the 1930s has to be evoked. Actually, a new interest in the depression of the 1930s, commonly classified as the Great Depression, has emerged cause of today's crisis. By now, it is commonly used as a benchmark for assessing the current global downturn. Of course, any historical comparisons should be treated with caution. There are fundamental differences with earlier epochs concerning the structure of the economy, degree of globalisation, nature of financial innovation, state of technology, institutions, economic thinking and policies.

The global financial crisis has exacerbated the long-standing weaknesses, taking a heavy toll on Italy's and on European countries' economies. In fact, the current crisis is not "new": it is from the beginning of the century that the "Stock Market dance" is much accentuated. As noted, most major financial crises in the past were preceded by a sustained period of buoyant credit growth and low risk premiums, and this time is no exception. Let us see briefly what happened into the economic and financial system. Every time a bank makes a loan, new money is created. In the run up to the financial crisis, banks created huge sums of new money by making loans. In just seven years, they doubled the amount of money and debt in the economy. Very little of the trillion pounds that banks created between 2000 and 2007 went to firms outside of the financial sector. Around 31% went to residential property, which pushed up house prices faster than wages, a further 20% went into commercial real estate. Around 32% went to the financial sector, and the same financial markets that eventually imploded during the financial crisis, just 8% of all the money that banks created in this time went to firms outside the financial sector and a further 8% went into credit cards and personal loans. Lending large sums of money into the property market pushes up the price of houses along with the level of personal debt. Interest has to be paid on all the loans that banks make, and with the debt rising quicker than incomes, eventually some people become unable to keep up with repayments. At this point, they stop repaying their loans, and banks find themselves in danger of going bankrupt. This process caused the financial crisis. As the chairman of the UK's Financial Services Authority, Lord (Adair) Turner stated in February 2013:

"The financial crisis of 2007 to 2008 occurred because we failed to constrain the financial system's creation of private credit and money."

Straight after the crisis, banks limited their new lending to firms and households. The slowdown in lending caused the drop of prices in these markets, and this means those that have borrowed too much to speculate on rising prices had to sell their assets in order to repay their loans. House prices dropped and the bubble burst. As a result, banks panicked and cut lending even further. Moreover, the risk premium on interbank borrowing rose sharply to 5 per cent, whereas typically it was close to zero. A downward spiral thus begins and the economy tips into recession. Banks lend when they are confident that they will be repaid. Therefore, when the economy is doing badly, banks prefer to limit their lending. However, although they reduce the amount of new loans they make the public still have to keep up repayments on the debts they already have. The problem is that when money is used to repay loans, that money is 'destroyed' and disappears from the economy. As the Bank of England describes:

"Just as taking out a new loan creates money, the repayment of bank loans destroys money. Banks making loans and consumers repaying them are the most significant ways in which bank deposits are created and destroyed in the modern economy."

Therefore, when people repay loans faster than banks are making new loans, it is like draining the oil from the engine of a car: the economy slows down and prices decrease. As a result, the economy risks slipping into a 'debt-deflation' spiral, where wages and prices fall but people's debts do not change in value, leading to debts becoming relatively more expensive in 'real' terms. Even those firms and people that were not involved in creating the bubble suffer, causing a recession. Although authorities scrambled to inject liquidity into financial markets, the damage was done. The result is that the global financial crisis has seen the largest and sharpest drop in global economic activity of the modern era. In 2009, most major developed economies find themselves in a deep recession. The fallout for global trade, for both volumes and the pattern of trade has been dramatic. Governments have responded with an easing of monetary and fiscal policy that in turn have their own effects on activity and financial and trade flows. The downturn in activity is causing unemployment to rise sharply and, whit it, a political response to protect domestic industries through various combinations of domestic and border protection. Governments, however, soon discovered that the provision of liquidity, while essential, was not sufficient to restore a normal functioning of the banking system since there was also a deeper problem of (potential) insolvency associated with undercapitalisation. Monetary policy has been extremely expansionary, due to swift policy rate cuts across the world and with policy rates now close to zero. This is the major difference with the crisis in 1930s when central bank policy responded in a contractionary way, in order to maintain the gold standard. The EU is now providing a shelter for the forces of depression in Europe: through its internal market, its single currency and its institutionalised system of economic, social and political cooperation should be viewed as a construction that incorporates the lessons from the 1930s. Within the EU, the flow of goods and services, of capital and labour remains free, with no discernible interruptions created by the present crisis.

1.10.1 Consequences

The financial crisis has had a pervasive impact on the real economy of the EU, and this in turn led to adverse feedback effects on loan books, asset valuations and credit supply. However, some EU countries have been more vulnerable than the others, reflecting inter alia differences in current account positions, exposure to real estate bubbles or the presence of a large financial centre. Not only actual economic activity has been affected by the crisis, also potential output (the level of output consistent with full utilisation of the available production factors labour, capital and technology) is likely to have been affected, and this has major implications for the longer-term growth outlook and the fiscal situation. The fiscal costs of the financial crisis will be enormous. A sharp deterioration in public finances is now taking place. The decline in potential growth due to the crisis may add further pressure on public finances, and contingent liabilities related to financial rescues and interventions in other areas add further sustainability risk. Part of the improvement of fiscal positions in recent years was associated inter alia with growth of tax rich activity in housing and construction markets. The unwinding of these windfalls in the wake of the crisis, along with the fiscal stimulus adopted by EU governments as part of the EU strategy for coordinated action, is likely to weigh heavily on the fiscal challenges even before the budgetary cost of ageing kicks in.

An issue of major concern is that public indebtedness is rapidly increasing. This is the case not only because fiscal deficits are (normally) debt financed, but also because governments have implemented capital injections in distressed banks and granted guarantees that are debt financed and yet do not show up in the budget balance since they do not entail public expenditure on goods and services in a national accounting sense. The substantial widening in sovereign risk spreads and the downgrading of the credit ratings of some Member States have been one of the striking features of this financial crisis. Widening risk spreads can be regarded as indicative of the insurance premium financial market participants demand to the sovereign borrowers that are providing these guarantees. Discrimination among sovereign issuers may also reflect a flight to safety and liquidity, resulting in a decline in the yields of the liquid sovereign bond markets (such as benchmark Bunds). Moreover, spreads are widening and may expose the worst affected Member States to a vicious circle of higher debt and higher interest rates.

The decline in consumption during recessions associated with house price busts also tends to be much larger, reflecting the adverse effects of the loss of household wealth. Output losses following banking crises are two to three times greater and it takes on average twice as long for output to recover back to its potential level. Also in comparison with other financial and real estate crisis driven recessions in the post-war period it is relatively severe. In terms of the contributions of demand components, the downturn is mainly driven by a virtual collapse in fixed capital formation, with second order, but sizable, contributions of contractions in household consumption, stock formation and net exports. The comparatively small contribution of net exports conceals sizeable contractions in gross imports and exports associated with the collapse in global trade. Gauging the impact of the crisis on potential growth is important because this is a main determinant of the development of the standards of living in the medium and longer run. It is also an important determinant of the gauge of economic slack, i.e. the output gap, in

the short run, which in turn defines the room for short-term policy stimulus beyond, which inflation pressures are likely to emerge. Conversely, if the level of potential output is underestimated, the risk of deflation and the associated case for policy stimulus will be understated. Potential output is, an important determinant of the structural or cyclically adjusted fiscal position: the lower potential output, the smaller will be the (negative) output gap and hence the larger will be the structural (or lasting) component of the budget deficit. A range of industries, including the financial sector itself, but also the construction and car industries, will have to 'right-size' after their disproportionate expansion fuelled by the credit frenzy. Moreover, productivity growth may be affected by the crisis, although the net impact is ambiguous. The development in R&D activity is generally found to be pro-cyclical, hence innovation may falter. But, on the other hand, since large chunks of the capital stock may become obsolete, the least efficient parts are likely to disappear and this could have a favourable impact on productivity.

The crisis may weaken the incentives for structural reform through a range of channels, and thereby adversely affect potential growth and the resilience of economies to recover. A slowdown or reversal in structural reform, if not outright protectionism, would lead to further losses in potential output. The financial crisis led to, and was reinforced by, a steep decline in economic activity from the fourth quarter of 2008 onwards. This forced EU central banks and governments to adopt an extraordinary expansionary stance of macroeconomic policies. Besides the lowering of borrowing costs, central banks stepped in as central providers of liquidity, thereby ensuring the allocation of short-term bank funding on dysfunctional money markets. Reflecting the discretionary fiscal stimulus adopted, but also, and more importantly, tax shortfalls and inertia in expenditure programmes, government deficits have increased more than twice as much as one would predict from the automatic stabilisers.

Looking at the global context, the crisis has been accompanied by a considerable correction in the magnitude of the global imbalances so far. In 2008 the current account deficits narrowed considerably in the United States, This is due mainly to the relatively pronounced decline in domestic demand in the United States. In most of the oil exporting countries, the surpluses widened in 2008, because of the steep increase in oil prices in the first half of the year, but this masks a marked reduction in the surpluses in the second half of the year. This reflects the plunge in oil prices affecting the oil exporting countries. Current account deficits also narrowed considerably in the UK, the European country most connected with the epicentre of the crisis.

The euro area has switched from a broadly balanced current account position to a deficit. It runs a small surplus during the period 2002-2007 but as of 2008, it posts a deficit. This is the result of export demand collapsing even more strongly than import demand. The euro area has thus provided a net demand stimulus to the rest of the world economy. Overall, the role of the euro area in global imbalances was negligible until the crisis broke. Part of the recent correction in current account imbalances may be sustainable. In particular, regarding the US, the crisis appears to be forcing the private sector to increase saving rates to adjust to the excessive advantage and to the massive deterioration of balances sheets in the wake of falling asset prices.

1.10.2 Impact on Labour Market and Employment

Labour markets in the EU started to weaken considerably in the second half of 2008, deteriorating further in the course of 2009. Increased internal flexibility (flexible working time arrangements, temporary closures etc.), coupled with nominal wage concessions in return for employment stability in some firms and industries appears to have prevented, though perhaps only delayed, more significant labour shedding so far.

Until the financial crisis broke in the summer of 2007, the EU labour markets had performed relatively well. The employment rate, at about 68% of the workforce, was approaching the Lisbon target of 70%, owing largely to significant increases in the employment rates of women and older workers. Unemployment had declined to a rate of about 7%, despite a very substantial increase in the labour force, especially of non-EU nationals and women. Importantly, the decline in the unemployment rate had not led to a notable acceleration in inflation, implying that the level of unemployment at which labour shortages start to produce wage pressures (i.e. structural unemployment) had declined. These improvements had been spurred by reforms to enhance the flexibility of the labour market and raise the potential labour supply. The reforms usually included a combination of cuts in income taxes targeted at low-incomes and a redirection of active labour market policies towards more effective job search and early activation. Measures to stimulate the supply side of the labour market and improve the matching of job seekers with vacancies were at the centre of policies in a majority of countries. Importantly, however, in many countries the increase in flexibility of the labour market was achieved by easing the access to non-standard forms of work.

Labour markets in the EU started to weaken in the second half of 2008 and deteriorated further in the course of 2009. In the early phases of the crisis, the bulk of job losses were concentrated in just a handful of Member States, largely because of pre-existing weaknesses as well as a larger exposure to the direct consequences of the shocks (e.g. adjustments in the financial sector and housing markets, relative exposure to international trade). However, as the crisis subsequently put a widespread brake on domestic demand across the whole of the EU, at a time when external demand was already fading, employment has been falling in all Member States since the first quarter of 2008. As noted, increased internal flexibility (flexible working time arrangements, short-time working schemes, temporary closures etc.), coupled with nominal wage concessions in return for employment stability in some firms/industries, may have prevented, though perhaps only delayed, more significant labour shedding so far (with short-time working and temporary closures in the car industry as the most prominent example). Given the decline in output, this has led to significant increases in unit labour costs, which are unlikely to be sustainable for an extended period. The increase in unemployment has so far been limited also by a contraction of the labour force, which may be due to discouraged worker effects.

A major challenge stems from the risk that unemployment may not easily revert to pre-crisis levels once the recovery sets in, since the exit probabilities from unemployment are bound to fall and the average duration of unemployment spells are set to go up now. In this respect, there is a concern that, if not adequately addressed by policy measures, skills erosion of the unemployed may contribute to unemployment persistency.

Together with long-lasting effects on potential growth, this could threaten the European model of social welfare, which are already strained by ageing populations.

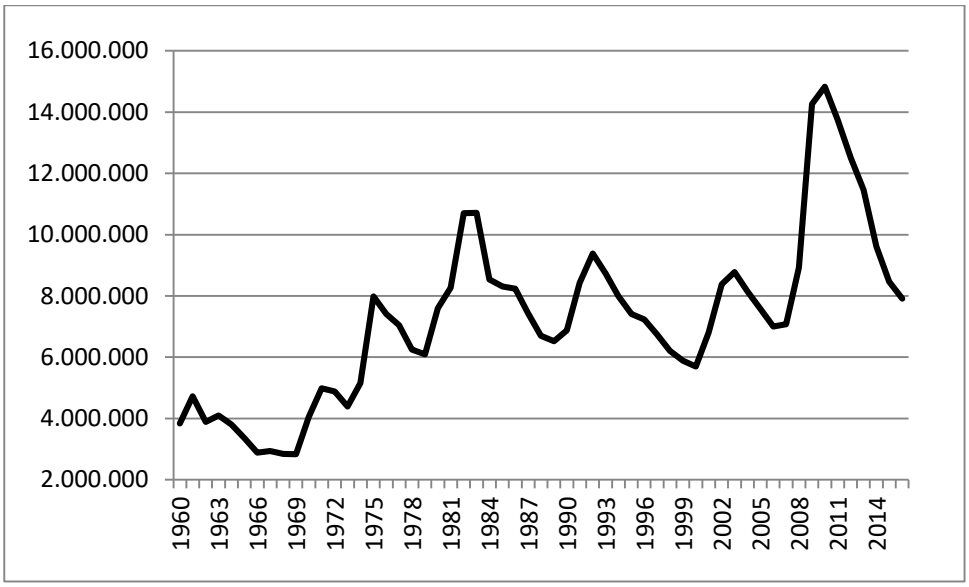


Figure 11. Total Unemployment USA
Sources: AMECO - Annual macro-economic database – European Commission

Figure 11 shows the USA Unemployment trend from 1960 until now. The values are increasing. In 1960 around four million persons were unemployed, in 1970 the number decreased of about one million. In 1982 there was a first pick with about ten million of persons unemployed, but the highest pick is in 2010, when the values reaches fourteen million. The trend started to increase from 2008, the years of the crises, when the people unemployed were about seven million. From 2010 until the most recent years, the trend is decreasing and it seems to come back to the values before the crisis. This last data confirm the efficiency of American economic policies to restore the negative effects of the financial crisis.

Summing up, the turnaround in labour market developments since the fourth quarter of 2008 has been very sharp. Employment is falling, and unemployment rising. However, the unemployment and employment responses have been relatively mild so far in comparison with earlier recession episodes, even if the output shock is extraordinary severe. The explanation is that there has been a strong reduction in average hours worked per person, except for workers with atypical labour contracts who are being laid off largely. There is also less of an associated discouraged worker effect than usual: job losers become active job seekers. The atypical working hours' response seems puzzling. Policy measures explain this to some extent, however: governments in various Member States have granted part-time unemployment compensation and allowed temporary plant closures. Another potential puzzle is that while the increase in unemployment looks relatively mild, unemployment expectations of households have worsened rapidly, also in comparison with previous recessions. This can be understood to some extent if one considers that unemployment expectations so far have materialised in part through shorter

working hours, which do not show up in unemployment statistics. However, this is probably not a sustainable situation and more lay-offs are likely to be in the pipeline.

1.10.3 Measure of prevention

Major policy initiatives have been taken in the EU pursuit of crisis control and mitigation. Financial rescue policies have focused on restoring liquidity and capital of banks and the provision of guarantees to get the financial system functioning again. Deposit guarantees were raised. Central banks cut policy interest rates to unprecedented lows and gave financial institutions access to virtually unlimited lender-of-last-resort facilities. Governments provided liquidity facilities to financial institutions in distress as well, along with state guarantees on their liabilities, soon followed by capital injections and impaired asset relief. Discretionary fiscal stimulus was released to hold up demand and ease social hardship over and above the automatic fiscal stabilisers. These crisis control and mitigation policies are largely achieving their objectives. Economic contraction has been stemmed and the number of job losses contained relative to the size of the economic contraction. This chapter discusses and assesses the policy actions in these areas in some detail.

After the September 2008 events, several countries scrambled to rescue their systemically important financial institutions, which exposed serious adverse effects, e.g. associated with cross-border banking groups or the nationality of depositors, which grossly violated level-playing field conditions. This prompted an immediate and coordinated EU strategy to prevent an outright collapse of the financial system. Member State governments, together with the Commission, spelled out the principles and objectives for a coordinated approach to tackle the crisis. Rescue packages for national banking sectors were rapidly set up, in line with the guidance swiftly provided by the Commission on the design and implementation of State aid in favour of banks. The main rationale of this guidance is to ensure that rescue measures can fully attain the objectives of financial stability and maintenance of credit flows. Central banks in turn responded by lowering the borrowing costs for banks. They also stepped up earlier measures to enhance market liquidity and later even resorted to unconventional policy measures like Quantitative Easing. Ensuring sufficient lending to the non-financial sector became a further immediate challenge as banks started the process of deleveraging. The uncertainty about the location and size of losses from impaired assets on banks' balance sheet continued to impact on investors' confidence, and the need to tackle this fundamental cause of the crisis became apparent. However, despite the various financial support measures, bank balance sheets are still fragile and the process of balance sheet adjustments in the banking sector is not yet over. Banks are still highly leveraged and persistent concerns about the quality of their assets raise worries about the overall health of their balance sheets. Near-term challenges relate mainly to issues of transparency, valuation of impaired assets and comparability of measures across jurisdictions. Medium-term challenges relate to the restructuring and return to viability of ailing banks, and efforts in these areas have to be sustained.

The European Economic Recovery Programme (EERP) could support aggregate demand, employment and household income in the short run during the crisis. Whilst at the same time improving the adjustment capacity to enable a faster recovery when conditions improve. The EERP has called for these measures to be consistent with long-term policy objectives such as those found in the Lisbon Strategy, the smooth functioning of the Single Market, and facilitating a move towards a low-carbon economy. The assessment below, which draws on an earlier publication by the European Commission services, shows that Member States are largely undertaking policy responses in line with these principles. In a number of EU countries, the adoption of temporarily shorter working hours or partial unemployment benefits prevented more labour, in particular in manufacturing. The existing social safety nets are also cushioning the social impact of the economic downturn. In addition, Member States are pursuing a wide range of complementary employment policies aimed at containing the impact of the crisis on labour markets under the aegis of the EERP endorsed by the European Council of 12 December 2008. The EERP recognised the need for public intervention to support viable businesses during the crisis to ease financing constraints facing and to support specific credit services (e.g. export credit insurance) which markets were temporarily unable to provide, at least at economically viable conditions and prices. Beyond the aggregate demand support provided by macroeconomic instruments, there may also be a case for temporary government support targeted at sectors where demand has been disproportionately affected by the crisis and could cause important dislocations. Temporary public support could help prevent unnecessary and wasteful labour shedding and the destruction of otherwise viable and sound companies. These measures will help contain the negative effects of the crisis on potential output by preventing a permanent loss of knowledge and skills and a reduction of productive capacity far beyond what would be expected during a normal cyclical slowdown. Finally, there may be instances, where government support on the supply side is warranted for sectors and business where there are technological or other benefits to the economy.

The ultimate resolution of the financial crisis requires removing investors' uncertainty about the quality of bank balance sheets. Stress tests can be a decisive tool for accomplishing this since they provide information about banks' resilience and ability to absorb possible shocks. They are already an important tool in financial institutions' risk management and bank supervisors use stress tests on an ongoing basis for monitoring the robustness of banks' financial health in accordance with the Basle II provisions. The EU has mandated the Committee of European Bank Supervisors (CEBS) to coordinate an EU wide forward-looking stress testing of the banking system. This exercise does not intend to duplicate the efforts at national level but it is a means to remove the negative confidence effects of having many different and often inaccurate estimates of likely bank exposures. The EU-wide stress test will be applied by national supervisors on a bank-by-bank basis, with the purpose to increase the level of aggregate information among policy makers in assessing the European financial system's potential resilience to shocks and to contribute to the convergence of best practices in the EU. The main advantage of an EU-wide stress test is to provide a more general outcome based on common guidelines and common stress scenarios. This will ensure comparable results and consistency in the analysis, thus increasing the level of information about the challenges ahead. The

Commission spring forecast serves as the foundation of the baseline scenario, while the ECB has proposed an adverse macroeconomic scenario surrounding the baseline. In order to enhance consistency and comparability of the approaches, the ECB has provided benchmarks for translating the macroeconomic shocks into the credit risk parameters. National supervisors may use their own estimates but are expected to explain the rationale for diverging from the benchmarks. The stress tests will be an important step in providing a more concrete perspective of the resilience of the financial sector in Europe. It is vital that Member States and industry capitalise on the work conducted. This could involve ensuring that the balance sheets of banks have been cleaned out and that there is an optimal level of transparency throughout the sector. It would also be an occasion for Member States to consider whether certain structural changes are needed to the configuration of the financial sector within their jurisdiction. However, the EU exercise is not intended to be used to assess specific institutions' needs for recapitalisation, considerable resources remaining available for bank support could prove useful for recapitalising banks found to be vulnerable. Apart from government support, recapitalisation could also be achieved through the Part III Policy responses issuance of new capital instruments or by the sale of assets and business lines.

Second Chapter

Growth Accounting

2.1 The Growth Accounting: a brief review

In the first chapter we introduced the main issue of this research project, the concept of growth, in particular we talked about the productivity growth and all the variables connected with it such as labour, capital, investments and innovation. Now it is time to answer more in deep at some crucial questions. What explains the *growth* of the economies in the various countries around the world? Why some economies grow more than the others do? Is it possible that there is a convergence in growth rates of the various economies and the rich are meant to be getting richer and the poor getting poorer?

The sources of Economic Growth is an issue that has received much attention in economic science. The growth question was crucial in the thinking of many classical economists such as Smith, Ricardo, Malthus and Mill. According to the latter, the engine of growth is the investment. It is possible, if the production generated by the product allows you to pay pensions and salaries, to pay back the initial working capital and to generate a surplus compared to the value of the resources used. This surplus coincides with the profit of the capitalists and can be invested, increasing year by year the capital employed in order to expand production.

A few years later *Ricardo* interested in focusing on growth in a kind of agricultural economy, in which there is a fixed factor, the land, which determines the stop in the course of the development process time. The expansion of production resulting from capital accumulation makes less and less fertile lands that are put under cultivation. The marginal productivity of capital decreases with the accumulation and it gets to the point where no profit is generated. The economy, therefore, is expected to reach a steady state in which the growth stops if other factors do not intervene to counter the diminishing marginal productivity of capital.

In the most recent period it affirmed the *Harrod* (1939) and *Domar* (1946) approach. It is a mathematical model used to explain the growth rate of an economy in terms of the level of savings and capital productivity. In particular, the model is designed to explain how to increase production in a situation of under-utilization of production capacity. Key ingredient for economic development is the mobilization of savings that can generate sufficient investment to start and "take off" the economy by accelerating economic growth. This model suggests that savings provide the necessary funds for investment and that the growth rate of the economy depends on the level of savings and the productivity of investment, namely the capital-output ratio. It also emphasizes the crucial role of investment and savings: greater savings involves greater investment, which in turn leads to a greater accumulation of capital, and, therefore, you will reach the growth.

One of the most popular and successful ways of summarizing the contribution of factors of production and technology to output growth is the growth accounting framework introduced by *Solow* (1957). We will analyse more specifically the Solow model and all other important exogenous growth models later in the research project, in chapter four. Now we will try to understand what the economic growth is and which variables and relationships are involved, through the growth accounting method.

2.2 The Method

Growth accounting is a procedure to measure the contribution of different factors, which are the factors of production (labour and capital) and technological progress to economic growth . Growth accounting leads to the well-known concept of the Solow residual, which measures Total Factor Productivity Growth (TFPG). TFPG is the part of output growth, not attributed to the use of factors of production such a capital or labour, but to technical change. A strong positive TFPG has been regarded as a desirable characteristic of the growth process since, given the growth of conventional factors of production, it further promotes output growth. However, there are still conceptual disputes about the subject, and Easterly and Levine (2001) note for example “economists need to provide much more shape and substance to the amorphous term TFP”.

Let us start, however, from the basics of the concept of growth. In economics, "economic growth" or "economic growth theory" typically refers to growth of potential output, i.e., production at "full employment". Growth is usually calculated in real terms (i.e., inflation-adjusted terms) in order to eliminate the distorting effect of inflation on the price of goods produced. Measurement of economic growth uses national income accounting. Since economic growth is measured as the annual percentage change of Gross Domestic Product (GDP), it has all the advantages and drawbacks of that measure. Economic growth is generally calculated from data on GDP and population provided by countries' statistical agencies, although independent scholarly estimates are also available. Increases in productivity have historically been the most important source of real per capita economic growth.

Economic growth has traditionally been attributed to the accumulation of human and physical capital, and to the increasing productivity arising from technological innovation. Before industrialization, technological progress resulted in an increase in population, which was kept in check by food supply and other resources, which acted to limit per capita income, a condition known as the Malthusian trap. The rapid economic growth that occurred during the Industrial Revolution was remarkable because it was in excess of population growth, providing an escape from the Malthusian trap. Industrialized countries eventually saw their population growth slow, a condition called demographic transition. Increases in productivity are the major factor responsible for per capita economic growth and this has been especially evident since the mid-19th century. Most of the economic growth in the 20th century was due to reduced inputs of labour, materials, energy, and land per unit of economic output (less input per widget). During the Industrial Revolution, mechanization began to replace hand methods in manufacturing, and new processes streamlined production of chemicals, iron, steel, and other products. Machine tools made the economical production of metal parts possible, so that parts could be interchangeable. Another major cause of economic growth is the introduction of new products and services and the improvement of existing products. New products create demand, which is necessary to offset the decline in employment that occurs through labour saving technology.

Economists distinguish between short-run economic changes in production and long run economic growth. Short-run variation in economic growth is termed the *business cycle*. The business cycle is made up of booms and drops in production that occur over a

period of months or years. Generally, economists attribute the vicissitudes in the business cycle to fluctuations in aggregate demand. In contrast, economic growth is concerned with the long run trend in production, due to structural causes such as technological growth and factor accumulation. The business cycle moves up and down, creating fluctuations around the long run trend in economic growth.

Growth accounting decomposes the growth rate of economy's total output into that which is due to increases for factors used; usually the increase in the amount of capital and labour, and that cannot be accounted for observable changes in factor utilization. The unexplained part of growth in GDP is then taken to represent increases in productivity (getting more output with the same amounts of inputs) or a measure defined technological progress. The technique has been applied to every economy in the world and a common finding is that observed levels of economic growth cannot be explained simply by changes in the stock of capital in the economy or population and labour force growth rates. Hence, technological progress plays a key role in the economic growth of nations. There are two methods of decomposition of the rate of GDP growth: the Arithmetic method and the Breakdown of Solow function production. According to the arithmetic method, the growth rate of real GDP can be factored into the contribution of: the total population, the share of the population of working age, the employment rate, the labour productivity, measured by output per worker ratio.

The theoretical analysis of the aggregate production function tells us that labour productivity depends not only on employment levels, but also on the allocation of capital per worker and technological progress. So to have a complete view of the causes of the productivity slowdown we have to study how and if these two additional factors have influenced the growth. How does the rate of growth per unit of product vary in time? We start from the aggregate production function:

$$Y(t) = A(t) \cdot F[K(t), L(t)] \tag{13}$$

Where *A(t)* is technology, *K(t)* refer to capital and *L(t)* is the labour, each variable is function of time *t*. We can rewrite the previous equation as a *Cobb-Douglas production function*:

$$Y(t) = A(t) \cdot K(t)^{\alpha} \cdot L(t)^{1-\alpha} \tag{14}$$

If we use the logarithmic:

$$y_t = \propto k_t + (1-\propto) l_t + a_t \tag{15}$$

Where $\propto$ is the share of income going to capital and *(1-*$\propto$*)* is the share of income going to labour. If we move backwards of a period:

$$y_{t-1} = \propto k_{t-1} + (1-\propto) l_{t-1} + a_{t-1} \quad (16)$$

If we suppose that:

$$g_y = y_t - y_{t-1} \quad (17)$$

So that g indicate the growth rate, we can write:

$$g_y = \propto g_k + (1-\propto) g_l + g_a \quad (18)$$

Where $(1-\propto)$ is the adjusted wage share. Focusing on the growth rate of technology (g_a), we can express it as:

$$g_a = g_y - \alpha g_k - (1-\alpha) g_l \quad (19)$$

g_a is the so called Total Factor Productivity (TFP). Therefore, with equation (19) we reach at the definition of this important variable. In the traditional growth accounting framework TFP is what remains from output growth after the contribution of the factors used to produce output. Developing some steps, we obtain:

$$g_a = g_y - \alpha g_k - g_l + \alpha g_l$$

$$g_a = g_y - g_l - \alpha(g_k - g_l)$$

$$g_y - g_l = g_a + \alpha(g_k - g_l)$$

$$\alpha(g_k - g_l) \quad (8)$$

Last equation (8) shows the so-called "Capital Deepening", formally it is the product between the share of income going to capital (α) and the difference between the growth rate of capital and the growth rate of labour ($g_k - g_l$). It is a situation where the capital per worker is increasing in the economy and it is referred to an increase in the capital intensity. Overall, the economy will expand and productivity per worker will increase. However, according to some economic models, such as the Solow model, economic expansion will not continue indefinitely through capital deepening alone. This is partly due to diminishing returns and to depreciation.

Investment is also required to increase the amount of capital available to each worker in the system and, thus, it increases the ratio of capital to labour. In other economic models, that follow the endogenous growth theory, capital deepening can lead to sustained economic growth even without technological progress. Traditionally, in development economics, capital deepening is seen as a necessary but not sufficient condition for economic development of a country.

2.3 Some Data

Our quantitative analysis starts from the observation of data and it aims to understand how big are the role of labour participation, capital accumulation and technological progress in the economies of the countries considered, trying to understand which was and which is nowadays the trend of economic growth.

By collecting data from the official database *AMECO* of the European Commission, we have observed the changes in GDP, Employment, Net Capital Stock and Total Factor Productivity (TFP) for the most important European countries. In particular we consider in our sample Italy, Germany, Greece, Spain, France and UK, (even if it has recently decided in a referendum to leave the Union), with a comparison with the U.S. and Australia. The period of observation starts in 1960 and ends in 2016 (using also forecast data) and we have divided the periods of observation into time spans of ten years, by calculating the average of the observed values within each of them.

We take the medium growth rate for each time span, in order to have the growth rates of each variable considered: g_y for gross domestic product, g_l for employment and g_k for the net capital stock; until reach the definition of TFP, as I have obtained arithmetically in the previous paragraph.

	1960 - 69	*1970 - 79*	*1980 - 89*	*1990 - 99*	*2000 - 10*	*2011 - 16*
			Italy			
Gross domestic product	5,59%	3,91%	2,51%	1,48%	0,51%	-0,09%
Employment, persons	-0,52%	0,83%	0,59%	0,06%	1,04%	-0,22%
Net capital stock	4,48%	3,81%	2,69%	1,82%	1,85%	-0,01%
Gtfp	4,24%	2,02%	1,11%	0,64%	-0,91%	0,03%
			Germany			
Gross domestic product	–	–	–	1,44%	0,79%	1,92%
Employment, persons	–	–	–	0,02%	0,48%	0,81%
Net capital stock	–	–	–	2,18%	1,01%	0,81%
Gtfp	–	–	–	0,55%	0,09%	1,12%
			Greece			
Gross domestic product	8,10%	5,28%	0,75%	2,05%	2,70%	-3,07%
Employment, persons	–	–	–	–	1,16%	-2,54%
Net capital stock	7,65%	6,65%	2,71%	2,11%	2,44%	-1,13%
Gtfp	–	–	–	–	-2,35%	-8,24%
			Spain			
Gross domestic product	7,41%	3,76%	2,65%	2,61%	2,71%	0,39%

Employment, persons	–	–	–	–	2,29%	-0,57%
Net capital stock	4,33%	5,16%	2,84%	3,53%	4,33%	0,87%
Gtfp	–	–	–	–	-2,88%	-5,09%
			France			
Gross domestic product	5,54%	3,99%	2,33%	1,98%	1,39%	1,11%
Employment, persons	0,47%	0,79%	0,37%	0,76%	0,65%	0,47%
Net capital stock	4,55%	4,35%	2,41%	1,93%	2,05%	1,27%
Gtfp	-0,50%	-2,15%	-3,79%	-3,63%	-4,11%	-4,57%
			UK			
Gross domestic product	3,07%	2,57%	2,56%	2,05%	1,89%	1,93%
Employment, persons	–	–	–	–	0,64%	1,13%
Net capital stock	2,78%	2,49%	1,97%	2,04%	1,72%	1,40%
Gtfp	–	–	–	–	-3,99%	-3,90%
			Australia			
Gross domestic product	5,22%	2,96%	3,34%	3,25%	2,99%	2,76%
Employment, persons	2,76%	1,60%	2,23%	1,22%	2,19%	1,38%
Net capital stock	2,84%	2,90%	3,24%	2,67%	4,11%	–
Gtfp	2,39%	0,15%	0,17%	0,66%	-1,02%	–
			USA			
Gross domestic product	-1,34%	-5,45%	1,68%	0,80%	-1,55%	4,51%
Employment, persons	2,00%	2,08%	1,70%	1,18%	0,46%	1,10%
Net capital stock	-1,53%	-0,45%	-0,47%	-0,64%	0,97%	-0,75%
Gtfp	-7,56%	-11,63%	-4,41%	-5,27%	-7,43%	-1,21%

Table 2. Countries Growth Rates
Sources: AMECO - Annual macro-economic database – European Commission

The table 2 shows the growth rates for every variable considered in each time span. Let us analyse the results obtained.

The growth rates of gross domestic product shows high values in the first span of time, especially in Greece (8,10%) and Spain (7,41%), but also in Italy, France and Australia, where it is around 5%. In UK it is positive but a more bit restrained (3,07%). Moving on the other spans of time, the gross domestic product growth rates of all European countries decrease evidently. In Italy from the new millennium, the value is near the zero (0,51%) and it becomes negative in the last period (-0,09%). The worst performance is that of Greece, where in the period 2011-2017 we have a value of -3,07%,

that means that the country shows even much difficulties in recover from the last crisis. The last value is around 1%, instead, in Germany, France and UK. Particular is the situation in USA, where in the first two spans of time, so until the Eighties, the gross domestic product growth rates are negative, -1,34% and -5,45%. The value becomes positive until the new millennium, when it decreases again below the zero (-1,55%); it must be considered that in this span of time (2000-2010) it lies the financial crises of 2008. The answer of USA, however, is considerable if we look at the last period considered, when there is the highest value for the American gross domestic product growth rate (4,51%) and this shows how USA committed to recover from the negative economic condition. Australian gross domestic product growth rate seem not to be affected by the crisis. The value is high in the first period (5,22%) and it maintain the trend around 3% in the others spans of time. It is slightly decreasing in most recent years until 2,76%, but it is not a worrying symptom.

Looking and the employment growth rates, the values are quite restrained in all the countries along all the period considered. In Italy, Germany, France and UK, the values are all around the zero. In particular, in the last span of time, Italy and Spain show negative employment growth rates, -0,22% and – 0,57% respectively, even if the worst performance is the one of Greece, with a negative value of – 2,54%, while the highest value is in UK (1,13%). This situation is quite worrying and means that there is recently a bucking of the employment trend. We talk about an increasing employment among the European countries, but this phenomenon stops in the last five years circa. In Australia and USA, instead, the employment growth rates follow a quite stable trend. It lies around 2% in the first country, with a slightly decrease in the last period (1,38%), while it stand below the 2% in USA, but there are no negative value. These evidences show how the Australian and the American labour markets did not suffer of any kind of friction in all the period considered also in the most recent years.

Different and peculiar in each country is the trend of the net capital stock growth rate. In the European countries it show high values in the first two span of time: 4,48% and 3,81% in Italy, 7,65% and 6,65% in Greece, 4,33% and 5,16% in Spain, 4,55% and 4,35% in France. In these countries, the trend falls moving on the others spans of time. In the last period the values are negative in Italy (-0,01) and Greece (-1-13%), while they are positive but near the zero in Germany and Spain, around 1% in France and UK. In Australia, values are positive and around 2% in all the spans of time, while it is increasing in more recent years (4,11%). The American net capital stock growth rate show a stable trend in all the period considered, even if the values are negative but always near the zero, the only positive value is on the period 2000-2010 (0,97%).

Finally, in the fourth row, we reach at the definition of the TFP growth rate, calculated through the equation that we have arithmetically obtain in the previous paragraph. The values and the trends, that result, are quite important to carry on my thesis in this research project and try to reach some conclusions. In Italy the value is quite high in the first span of time (4,24%), the trend is then decreasing, until reach a negative value in the period 2000-2010 (-0,91%), while it is positive again in the recent years (0,03%). In Germany the values lie around the zero, while in the last span of time TFP growth rate is increasing (1,12%). Spain and Greece show the same, let us say, dramatic situation with negative value around -2% in the period 2000-2010, and even more decreasing in

the last years with -5,09% in Spain and -8,24% in Greece. We find negative TFP growth rates also in France, where it stands around -4%, and in UK, where it is around -3% in the last two spans of time. Australia shows all positive values, except in the period 2000-2010 where there is a negative value of -1,02%. American TFP growth rates are actually below the zero, the worst performance is in the period 1970-1979 with a negative value of -11,63%. In the period 2000-2010 the value is even quite negative (-7,43%), but in the last years USA has recover the gap rapidly, reaching -1,21%.

2.4 Technological Progress

The theory of Growth Accounting, starting from the Cobb- Douglas production function, puts the attention on productivity and its growth, a key variable to the long run improvement in terms of income and (un)employment. The production function tells us that we can boost output in three ways: by increasing the capital stock, by increasing employment, or by boosting total factor productivity (TFP). This assumption can be now confirmed: after collecting and analysing data, in fact, we can affirm that productivity depends upon a combination of investments in physical and human capital, knowledge and technical progress.

An important element that appears in the Cobb- Douglas production function and that is critical in the calculations of Growth Accounting, indicated with *A*, is *Technology*. Technology can be most broadly defined as the entities, both material and immaterial, created by the application of mental and physical effort in order to achieve some value. It is the collection of techniques, skills, methods and processes used in the production of goods or services, or in the accomplishment of objectives, such as scientific investigation. Technology can be the knowledge of techniques, processes and so on, or it can be embedded in machines, computers, devices and factories, which can be operated by individuals without detailed knowledge of the workings of such things. Technology has an important relationship with human capital. It can be applied in two different firms, but output varies with respect to the labour force of that firm. Adaption to new technology is directly proportional to pace of economic growth of the country. Hence, labour should be experienced with the technology. Education also plays an important role as it helps in accumulating human capital that in turn helps technology diffusion. Education also helps a person be acquainted with technology efficiently and rapidly. Technological progress enables output to rise even if the capital stock or hours worked do not increase, so it has been the major force behind economic growth over time. Technical progress boosts output directly through the production function and by increasing the steady state capital stock. Let us see simply what happen graphically.

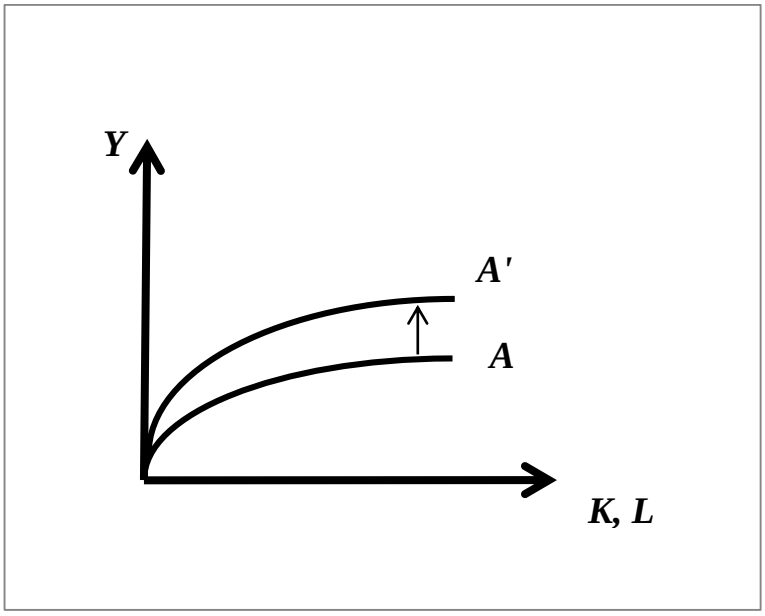


Figure 12. Productivity Function shift after an increase in technological progress

Figure 12 shows the typical trend of production function, given a certain level of capital (*K*), labour (*L*) and technology (*A*). After an increase in technology (*A* to *A'*), the curve shift upward, determining a major level of output (*Y*), without spending less or saving more. So we can conclude that an improvement in technological knowledge increases output for a given capital stock and human capital.

Technological progress can and has taken many different forms. One useful distinction is between invention and innovation. Invention is the discovery of new ideas, while innovation is about implementing them. Although we give inventions a higher social status, historically innovations account for most of economic growth. When new technologies are invented, it is often impossible or too costly to implement them (for instance, Leonardo da Vinci allegedly designed the world's first submarine and helicopter long before people could construct such machines). Further, the first implementations of a new invention are often not efficient or productive. For instance, during the Industrial Revolution in the UK in the eighteenth century, technological progress led to substantial increases in productivity in the textile industry. However, even here innovation and improvement had more impact than invention.

In reviewing the history of technological change, Mokyr distinguishes between "macro-inventions" and "micro-inventions." Macro-inventions are radical changes in the nature of technology, such as the use of animals to provide power, and the shift first to wind power, then to steam, and then to electricity. In each case a new and better way of organizing production was discovered, and the discovery set in motion a widespread process of adoption that boosted investment and output. By contrast, micro-inventions improve existing processes within the existing technological paradigm. For instance, the introduction of wind power and the use of windmills were a macro-invention, but productivity could still improve through micro-inventions, selecting the optimal number

of blades on the windmill, angling these blades, making the windmill moveable to maximize wind power, and so forth.

A country able to increase the output of final goods and services faster than its population grows can improve its citizens' standard of living. However, the speed with which such change occurs can vary greatly. Technological progress is the key to a country's long-term increase in its material well-being. It is the fundamental force, which reflects the growth of human knowledge, from advances in basic science. Such as the discovery of the laws of thermodynamics, to highly practical and applicable ideas regarding production, like the design of an airplane wing or the mechanization of repeated actions or management and workplace organization, like double-entry accounting, just-in-time production and the techniques of modern inventory management. It involves two activities: process innovation and product innovation. Therefore, in recent time, technological progress is considered an economic measure of innovation.

It is nearly impossible to overstate the role of technology in economic life. Imagine, for example, how one's life would be different without such everyday inventions as computers and telephones, anaesthesia and antibiotics, automobiles and airplanes, and electricity and petrochemicals. Economic growth occurs because individuals have either more resources at their disposal or better ideas for turning resources into goods and services. Increases in resources alone cannot drive persistent economic growth. Natural resources are limited in a finite world, and while education can dramatically increase the productivity of human resources, such gains are constrained by human lifespans. Countries have doubled the education of their workforce, going from five years of schooling to ten, but it is hard to imagine repeating this accomplishment. The gains available from mechanization are also limited. If industry increases the number of machines per worker, growth will slow as each machine adds less to output than the one before.

In production, technological progress has been the primary force underlying the shifts from manual to mechanized production methods, from natural to synthetic materials, from human and animal to mineral sources of power, and from raw labour to highly educated and specialized workers.

The adoption of new technologies often drives the expansion of markets. Larger markets are required to allow workers and firms to concentrate on highly specialized activities and increase the return to innovations that involve investments in specialized knowledge or machinery. Innovations in transportation and communication have induced correspondingly dramatic changes in the organization of economic activity, shifting production out of the home, raising the average size of business enterprises, concentrating production in cities, and technological change increasing the geographic extent of trade and the role of international transactions in local and national economies.

2.4.1 Related Literature

Technological advancement and economic growth are truly related to each other. The level of technology is an important determinant of economic growth. The rapid rate of growth can be achieved through high level of technology.

Many economists, during the years, have been interested in studying this kind of variable. They try to understand in which way technology is able to drive the economic growth and how big is its force. Let us see more in depth, which are the most important definition of it.

Schumpeter observed that innovation or technological progress is the only determinant of economic progress. However, if the level of technology becomes constant the process of growth stops. Thus, the technological progress keeps the economy moving. Inventions and innovations have been largely responsible for rapid economic growth in developed countries. The growth of net national income in developed countries cannot be claimed to have been due to capital alone. *Kindleberger* observed that major part of this increased productivity is due to technological changes. *Robert Solow* identified technology in his aggregate production function and he also suggested a neutral technical progress and economic growth model; he estimated that technological change accounted for about 2/3 of growth of the U.S. economy; after allowing for growth in the labour force and capital stock. Similarly, *Karl Marx* and *Schumpeter* have emphasized the significance if technical progress in their growth model formulations. In the words of *Mansfield:* "Technological change is one of the most important determinants of the shape and evolution of the economy". *Edward Denison's* empirical data proved technology as major contributor to economic growth. *Kuznets* in his model proved and showed importance of technology innovation in the growth of an economy. *Harrod* also proposed a neutral technical progress and economic growth model.

Technological change has improved working conditions, it has permitted the reduction of working hours and it has provided the increased flow of products. In fact, the technology can be regarded as primary source in economic development and the various technological changes contribute significantly in the development of underdeveloped countries.

Technological progress also might hold a key to understanding persistent differences in the rates of improvement in the standard of living among countries. Technological progress appears to have shifted around 2001, when the median emerging economy's growth rate accelerated and surpassed that of advanced economies. This change was accompanied by a declining rate of capital-driven growth in advanced countries as investment expanded in some emerging nations. These patterns are not uniform across emerging countries, since significant technological gaps persist. The net result: in spite of large gains by many emerging countries, there was no broad-based catch-up in the standard of living around the world.

Therefore, we understand that technological progress is the key to increases in the standard of living. However popular discussions of technological progress are often more ambivalent. It is often blamed for higher unemployment, and for higher income inequality. Are these fears groundless?

Along with technological progress comes a complex process of job creation and job destruction. For those who lose their jobs or for those who have skills that are no longer in demand, technological progress can indeed be a curse, not a blessing. As consumers, they benefit from the availability of new and cheaper goods. As workers, they may suffer from prolonged unemployment and have to settle for lower wages when taking a new job.

The standard model based on *Solow* and *Swan*'s work shows labour productivity growing either through factor accumulation, as an economy adds more units of capital per worker, a process known as capital deepening, or through technological progress. Technological progress refers to gains in the efficiency with which the inputs needed to make goods and services are used. This model tells us that only technological progress, and not capital deepening, can sustain the growth of output per worker over the long run, offsetting diminishing returns on capital. If technologies are common, and economic and social institutions (demographics, saving rates, laws, education and economic policies) are similar, then Solow–Swan model anticipate that living standards in emerging countries should eventually catch up with those of advanced economies. As this occurs, labour productivity in emerging countries, such as China and India, should grow faster than in advanced countries. Labour productivity differences among countries may arise because of varying economic and social institutions. However, as long as countries share the same technology, the Solow–Swan model says that these differentials won't persist in the long run, because they result from temporary differences in capital deepening. Crucially, Solow–Swan model assumes countries have access to and adopt identical technology to allow achievement of a common TFP growth rate. Historically, this has not been the case. Technological progress appears to vary with the level of economic development that, in turn, carries implications for long run labour productivity growth.

2.5 Total Factor Productivity (TFP): the key variable

Studies show that GDP growth is explained only for a small part (4.7%) by the increasing amounts of the two classical inputs, capital and labour. Most of the growth (95.3%) is explained by a set of invisible factors, what we can call the "residual" and that can consist of organization of work and production, economies of scale, investment in R&D and use of more advanced knowledge, training of workers, institutional characteristics, and so on. The so-called "residual", which is often named "Total Factor Productivity" (TFP). Total-Factor Productivity, also called multi-factor productivity, is the portion of output not explained by the amount of inputs used in production, is a measure of the efficiency of all inputs in a production process.

As I described in the previous paragraph, increases in TFP result usually from technological innovations or improvements. If all inputs are accounted for, then total factor productivity can be taken as a measure of an economy's long-term technological change or technological dynamism. Technology growth and efficiency are regarded as two of the biggest sub-sections of Total Factor Productivity.

TFP is often seen as the real driver of growth within an economy and studies reveal that whilst labour and investment are important contributors, it may account for up to 60% of growth within economies. TFP is more accurately measured in long term, since it can vary substantially from one year to another. It cannot be measured directly; instead, it is a residual, often called the Solow residual, from the Solow's model, which accounts for effects in total output, not caused by inputs.

How much of the growth in output per worker is associated with growth in physical and human capital per worker and how much is due to technology, institutional change and other factors? An economy's output is a positive function of physical and human capital, given the technology. Assumptions of constant returns to scale and competitive factor markets make it possible to calculate the growth rate of output implied by the growth of physical and human capital; deviations of actual output from this implied growth rate are due to changes in technology, institutional change, failure of the twin assumptions of constant returns to scale and competitive factor markets. These deviations are called "growth in total factor productivity" although these deviations include much more than what is suggested by the word "productivity" and probably are more fairly called the "residual" or "Solow residual" in growth. The Solow residual, in fact, usually measures TFP growth.

Growth of total factor productivity provides society with an opportunity to increase the welfare of people. It is, therefore, worthwhile to ask, what determinants should policy focus on to enhance the performance of TFP? It is not easy to answer at this question. Let us see which was in the last twenty years and which is now the trend of TFP in the most of European Countries, in USA and in Australia. In the graph below, we have grouped the trend of the growth rates of TFP for the countries considered for the period between 1996 and 2016, constructed with the data showed in the table above.

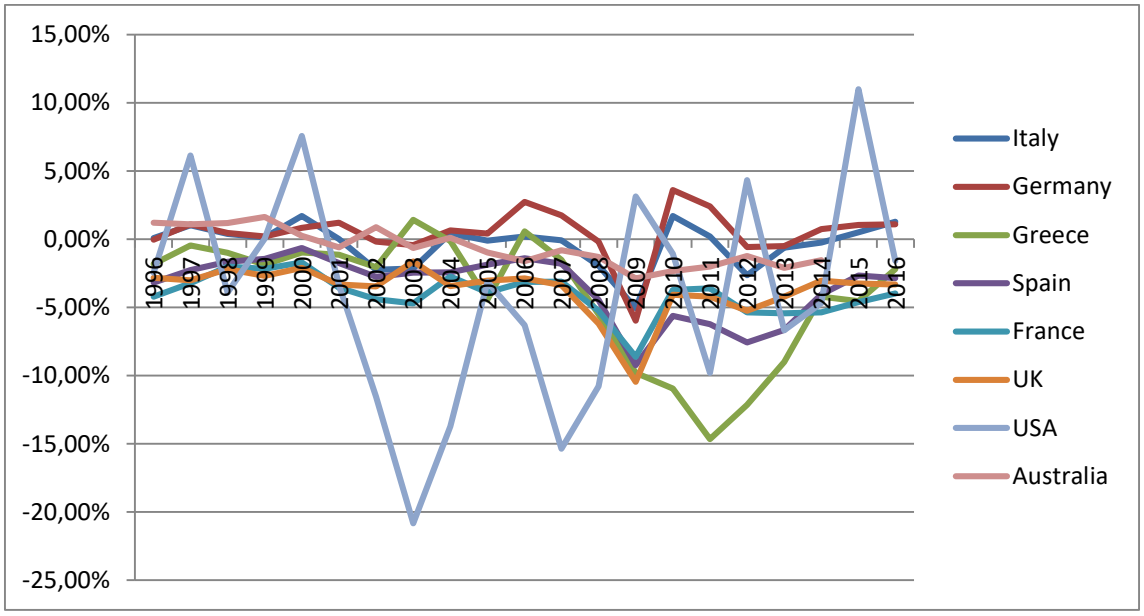


Figure 13. TFP Growth Rates

From 1996 until 2006, the trend is quite stable, even if most of the value are near or under the zero. From the second half of 2006 and until 2009, in correspondence of the outbreak of the USA Financial Crisis, the growth rates of TFP of all countries broke down evidently, most of them reach the negative value of -10%. From 2009, there is a recovery, with some exceptions like Greece and Spain, where TFP remains very low or becomes even lower. In the most recent past (2012 – 2015), the values seem to increase but are all negative yet. Only Germany and, strangely, Italy show positive TFP values. Overall, it is easy to notice the hard fluctuating trend of American TFP growth rates. It is very low in 2003 and 2007, while paradoxically after the crisis in 2008 it seems to rise even if there are other negative peak in 2011 and 2013. In 2015 the value reach 10% but in the last years they downturn again around the zero.

By the performance of TFP, we can easily deduce that this is a key variable to understand the situation and the economic cycles within individual countries. From the graph we can draw a general view that captures the times of crisis and the more recently one of recovery, so we can understand that TFP is able to reflect the economic cycle.

2.5.1 Related Literature

Economists have long recognized that total factor productivity is an important factor in the process of economic growth. However, just how important it is has been a matter of ongoing controversy. Part of this controversy is about methods and assumptions. Total factor productivity growth is estimated as residual, using index number techniques. It is thus a measure of our ignorance, with ample scope for measurement error. Another source of controversy arises from sins of omission, rather than commission. A New Economy critique of productivity points to unmeasured gains in product quality, while an environmental critique points to the unmeasured costs of growth. TFP plays a critical role on economic fluctuations, economic growth and cross-country per capita income

differences. At business cycle frequencies, TFP is strongly correlated with the output and the hours worked. Based on this observation, Kydland and Prescott (1982) initiated the real business cycle (RBC) literature. In the standard business cycle model, shocks to TFP are propagated by pro-cyclical labor supply and investment, thereby generating fluctuations in output and labor productivity at business cycle frequencies with an amplitude that resembles the U.S. data. Subsequent work has introduced pro-cyclical fluctuations in measured TFP by incorporating unmeasured labor hoarding and/or capacity utilization in the standard framework (e.g. Burnside et al. (1995) and King and Rebelo, 1999).

As shown in the landmark article by Robert Solow (1956), long run growth in income per capita in an economy with an aggregate neoclassical production function must be driven by growth in TFP. For over 30 years, the conceptual difficulty when trying to endogenize TFP growth was how to pay for the fixed costs of innovation in a perfectly competitive economy with constant returns to scale in capital and labor. In this context, all output is exhausted by paying capital and labor their marginal products, and therefore, no resources are left to pay for the innovation costs. Romer (1990) and Aghion and Howitt (1992) solved this problem by granting the innovator monopolistic rights over his innovation, which are sustainable through the patent system. In this way, innovators can recoup the initial fixed costs of innovation through the profit margin they make from commercializing their patent. By linking the TFP growth rate to innovation, endogenous growth models shed light on the determinants of TFP growth.

Solow (1956) demonstrated also that cross-country differences in technology might generate important cross-country differences in income per capita. Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999) have confirmed that a majority of the gap in income per capita between rich and poor countries is associated to large cross-country differences in TFP. Cross-country differences in TFP can be due to differences in the physical technology used by countries or in the efficiency with which technologies are used. To explore the relative importance of these factors, it is necessary to have data on direct measures of technology. Comin, Hobijn and Rovito (2006) put together direct measures of technology adoption for approximately 75 different technologies and show that the cross-country differences in technology are approximately four times larger than cross-country differences in income per capita. Further, technology is positively correlated to income per capita. Thus, cross-country variation in TFP is largely determined by the cross-country variation in physical technology.

A significant fraction of innovations is not patented. For some, this is because they are not embodied in any new good or are not a recipe for a new chemical process and, therefore, are not patentable. Others are not patented because innovators simply decide not to apply for a patent. Three important areas of research are to understand how important patents are for innovation activity, the determinants of non-patentable innovations and how they interact with the patentable-R&D type of innovations that fit the properties of the Romer (1990) and Aghion and Howitt (1992) models. Two recent papers have argued that patents are not necessary for the innovators to recoup the innovation costs. Innovators in Hellwig and Irmen (2001) can obtain rents to cover innovation costs despite being perfectly competitive because they face an increasing marginal cost of producing the intermediate goods that embody their innovations. Boldrin

and Levine (2000) model innovation in perfectly competitive settings. In their model, to copy an innovation, it is necessary to purchase one unit of the good that embodies it. Hence, the innovator is the monopolist of the first unit produced, and the revenues he extracts from selling it may cover for the innovation costs, making up for a lack of patent protection. Comin and Mulani (2006) model the development of disembodied innovations such as managerial and organizational techniques, personnel, accounting and work practices, and financial innovations. These are very different from embodied innovations in that the rents extracted by the innovators are not associated to selling the innovation per se. This has some interesting implications. First, the revenues accrued by the innovator-producer originate from the increased efficiency in producing his good or service with the innovation. If the innovator-producer has some monopolistic power in the market for his good or service, the increased efficiency from using the innovation in production yields an increase in profits that may cover the innovating costs. Second, since the innovator-producer's gain from innovating comes from the increased efficiency of production, the marginal private value of developing disembodied innovations is increasing in the value of the firm. This has important cross-sectional and time-series implications. In the cross-section, firms with higher values (resulting from larger sizes or ability to charge higher markups) have more incentives to develop disembodied innovations. In the time series, shocks that reduce the value of the firm reduce its incentives to develop disembodied innovations. One such shock may be an increase in the probability that a competitor steals the market. If the occurrence of this shock requires the development of a new patentable product, the model implies the possibility of an aggregate trade-off between investments in developing disembodied and embodied innovations.

2.6 Matter of nowadays: Labour Market Flexibility

After analysing the production process, the production function, the production inputs and among them the technological progress, the main factor that determines the TFP, we now have some more well-defined elements, so that we can understand more in depth the current economic situation and the one of the last fifteen years. We have already listed in the first chapter among the important stylized facts that have characterized the labour market in recent years the structural reforms that have involved employers and workers, determining a major flexibility among the European labour markets, especially the Italian one. I discussed also the relationship between innovation and labour flexibility and the related debate between economists that support a positive correlation and those who consider the existence of a negative correlation. Let us see now, however, in what consists the concept of Labour Market Flexibility, and in particular, which are its features and the effects on employment.

Nowadays labour market flexibility can be seen as the firm's ability to make changes to their workforce in terms of the number of employees they hire and the number of hours worked by the employees. It also includes areas such as wages and unions. A flexible labour market is one where firms are under fewer regulations regarding the labour force and can therefore set wages (i.e. no minimum wage), fire employees at will and change their work hours. A labour market with low flexibility is bound by rules and regulations such as minimum wage restrictions and requirements from trade unions.

During the years, however, the most common definition of labour market flexibility has been the neo-liberal definition. This entailed the ease of labour market institutions in enabling labour markets to reach a continuous equilibrium determined by the intersection of the demand and the supply curve. In the words of Siebert, labour market institutions were seen to inhibit "the clearing functions of the market by weakening the demand for labour. They make it less attractive to hire a worker by explicitly pushing up the wage costs or by introducing a negative shadow price for labour; by distorting the labour supply; and by impairing the equilibrating function of the market mechanism, for instance, by influencing bargaining behaviour. From the point of view of general equilibrium theory, perfect flexibility may be understood as a situation where all resources in a given market are allocated in a Pareto efficient way (Hahn, 1998). However, it could be also argued whether we treat this term as characterizing a state or a process. It seems to be more appropriate to describe flexibility as a process. For instance, a market is more flexible if it moves towards Pareto efficient resource allocation faster than the other does. In principal, it means that we use the framework of the neoclassical equilibrium model and any kind of intervention in the labour market will slow down adjustment speed. Therefore, we can say that labour market flexibility shows how quickly markets adjust to the external shocks and changing macroeconomic conditions. This definition is very broad and it is very difficult to measure empirically such effects as adjustment speed. However, labour market flexibility refers to more than the strategies used by employers to adapt to their production or business cycles as it is in the definitions above. Increasingly, the common view is that labour market flexibility can potentially be used for both workers and firms, or employees and employers. It can also be used as a method to enable workers to "adjust working life and

working hours to their own preferences and to other activities". As firms adapt to business cycles and facilitate their needs with labour market flexibility strategies, workers adapt their life cycles and their needs through it. Therefore, in practical reasons this term has a wide range of applications. For example Treu (1992) considered numerical (or external) flexibility, i.e. the freedom of employers to expand or contract their workforce as they wish and to employ workers on a temporary or part-time basis; working time flexibility, functional flexibility; and pay flexibility. Nickell (1997) pointed out three aspects of labour market flexibility: employment protection, labour standards and labour policy. The OECD drew up the employment protection index (EPL) and it is based on the strength of the legal framework of the government. The labour standards index refers to the strength of the legislation governing a number of aspects of the labour market. Labour policy was divided into active and passive labour policy. Benefit systems were characterized by replacement rate, which shows what share of income is replaced by unemployment benefits and the duration of these benefits. Active labour market policies refer to expenditures on activities for the unemployed that are geared to help them back into work (labour market training, assistance with job search, subsidized employment and special measures for the disabled).

So, in the light of these tools just described, let us see what have been the employment and unemployment trends in the countries that we have previously considered, in the past twenty years. Collecting the data from the same database, AMECO, as in Table 1, I build the graphs below in order to understand the possible relationship between labour market flexibility and (un)employment.

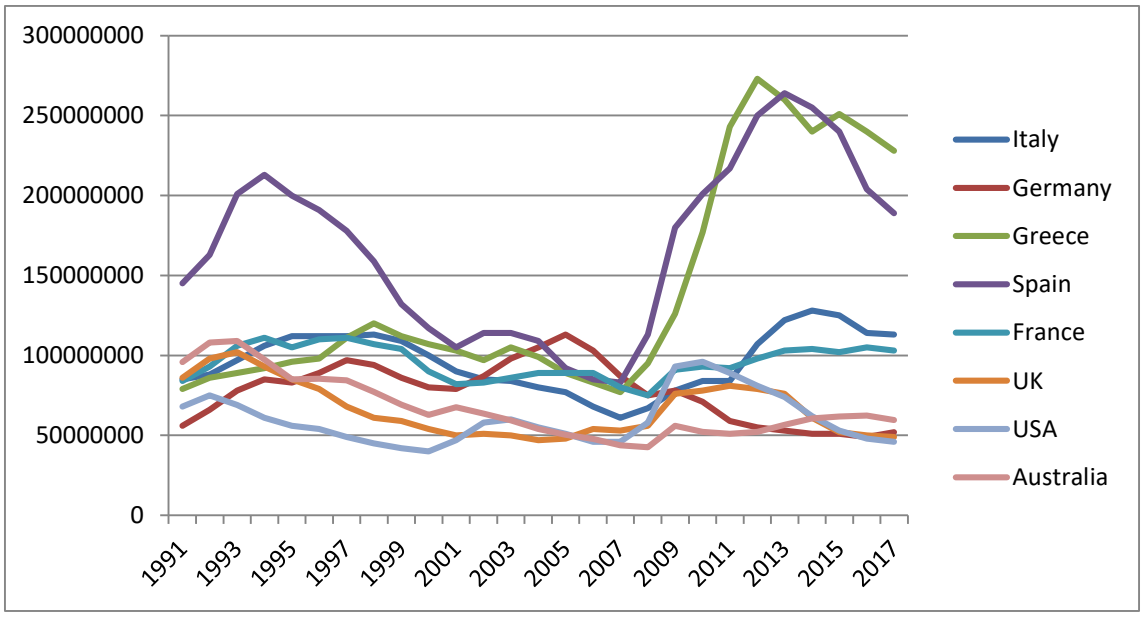
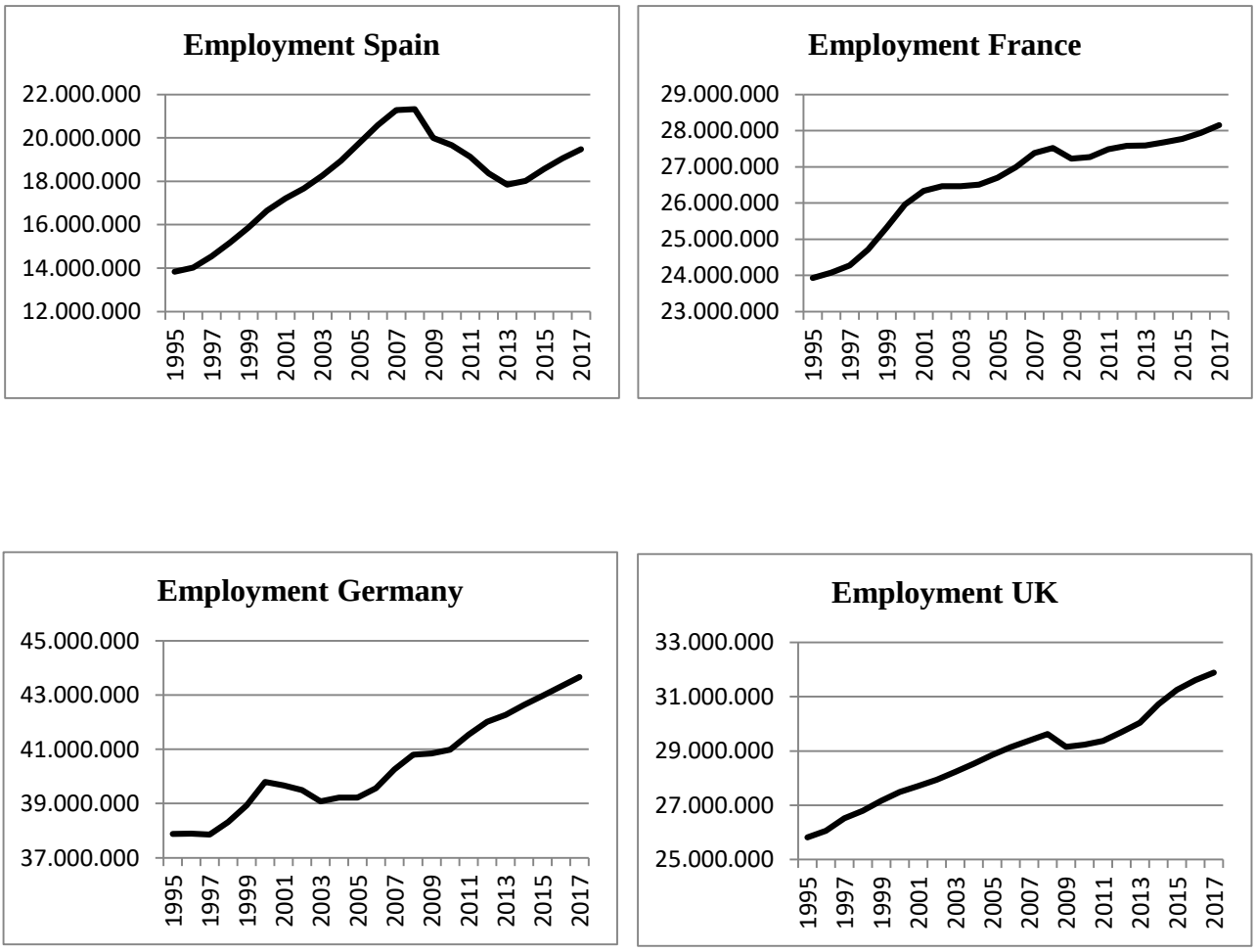


Figure 14. Unemployment Rates

Figure 14 shows the unemployment rates of the countries object of the analysis in this research project. The curves of Spain and Greece are quite noticeable. Greek unemployment rate has the major values among the others countries from 1991 until

2001; until 2008 it decreases, but then it comes back to increase evidently; in recent years it descending, but the values are very high. Spanish unemployment rate has the same trend from 2008, while before was quite stable. Except from Greece and Spain, all the others countries show a quite linear trend, however after 2008, in correspondence of the financial crisis most of the curves upward. In recent time Germany and UK have recover, coming back to values, like those before the crisis, while France and Italy still have high values of unemployment rate. Australia as opposite to European countries shows a descending unemployment rate trend, which seems not be affected by the crisis. In addition, USA has a quite decreasing trend, it increases starting from 2001, more incisively from 2008, even if in recent years the curve reduces again. This confirms that also in the labour market, USA has been able to face off the difficulties of the crisis.

Figure 15. Employment Trends



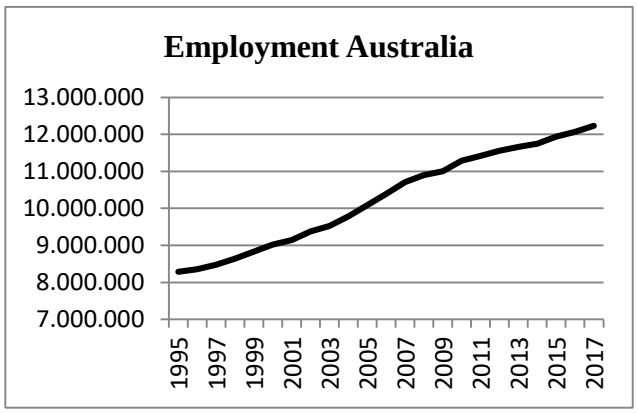


Figure 15 collects all the employment trends of the countries considered in a period between 1995 and 2017, so including a prevision. Spain, Greece and Italy show a similar trend of the curve: the trend is increasing, maybe in Italy more evidently, until 2008, then there is a reverse and it decreases until 2013 circa, when it became stable or slightly rising. Another kind of trend but similar among them is those of Germany, UK, and France, where the curve is increasing along all the period considered. In particular, the Deutsche curve is always quite increasing with a slightly reverse between 2001 and 2003; French and English curve only become quite stable around 2008 but from the next years they rise again. American employment trend is quite stable during the period considered, we can notice only a slightly decreasing around the year 2001 and 2008. Australia show an always-increasing trend, maybe the rate of increasing is higher before 2008.

2.6.1 Related Literature

The concept of labour market flexibility, albeit being fairly new and recent, it has been very considered and debated by several economists in the last years. Their aim is overall to try to understand the characteristics of this phenomenon that involves the labour market. The most common interpretation of labour market flexibility is connected with labour market regulations and institutions (for example Siebert, 1997; Berthold and Fehn, 1996; Jackmann, Layard, Nickell, 1996; Lazear, 1990). In all OECD countries, there are rules and regulations that govern the employment relationship between workers

and firms. Those concerning to hiring and firing practices are often referred to employment protection legislation (Boeri 2000). These rules and regulations govern unfair dismissals, restrictions on lay-offs for economic reasons, compulsory severance payments, minimum notice periods and administrative authorizations.

The question of whether and to what extent job security regulations affect labour market flexibility remains a matter of continuing controversy and discussion. Critics have claimed that strongly entered job rights prevent employers from adjusting to economic fluctuation. It also has been alleged that, by preventing layoffs during downturns, strong job security provisions reduce employers' willingness to hire during upturns and thereby contribute to unemployment (OECD, 1999). For instance, if employment protection legislation leads to a long-lasting work relationship, it may encourage employers to provide training for workers with potentially beneficial effects for human capital and labour productivity. A better skilled worker may also increase internal (functional) flexibility and, thus, lead to a better functioning of production activity (Piore, 1986).

Several empirical studies have tried to measure the effect of job security legislation on labour market outcomes. Bentolila's and Saint Paul's (1992) use a "before and after" approach to analyse the Spanish case. They show that labour demand fluctuated more in response to output shocks, after some flexible employment rules were adopted. If we consider the tightness of the country's employment protection legislation as a proxy for labour market flexibility, we can see that Western European countries have relatively inflexible labour markets (Bertola, 1990; Grubb, Wells, 1993). In the paper of Baker et al (2002) authors conclude that the empirical findings to not support the common idea of causality of deregulation and better labour market performance. They stress that it is even less evident that further weakening of social and collective protections for workers will have significant positive impact on employment prospects. According to their results, the effects of various kind of deregulation on unemployment are very hard to determine and may be quite negligible.

Labour market flexibility should be measured at two different levels: the macro level and the micro level (Eamets 2004). The former can be further divided into institutional and wage flexibility. The institutional flexibility of labour market denotes to what extent state institutions and trade unions are involved in the regulation of the labour market. Wage flexibility denotes how responsive wages are to market fluctuations. Micro level flexibility relates to labour market flow analyses. The labour market can be characterized by various flows of workers (transitions between labour market states, occupational mobility and geographical mobility) and by jobs flows (job creation and job destruction.). Presumably, different aspects of flexibility are related to each other. If institutional involvement is very high, workers transition rates are likely to be low. If trade unions are weak, then wages are more flexible and so on.

Belot and van Ours (2000) analysed in what extend labour market reforms determine unemployment in OECD countries. They examined the relationship between unemployment rate and labour market institutions such as tax rate, replacement rate, employment protection, union density, union coverage, coordination of bargaining. Since they were interested in potential complementarities in institutions and changes in institutions, they investigated both direct effects of institutions and interactions between them. They found that particularly interaction effects are important. They concluded that

in most countries they observed interaction effects enforce direct effects and for some countries, interaction effects were even more important than direct effects.

2.7 Employment Protection Legislation (EPL)

Inevitably, with the birth of new forms of flexibility in the labour market in recent years, they were born at the same time also forms of legislative protection for workers.

According to Barone (2001) with the acronym EPL economists refer to the entire set of regulations that place some limits to the faculties of firms to hire and fire workers, even if they are not grounded primarily in the law, but originate from the collective bargaining of the social partners, or are a consequence of court rulings. In particular, provisions favouring the employment of disadvantaged groups in society, determining the conditions for the use of temporary or fixed-term contracts, or imposing training requirements on the firm, affect hiring policies, while redundancy procedures, mandated pre-notification periods and severance payments, special requirements for collective dismissals and short-time work schemes influence firing decisions. The nature of these restrictions on the firms' freedom to adjust the labour input is quite similar in all OECD countries, but the actual procedural details and the overall degree of stringency implied by them varies considerably. These provisions are enforced through the worker's right to appeal against his lay-off. Some aspects of these regulations, like the length of advance notices or the dimension of severance payments can be measured with precision. Other important features of EPL, like for example the willingness of labour courts to entertain appeals by fired workers, or how judges interpret the concept of "just cause" for termination, are much more difficult to quantify.

Employment protection encompasses any set of regulations, either legal or due to labour contracts, which limit the employers' ability to dismiss a worker immediately or without cost (Pissarides 2001). Different indicators have been used in the literature to assess the strictness of EPL provisions. Perhaps the best-known detailed measure is from Lazear (1990): the size of the statutory compensation in case of no-fault individual dismissal for economic reasons.

Summary indicators of EPL strictness obtained by compressing the information from a list of detailed indicators, greatly facilitate the analysis of employment protection and its effects on labour market performance. The actual construction of such numbers raises difficult choices of quantification and weighting. Both ordinal and cardinal approaches towards aggregating the information have been used.

Grubb and Wells (1993) and the OECD (1994) constructed the summary indicator by first computing a rank for each of the first level indicators, for each country in the sample of countries under investigation, and then they calculate the average of these ranks across indicators. The drawback of the method is that if national rankings differ too much across basic indicators, performing cardinal operation in an ordinal measure can lead to unreasonable results. Another drawback is the difficulty of updating the information and evaluating changes in the EPL over a period. In a later study, OECD

(1999) developed cardinal summary indicators that allow meaningful comparisons to be made across countries and over time. Since the theoretical analysis emphasizes the analogy of EPL to the taxation on employment adjustment to be paid by employer, the overall intent was to reflect the cost implications of various regulatory provisions for employers. Initially, 22 first level indicators of EPL were converted into cardinal scores, after which various averages were calculated based on these scores. Usually equally weighted averages were used, except when a single aspect of EPL was reflected in multiple measures or when some aspects seemed to deserve stronger economic weights than the others did. So the notice period was deemed be more important than severance payment, and for the measure of overall EPL strictness collective dismissal were allocated only 40% of the weight for regular and temporary contracts.

In another paper, Nicoletti et al (2000) used aggregate indicators factor analysis, in which each component of the regulatory framework was weighted according to its contribution to the overall variance in the data. Factor analysis revealed families of detailed indicators that were most associated with different unobserved factors. As a result, countries were "scored" on each of the factors using the estimated weights that were according to the cross-country variance, explained by the factor. Individual indicators were aggregated into factors, after which all factors were weighted and summarized into an aggregate indicator. Interestingly, the results provided by this method were almost similar to the results obtained by the ranking of EPL rigour by the method in OECD Employment Outlook.

Researches have also exploited indices based on surveys of employers. The rankings of countries from the International Organization of employers and the EC ad hoc surveys are based on the employers' assessments of the restrictions they face in dismissing workers (OECD 1999). For instance, the International Organization of Employers classifies regulatory constraints as insignificant, minor, serious or fundamental for both regular and fixed-term contracts. Surveys of employers from a rather long list of countries are also included in the economic freedom indexes by World Competitiveness Report, Fraser Institute, the Heritage Foundation/Wall Street Journal and Freedom House (Addison, Texeira 2001).

Finally, the most ambitious approach to measure EPL rigor is to calculate the costs of complying with those rule. Heckman made a step in this direction and Pages (2000), who created a job security index, which attempts to measure the expected future cost, at the time of hiring, of dismissing the worker for economic reasons. Bertola, Boeri and Cazes (2000) emphasised several drawbacks of the existing indicators. First, these do not always capture the role of atypical forms of employment, like overtime work, that may give flexibility if hiring and firing are restricted. Secondly, the present indicators ignore links between EPL and other labour market institutions: firing restrictions would be ineffective, if wages were completely deregulated and employers could reduce them to induce voluntary quits. Thirdly, labour market institutions aim to protect workers against the uninsurable unemployment risk. Protection against job loss arising from EPL is the more desirable when only scant unemployment insurance is available, and vice versa.

2.7.1 Related Literature and Correlation

Some economists have claimed that empirical evidence gives support to their theories. According to them, EPL leads to a segmentation in the labour market. This segmentation is between the so-called insiders, the workers with a protected job, and the outsiders, who are the people that are either unemployed or employed with fixed-term, part-time or temporary contracts, or even in the black economy. They faced big difficulties to find a job covered by EPL because of the firms' reduced propensity to hire. Youths, women, racial minorities and unskilled workers constitute this latter group.

Whether EPL has any effect on unemployment is an issue of contention between economists. On the one hand, assuming that the cyclical wage pattern is not affected by mandated firing costs, EPL reduces the propensity to hire by employers, since they fear that such decisions will be difficult to reverse in the future, in case of a recession. On the other hand, EPL also leads firms during downswings to keep more workers employed, than they would have otherwise done. Therefore, EPL reduces both job creation and job destruction, so that the net effects on average employment and unemployment are not identifiable a priori. What is agreed, instead, among economists is that more stringent EPL lowers the fluctuations in the quantity of labour demanded over the business cycle, leading to smoother dynamic patterns of those aggregates. Economists considering that EPL has no effect on unemployment include Blanchard and Portugal (2000). In their article they compare two opposite countries as regards their EPL stance: Portugal with one of the more strict legislations in the world and the US with one of the more flexible ones. In spite of these differences, both countries have similar unemployment rates, which undermines the argument considering that EPL has any effect on unemployment. Instead, the authors claim that EPL does affect two other variables: job flows and unemployment duration. EPL would reduce job flows (from employment to unemployment: employers are less willing to fire, given that they must pay indenisations to workers) therefore reducing unemployment but would increase unemployment duration, increasing the unemployment rate. These two effects would neutralize each other, explaining why overall, EPL has no effect on unemployment. Nickell (1997) arrived to similar conclusions when stating that labour market rigidities do not appear to have serious implications for average levels of unemployment included strict employment protection legislation and general legislation on labour market standards.

Among those that have found evidence suggesting that EPL increases unemployment are Lazear (1990). The author argued that mandated severance pay seemed to increase unemployment rates. His estimates suggested that an increase from zero to three months of severance pay would raise the unemployment rate by 5.5 percent in the United States. Lazear (1990) once again argues he has evidence suggesting that EPL reduces the employment-to-population ratio. In his article, he claims that the best estimates suggest that moving from no required severance pay to three months of required severance pay to employees with ten years of service would reduce the employment-population ratio by about one percent. In the United States that would mean over a million jobs. Lazear argues that the young could bear a disproportionate amount of the burden. To the contrary, Bertola and Bentolila (1990) found evidence supporting the idea that

firing costs have a larger effect on firms' propensity to fire than to hire, and therefore (slightly) increase average long run employment.

Several authors have found that EPL has significant effects on wages. As stated by Lazear (1990), in a perfect labour market, severance payments can have no real effects as they can be undone by a properly designed labour contract. Leonardi and Pica (2006) found evidence supporting this claim. They suggest that in the case of Italy an EPL reform in 1990 had as effect to reduce entry wages by 6 percent, implying that firms tend to transfer the increase in the cost of firing (due to EPL) onto workers. In fact, in their study they find that 25 percent of the firing cost was shifted onto lower wages in the case of Italy.

In principle, the effects on profits are ambiguous. Because of EPL, firms engage themselves in labour hoarding practices, which lead them to employ a lower quantity of workers during upswings, while keeping inefficient levels of employment in downturns. For a given level of wages, this loss of productive efficiency would result in lower average profits. On the other hand, if firms operated in a context of efficiency wages, by inducing more stable relationships with the workers and reducing their job and income insecurity, EPL could allow them to pay lower wages, without reducing the effort provided by the labour force employed, with beneficial effects on profits.

There appears to be agreement among economists on the positive correlation between product market and employment regulation. Although employment protection legislation is only one aspect of the wide range of regulatory interventions in the labour market, Nicoletti et al. (2000) find evidence suggesting that, across countries, restrictive regulatory environments in the product market tend to be associated with restrictive employment protection policies. They claim that the indicators presented in their paper are closely related, with a statistical correlation of 0.73 (significant at the 1% level). In other words, according to these results, restrictive product market regulations are matched by analogous EPL restrictions to generate a tight overall regulatory environment for firms in their product market as well as in the allocation of labour inputs. The strong correlation between regulatory regimes in the product market and EPL also suggests that their influence may have compounded effects on labour market outcomes, making regulatory reform in only one market less effective than simultaneous reform in the two markets. Kugler and Pica (2003) find similar results in the case of the Italian economy. They present a matching model which illustrates how barriers to entry in the product market(product market regulation) mitigate the impact of labour market deregulation, (that is, mitigate the effects of a reduction in the strictness of EPL). In the author's opinion, this means that there are economic complementarities between labour and product market policies in their model, in the sense that the effectiveness of one policy depends on the implementation of the other policy. Thus, an important implication of their model is that labour market deregulation will be less effective in the presence of heavier regulations of entry. Koeniger and Vindigni (2003) obtain similar results.

Third Chapter

The Italian Case

3.1 Italian Economic Situation

In the previous chapters we analysed the overall economic situation of the group of European countries being surveyed, deducting the trend over the last twenty years and comparing it with that of non-European countries, such as the USA and Australia. Collecting data from the labour market, in particular related to employment and productivity, we confirmed the initial assumptions about a period of severe economic decline on the growth front, with heavy falls of the productivity of capital and labour in the last fifteen years. There is an European situation of slight recovery only in the last few years, in contrast to the American economy, that responded promptly and decisively to the devastating financial crisis of 2008 since few years later.

In this chapter, our aim is to analyse more specifically, the economic situation of the last two decades of a single European country, Italy, eventually comparing the data with those of the European average. Let us see more in depth, which was the economic history of the country in order to understand better the difficulties that are facing its economic system nowadays.

After World War II, Italy experienced a shift in its economic structure. It transformed itself from an agricultural country to one of the most industrialized economies in the world. The force behind the post-war economic miracle was the development of small and medium-sized companies in export-related industries. In the following decades, the economy has had both ups and downs. Being a country with very few natural resources, Italy is strongly dependent on oil imports. The economy was hit hard by the two oil crises during the 1970s. As a result, it experienced a stage of stagflation, weak economic growth combined with high unemployment and a high inflation rate. The economy began to recover in the early 1980s due to the implementation of a recovery plan. Restrictive monetary policies brought inflation down, while fiscal- and growth-oriented policies reduced public spending and tightened the budget deficit. Before the 1980s, most of the Italian state-owned companies were a key drivers of growth. However, in the mid-1980s, the state sector started to create distortion in the economy. The mismanagement of public spending led to a deterioration of public finances and triggered excessive corruption. A round of privatization was carried out at the end of the 1980s and beginning of the 1990s. The diminishing role of the state in the economy created more space for private investment. In 1999, Italy qualified to adopt the euro and entered the European Monetary Union (EMU). The Euro was officially introduced into the economy on 1 January 2002. Italy was hit by the financial crisis in 2007, since then, the economy has underperformed.

The crisis was, perhaps, the straw that broke the camel in an economy already under strain: Italy, in fact, has gone and is still going through a moment of decisive changes, due to several structural reforms and to different European economic policy measures. In particular, what needs more attention is the innovation gap between Italy and other developed countries. Several factors explain the low capability of Italian firms to produce innovation, such as institutional features of the Italian economy, the structure of the credit market, and characteristics of firms, typical is their small size. So, despite being among the most industrialized countries and between world powers, Italy has

shown in the last twenty years strong weaknesses both in the real economy and in the financial economy.

Under the real aspect, the first sign of difficulty is shown by the Italian industry that is heavily indented with technology gaps, which are not indicative of future growth prospects. Financially, instead, Italy shows a banking system focus on investments, but structurally weak, with negative consequences on the production system, and, therefore, necessarily on growth. In times more recent however, cyclical factor such as the low price of oil, the quantitative easing policy of the Central Banks and the consequent low interest rates on government debt, seem to hope for a more favourable international situation and the recovery from recession. We can capture better the evolution of the situation both real and financial of the Italian state, looking at the performance of two important variable as the unemployment rate and the inflation rate, which can be drivers of the two spheres of economy.

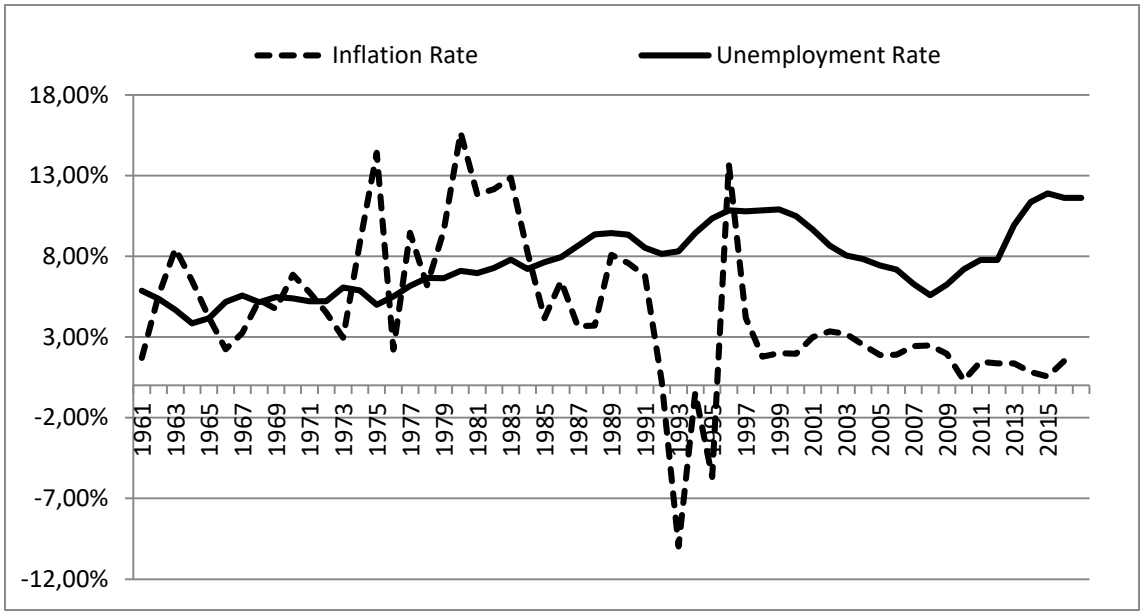


Figure 16. Italian Inflation and Unemployment Rate

Figure 16 describes the Inflation Rate trend and the Unemployment Rate trend of Italy in the period between the 1961 and the 2015 and it is quite important in order to connect the two spheres of economy, the real one and the financial one. The Unemployment Rate appears to be stable and a bit increasing, ranging between 5% and 12% from the beginning to the end of the period with a decline between the years 2000 and 2012, near 5% confirming the stylized fact of which we have already spoken. In the last recent years, starting from 2009, it is increasing again, rising above 10%. The Inflation Rate instead has a trend quite troubled, with numerous short-term variations, confirming the strong volatility and uncertainty that characterize most of financial variables. It is important to emphasize the fall of the rate below zero since 1992, the year of the sharp devaluation of the lira, up to a negative peak of 10% in 1993. However, since 1998 the rate has remained stable at around 2%, the primary objective of price stability that ECB aims to achieve,

because of the introduction of the single currency to which Italy has joined, as an EU member country.

3.2 Italian Real Economy

The growth rate in GDP per capita and the one in productivity are affected by the articulation and the specialization of the productive apparatus of a country. Therefore, if we look at the trend of GDP per capita and at its growth along time, it is possible to deduce which was and which is nowadays the main features and the evolution of the Italian productive and firms' system.

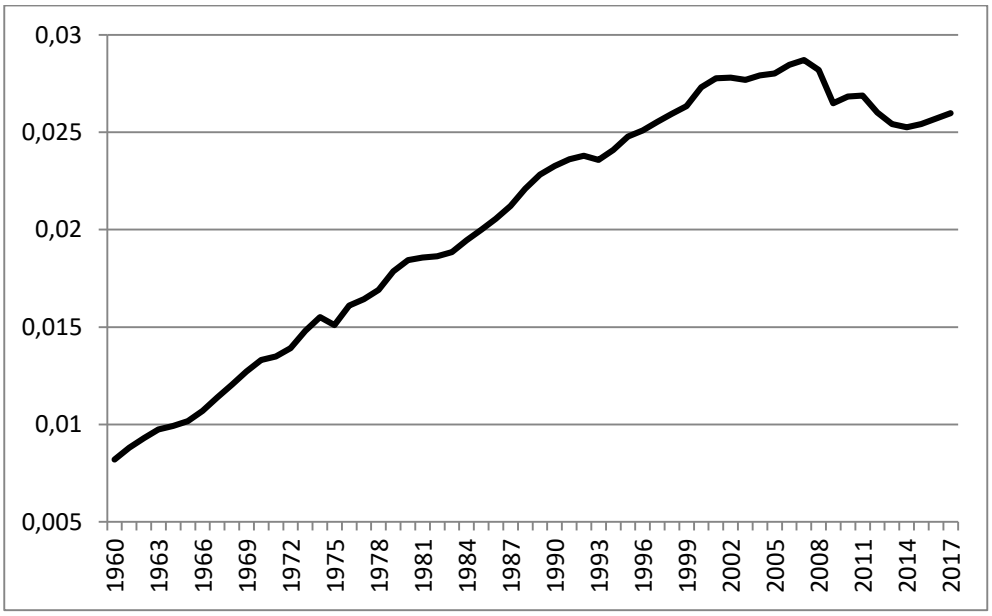


Figure 17. GDP per capita

Figure 17 shows the Italian GDP per capita trend from 1960 until 2016. The curve is always increasing until 2001 circa, and then it became quite stable and slightly growing between 2006 and 2008. From 2008, the trend falls but not heavily, compared with other macroeconomic variables and it turn to be stable from 2012. In most recent years, it seems to be lightly rising, symptom of a shy recovery from the crisis.

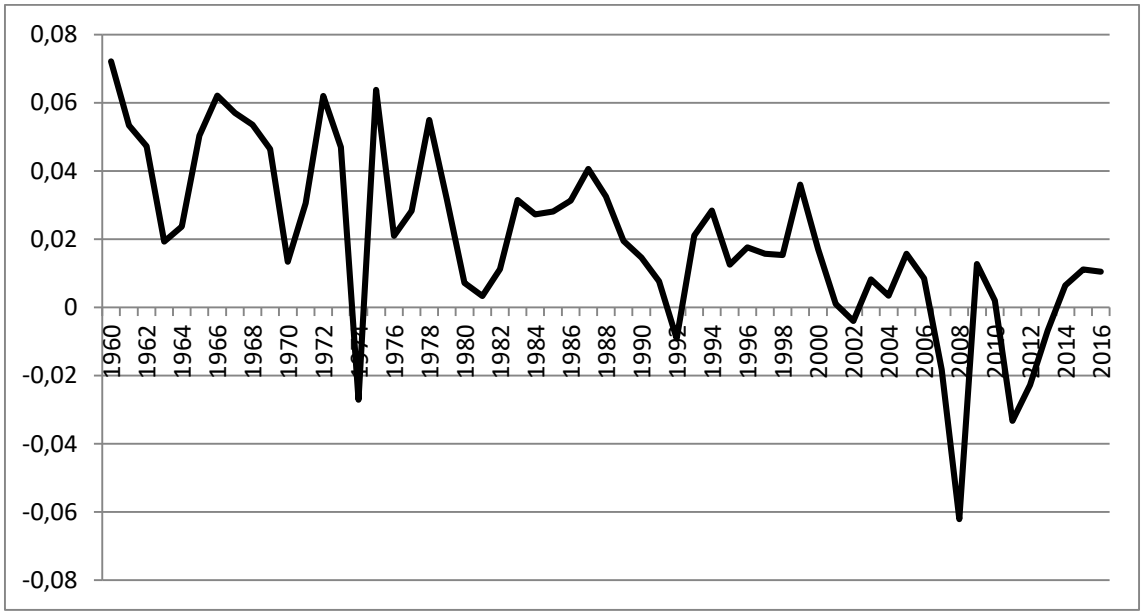


Figure 18. GDP per capita Growth Rate

Figure 18 indicates the trend of Italian GDP per capita growth rate, always in the period between 1960 and 2016 and it is quite important in order to understand the short-term variations, from year to year. The curve is quite jagged with peaks and descents. The values are almost positive except in 1974, where the curve falls from a value of 0,06 to a negative value of -0,02, in 2008 where it reaches the negative value of -0,06 and in 2011 at -0,03. As we can see in the trend of GDP per capita, also its growth rate show a slightly recovery in more recent time.

It is known and quite evident that the Italian firms' system has two long-term problems that distinguish it from that of other advanced economies: the particular specialization of the industrial sector and the dimensional fragmentation of firms. Italy, albeit with increasing difficulty, remains, in fact, the second manufacturing country including those in Europe, after Germany. However, this position of the industrial sector is increasingly deteriorating. The Italian industry weight decrease over the years, with a marked decline with the crisis of 2008: data show that industrial production fell by more than a fifth between 2007 and 2012, and the number of new firms is negative for all two thousand years. Moreover, it should be noted that a significant share of manufacturing value added was produced by traditional industries, with low added value and low tech. Besides this, in the highest technological sectors, characterized by significant economies of scale, such as the electronics and motor vehicles, there has been a worrying recessive long-term trend.

An idea on the situation of the Italian industry is provided by the list of the largest 500 firms in the world, in terms of turnover size and employment, published annually by the magazine "Fortune". As Italy still maintains, for the moment, the eighth position for the economy in the world, one would expect that in this ranking is present an adequate number of Italian firms. In 2012, however, it appears only one, Eni, which operates in the energy field, in seventeenth place. It is normal that the production systems of different countries are characterized by the presence of small firms. The most important aspect of Italian economy, however, is that there are too many micro-firms, which weave 95% of

the total. The average firm size is less than four: that is, there are fewer than four employees per firm on average. In Spain, the average size is greater than five, in France is greater than six and than twelve in Germany. This Italian dimensional specificity was accentuated by de-industrialization and the recent economic crisis. This question is crucial to the economic system as it generates obvious negative effects on labour productivity. Defining the average labour productivity as the ratio of value added and number of employees, it is observed that in the transition from small to large firms, labour productivity increased by a factor of between two and three. In the micro-firms the added value produced by each employee it is on average equal to 27 thousand euro, while in large firms reaches 61 thousand. A major share of productivity is absorbed by the cost of labour, which includes not only salary, also social contributions (pension and health). The relationship between these two quantities, productivity and cost of labour, defines the index of the cost competitiveness of firms, which increases with firm size.

In more recent time, in Italy there are faint signs of industrial restructuring in favour of technologically advanced sectors and the growing size of the firm. To cope with the competition from emerging countries, a part of the Italian firms, especially medium-sized firms, have try to raise the level of the quality of goods produced. However, these changes do not seem sufficient to recover quickly the level of competitiveness dispersed by the country over the past two decades. It is easily to understand, in fact, that the process of de-industrialization of the Italian economy negatively affects both productivity and accumulation, and the international competitiveness. Employment and productivity in Italy have different roles than those they have had in the past. Until the Eighties the main contribution to growth came from labour productivity, the Italian one was the highest in the world. Since the beginning of the Nineties, however, we have seen a reversal of roles. With the crisis from 2008, finally, there were negative variations both productivity and employment. Labour productivity depends positively on capital investment and on technical progress. In fact, what matters for aggregate productivity is not the only work, but also the capital and technological progress embodied in means of production, material and immaterial, or resulting from process and product innovations at the firm level. All these factors, which are beyond the direct injection of capital and labour, is called, as I have already mentioned in the precedent paragraphs, Total Factor Productivity (TFP), which measures the contribution to the productivity of all that the inputs of the production process cannot capture. Therefore, the rate of productivity growth reflects in each period also changes in employment, accumulation and TFP. The graph below reports the trend of the Italian TFP growth rate from 1960 until 2015.

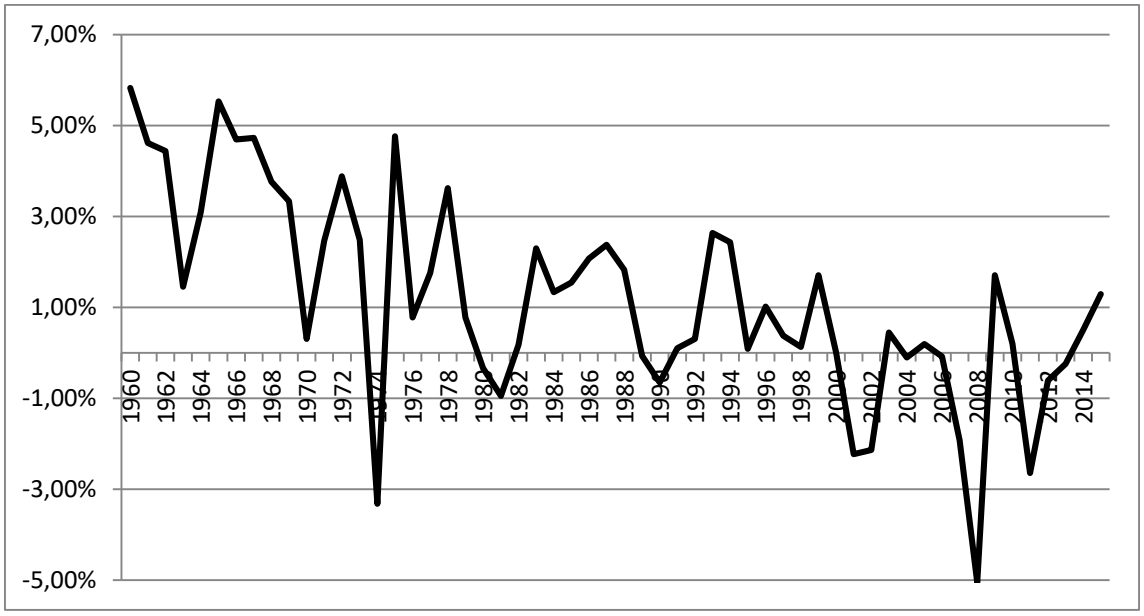


Figure 19. TFP Growth Rate

Italian Total Factor Productivity trend is similar to the GDP one, if we compare them. The trend is quite rugged, with abrupt descents and ascents and a slight downward trend. We can see the most evident falls in 1974, in correspondence with the oil crisis and in 2008 with the US economic and financial crisis, which has reached a negative value of about 5%. The variable has risen before falling back in 2011, in correspondence of the public debt crisis. In the last few years, it appears to have turned positive and it rising.

A further feature of the Italian labour market is given by the flexibility. It is often argued that in Italy there is the most rigid labour market among the economically advanced countries and European ones in particular. No doubt, this rigidity compromises the ability to do firms. I have also already mentioned the synthetic index of *Employment Protection Legislation (EPL*) calculated by the OECD, which measures the degree of labour market regulation for employment protection in several Western countries. The EPL is within a range of values between 0 and 6, where at lower levels, there is the lower rigidity of the labour market. Removed the Anglo-Saxon economies and Japan, Italy, among the European economies, shows the lowest EPL and it is the European country where currently there is higher labour flexibility. In Italy the reduction of the EPL in the last twenty years is the result of reforms Treu (1997) and Biagi (2003) which facilitated the entry and exit from the labour market, using atypical contracts and low protection. The change that followed was not accompanied by targeted industrial policies to support productivity, quality of employment and, therefore, wages.

Finally, the net reduction in the share of labour income in GDP should also be remembered and that this change in the distribution of income from wages to profits and to rents has not paid the recovery of investments, tangible and intangible, but rather the alarming total drop national economic competitiveness. In Italy, the field of innovation is bringing up the rear among the EU countries. Very few resources are allocated to research and to the economic and industrial development.

By its fifth survey on industrial machinery, the UCIMU (the industry trade association) informs us that the Italian industry is old, overwhelmed by a widespread and

dramatic technological obsolescence. Almost a third of industrial machinery has more than twenty years, only just over 10% of the machinery has more than five years while the average age of the fleet in 2014 is just under 13 years, and even 79% of the total of the production plants does not present any kind of integration with electronics and information technologies. A situation has worsened over the past decade but that was already the expression of a badly deteriorated context. In 2005, the average age of the fleet had indeed reached the age of 10, a figure difficult to reconcile with the idea that the main asset of competitiveness of Italian manufacturing was the innovation process. However, the reality was already that of a decline started, and whose contours would be confused shortly thereafter with the state of supervening difficulty resulted from the explosion of the international crisis.

The sharp slowdown in economic activity and investment determined by the crisis, to which today we would like to ascribe such a set-up compromise of the production structure, is therefore only one component, albeit important, of the state of Italian industry's technological backwardness. At this decrease it did not correspond, however, a decline in the deficit in trade in high-tech capital goods, making it clear that the overall weakening of the technological level of the industry. And making it even more overt systemic effects of a production system in which long had weakened the base of technological expertise, and thus weakened so much the ability to produce innovation, as that from requesting, on the basis of the close relationship between the level of technological advancement and absorption capacity of new technologies. The advent of the crisis in 2008 has done nothing but accentuate these trends, further delaying investments that even before demonstrating a lower ability to activate the application of new technologies.

The UCIMU survey results mean thus much more than suggested by the simple observation of the aging national fleet industry and its weak degree of technological innovation. It means that the Italian production system has entered, also because of the crisis, in a tightening process that has deep roots and that pushes the whole economic system on a decline in productivity which compromises once again the prospects for growth, making it even unsustainable financial constraints dictated by Europe. The patent trend of Italy confirms a decline that has its origin in the delay of the industrial culture, one issue that has distant origins. The question I want to focus on is that the accumulation of delays have produced structural effects not remediable by traditional measures of financial incentives. In fact, these have gradually occupied specialization from now competitive countries also in terms of technology, as well as on that of labour costs. To overcome these structural limitations and to look beyond the current technological constraints, there will certainly need investment for firms' research, but no rain, much less to allow a simple of the existing resistance. We need first skills and tools such as open the necessary technological and structural changes. To this end, a very wide-ranging policy actions, starting from the intervention of public research and by an articulated and planned industrial policy.

In addition to the technological backwardness, there is in recent years and, especially after the financial crisis, a worrying situation of the firm cycle with falls in demand e consumption. Against the backdrop of a weak domestic demand, the external sector's performance is crucial for the Italian economy. One of the most important pillars

of the economy is the production of high-quality products such as in the machinery, textiles, industrial designs, alimentary and furniture sectors. These products contribute substantially to the country's exports. However, as a country poor in national resources, its energy and manufacturing sectors are highly dependent on imports. This makes Italy's external position vulnerable to changes in import prices such as fuel. Italy's main imports, in fact, are fuels, which account for around 17% of total imports. This is due to the country's lack of natural resources, which makes it highly dependent on energy imports. Other imports include machinery (14.2%), raw materials (10.0%) and food (7.0%), Italy is a net food importer because the landscape is not suitable for developing agriculture. About exports, instead, since the country's manufacturing sector is specialized in high-quality goods, Italy plays an important role in the global market of luxury goods. The country's main exports are mechanical machinery and equipment, which account for around 24% of total exports, as well as motor vehicles and luxury vehicles (7.2%). Home to some of world's most famous fashion brands, Italy occupies a special niche in the global market of fashion and clothing. In fact, exports of clothing and footwear account for around 11.0% of the country's total exports. Other important exports include electronic equipment (5.6%) and pharmaceutical products (4.6%).

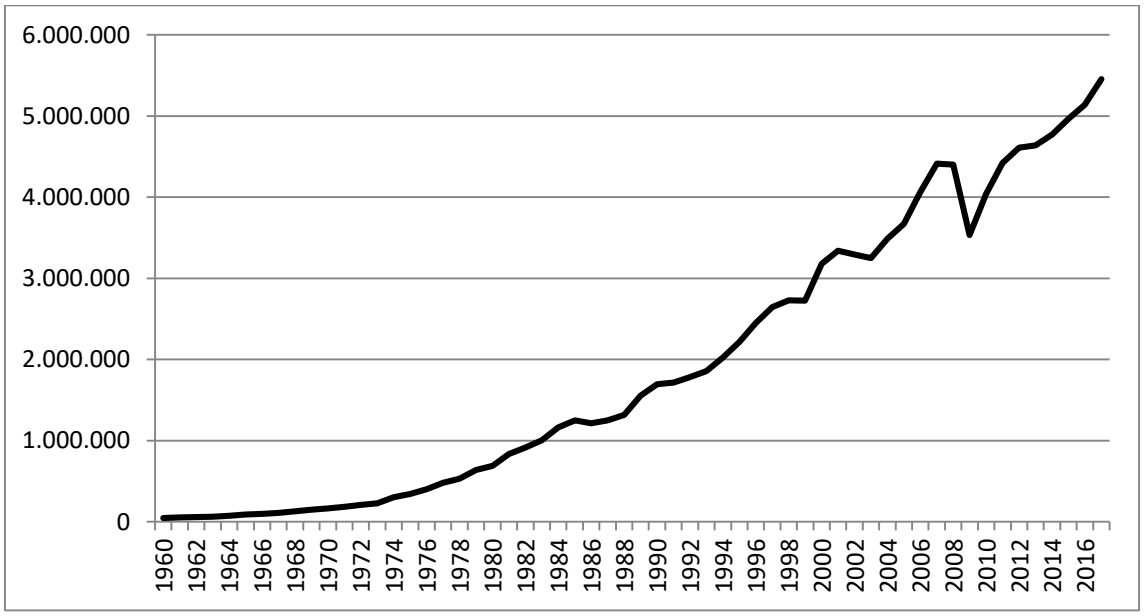


Figure 20. Italian Exports

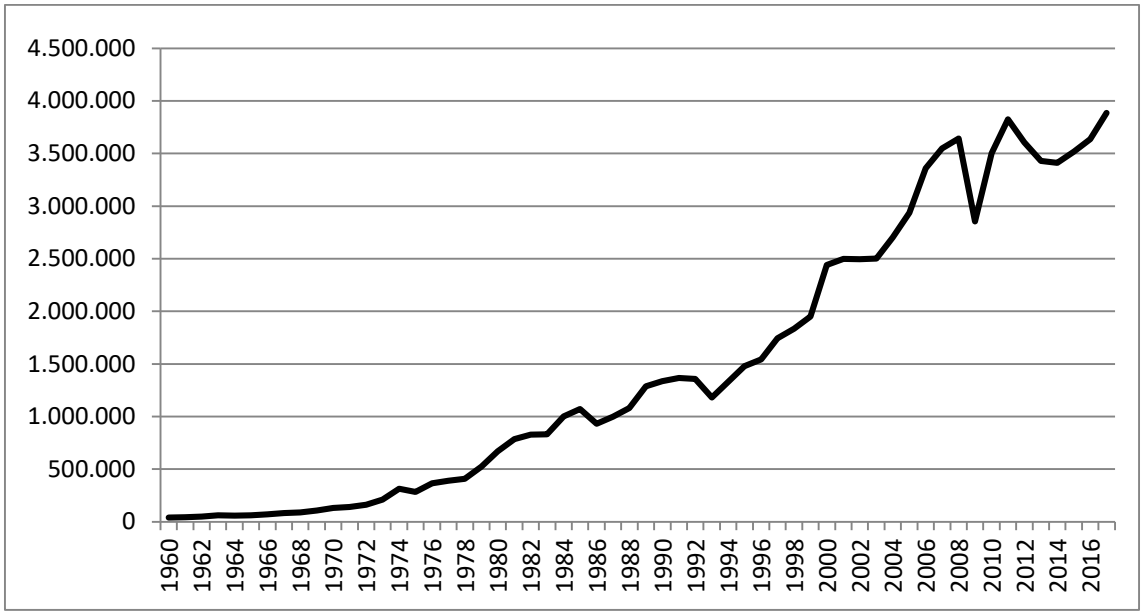


Figure 21. Italian Imports

The two graphs above show the trends of Italian imports and exports over the period between 1960 and 2016. The curves are very similar in the form even if the values of exports are bigger than those of imports. In figure 20 we can see like an exponential growth of exports from 1960 until 2002, then the trend become more stable, slightly increasing until the fall of 2009. However there is immediately a recover and, in more recent years, exports are increasing again. Figure 21 shows an exponential growth too of Italian imports until 2001. In addition, in this case there is a fall in 2009, consequence of the effects of financial crisis in international trade. In 2012, exports recover the precedent value but the trend downturns again in 2014. In more recent time it seems to lightly rise.

3.3 Italian Financial Economy

The problems posed by the banking system after the 2008 crisis, the recent events of the Italian financial system, technological change that is likely to upset the equilibrium of the sector, launching troubled European banking union, are some of the factors that drive us to take stock of the entire economic situation of the peninsula.

Italy is well known for the inefficiency of the *banking system.* The storm that is coming down on Italian banks in this last time is the result of the criminal policy of the European Union, to which were added the grave errors of Italian politics. In recent decades important phenomena of disintermediation have occurred, banks have reacted in many ways, entering the field of institutional investors, focusing on innovation of products and processes, developing a fierce competition, relying also on the power given to them by the collusion with political power. The dimensions of the current crisis and the difficulty of guaranteeing a stable recovery can hence be understood only by facing the fact that Italy proved unable to deal with important changes, which started to materialize in the 1990s at the international level. More precisely, three main changes, that took place in the first half of that decade, totally upset the economic scenario, in

which firms were operating. First, the increasing integration of real and financial markets and the competitive aggressiveness of the emerging market economies deeply changed the international context. Second, the diffusion of new technologies, such as information and communication technologies (ICT), not only radically transformed production processes and communications, but also contributed to market globalization. Third, the creation of the European Monetary Union prevented Italian firms from relying on the main instrument that they had traditionally relied upon to compensate for the competitive losses they were experiencing on a cyclical basis, which is exchange rate depreciation. These changes dramatically increased competitive pressures on the Italian economic structure and uncovered its structural weaknesses. The depth of the current crisis is a consequence of the fact that Italian firms did not react effectively to these 'shocks'. This is especially true for those firms in the manufacturing sector and characterized by higher labour intensity, less developed technology and less differentiated products. A large share of Italian firms lost the opportunity to exploit the fall in real interest rates, following the birth of the euro, to invest in innovation and change the composition of their output in favour of higher value-added production and selling to emerging markets products that would be very difficult to imitate, tourism included. This lack of response can be partly explained by the particular features of the Italian system, which of course also contribute to its structural weaknesses. In particular these include a productive system dominated by firms of very small size; with little 'distance' between company management and ownership; a low propensity towards risk; productive specialization that was mostly centred on highly labour-intensive goods.

About monetary policy, the lira was Italy's currency from 1861 until 2002, when the country officially introduced the euro. In 1979, Italy became part of the Exchange Rate Mechanism (ERM), a system that links the currencies of most of the European Economic Community (EEC) nations. In order to prevent big fluctuations relative to the other EEC countries, Italy had to maintain its exchange rate stable within threshold bands of +/-2.25%. However, in 1992, Italy had to devalue the Italian lira by 7.0% and as a result entered into a system where the fluctuation bands was wider. Nowadays, the Bank of Italy, as part of the Euro system, participates in foreign exchange market interventions along with the ECB and the other National Central Bank of Eurozone. The Bank conducts foreign exchange operations to keep its foreign currency reserves under control. In order to balance inflows and outflows of foreign currency without changing the composition of foreign currency reserves, the Bank of Italy buys or sells foreign currency with market counterparties. The Central Bank of Italy is completely separated from the influences of the government and has to comply with the rules dictated by the ECB, which are the same for all the member countries of the union. The main aim of these rules is to protect the common currency. The Bank of Italy, as part of the Euro system, helps to draft the monetary policy for the Euro area. The primary objective of the Euro system is price stability. To achieve price stability, the European Central Bank controls short-term interest rates. Changes in interest rates accommodate the financial needs of the banking system.

Looking at the external relationships, Italy has been an international debtor in most years during the past decade. Following the financial crisis in 2008, Italy, like the other periphery countries, experienced a sudden stop in private capital inflows as the level

of government debt became unsustainable. Since Italy is part of the Eurozone, it cannot rebalance its current account by adjusting the exchange rate. As a result, the country entered a system of adjustment called TARGET2. This system replaced the private capital flows with public capital flows and allowed the troubled countries to run current account deficits and avoid balance of payments crises. This gave Italy the opportunity to adjust gradually its current account balance.

3.4 A first conclusion

The debate on the trajectory of the Italian economy in this period has mainly focused on the negative effects of the prolonged cyclical phase and of policies frequently labelled as 'expansionary austerity measures'. Consequently, explanations of the persistent difficulty of restoring acceptable rates of economic growth and reducing unemployment rates tend to invoke the lack of aggregate demand and call for two principal types of policy. On the one hand, as consensus grows that the austerity measures have been unable to restore confidence and foster economic growth, a number of observers have suggested that public expenditure should become more expansionary, at least on the investment side. On the other hand, others call for political interventions to convince the strong exporting countries of the euro area (i.e. those experiencing a significant surplus in the current account of their balance of payment) to adopt policies to stimulate their own internal demand and imports, thereby contributing to a readjustment of external imbalances. However, the expansion of domestic and external demand would provide only a partial and short-term solution to Italy's problems, because the economic system also suffers from supply-side shortcomings. Increasing and convincing evidence indicates that the current difficulties are primarily the consequence of the structural conditions of the productive sector, which have progressively deteriorated in the last twenty years.

Moving to the overall picture, we can identified four key features of the Italian economic system:

1. a financial system centred on banks
2. an inefficient and costly bureaucracy, now under reform
3. a high and diffuse system of corruption and fiscal evasion (which is, of course, the other face of an ample underground economy).
4. a deteriorating physical infrastructure.

Over the last twenty years, a sequence of reforms has radically modified the functioning of the Italian labour market, through the expansion of flexible, or 'atypical', labour contracts. The increased flexibility progressively introduced in this market, together with recorded changes in the supply of labour mainly due to immigration, have caused wages to fall. But, instead of stimulating investment in innovation and R&D through higher

profits, the modification of the price of labour relative to that of capital has encouraged firms to remain in labour-intensive traditional sectors, to employ non-highly skilled workers and to endow them with non-innovative traditional capital. This kind of response has produced negative effects and worsened the existing structural weaknesses. Two are worth stressing right at the start: the slowdown of investment, especially of the ICT type; and (as a consequence) a reduced ability to exploit technological progress.

At the beginning of the new century, the Italian production system reveals a structural lack of competitiveness compared to other world economies. However, the issue is not new, but has returned to the limelight with the change of technological paradigm determined by the ICT revolution and the emergence of new international competitors, who have exhibited our exports to the risks of a new and more aggressive competition. What are the causes of this lack of competitiveness? In addition, what answers they gave Italian firms in these changes? As we mentioned, in recent years the world economy has been globalized and has grown exposure to international competition. Of course, the ability to adapt and the rescue of individual economies to the new international environment depends on many factors, and among these is the economic structure of the production system. It is useful to focus our attention on five key factors: the size of the firms, the specialized production, the weight of the medium-sized firms, economic performance and technological specialization. The Italian production structure is highly fragmented with a prevalence of small and very small firms, a relatively few large firms and a few medium-sized firms. The first question is of course areas in which they operate. To form an idea we take the ISAT data of 2007 relating to firms operating in the sectors of industry and services (excluding those from financial intermediation). Together these two sectors covering two-thirds of total employment in Italy and are the core of the production structure of the "real", i.e. non-financial. The size structure of firms skewed towards small size combines a traditional specialization in the manufacturing sectors of the supply chain of goods for the person and the house, and mechanical engineering (the heart of made in Italy) which constitute the foundation of growth but Italian, at the same time, its main element of vulnerability. Conversely, the Italian specialization continues to be weak in the high technology and knowledge-intensive, characterized by higher levels of productivity, less exposed to competition from emerging economies, where demand is growing faster. Italian production system preserves then its balance related to the maintenance of a low cost of labour and specialization in the traditional sectors. This balance is however fragile, is because it is based on company size reduced, squeezing productivity, and because less able to absorb the pressures arising from changes in technology and markets. This combination of factors highlights some important limitations of the system's capacity to produce and absorb innovation. The Italian production system lacks medium-sized firms. Many studies suggest that productivity growth depends on the growth of firms. In addition, there is agreement that the transition from small to medium size increases efficiency for the benefits of economies of scale and to research and development. Altogether, these considerations suggest that the size of firm count for growth and that the existence of a relevant core of medium-sized firms benefits the production system. However, we can say that Italy is experiencing at present the most serious economic recession of the post-war period. Many

recent studies show an evident fall of the Italian productivity between 1990 and 2013, due to two major changes:

1. the introduction of *reforms* in the labour market, that determines more *flexibility*

2. the adoption of the *euro* and its impact on *exchange rates*

Therefore, we can identify a problem that come from inside and one from outside, from the European context.

The two charts below are particularly significant to synthesize the Italian economy in recent years, comparing values even with years older to get a visual concreted and more realistic.

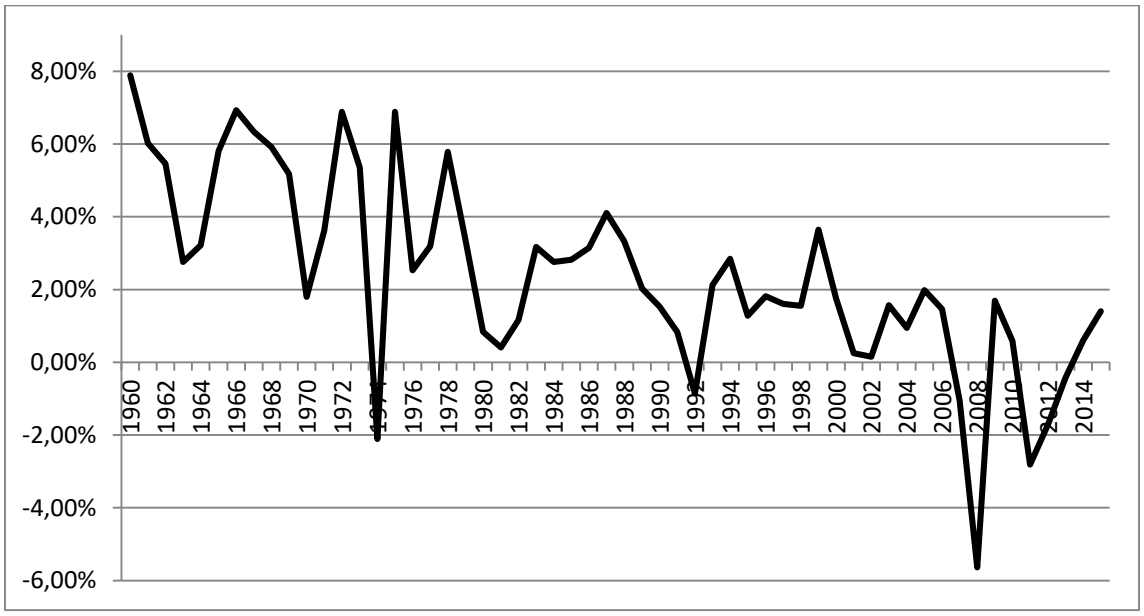


Figure 22. GDP Growth Rate

Figure 22 shows the trend of the Italian GDP variation from 1960 to 2015. The overall trend is downward, with frequent peaks on the rise and on downhill. In 1960, the GDP has its maximum value at around 8%. We can see slight declines around 1963 and 1970, although the first clear fall dates back to 1974 and is due to the sudden and unexpected interruption of oil flow from member nations of OPEC (the Organization of exporting countries oil) to the importing of oil nations, the so-called Oil crisis. In 1992, the devaluation of the Lira makes again the change of GDP negative. Remains constant even with values near zero until 2008, the year of the financial and economic crisis. This time the fall is heavy, reaching a negative value of nearly 6%. After returning the following year positive, in 2011, he goes down again for more than 2%. In recent years the trend is on the rise and positive again.

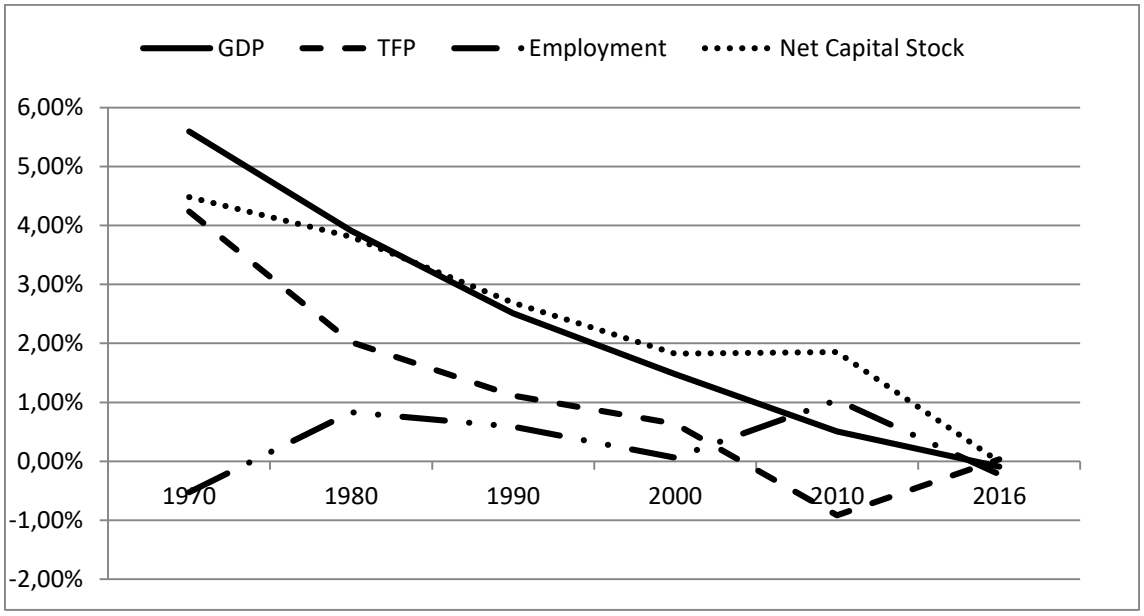


Figure 23. Italian Growth Rates

The graph in Figure 23 collects all of the variables used in evaluating the trends of growth theory for Italy. It is easy to see that all trends are decreasing sharply, except for employment, that is negative in the 70's, it has always maintained positive, albeit close to zero, until 2016 when it came back negative again. TFP with an initial value at the beginning of the observation period of around 4%, becomes negative since 2009, peaking in 2010 downward by 1%, it is increasing to 2016, although always below zero.

3.5 Inside Context : Italian Labour Market

Italy is the world's ninth biggest economy. Its economic structure relies mainly on services and manufacturing. The services sector accounts for almost three quarters of total GDP and employs around 65% of the country's total employed people. Within the service sector, the most important contributors are the wholesale, retail sales and transportation sectors. Industry accounts for a quarter of Italy's total production and employs around 30% of the total workforce. Manufacturing is the most important sub-sector within the industry sector. The country's manufacturing is specialized in high-quality goods and is mainly run by small- and medium-sized enterprises. Most of them are family-owned enterprises. Agriculture contributes the remaining share of total GDP and it employs around 4.0% of the total workforce. The country is divided into a highly industrialized and developed northern part, where approximately 75% of the nation's wealth is produced; and a less-developed, more agriculture-depended southern part. As a result, unemployment in the north is lower and per capita income in higher compared to the south. To understand the roots of the Italian economic decline over the last 20 years is necessary to analyse a key variable: the productivity. Italy's deep-rooted structural problems resulted in an unsatisfactory productivity performance and a dismal growth. Inevitably talking about productivity, we need to understand what has happened and is happening in the *labour market*. There was a local shock that hit the Italian economy, along with other European countries, it is represented by change of the contractual framework that regulates the labour market is made the set of *labour market reforms* that go by the name of package Treu and Biagi Law. As we shall see, these reforms have indeed allowed the entry labour market of new forces and allowed growth without employment earlier, but they have also led to the emergence of new forms of contractual work temporary for new employed and a lower level of productivity for the entire system statement.

Innovation is affected by the degree of *labour flexibility* at the firm level. The proportion of temporary workers employed by a firm measures labour flexibility. Studies (Franceschi, Mariani) show that a higher proportion of temporary workers reduces innovation considerably among high-tech firms, whereas no significant effect is found among the other firms. This evidence suggests that firms may be willing to trade innovation and future profit against lower current labour cost, shedding some light on another possible channel explaining the innovative gap affecting Italian firms. Many sociologists have emphasized the social effects of flexibility and insecurity, most of them stressed the disappointing performance of legislative measures, the emergence of a worrying social inequality, de-skilling of jobs and the production structure. The labour market reforms passed in Italy since the end of the 1990s have widened the gap between the cost of permanent and temporary workers. This may have contributed, together with other well-known structural weaknesses of the Italian economy, to the low level of innovation and to the slow growth experienced in the last decade. Among the many faces of the crisis, the dynamics of the labour market occupy a prominent place. It is required a deep analysis and a model of processes on the labour market that will allow to take into account the effects of different types of shocks that are specific to the unstable economic

development of our country, and to evaluate their impact both in the short and in the long run.

Recently the Italian Economy Minister recognizes the need for a mixed intervention, based on the monetary policy efforts already undertaken by the European Central Bank, and on a more expansionary economic policy: we must support demand and employment to make the stable and sustainable fragile recovery that characterized the euro area. In short, it is time investment, especially those at high content of knowledge, research and innovation.

The three graph below show the trend of some important variables that are able to describe as better as possible the Italian Labour Market situation from 1960 until the more recent years.

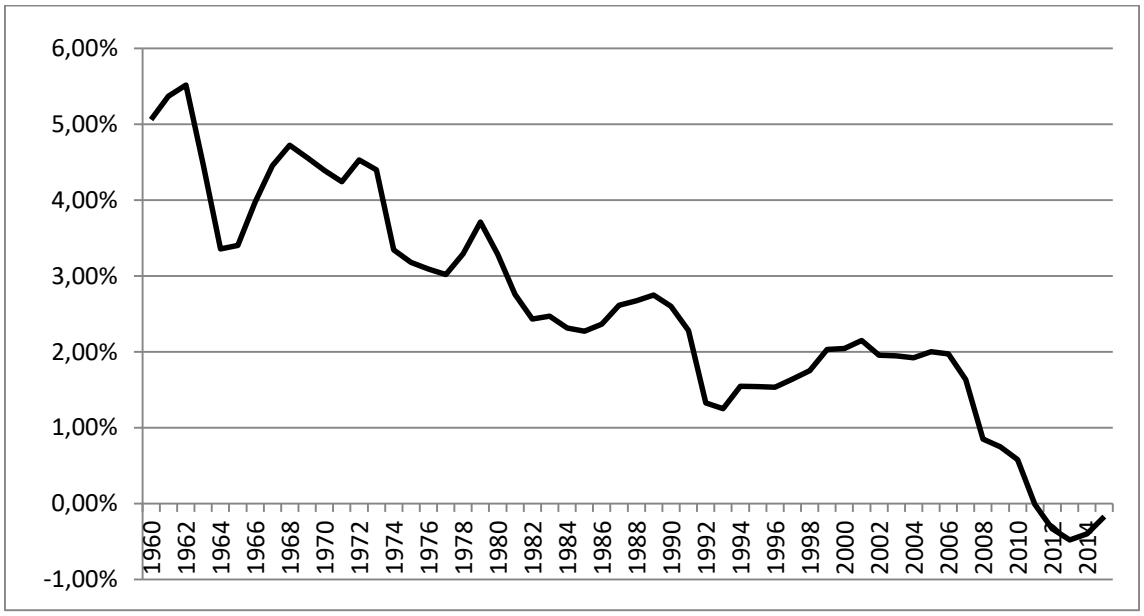


Figure 24. Net Capital Stock Growth Rate

The trend of Net Capital Stock in Italy, reported in Figure 24, from the beginning of the period considered is clearly downward, with some ascents but of little importance. From 2000 to 2008, it was quite stable around the value of 2%, but from 2008, in correspondence of the financial crisis, it fall evidently. Around 2011 the values have dropped below zero, although they seem to be back on the rise in recent years, but they are always negative.

Figure 25. Employment Growth Rate

The Italian employment growth rate has a peculiar trend, as shown in Figure 25. There is no general trend, but many ascents and descents alternated at precise periods. Since 1960, year of the start of observation, to 1965 is negative. It remains positive or close to zero until 1991, when there is an evident drop to a negative value of 3%. It returns positive from 1994 to become again negative again in 2007 and 2011. From 2013 the values are positive but close to the zero.

3.6 Italian Prospective

As I have discussed in this paragraph, since the late 90's, Italy's main problem is the lack of growth of the economy. The sluggish economy has left Italy behind in many areas of well-being, in particular education and skills, employment, income, and housing. The Government has launched an ambitious reform program to address deep-rooted structural problems that have led to stagnation in productivity since the late 90's.

The recession has accentuated the deep regional divide. Italy has long suffered from vast differences between North and South with regard to important socio-economic factors such as unemployment, participation in the labour market for women, family income, and the various types of crime, especially violent crime. The impact of the recession on economic activity and employment has been even tougher in the South than in the North. Internal migration, or the movement of people from regions of low employment in high employment regions, could serve as a safety valve. In the 50s and 60s, the rate of emigration from South to northern Italy and other countries, they were very high. However, in recent years, despite the grow of the gap between the unemployment rates, migration has remained at low levels. The envisaged constitutional reform, centralizing responsibility in key areas such as active labour market policies and competitiveness, could help reduce regional gaps.

The low productivity growth resulted in the worsening of cost competitiveness following enlargement to the monetary union, and then there have been no improvements. Weak economic growth, with the persist of a budget deficit, has maintained the debt / GDP ratio to one of the highest levels among the OECD countries. This has meant that, with the international financial crisis and the euro, Italy would remain exposed to sudden changes in market perceptions.After a long period of stagnation that made its economy vulnerable to the financial crisis; Italy is undertaking an ambitious and wide-ranging program of reforms to stimulate growth, taking advantage of the synergies between the various public policies. In the past, many good projects of reform have not been fully implemented, thereby preventing the economy way to fully benefit from their effects. The Government is focusing on changes in the political-institutional framework and the judicial system to remove previous obstacles to the implementation of the reforms. The continuing expenditure restraint and tax increases have contributed greatly to strengthening the budgetary position. Along with the revival of growth and falling interest rates, this will reduce the public debt burden.

From an European point of view, although the implementation of appropriate monetary policies tend to reorganize the country, the Quantitative Easing (QE) alone cannot ensure long-term competitive advantages to peripheral Eurozone countries. Therefore, the bet on structural and institutional reforms in Italy is to rapidly modernize the country, mainly through the reform of the labour market, judicial reform, and the reform of public administration, in order to enhance the structural competitiveness of the country and make it more attractive to national and international investors. Remains a key element for the development of the country and its competitiveness, the commitment that process will ensure in the next few years in terms of increased public and private investment. Therefore, this means: the expansion and modernization of infrastructure, the spread of the culture of merit, incentives for the development of innovation, growth, more capital, internationalization, and firms combinations, research and development, education, the review and restructuring of the welfare system to take account of demographic aging, the reduction of non-productive public expenditure, the fight against tax evasion and corruption and a significant reduction in the tax burden.

Looking ahead, the main challenge is to make the economy more productive, more competitive and more flexible, in order to raise the standard of living and the welfare of all Italians. The top priority is the reform of the labour market, whose excessive stiffness is an obstacle to the creation of jobs and a better match between skills and needs of this kind of market. The aim of the Government is to complete this task by the next few years. In order to improve, for example, the effectiveness of active policies of the labour market, has decided to transfer its expertise from the regions to the state. The Government also intends to address existing structural weaknesses in other areas, such as competition and regulation, thanks to a project of far-reaching reforms to be implemented in the next two years. Such initiatives are needed to boost productivity and put the economy on a path to sustainable growth. If fully implemented, could lead to a 6% increase of GDP over the next 10 years. A well-functioning labour market is essential to promote the creation of jobs, raise living standards, and to develop a cohesive society. In Italy, the various deficiencies of the labour market have led to high unemployment, low participation in the labour force and lack of job-skill matching. These failures contributed

to the problem of resource allocation, income distribution, and low productivity, reducing the welfare of the people. The current government, following the reforms of previous governments, is introducing of a package of labour market reforms, the so-called “Jobs Act” to improve the labour market consistently. The reform will make the market more flexible and inclusive labour, and reduce the duality. The actual implementation of long-term problem will be overcome, with a greater focus on rapid implementation. A set of well-designed institutions, and not the labour market policies alone, but also the regulation of the education system and product market, encourage greater labour force participation, especially among women, and produce more and better jobs quality jobs in a more skill-intensive.

Fourth Chapter

Labour Market Models

4.1 The Labour Market

In the first chapter, we have introduced the main problem that we would try to solve, which is the productivity slowdown puzzle among the European countries. In the second chapter, we have used the growth accounting method to analyse and to decompose all the determinants of growth, reaching the conclusion that an important element of production process is technology, which is best represented by Total Factor Productivity (TFP). We described its characteristics and its trend, focusing on the important role played in the growth and in the productivity of an economy. However, it is necessary to have a complete panoramic of the productivity slowdown puzzle, looking also at the other classical inputs of production: capital and labour. Capital is connected with the investment decisions of a firm, while labour is something more articulated and its demand and supply come from the situation in the *Labour Market.* Some fundamental variables such as labour productivity, capital productivity and TFP play an important role in the Labour Market. In particular, talk about *Labour Productivity* means focus on the production system of firms, a fundamental part of the whole economy of a country. Firms, to make their production process, must necessarily employ capital, but also labour. Hence, the need to investigate the characteristics of the labour market to find possible causes but also solutions to the problem of the fall in productivity.

The branch of political economy defined "*Labour Economics*" focuses first place on the following two questions: in a capitalist economy, what determines the level of employment, and therefore, the level of revenue generated? What determines the level of wages of workers, and, more generally, the distribution of income produced? Labour economics seeks to understand the functioning and dynamics of the markets for wage labour. Labour markets function through the interaction of workers (supply) and employers (demand). The economic approach is based mainly on the analysis of supply-demand market mechanism that regulates the exchange of labour in a manner substantially similar to any other commodity.

The graph below describes the functioning of the labour market in the standard model: on the horizontal axis is measured employment *(N)*, on the ordinate axis the level of wage *(W)*. The trend of the supply curve *(S)* is increasing, while the demand curve *(D)* is decreasing in relation to the salary.

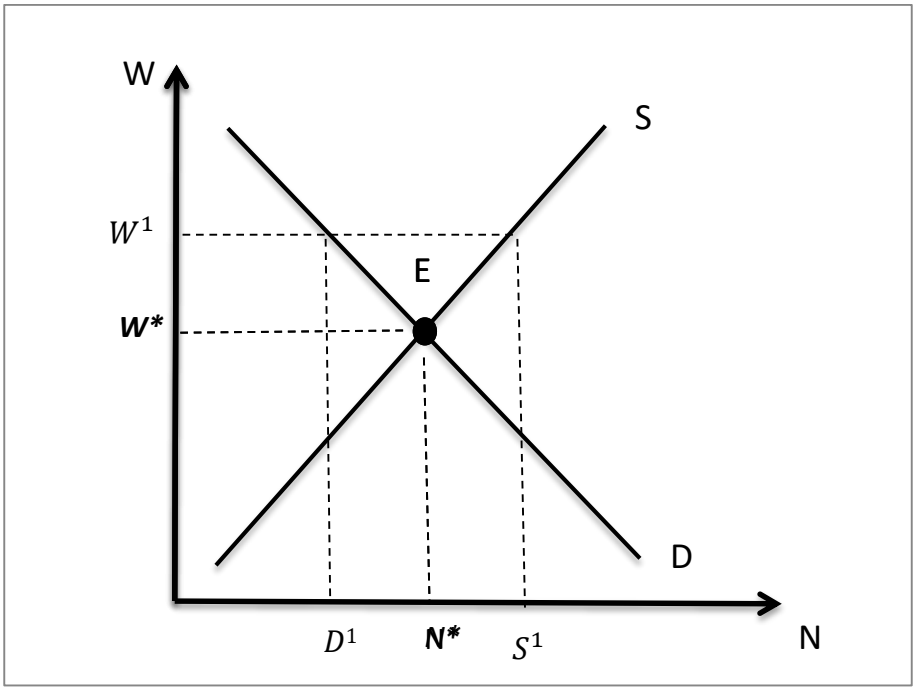


Figure 26. Labour Market in the Standard Model

Only at the level of the wage W^* the demand is equal to supply (point E), and this situation is called, of course, balance of the labour market. For every other level of wages, there would be no balance: for example, the W^1 level labour demand and supply would be D^1 and S^1 and, therefore, there would be an excess supply of labour (vice versa for a lower wage of W^* there would be excess demand).

Now, excess supply in the labour market means unemployment: not everyone who would like to work at wages as they can find a job. For example, in correspondence of the W^1 salary unemployment it is measured by D^1 - S^1 segment. Conversely, when the labour market is in equilibrium it is said that there is full employment, meaning that not all workers are working, but working all those willing to work for the W^* wage.

If either (or both) curves shown in the graph changes its position, the equilibrium conditions (employment and earnings) are changed. As we have already said, the demand curve can be moved if you change the selling price of the product enterprises: if the price increases, then the labour demand curve shifts upwards, and so both the number of employed and the equilibrium wage increase.

In short, the standard model predicts that following the price fluctuations of any goods (caused by many different phenomena, which always occur in reality) you should attend to ongoing layoffs, hiring, and changes in wages in all sectors of the economy. However, this does not happen in the real world. For this reason, the standard model seems hardly appropriate to understand the real phenomena that surround us every day.

In this kind of market are involved the suppliers of labour services, workers, and the demands of labour services, employers, and it attempts to understand the resulting pattern of wages, employment, and income. There are two different point of view of labour economics: it can be generally seen as the application of microeconomics or as macroeconomic techniques to the labour market. Microeconomic techniques study the role of individuals and individual firms in the labour market. Macroeconomic techniques

look at the interrelations between the labour market, the goods market, the money market, and the foreign trade market. These last interactions influence macro variables such as employment levels, participation rates, aggregate income and gross domestic product.

4.2 Existing Literature

It must bear in mind that there is no unique way of conceiving labour economics and labour market. Like in all other branches of the economy policy, the economy of labour is deepened in different ways from the several schools of economic thought. We find the typical distinction or, maybe, opposition between the "vision" of the classical economists and the one of the neoclassical economists, but we will describe in this paragraph many other contributes to build a labour market model, until rich the more recent growth model, which take a long run prospective of the variables involved. These last models give a strong contribution to the construction of our modelling in the fifth chapter. Let us see them more in depth.

4.2.2 Classical Model

The classical labour market model provides the first systematic analysis of the fundamentals elements of a macroeconomic system and the interrelationships between the most important macroeconomic variables such as national income, real wage, the level of employment, the price level, the interest rate and so on.

Classical thought assumes that two economic entities operating in the economy, consumers and entrepreneurs, they exchange four goods, which are goods, which can be used both for consumption and for investment, work, money and securities. The classic model is thus composed of four markets corresponding to the four traded goods in the economy: that of the goods, of the labour, of the money and finally that of the securities. Classical model, like any other macroeconomic model, can be divided into two parts: the real one and monetary one. The first is made up of the labour and goods markets, the second from the markets of money and the one of securities. Classical economists make some assumptions about the function of economic system:

- The markets are perfectly competitive: this implies that economic actors assume as given the price of the commodity that is realized in a generic market. In other words, they believe that their actions cannot influence in any way the equilibrium value of the commodity-traded price.

- Prices are flexible and they guarantee, instantly and perfectly, the absorption of any imbalances that arise in the different markets: this represents, therefore, the adjustment mechanism that is activated in the economy when the latter is in imbalance (that is, when there is no overlap between supply and demand). In the presence of an excess of positive (negative) demand of a given commodity, the price of the latter increases (decreases) instantaneously so that it is reabsorbed this excess.

- The economic actors, in defining their actions, act in a rational and individualistic way: this implies that the economic subject for making their own decisions with respect to the quantity of goods asked and/or offered act rationally and individualistic. In other words, the individual in defining a consumption or production plan maximizes an objective function, which is an indicator of his welfare (principle of individualism) in the presence of a bond (of resources, technological or temporal).

- The economic subjects do not suffer from money illusion: this implies that he, in determining the amount of quantities of the different goods asked and offered, considers the relative prices rather than absolute prices. Then in the presence of a general and proportional increase of the prices of various goods, which leaves unchanged the relative prices, the economic actor does not change the demand or the supply of goods.

- The stock of capital (K), the size of the workforce (N), and technology are assumed constant: this shows how the classical model is essentially a short-term model. The firms, in fact, to define the production plan assume both the capital and technology as given, so that the actual product, X, depends only on the amount of labour employed. The latter is a variable that can take on values between zero and the amount of labor available in a given period. So the aggregate production function is:

$$X = F(N) \tag{20}$$

- The marginal product of labour is positive, but decreases with increasing amount of labour used (law of diminishing returns). This law states that, to parity of capital used and given the state of the technology, an increase of a unit of work results in an increase of the product, however, the variation of the incremental product decreases labour productivity, when increases the amount of labour used.

$$F'(N) > 0$$
$$F''(N) < 0$$

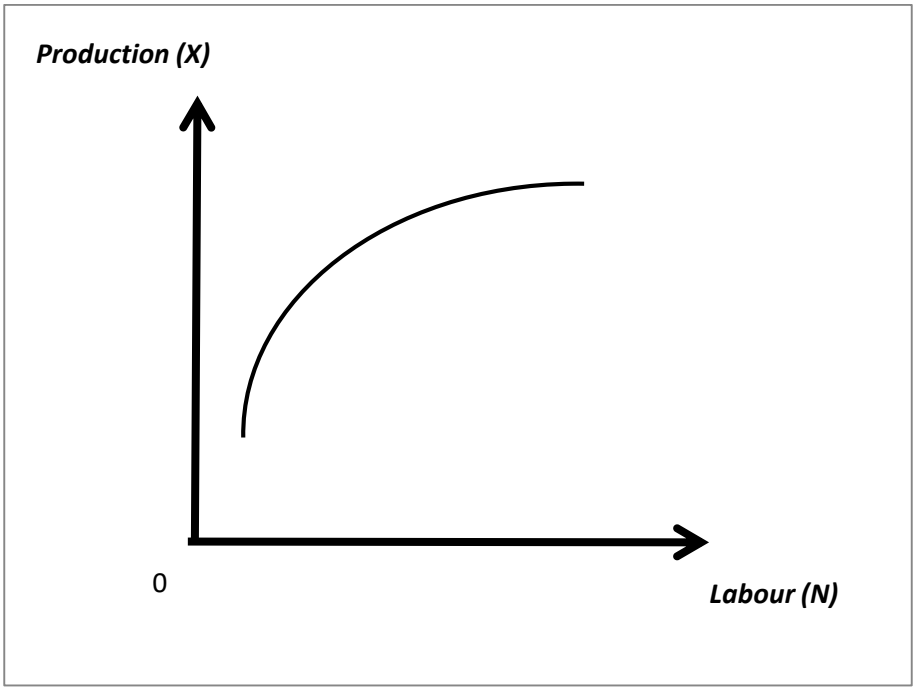


Figure 27. Classical Production Function

In Figure 27 it is represented the production function, the product *(X)* increases with the increment of units of labour *(N)*. The increase, however, is less than proportional respect the increment of unit of labour.

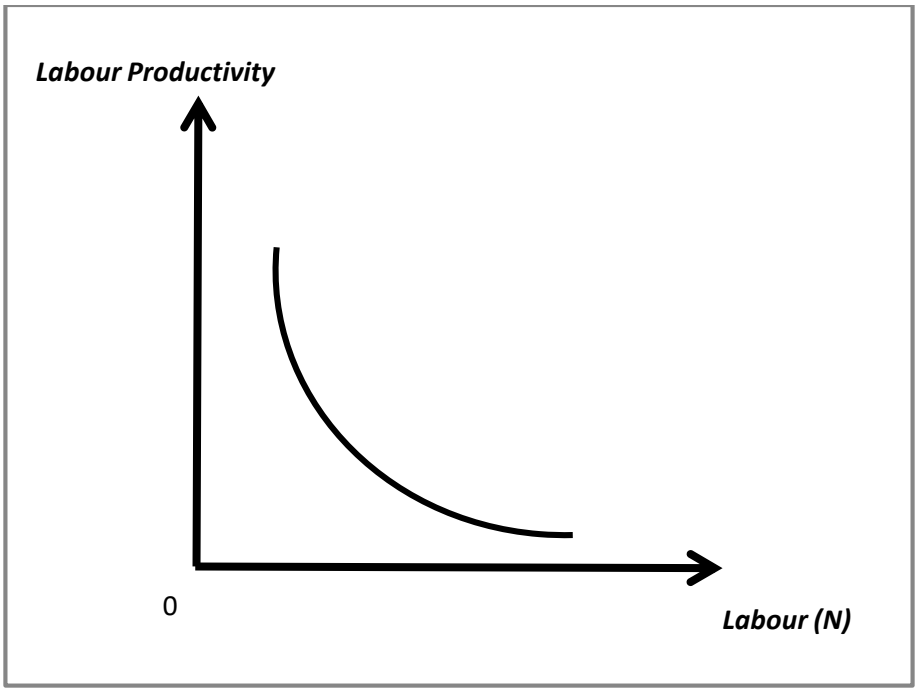


Figure 28. Marginal Productivity Law

Figure 28 shows the marginal productivity law, which means that incrementing the labour employed, the productivity of labour decreases. In the labour market faced firms, which demand work, and workers, that offer labour. Firms must decide the amount of goods to offer and, consequently, since the capital and technology are given, they must determine the amount of work needed to produce the desired quantity of the goods offered. The firm maximizes profit, the difference between revenues and costs, compared to the amount of labour employed given the technological constraint, represented by the production function:

$$\pi = PX - WN \tag{21}$$

Where P is the price of good X, W is the monetary wage of the labour employed N. Deriving the objective function, the profit one, compared to N, is obtained:

$$\frac{d\pi}{dN} = PF'(N) - W = 0$$

From the first order, condition of the profit maximization problem is obtained:

$$PM_N = F'(N) = \frac{W}{P} = w \tag{22}$$

where $w = W/P$ is the real wage. The last equation implies that the rational firms demand that amount of work at which the marginal cost (i.e. the real wage) is equal to the marginal profit (i.e. the marginal productivity of labour). Moreover if the real wage decreases, then the demand for labour increases, while the aggregate supply of labour increases with the real wage.

If there is a positive excess demand for labour, the real wage increases instantaneously, so that immediately it brings into balance the labour market. Consequently, in the classical model it is realized a continuous equilibrium, in which the employment balance value coincides with the full level employment. In other words, in the classical model, it is admissible only voluntary unemployment since all workers who wish to work at the balance real wage find work. The idea that manufacturing activity was subject to the law of increasing returns had been one of the cornerstones of the classical theory.

The hegemony of the classics and *Marx* goes from 1776, the year of publication of the Wealth of Nations Smith, 1867, when it was published Marx's Capital. They saw capitalism as a system characterized by continuous conflicts between opposing social groups. In their view, for example, the salary was influenced by the customs and traditions of a given historical epoch, which in turn were influenced by the state of the balance of power between social classes.

Adam Smith in the first three chapters of the Wealth of Nations argued that productivity depended on the degree of division of labour, that is, the degree of specialization. The division of labour in turn depended on the size of the market: the higher the size of the market, greater differentiation and specialization, greater efficiency.

A greater division of labour is more productive because it brings with it the development of greater skills and knowhow.

Ricardo introduces diminishing marginal returns. The production has a fixed factor: the land. The process of capital accumulation and the increased production mean that less productive lands are increasingly under cultivation. The marginal productivity of capital and labour decreases with the accumulation and gets to the point where no profit is generated. The rate of profit depends on technical conditions and the wage rate (inversely related). Only technological progress can continue to process development.

The marginal-productivity theory generalizes the Ricardian law of diminishing returns, applying it to the sphere of consumption (principle of utility but descending) and to the industrial production in capital and labour. There are some exceptions: *Marshall & Young* emphasize, though without rejecting the implant marginal economy, the importance of the interaction between static and dynamic factors in determining the increasing returns to grow the scale of industrial production.

4.2.3 Neoclassical Model

Neoclassical theory is imposed between 1870 and 1929, year of the beginning of the Great Depression worldwide. The exponents of the neoclassical theory offer a different vision of capitalism. In their view, any economic agent aims to maximize their well-being under the constraint of resources at your place. Families aim to maximize utility, firms aim to maximize profit. In order to maximize utility and profit households and businesses exchange staff resources on the market. In versions of the basis of the theory neoclassical, the free play of supply and demand in the market will be to determine a balance "good", that many neoclassical define "natural". According to this view class conflicts may also exist, but will determine a deviation from equilibrium "natural" that will result in the inefficient results in terms of welfare. For example, if the unions demand a salary too high compared to the corresponding equilibrium "natural" market, the result will be an increase in unemployment.

Neoclassical economists view the labour market as similar to other markets in that the forces of supply and demand jointly determine price (in this case the wage rate) and quantity (in this case the number of people employed). However, the labour market differs from other markets (like the markets for goods or the financial market) in several ways. Perhaps, the most important of these differences is the function of supply and demand in setting price and quantity. In markets for goods, if the price is high there is a tendency in the long run for more goods to be produced until the demand is satisfied. With labour, overall supply cannot effectively be manufactured because people have a limited amount of time in the day, and people are not manufactured. The labour market also acts as a non-clearing market. While according to neoclassical theory most markets have a point of equilibrium without excess surplus or demand, this may not be true of the labour market: it may have a persistent level of unemployment. Contrasting the labour market to other markets also reveals persistent compensating differentials among similar workers. Among the most famous versions of the neoclassical theory of the labour market,

it must be included "The Theory of unemployment" written by *Arthur C. Pigou* and published in 1933.

Therefore, we have said that in the neoclassical model the supply and the demand of labour resulting from the maximization of profits and of utility, respectively by firms and families (individuals). We can now go on to analyse graphical labour market. In Figure 28 we lay on the x-axis the amount of work and on the ordinate the real wage and track the supply and demand of labour:

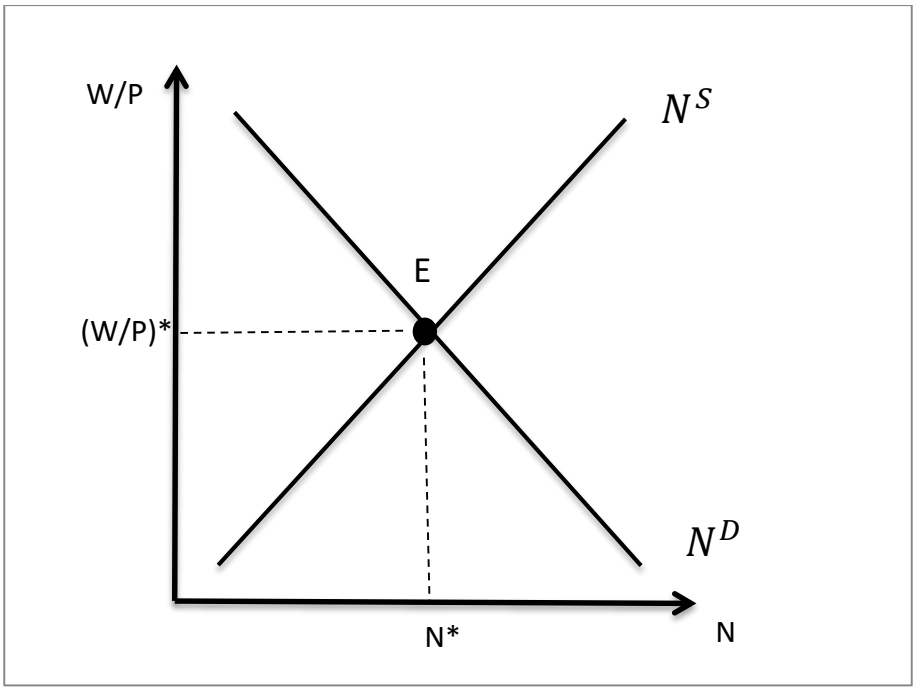


Figure 29. Neoclassical Equilibrium

The neoclassical claim that the forces of the free market, left to themselves, will lead automatically to the real wage *(W/P)**, which preserves the balance between supply (N^D) and demand (N^S) of work, sometimes called natural balance, and that ensure the full employment al level *N**. To test this assertion we assume that the real wage of the market is $(W / P)^0$. At this wage, there is an excess of labour supply over demand of work:

$$(w / P)^0 \rightarrow N^D > N^S$$

This is a situation of unemployment. Workers who are offering N^S_0 but firms only hire N^D_0. Therefore, there is a number of involuntary unemployed equal to the segment N^S_0 - N^D_0, as we can see in Figure 29.

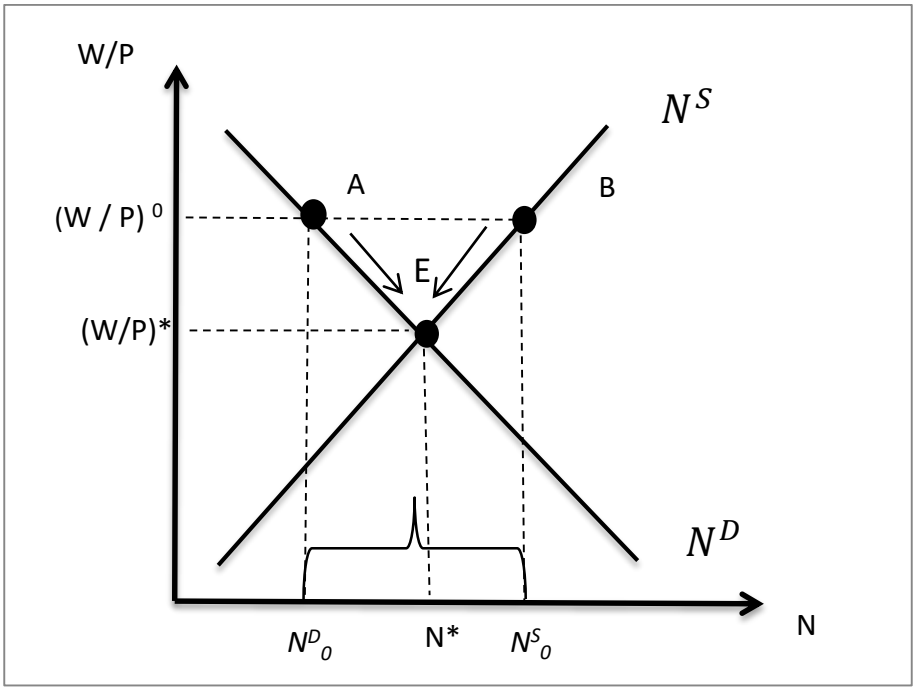


Figure 30. Involuntary Unemployment

These unemployed are called involuntary because at the current market wage $(W / P)^0$, they would like to work but do not find a job. For neoclassical however this situation is only temporary. The market mechanism will lead spontaneously to equilibrium in the system E. The unemployed are in fact in competition, both among themselves and with the employed, and thus exert downward pressure on wages, which will increase the demand for labour and N^D N^S to decrease the supply balance. This race to the bottom on wages It is sometimes called "underbidding", and should lead to balance the market. The reduction of W / P fact causes:

- An increase in labour demand N^D: reducing the cost of the work Businesses can hire additional workers, who have a lower marginal productivity.

- A reduction in labour supply N^S: some workers, seeing that wages is reduced, believe that the game is not worth the candle and choose to withdraw from the market.

At equilibrium (E) labour demand, N^D, is equal to supply, N^S (I.e. in $E \rightarrow N^D = N^S$). All workers willing to offer their work to the current real wage (w / P) * will find a corresponding demand for labour and thus the fall of wages stops. Note that there are more unemployed involuntary: the spontaneous forces of competition on the market made it possible to absorb unemployment involuntary. But the unemployed remain voluntary, that is, those that wage regulations are not willing to work but that it would make available to a higher salary (segment N_S^0-N^*).

The neoclassical, however, argue that the unemployed volunteers have freely chosen not to work. Then they should not be a priority, either analytically or politically. The important thing for the neoclassical is that the market is able to absorb spontaneously

involuntary unemployment that is able to secure a place for all workers willing to work at the market wage equilibrium. Since balancing the system fails to eliminate involuntary unemployment, then we can say that the point E, sometimes called "natural" balance in this model can also be called a full employment equilibrium.

It is good to remember that the result of convergence to the natural balance depends on the inclinations of the functions of demand and supply of labour. If the inclinations change, it can occur that the spontaneous mechanism of the market is no longer able to determine the balance. For example, if the so-called income effect prevails, then an increase in the real wage causes a reduction in labour supply of households: in which case, the job offer was a downward trend compared to wages.

Now, if the job offer is also more "flat" in labour demand, which can happen with a real wage higher than the equilibrium wage will have the offer is less than the demand, and then, rather than decrease, the wage increases further. One speaks in this case of an unstable equilibrium. In such a case, it is evident that the spontaneous market forces are not able to determine the equilibrium, and therefore cannot eliminate the involuntary unemployment. To exclude this awkward circumstance the neoclassical usually assume that the substitution effect will always prevail on the effect household income.

4.2.4 Keynesian Theory

According to pre-Keynesian economists the labour market tended always towards maximum employment so that, in the event that it would be determined a situation of unemployment, workers would accept lower wages so that the firms, would assume them returning to a situation of full employment. This optimistic view, deriving from the old economic analyses of Adam Smith. As we have seen in the previous paragraph, imagined that an "invisible hand" would lead, in the long run, to full employment of all production factors due to "natural laws of the market". Therefore, according to this theoretical approach, it is essential that the State would leave individuals free to produce and to commerce (the so called “laissez faire, laissez passer”) without intervening in the economy (or non-interventionist liberal state).

The optimistic view of the classical economists, however, was denied by the severe economic crisis at in the US in 1929: at that time the firms facing a crisis of overproduction (insufficient demand of goods and services than supply), applying the classical theory, they reduced wages and in many cases, they fired workers. This, however, did not bring to the desired effect but, on the contrary, it sharpened the crisis, as workers with lower wages and new unemployed decreased their demand of goods and services with devastating effects for the whole economic system. This scenery substantially contradicted the law of markets, formulated by J.B. Say in 1803, according to which the supply of goods on the market it is always able to create a demand of equal intensity, given the substantial neutrality of money.

The English economist *John Maynard Keynes* (Cambridge, 1883 - Firle Beacon, Sussex, 1946) belonged to the group of those who believed that capitalism was suffering from deep dams, the more difficult to treat the more one take in consideration the

mystifying interpretations of the neoclassical thought. The reasons that explaining the causes of the persistent state of the system imbalance were sought in something deeper than simplifying and reductive assumptions that spoke of price rigidity. Say's Law could not be accepted because in an economy not bartering, but monetary, there is no guarantee that the offer of a good will correspond necessary to a similar act of demand for the same amount. In addition, there is no evidence to support the equality between the accumulated savings and the investment to be financed, as well as makes no sense the dichotomy between the real economy and monetary economy, unless we use is a very simplistic view of the currency, such as that on which was based the quantity theory.

The most important work of Keynes is *"The general theory of employment, interest and money"* (1936) a volume that has an important impact on the economic science and it is the first core of modern macroeconomics. Keynes in it lays the foundation for the theory based on the concept of aggregate demand, explaining changes in the overall level of economic activity as well as observed during the Great Depression. Keynes' model was built for a short-term horizon and a closed to an economy of advanced capitalist country, what was the UK at that time, he tried to define on which variables depend the level of income from which, in turn, it is defined in the employment level. The latter, is ultimately linked to the amount of actual demand, which in turn is generated from the expenditure for consumption and investment. In particular to address this crisis, Keynes advocated the need to reverse the liberal setting and he sought the intervention of the State in the economy (interventionist state or Welfare State), through the assignment, during the stages the economic crisis, the unemployment benefits and the construction of public works. In this way the demand within the economic system would be increased and, consequently, the entrepreneurs would have to increase the supply and, therefore, to hire more workers (multiplier effect of public spending). The income share not intended for consumption generates saving, that is a function of the amount of income, which each one has, and not the interest rate, as supported the neoclassicals. It, however, will grow in a more than proportional increase in income: in fact, the more incomes are higher and the more will be easy to accumulate savings. For system balancing, this increasing saving should be accompanied by an equivalent increase in investments, which depend in their turn from completely different factors, like the waiting of capital profitability. This happens, however, rarely, since the mass of savings remains usually higher than investment, creating, as a result, an oversupply of goods that have not place in an appropriate demand, and this creates depression. This theory, which I have briefly explained, was divided on the study of four markets that one of work, of goods, of capital and the last one of money, united by a logical connection that we are going to describe. With regard to the labour market, after criticizing the traditional theory that spoke of an equilibrium based exclusively on wage levels, so that to increase employment was sufficient to reduce the same salaries Keynes argued that in this case the level of employment is closely related to the amount of global demand and hence the firms' decisions regard investments. Therefore, the labour market is closely linked to what is recorded on the market of goods, where priority is the role of effective demand, in its two main components, the one of consumer goods and the other of capital goods: the demand that interested is that "effective" demand, as it must actually translate into an expenditure. The consumption does not depend, as the neoclassical thinkers believed, only on the

prices, but mainly on income level: among other things, it is from the level propensity to consume which depends the size of the multiplier for the whole economy. Therefore, the theory of utility and prices lost importance in Keynesian analysis, while income, that in the traditional theory was only a budget constraint, becomes here the main variable on which depends the amount of consumption, which in turn grows, but at a lower rate than the growth rate of income. This growing mass of non-consumed income should be absorbed by the investment in order to maintain balance in the whole system. It is in the capital market that it is determined the investment, in relation to the expected return on capital, compared, of course, with the level of current interest rate. In this market, however, it is not determined, as the neoclassical thought, the automatic balance with the savings. For Keynes the savings do not automatically generate investment, it is a residual variable that depends on the income level. In the capital market does not exist, therefore, a mechanism that automatically equals these two variables, savings and investment, which depend from the choices of completely different categories of workers. Savers on the one hand, that the more they save much higher are their personal incomes, and entrepreneurs on the other, that the more they invest the higher are the prospects for future profits. Given the existence of these two categories of operators, no mechanism can ensure compatibility between their decisions: they are precisely the uncertainties related to the definition of these expectations, which, according to Keynes, generate the ups and downs of the business cycle.

The last market analysed by Keynes is the money market, in which it is determined the rate of interest, the strategic variable that affects, in sequence, the global demand, income and, therefore, employment. The interest rate is not a variable of the capital market, as believed the neoclassical, because it do not provide the amount of savings, which is a residual variable income. The interest rate depends, therefore, on the demand and on the supply of money. While the latter is regarded as an exogenous variable, established by monetary authorities, the demand for money depends on the choices of individuals, justified by the exceptional prerogative that characterizes the coin, to be a perfectly liquid good, that is immediately usable in anywhere type of exchange. Therefore, Keynes defines the demand for money as a "liquidity preference" and the rate of interest as the reward for the temporary abandonment of this liquidity. This theory also allows overcoming the traditional dichotomy between monetary theory and real theory. There are, then, several unresolved contradictions in all the markets that characterize a capitalist system, starting with the fact that the interest rate is not able to match savings and investments, and this in turn justifies the inadequacy of the effective demand compared to supply, and consequently, it affects negatively the employment.

Let us see more analytically how Keynes builds his theoretical model. The Keynesian theory of employment and income determination, despite the misunderstanding and the darkness that surrounded it at the time of printing, may now be expressed in a simple and effective way.

Once it was understood the fundamental process of generating income because of effective demand, it is natural to go over to investigate what are the determinants of the effective demand. Keynes, in a typically classical way, divides people into two broad categories: consumers and producers. The total effective demand is, therefore, the sum

total demand for consumer goods (C) and demand for investment goods (I), and since the effective demand generates income, we can simply write:

$$Y = C + I \tag{23}$$

It is necessary, at this point, to formulate a theory of consumption and of investment. The consumption is simply regarded as a dependent on income. Keynes says that consumers, on average, tend to spend only a part, precisely a decreasing fraction, of any increase in income. Therefore:

$$C = f(y) \tag{24}$$

where *f* represents the "marginal propensity to consume" and its complement to the unit, *(1 - f)*, is the "marginal propensity to save." Employing, for simplicity, a linear approximation, the previous equation can also be written in the following way:

$$C = A + aY \tag{25}$$

where *A* is a positive constant, *a* is the marginal propensity to consume, and $1 - a \equiv s$, the marginal propensity to save.

About investments, Keynesian theory is decidedly detached from the traditional theory, in which there is no distinction between demand for consumer goods and demand for investment goods. Investments are not made in connection with income. In any given short-term situation (with a given technology and a given capital structure), the total amount of investment depends on the expected profitability of all investment projects that are possible and on the rate of interest. One can imagine that entrepreneurs put all possible investment projects in order of decreasing profitability and then they realize the investments up to the point where the rate of expected profit from the last project (called "marginal efficiency of capital") is just greater, or at least equal, to the current rate of interest, as expression of the cost of loans. So we can write:

$$I = \varphi(E, i) \tag{27}$$

where *E* represents the expected decreasing profitability of investment, *i* is the rate of interest. At this point, however, enters in the scene a new variable: the rate of interest, which had been carefully excluded from previous relations. Keynes is thus induced, by the logic of his own theoretical framework, to seek a new theory of the interest rate. He argues that, for a number of reasons (which he leads back to the need for current transactions and to precautionary and speculative purposes), exists for each level of the rate of interest a certain amount of money that people want to hold back. This amount of money (demand of money) is inversely related to the interest rate and tends to infinity before the rate of interest becomes invalid (the "liquidity preference function"). Given this relationship, the rate of interest will therefore determines the quantity of money *M** issued by the Central Authority, a purely monetary phenomenon.

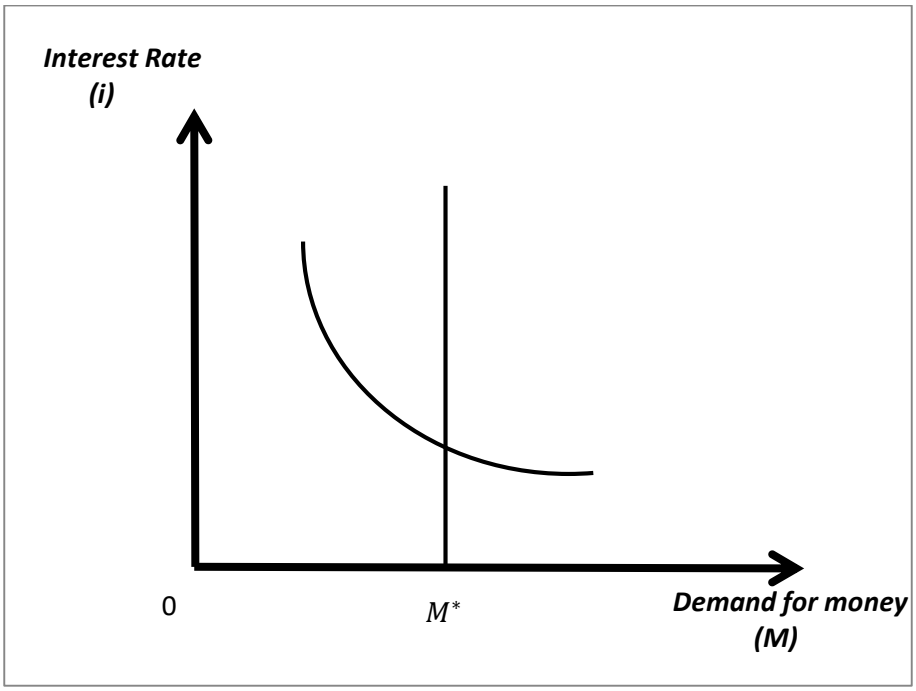


Figure 31. Keynesian Model

So:

$$I = \varphi(L, M^*) \tag{28}$$

where *L* represents the decreasing preference function for the liquidity, *M** the amount of money issued by the Central Authority.

Finally, given the curves of consumption, the marginal efficiency of capital and liquidity preference, and given the amount of money *M** fixed exogenously, the following four equations determine the four unknowns *Y, C, I, i*. The last two equations are a simplified but effective way, to represent the determination of *I* and *i* in the Keynesian theory. A more detailed formalization could be made writing each of them as a set of two equations, the second of which is an equilibrium relationship. More precisely:

$$I = E(r) \tag{29}$$
$$r = i \tag{30}$$
$$M = L(i) \tag{31}$$
$$M = M^* \tag{32}$$

where *r* is the expected profit rate and M is the demand for money. In this case, we would say that the six previous equations determine the six unknowns: *Y, C, I, i, r, M*.

It is important to underline that these equations are always considered to represent a first approximation of Keynesian theory. We should not rely too heavily on them when considering situations far removed from equilibrium points. We also should be careful when conducting arguments that involve displacements of some curve, since

the movements of any of these curves are not independent. The important novelty of this scheme, compared to previous theories, is to show that there is no reason why the net national income level should be exactly what you would ensure the full utilization of production capacity and full employment of the labour force. When the system is left to itself, only by pure chance it may happen that it reaches that point, on the straight line at 45 ° from the origin, which corresponds to the full employment. In effects, Keynes always considers as "normal" a situation in which there is full employment, as is shown in the figure below, the consumer demand is a function of the income and the investment demand is simply added to the consumption. The equilibrium occurs at the point β, where $C + I$ intersects the straight line at 45 ° from the origin. At this point, the aggregate demand equals the total production *(AD = Y).* Therefore, there is indeed a balance between aggregate demand and aggregate supply, but it is a balance of underemployment. The difference $(\overline{Y} - Y')$ indicates spare capacity and unemployment. This is the type of unemployment (due to lack of effective demand), which has now become known as "Keynesian unemployment".

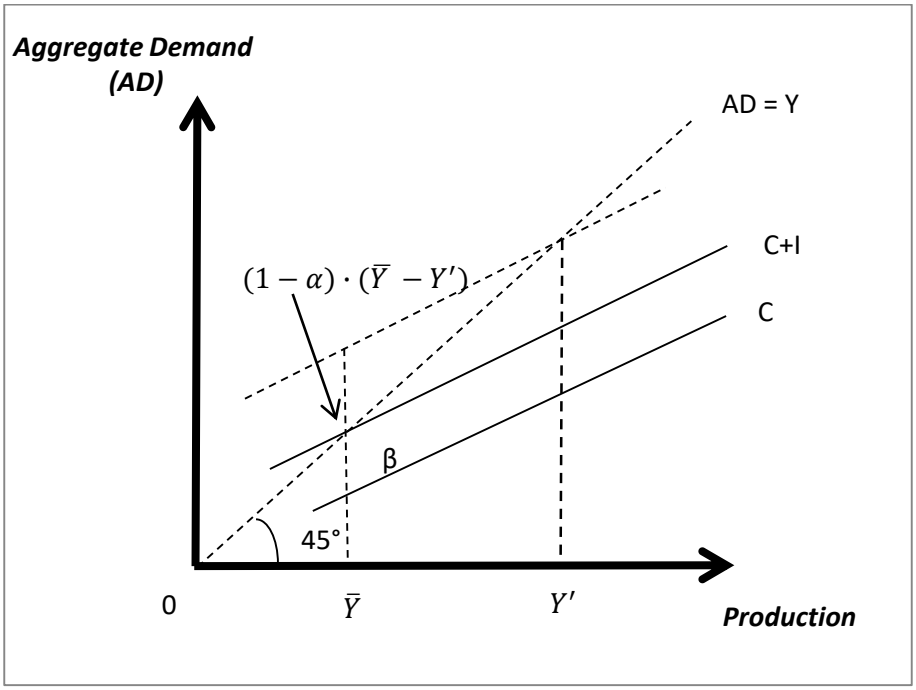


Figure 32

According to Keynes wages can not fall below a certain level, since workers' unions don't permit it. On the other hand, low-wages are not convenient for the entire economic system since they decrease the demand of workers/consumers and, therefore, do not allow the development of economic system.

It should be noted that throughout the analysis of Keynes, unused capacity and unemployment are always used as synonyms, because, in the short term, they can be considered proportional to one another. The most striking feature that emerges immediately is the sharp break with tradition, then sixty years old, the marginal economic

theory and the return of Keynes methods of analysis of previous economists: the classical economists start of the nineteenth century.

The use of macroeconomic variables, the division of all economic operators into broad categories (consumers and businesses), the research of the determinants of the interest rate in an outer sphere to the production: all these are characteristics inherited from the classic economic analysis. Even the marginal efficiency of capital function, which may, to a first and superficial glance, appeared to be part economic marginal analysis, reveals, on closer examination, quite different origins. The sort that Keynes makes of all investment projects in descending order of profitability is close to the order, which does Ricardo of all lands in order of decreasing fertility and not to any marginal economic development. In any case, there is no need to consider the marginal efficiency of capital Keynesian function as an expression of the marginal productivity of capital theory. The latter theory necessarily implies a monotonic inverse relationship between capital intensity and the rate of interest. However, this is not really the case of Keynesian order of investment projects. In a recessionary situation, the latest project to be carried out could very well be the one that has all of the intensity of lower capital and therefore result in a decrease (not increase) average amount of capital per unit of labour employed.

Going down to a more specific comparison, the analytical similarities are more apparent are those with the Ricardian scheme. Despite the understandable Keynes' enthusiasm for Malthus and despite the frequent and severe criticism of Keynes to Ricardo, is the Ricardian analysis method that Keynes has brought to the fore. The most significant clue is the immediacy with which Keynes proceeds in the selection of its assumptions. Like Ricardo, he is always in search of the key elements; it highlights the variables that he considers most important and "freezes" all the others, that give rise to no significant complications, using simplifying assumptions, although, as he says, keep them always "in the depths of our minds" for necessary reserves and qualifications. The typical consequence of this approach is the emergence in Keynes, as in Ricardo, of a system of causal equations, as we have seen above, as opposed to the system of simultaneous equations or interdependent systems of the marginalist theory.

4.2.5 The Current Mainstream

The current mainstream, that is the vision that prevails today, it is based on contributions of the exponents of modern "neoclassical synthesis", as *Olivier Blanchard*, a French economist.

As the macroeconomic model of Blanchard points out, the members of the mainstream believe that fluctuations in demand for goods have effects on unemployment, even if only temporary. Furthermore, they consider that even in balance conditions may be a situation of involuntary unemployment, caused by example by the presence of labour unions, or by firms with power market, or by other "imperfections" in the market. On the contrary, for the neoclassical, the involuntary unemployment could be only a phenomenon of imbalance. These theses are in some ways a novelty and in other ways a recovery analysis neoclassical traditional. A common element is that the unions is

attributed again the responsibility of involuntary unemployment, or at least a part of it. An element halfway between the recovery and the novelty is that the demand for goods is given a role in determining the unemployment, but only in the short period: in the long run the economy returns to the natural equilibrium, which is independent of the demand for goods. A novelty is that the natural balance no longer corresponds to a balance of perfect competition, free from involuntary unemployment. The new definition admits the existence of imperfections market, which can generate involuntary unemployment just under natural balance.

The *Blanchard macroeconomic model* describes an economy not fully competitive, characterized by market failures and asymmetric information. In this economy, for example, workers organize in unions and businesses are large enough to enjoy market power. The mainstream model of *Blanchard* results in a balance also defined "natural," however that may correspond to a situation of unemployment involuntary. We said that this result is a novelty compared to the models neo-classical, traditional and contemporary.

For the model of Pigou, in fact, the involuntary unemployment may be only a phenomenon of imbalance. For analyses that are based on Prescott, however, the same possibility to occur involuntary unemployment is questioned. If you conceive of involuntary unemployment as equilibrium phenomenon, we must demonstrate that there are no forces able to edit it abruptly. To this, a problem immediately arises: why don't the involuntarily unemployed trigger the competition downward payroll? In other words, why it does not incentive the phenomenon of "underbidding", that in the neoclassical model allowed to achieve full employment?

We look below the graph of the labour market of Blanchard. Let us start with a situation described from point A, corresponding to a natural balance with a unemployment rate equal to one. Blanchard and the other members of the mainstream admit that a part at least of this level of unemployment could consists of *involuntary unemployed*. So a question arises: what prevents involuntarily unemployed to exert competitive pressure on the downside that let the conflict *z* parameter get lower and permit to reduce the real wage curve requested by the workers? So what hinders the process of underbidding that it should lead to equilibrium at point B, where the natural balance has a level of unemployment a bit lowest, plausibly characterized by a number of involuntarily unemployed lower or even zero?

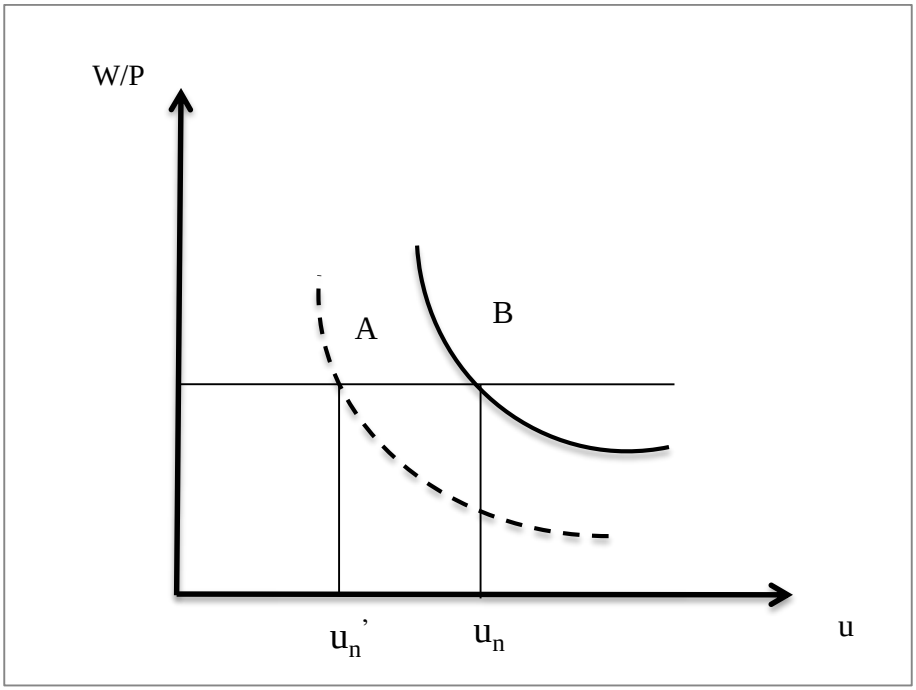


Figure 33

The response of Blanchard and the other members of the current mainstream is the following: the right imperfections and asymmetries in the market make impossible or ineffective the reduction wages in case of unemployment. It may happen, for example, that even if the unemployed offer their work at lower levels of wage, firms will decide anyway do not hire them. Possible reasons for this behaviour are varied.

4.2.6 AS – AD Model

The AS-AD (Aggregate Supply - Aggregate Demand) model is a mathematical model used to represent the simultaneous economic equilibrium in financial markets, goods market and labour market. In the AS-AD model, the equilibrium is represented by a certain level of production (*Y*) and from a certain price level (*P*). Two curves are used for the graphic representation of this model, the AS curve and the AD curve. This model for its innovative ability to combine macroeconomic variables with financial variables is the first significant contribution to our modelling.

We let look at how the model works in the appendix.

4.2.7 Phillips Curve

The previous model analysed, the AS-AD model, introduces the concept of aggregate supply and all the variables in it involved. The aggregate supply, however, can be expressed also in another way: as a relation between inflation, expected inflation and unemployment. The higher expected inflation, the greater will be the inflation. The higher the unemployment, the lower inflation. When inflation is not very persistent, expected

inflation does not depend much inflation passed, then the aggregate supply becomes a relationship between inflation and unemployment.

This is what they discovered in the sixties Phillips in the United Kingdom (1958) and Solow and Samuelson in the US (1960) when they observed the behaviour of inflation and unemployment. The Phillips Curve is an historical inverse relationship between rates of unemployment and corresponding rates of inflation that result in an economy. Stated simply, decreased unemployment, (i.e., increased levels of employment) in an economy will correlate with higher rates of inflation. While there is a short run trade-off between unemployment and inflation, it has not been observed in the long run.

In 1968, Milton Friedman asserted that the Phillips Curve was only applicable in the short-run and that in the long run, inflationary policies will not decrease unemployment. Friedman then correctly predicted that, in the upcoming years after 1968, both inflation and unemployment would increase.

The long run Phillips Curve is now seen as a vertical line at the natural rate of unemployment, where the rate of inflation has no effect on unemployment. Accordingly, the Phillips curve is now seen as too simplistic, with the unemployment rate supplanted by more accurate predictors of inflation based on velocity of money supply measures such as the MZM ("money zero maturity") velocity, which is affected by unemployment in the short but not the long term.

In the 1970s, many countries experienced high levels of both inflation and unemployment also known as stagflation. Theories based on the Phillips curve suggested that this could not happen, and the curve came under a concerted attack from a group of economists headed by Milton Friedman. Friedman argued that the Phillips curve relationship was only a short-run phenomenon. In this he followed 8 years after Samuelson and Solow (1960) who wrote:

"All of our discussion has been phrased in short-run terms, dealing with what might happen in the next few years. It would be wrong, though, to think that our Figure 2 menu that related obtainable price and unemployment behaviour would maintain its same shape in the longer run. What we do in a policy way during the next few years might cause it to shift in a definite way. "

As Samuelson and Solow had argued eight years earlier, he thinks that in the long run, workers and employers will take inflation into account, resulting in employment contracts that increase pay at rates near anticipated inflation. Unemployment would then begin to rise back to its previous level, but now with higher inflation rates. This result implies that over the longer-run there is no trade-off between inflation and unemployment. This implication is significant for practical reasons because it implies that central banks should not set employment targets above the natural rate.

Researches that is more recent have shown that there is a moderate trade-off between low-levels of inflation and unemployment. Work by George Akerlof, William Dickens, and George Perry, implies that if inflation is reduced from two to zero percent, unemployment will be permanently increased by 1.5 %. This is because workers generally have a higher tolerance for real wage cuts than nominal ones. For example, a worker will

more likely accept a wage increase of two percent when inflation is three percent, than a wage cut of one percent when the inflation rate is zero.

Most economists no longer use the Phillips curve in its original form because it was shown to be too simplistic. This can be seen in a cursory analysis of US inflation and unemployment data from 1953-92. There is no single curve that will fit the data, but there are three rough aggregations, 1955–71, 1974–84, and 1985–92, each of which shows a general, downwards slope, but at three very different levels with the shifts occurring abruptly. The data for 1953-54 and 1972-73 do not group easily, and a more formal analysis posits up to five groups/curves over the period. Still today, modified forms of the Phillips Curve that consider inflationary expectations remain influential. The theory goes under several names, with some variation in its details, but all modern versions distinguish between short-run and long run effects on unemployment.

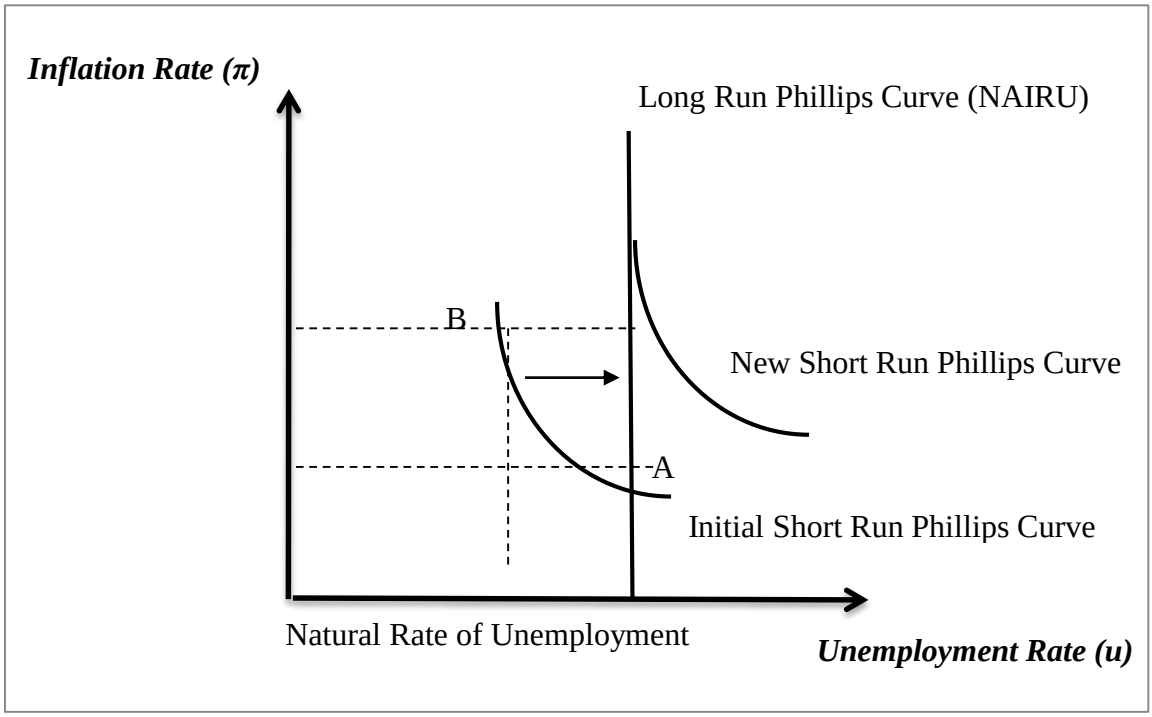


Figure 34

The "*short-run Phillips curve*" is also called the "*expectations-augmented Phillips curve*", since it shifts up when inflationary expectations rise, Edmund Phelps and Milton Friedman argued. In the long run, this implies that monetary policy cannot affect unemployment, which adjusts back to its "natural rate", also called the "*NAIRU*" or "*long run Phillips curve*". However, this long run "neutrality" of monetary policy does allow for short run fluctuations and the ability of the monetary authority to temporarily decrease unemployment by increasing permanent inflation, and vice versa. Blanchard gives a textbook presentation (2000) of the expectations-augmented Phillips curve.

4.3 Growth Models

In previous paragraphs, we described and discussed the labour market models that focus on a specific and determined time horizon, usually the short period. However in more recent times, characterized by globalization, financialization and, inevitably, by uncertainty and risk, it has become a strong need to look at a longer time horizon. For this reason many economists have questioned how would move the variables involved in the market in the medium and long run period. In particular, together with variables such as capital, labour, employment and production it has been introduced the increasingly important concept of productivity. Over the centuries, many economists and scholars have questioned the issue of productivity and have built models that differed in the variables involved and the weight assigned to these assets. The theme of productivity is central in our research. For this reason, through the various models built by economists over time, we have been able to formulate our modelling to understand how the labour market and the productivity move and, thus, obtain the responses and the implications as more as possible close to the reality. Let us first see which these contributions are, and then we will describe our modelling in the next chapter.

If the laws of economics and finance would respond to a formula always equal to itself or even in a series of formulas wealth would be a simple task to do at home after dinner. If there would be sibyls of risk, we would not have bankrupts nor crisis, like the one from 2008 affecting international markets. The fact is that there is no key formulas, does not mean they cannot exist models for the analysis and understanding of economic and financial dynamics.

For the study of productivity and the analysis of its dynamics within a country, we have to refer to models related to growth theory. Recent growth theories extend attention to the role of "intangible" contributions, such as human capital or "good governance". While connecting to the neoclassical paradigm, they shift the emphasis from exogenous to endogenous components, specific to each economic system, with very interesting implications for Development Economics. The reasons why economic growth are beginning to fascinate scholars after great crisis that involved the world economy in the late '30s, is that the market was capable of himself to feed a continuous development. The focus for growth arises, then, from the Keynesian theory, that was the first demonstration of the possibility that an economic system can evolve at a lower rate than necessary to ensure full employment of resources.

In recent years, the themes of growth and economic development have been the subject of a renewed interest on the part of the economic literature, including in relation to new and important phenomenon of globalization and financialization of the world economy. This interest stems from a dual need: the examination and verification of so-called “stylized facts ", the main trends of the world economy long-term, and the search for an adequate theory to them, which allows explaining the reasons and processes. Indeed, research has produced many empirical studies for comparison and measurement of results (indicators) pursued in the long run by the different countries and, secondly, numerous endogenous growth models for the interpretation and the explanation of the dynamics of economic growth.

An important aspect to be taken into account is that each country has grown with different times and different rates. Although many argue that there is convergence to the same levels of income per capita, some gaps between advanced countries and developing countries have not been reduced either in absolute or relative terms.

The income level of the departure of each country, as well as the material factors (resources) and intangible assets (culture, institutions, religion), that characterize it, then play a fundamental role and it mean that not all of the theories can be applied indifferently at advanced or depressed reality.

The last fifty years have shown how the conditions of economic progress are influenced by the degree of development of the country. In the economic literature, it has established the difference between growth and development:

- *Growth* as a synonym for improvement of the welfare conditions in economic realities that have solved the institutional and social problems.

- *Development* as an evolutionary process affecting the realities, where remain unresolved issues relating to the governance, social arrangements, economic organization etc.

The problem, then, is to use the potential of the new growth theory or growth theory to fit the needs of the development. The family of models born within the growth theory will introduce, in fact, adjustments to be able to grasp the specificity of development processes, and the consequent prevalence of extra-economic components. The growth theory has contributed significantly in laying a greater emphasis on the importance, in the context of the economic development process, training, dissemination and accumulation of knowledge, technological innovation and "human capital". Finally, we should not overlook the fact that the latest generation of technical progress (Information and Communication Technology, ICT) supplies a globalization economy, which introduces deep changes in the development process.

4.3.1 Exogenous Growth Models

The exogenous growth theory, unlike the endogenous one, attributes the economic growth in the long run to technical progress and it thinks that does not depend on other economic variables, it is for that reason that it is called exogenous.

In 1963 the Hungarian economist Nicholas Kaldor, the leading proponent of this line of thought, listed some of those, which appear to seem to be, with sufficiently widespread, the general empirical regularities of the growth process:

- The growth rate of the per capita income level tends to remain constant and do not manifest significant trends to the secular decline.

- The level of capital per capita tends to grow over time: the growth rates of capital and the product tend to be roughly equal.

- The actual rates of return on capital seem to be sufficiently stable and almost constant in the long run.

- The relationship between physical capital and product tends to remain constant.

- The shares of the two main factors of production, capital and labour, on national income also appear to be very stable.

- The rates of growth of per capita product seem to show significant and stable differences across economies.

- These regularities were the subject of extensive historical research and empirical literature and seem largely still valid today.

The exogenous growth theory is consistent with the first five empirical regularities but not with the sixth. The main exogenous growth theory models are: the Solow-Swan model, the Ramsey Model and the Model of Cass-Koopmans, although there have been many other economists, who have taken up this theme over the years, such as those presented below.

4.3.2 The Neoclassical point of view: Solow Model

Robert Merton Solow (New York, 1924), an American economist, is best known for his economic growth model, that takes his name and which later became the paradigm of the neoclassical growth model, also called exogenous growth model. He thinks that the aggregate output depends in the short period on the aggregate demand (capital, labour and technology are given), while in the long run it depends on capital, labour and technology and his analysis focuses not on the fluctuations, but on growth, that is the increase in aggregate output over time.

The model separates the determinants of output growth in input positive changes, of labour and capital. The increase in income that is not explained by the increase of the two inputs is attributed to technological progress. In the context of this theory, technological progress is also called *Solow residual*.

The *Solow* model, or Solow-Swan model, is a neoclassical growth model. Solow argued in his important work *"A contribution to the Theory of Economic Growth"* (Quarterly Journal of Economics, 1956), where he show how the savings (which determines the accumulation of capital), the population growth (which affects the labour force) and technological improvements are the factors that influence the growth of an economic system. Solow received the 1987 Nobel Prize in Economics for his work on the model and his work is considered the most important contribution to the Neoclassical Growth Theory, trying to overcome the problem of instability of the equilibrium model developed by *Harrod-Domar*.

The model, in fact, studies the dynamics of the economic growth of a country in the long run and it was born as an extension of the model of Harrod-Domar, with the

addition of a fundamental term: productivity growth. In particular, he developed what is now the dominant approach to the measurement of productivity growth. He says, in particular, that productivity growth should be uncorrelated with any variable that is a driving force for output. For example, in the face of an exogenous upward shift in the demand for a particular firm's output, the productivity of those firms should remain unchanged; or, if the price of one of the factors used by the firm rises sharply, productivity should also remain unchanged.

Solow places some general conditions: constant returns to scale, closed economy and lack of government, and he thinks that technological progress induces simultaneous increase of the value of the three variables, production (*Y*), labour (*L*) and capital (*K*). So technological progress allows the improvement of production efficiency, but is considered an exogenous variable. Solow growth model, in fact, describes how capital accumulation, growth demographic and technological progress affect the level of aggregate output of an economy and its growth over time.

For Harrod-Domar, in the long run, population growth and technical progress represent an insurmountable barrier to economic growth. If the population, and hence the supply of labour, does not develop at an appropriate rhythm, the growth rate of the capital stock cannot be maintained: new machines require to be used, new workers are employed and they will be available only if it increases the population. Solow extended the Harrod-Domar model by:

- Adding labour as a production factor.
- Requiring diminishing returns to labour and capital separately, and constant returns to scale for both factors combined.
- Introducing a time-varying technology variable distinct from capital and labour.
- So the short-run implications of the model are:
- Policy measures, like tax cuts or investment subsidies, can affect the steady state level of output but not the long run growth rate.
- Growth is affected only in the short-run, as the economy converges to the new steady state output level.
- The rate of growth as the economy converges to the steady state is determined by the rate of capital accumulation.
- Capital accumulation is in turn determined by the savings rate (the proportion of output used to create more capital, rather than being consumed) and the rate of capital depreciation.

In the long run instead the rate of growth is exogenously determined, in other words, it is determined outside of the model. A common prediction of neoclassical models

is that an economy will always converge towards a steady state rate of growth, which depends only on the rate of technological progress and the rate of labour force growth. Within the Solow growth model, the Solow Residual or Total Factor Productivity is a measure of technological progress. The model can be reformulated in slightly different ways using different productivity assumptions, or different measurement metrics:

- *Average Labour Productivity (ALP)* is the economic output per labour hour.

- *Multifactor productivity (MFP)* is the output divided by a weighted average of capital and labour inputs. The weights used are usually based on the aggregate input shares. This ratio is often quoted as 33% return to capital and 66% return to labour (in Western nations).

In a growing economy, capital is accumulated faster than people born, so the denominator in the growth function under the MFP calculation is growing faster than in the ALP calculation. Hence, MFP growth is usually lower than ALP growth. Technically, the "Solow residual", not the ALP, measures MFP.

Let us see a simple scheme of the model of the American economist. Solow assumes an aggregate production function with two factors, labour *(N)* and capital *(K)*, at constant and decreasing returns to scale marginal productivity of individual factors; it is a Cobb-Douglas such as:

$$Y = A \cdot K^{\alpha} \cdot L^{1-\alpha} \tag{38}$$

where *A* is the technical progress or Solow Residual and it is a multiplicative value that can change over time. The savings *(S)* are considered a constant fraction *(s)* of income:

$$S = sY \tag{39}$$

where *s* is precisely the propensity to save. It is assumed a geometric depreciation law for the capital, the law ensures that depreciation in each period are always a constant fraction of the capital stock *(δ)*, regardless of the time structure of the investments that have produced it. The law of capital accumulation is given by:

$$\overline{K} = I - \delta K \tag{40}$$

Where $\overline{K} = \frac{dK}{dt}$ is the variation of the capital stock over time.

The conclusion that the economist reaches is that only the technology growth rate, or efficiency per worker, can influence the growth rate of the economy. All other parameters have no effect on the growth rate of steady state. Moreover, if the propensity to save (*s)* increases, consumption decreases and the economy is not growing.

In his article, Solow examines data relating to the US for the 1909-1949 period and attributes the average production growth of 2.9% in this measure to several factors: 0.32% is the contribution of capital, 1.09% is the contribution of labour and 1.81% is due

to technological progress. So with the use of his model, Solow calculated that about four-fifths in the marginal growth per unit of labour in the US was attributable to the technology, cause of it was not attributable either to capital growth or the labour force growth.

Many empirical studies have tried to establish the extent to which the Solow model can help to explain the long-term economic growth, revealing that may explain many phenomena, which occur in the analysis of empirical data, such as the balanced growth and the convergence. The growth steady state (balanced), in fact, depends on technological progress and then on improving production efficiency. However, technological progress is an exogenous variable, not explained by the model: Solow argues that the growth depends on technological progress, but does not explain how it would be possible to increase this important variable.

4.3.3 A vision to the UK productivity: Pessoa and Van Reenen

Another contribution to our modelling is the paper of Pessoa and Van Reenen. The economists analyse the UK productivity dynamic. The availability of good-quality data on capital per worker has historically been limited in the UK, so researchers have often compiled their own series, leading to the different views on the changing role of the capital in the economy.

For their investigations on productivity trend, Pessoa and Van Reenen in 2014 constructed an estimate of capital stocks using the perpetual inventory method, estimating that capital per worker declined by 5% between the second quarter of 2008 and the second quarter of 2012. In their article, the two economists find out one explanation that can potentially account for both the twin puzzles of low productivity and low unemployment that they have reordered for the UK economy. This explanation emphasises wage flexibility. They think that real wages are much more responsive to negative output shocks in the last few years than they have been in previous recessions. The weaker union power and welfare reforms keep effective labour supply high even when demand is low. This flexibility mean that unlike earlier recessions, real wages fell significantly and employers faced lower labour costs than in earlier downturns. As real wages fall, there is likely to be downward pressure on the capital–labour ratio (‘capital shallowing’), as people are substituted for structures and equipment.

A second force increasing capital shallowing is the fact that the post-2008 recession stemmed from a global financial crisis that increased the effective cost of capital, especially for small and medium-sized enterprises. Banks have been reluctant to lend as they repair their balance sheets. Falling capital–labour ratios in response to changing factor prices mean that labour productivity will fall, but not necessarily total factor productivity (TFP). Given that TFP determines long run economic growth, their view is that this more important measure of productivity has been more resilient than usually thought. They consider a representative firm facing competitive market conditions with a constant returns production function of the form:

$$Q = A \cdot L^{\alpha} \cdot K^{1-\alpha} \tag{41}$$

where Q is output, L is labour, K is capital and A is TFP. From the first-order conditions, labour productivity is related to the real product wage, i.e. nominal wages *(W)*, deflated by the output price deflator *(P)*:

$$\frac{Q}{L} = \frac{1}{\alpha} \cdot \frac{W}{P} \tag{42}$$

This gives a conventional downward sloping labour demand curve as illustrated in Figure 38. For simplicity, they consider an inelastic supply curve, which generates an equilibrium wage with full employment $L = L^*$, where L^* is the labour force. Then they consider a recession, which is a negative output shock (Q to Q') shifting the labour demand curve to the left. In a 'normal' recession, real wages are downwardly rigid, hence employment will fall and unemployment will emerge ($L^* - L'$). Notice that () still holds as even though output and employment are lower, their ratio remains the same (Q'/L'). Because real wages are unchanged, labour productivity is also unchanged.

The polar opposite case of a neo-classical labour market where real wages are completely flexible is illustrated in Figure 39. In this case, real wages fall to ensure full employment but now labour productivity has fallen:

$$\frac{Q'}{L} = \left(\frac{1}{\alpha}\right) \cdot \left(\frac{W}{P}\right)' < \frac{Q}{L} \tag{43}$$

The greater flexibility of real wages has protected jobs but measured productivity is lower. One way the adjustment takes place is through changes in the capital–labour ratio. Combining the first-order conditions for labour and capital, we obtain:

$$\frac{K}{L} = \left(\frac{1-\alpha}{\alpha}\right) \cdot \left(\frac{W}{R}\right) \tag{44}$$

where R is the cost of capital. Assuming that the cost of capital is unchanged, the fall in W means an offsetting fall in K. This fall in the capital– labour ratio will depress labour productivity, the output-to-labour ratio. Another way to see this is to re-write the production function in logarithmic changes and solve for TFP growth:

$$\Delta lnA = \Delta \ln\left(\frac{Q}{L}\right) - (1-\alpha) \cdot \left(\frac{K}{L}\right) \tag{45}$$

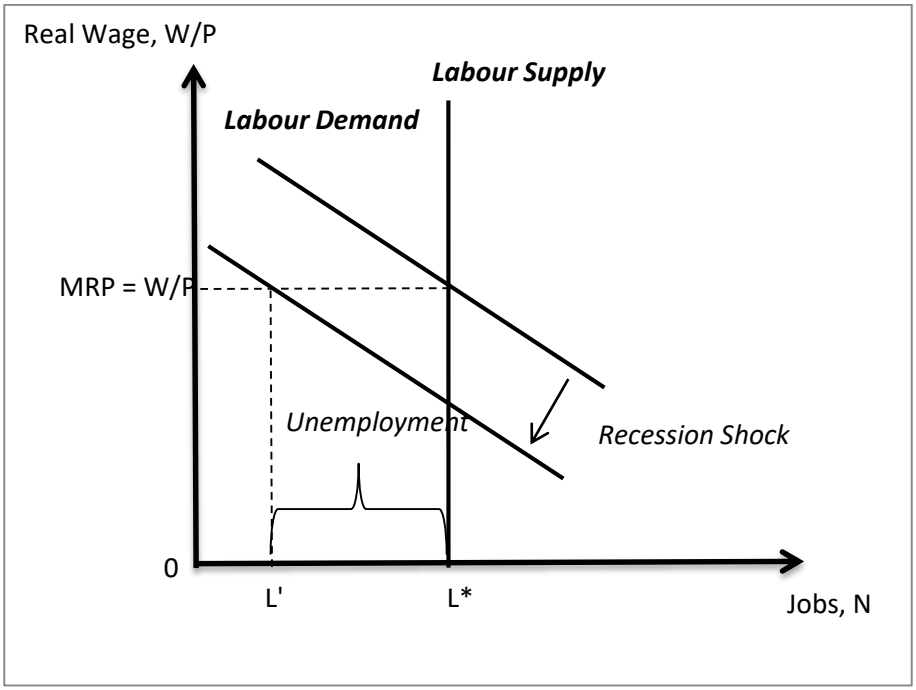


Figure 35

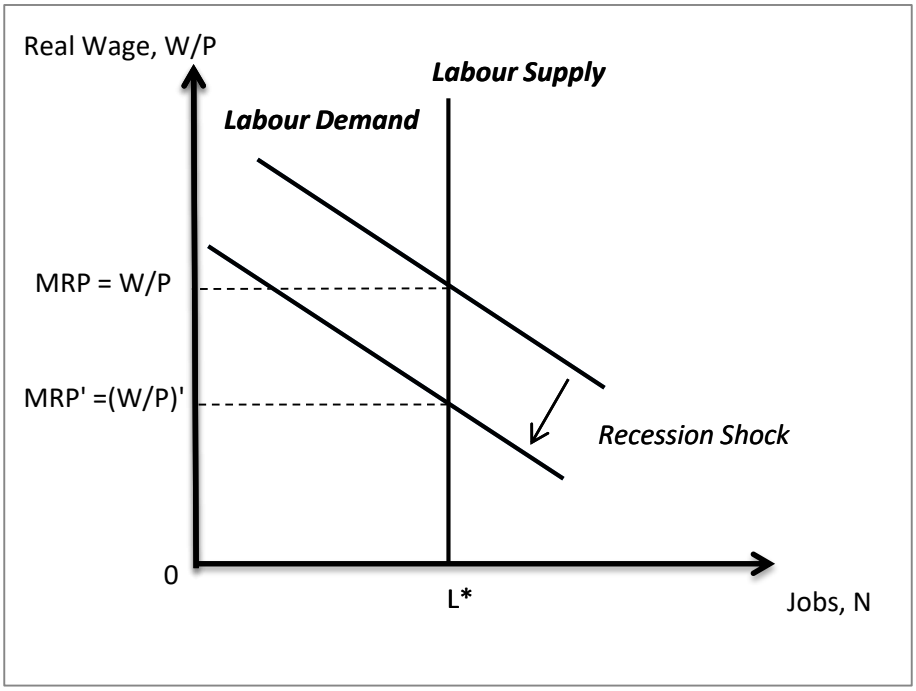


Figure 36

Total factor productivity growth is the difference between labour productivity growth and the change in the (weighted) capital–labour ratio. A pure demand shock causes a fall in $\Delta\ln(\frac{Q}{L})$ and $\Delta\ln(\frac{k}{L})$ but leaves TFP unchanged. This is obviously an extreme model as real wages are not really fully flexible and will not fall by as much as suggested in Figure 38. Nevertheless, if the most recent recession is closer to Figure 39 and previous recessions were closer to Figure 37, then this may explain why employment has fallen by

less in this recession than in previous recessions but labour productivity has fallen by more.

For the two economists in addition to falls in real wages, other factors may have depressed the capital–labour ratio. Even though this may be a temporary effect, according to Bank of England (2012), the cost of capital for large firms has risen by about a quarter from 8% in the pre-crisis period to 10% in 2012. The cause of this is that banks have been re-building their balance sheets and so are very reluctant to lend. Low demand expectations, a higher cost of capital and perhaps the halving of public investment have held business investment back. However, another factor is that uncertainty has also risen. This always tends to increase in recessions but the increase in uncertainty in this recession may have been particularly severe due to the size of the demand shock. Another explanation for the puzzle is mis-measurement. The denominator of labour productivity is simply employment or hours and measurement error is not a major concern. A more serious concern is that GDP may be understated. The GDP number is subject to very large revisions but Grice (2012) shows that the magnitude of these revisions is not usually large enough to explain away the puzzle and future revisions may lower the GDP number rather than raise them. Moreover, they think that allocating too much capital to inefficient firms, that they call "zombies" will diminish aggregate productivity. Finally, they consider a cause of the fall in labour productivity the fact that the quality of the workforce could have deteriorated: for example, older workers may be delaying retirement because of the fall in house prices. In fact, average labour quality of the employed tends to rise during recessions, as unskilled and less experienced workers are more likely to be unemployed. The current recession is similar in this regard.

Their analysis suggest that UK economy was not fundamentally the victim of a large and permanent supply side shock, but rather a very severe demand side shock, exacerbated by the ongoing problems of the financial system. However, these demand problems are amenable to conventional solutions of fiscal and monetary stimulus as they imply a substantial output gap. The message of this article is not that structural policies are unnecessary. For example, strategies to improve the functioning of credit markets are vital. Longer run policies to improve investment in human capital, infrastructure and innovation are also extremely important for long run economic health. The work of the LSE Growth Commission (Aghion et al. 2013) proposes politically robust institutions and policies to tackle these supply side problems.

4.3.4 A focus to Unemployment: Layard, Nickell and Jackmann

Not only productivity and TFP are variables involved in our modelling, but also the variables of the labour market, such as unemployment. In 1991 Layard, Nickell and Jackmann published the book "Unemployment: Macroeconomic Performance and the Labour Market". Explaining what has happened to employment levels in the industrialized countries in the 1970s and 1980s, the authors discuss why unemployment is so high and why it has fluctuated so wildly, how unemployment affects inflation, and whether full employment can ever be combined with price stability. For each issue they

develop a relevant theory, followed by extensive empirical analysis, drawing on material from both Europe and America.

They aim to provide a basis for better policy: showing how the lessons learned from experience and theory can be applied to greatly reduce the waste and misery of high unemployment. The book surveys in a clear, concise manner the main aspects of the unemployment problem. It integrates macroeconomics with a detailed microanalysis of the labour market. The authors use a particular model to explain the puzzling post-war history of OECD unemployment and shows how unemployment and inflation are affected by systems of wage bargaining and unemployment insurance. For each issue the authors' develop a relevant theory, followed by extensive empirical analysis. The authors are established experts in the field, and this book gives their definitive treatment. They revised it in 2005 to include an analysis of unemployment changes since 1991.

They focus their attention in particular on unemployment. For them unemployment is the mechanism which ensures that the claims on the national output are compatible. They show that with an example. If a worker produce 100 units of output priced $1, wage-setters set his wage at $60, then the worker get 60 units of output, and profit-receivers get 40 units per worker. If this is what wage-setter and price-setter intended, we have an equilibrium. However, if wage-setters aim at 61 units (W/P=61) and price-setters aim to provide profits per worker equal to 41 units (W/P=59), there is an inconsistency. This leads to a wage-price spiral, as wage-setters try to recoup the losses imposed on them by price-setters, and vice versa. In the long -run, unemployment will have to be higher in order to reduce both sets of claims until they are equal with each other. Only in this way is the wage-price spiral eliminated.

The authors think that there is another equally important spiral, which unemployment eliminates. This is the so-called wage-wage spiral. If unemployment is too low, wage-setters will try to rise their relative wage. Only if the labour market is slack enough will this leapfrogging eliminated. In the equilibrium, unemployment must be high enough to induce each particular wage-bargain to equal the bargain expected to prevail elsewhere.

The authors try to illustrate their argument with the following stripped-down model, in which parameter symbols are written and considered as positive. They focus both on price setting and on wage setting. Prices (of value added) are set as a mark-up on expected wages. The mark-up tends to rise with the level of activity although this effect may not be very strong. Thus:

$$p - w^e = \beta_0 - \beta_1 u \qquad (46)$$

With $\beta_1 \geq 0$ and where:

p = log prices
w^e = log expected wage
U = unemployment rate

The equation show the price-setting intended by the authors. It can be thought of a “feasible” real wage, that real wage which, for given productivity, price-setters are willing

to concede. Turning to wage setting, wage are set as a mark-up on expected prices, with the mark-up tending to rise as the employment rate rise and unemployment falls. Hence:

$$w - p^e = \gamma_0 - \gamma_1 u \tag{47}$$

With $\gamma_1 > 0$. It is the "target" real wage, which wage setters intend, and it is graphed in the figure below.

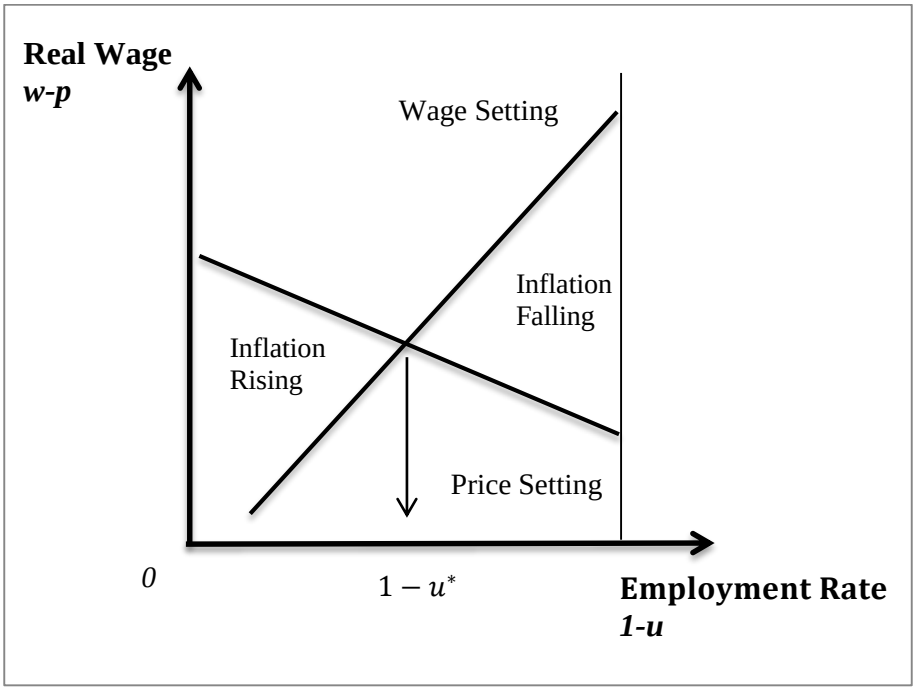


Figure 37

If actual wages and prices are at their "expect" values ($p = p^e,\ w = w^e$), the equilibrium unemployment rate is given by adding the first equation with the second one to obtain:

$$u^* = \frac{\beta_0 + \gamma_0}{\beta_1 + \gamma_1} \tag{48}$$

The wage-setting and price-setting lines are drawn for $p - p^e = w - w^e = 0$, and their intersection determines equilibrium unemployment and real wages. Any factor that exogenously raise wage push (γ_0) or price push (β_0) raises the equilibrium rate. Any factor that raises real wage flexibility (γ_1) or price flexibility (β_1) reduce the equilibrium rate.

A major theme of Layard, Nickell and Jackmann is that both shocks and institutions shape the evolution of the unemployment rate. The broad historical description they gave in 1991 blamed adverse shocks, in particular the two increases in the price of oil in the 1970s, for the initial increase in the natural rate of unemployment, and labour market institutions for the persistence of this high natural rate. These

institutions, they argued, had led to a large increase in the duration of unemployment in response to the adverse shocks; the near irrelevance of the long-term unemployed in wage setting implied little downward pressure on wages and on unemployment.

4.3.5 Blanchard: The medium Run

Olivier Blanchard is one of the most well-known and influential economists on the world academic landscape. Of French origin, he was the founder and, until recently, director of the research centre at the International Monetary Fund (IMF). According to his point of view, in the paper written in 1997, *"The Medium Run"*, macroeconomics is largely divided into two subfields. One focuses on the short run, on the study of business cycles. The other focuses on the long run, on growth and its determinants. The assumption implicit in this division is that the medium run is primarily a period of transition from business cycle fluctuations to growth. This simplification is clearly convenient, but it is ,misleading. Modern economies are characterized by medium run evolutions that are quite distinct from either business cycle fluctuations or steady-state growth.

He analysed, in particular, two facts. The first is that unemployment rates have steadily increased in continental Europe over the past twenty-five years, while remaining largely stable in "Anglo-Saxon" countries. The other one is less well known, but equally important: capital shares have steadily increased in continental Europe over the past fifteen years, and in many cases currently stand at post-war highs; in contrast, capital shares have remained largely stable in "Anglo-Saxon" countries.

With an eye on the evolution of capital shares, the first section of the paper documents the evolution of capital, employment, and wage and profit rates since 1970 in fourteen countries of the Organisation for Economic Co-operation and Development (OECD). He starts from the basic proposition that under Harrod neutral progress, there should be a close relation between the ratio of the profit rate to the wage rate and the ratio of labour (measured in efficiency units) to capital. He then shows that much of the increase in the ratio of the profit rate to the wage rate and by implication; much of the increase in capital shares in the Continental countries over the past fifteen years does not reflect corresponding movements in relative factor quantities. He suggest three potential explanations for this divergence. The first is that there are long lags in the adjustment of factor proportions to factor prices, and one is still seeing the dynamic effects of the earlier adverse labour supply shifts. The other two explanations start from the premise that the relation between factor prices and factor quantities has genuinely shifted. The second explanation attributes the shift to changes in the distribution of rents from workers to firms. The third attributes it to technological change biased against labour.

To explore the logic and the role of these potential explanations, the second section develops a simple model of employment and capital accumulation. Firms are assumed monopolistically competitive. There are costs to adjusting capital, as well as to adjusting the ratio of labour to capital. Labour supply is upward sloping: the wage is a decreasing function of the unemployment rate. The interest rate is given and independent of capital demand. That model makes clear how an adverse labour supply shift leads first to a decrease and then to an increase-above its initial level if the elasticity of substitution

between labour and capital is greater than one in the capital share, and to a steady increase in the unemployment rate. It also shows how adverse shifts in labour demand, whether caused by a shift in the distribution of rents or by technological bias against labour, lead to increases in both unemployment and the capital share.

The third section explores how well the model can explain the evolution of a particular country, he focus on the evolution of France since 1970. He construct series for shifts in labour supply, labour demand, and the user cost. Taking those shifts as primitives, he simulate the model. The simulations show how the shifts can explain the evolution of the ratio of labour to capital, the capital share, and unemployment. In the fourth section, he looks for evidence of lags in the response of the ratio of labour to capital to real wages. In the fifth section, he tries to determine whether the shifts in labour demand reflect biased technological progress or changes in the distribution of rents. The empirical strategy is simple. Shifts in the distribution of rents should not affect the production function; bias in technological change should be reflected in shifts in the production function. However, estimating production functions is tricky, and the empirical evidence speaks only weakly. Point estimates suggest technological bias, but they are not tight.

He conclude with a discussion of open issues, including the sources of the shifts in labour supply and demand, the sources of differences be-tween the experiences of Continental and "Anglo-Saxon" countries, and the relation if any of the shifts discussed here to shifts in relative labour demand between skilled and unskilled workers.

The basic structure of the model is a set of demand and supply equations for labour and for capital. The two demand relations are derived from costs of changing capital and costs of changing factor proportions. Capital accumulation depends on current and expected future marginal profits; adjustment in factor proportions, on the relation between current and expected marginal revenue products and wages.

On the supply side, the wage is an increasing function of employment, while the interest rate is assumed independent of capital accumulation. The specific assumptions are as follows. The economy is composed of monopolistically competitive firms. The reason for introducing monopolistic competition is to be able to trace the effects of mark-up changes, taking these as a stand-in for shifts in the distribution of rents in the economy. Each firm uses one unit of capital, which it combines with variable amounts of labour to produce output. The production function of a firm is given by:

$$y = f(n, 1) \tag{49}$$

The capital stock is, thus, equal to the number of firms in the economy, and changes in the capital stock correspond to the entry and exit decisions of firms. A continuing firm makes only one decision at any point in time: how much labour to employ. Note that *n* is both employment in a given firm and the ratio of labour to capital for the economy as a whole. As noted, each firm is monopolistically competitive in the goods market. The demand for its good is given, in inverse form, by:

$$p = \left(\frac{y}{\bar{y}}\right)^{-\gamma}; 0 \leq y < 1 \tag{50}$$

where p is the price charged by the firm relative to the price level, $\overline{y}$ is average output, and γ is the inverse of the elasticity of demand. It follows from this constant elasticity specification that the mark-up of price over marginal cost charged by a firm will be equal to:

$$\mu = \frac{1}{1-\gamma} \tag{51}$$

Each firm faces costs of adjusting its ratio of labour to capital; equivalently, its employment level. Rather than explicitly allowing for a putty clay structure of technology, he assumes that each firm faces costs of adjusting factor proportions. Specifically, I assume the cost of adjusting n to be given by:

$$\left(\frac{c}{2}\right) * \left(\frac{dn}{dt}\right)^2 \tag{52}$$

where c is a parameter. Each firm faces a constant probability of death δ, a real interest rate r, and a real wage (in terms of the price level) w. Under these assumptions, at any point in time, the firm chooses employment to maximize its value, given (for time 0) by:

$$v = \int_0^x e^{-\int_0^t (r_{s+\delta}) * ds} \cdot \left[\pi_t - \left(\frac{c}{2}\right) * \left(\frac{dn}{dt}\right)^2\right] \cdot dt \tag{53}$$

Where:

$$\pi = p \cdot y - w \cdot n \tag{54}$$

The first order conditions and the symmetry condition that all firms must charge the same price, so that $p = 1$, are then given by:

$$\frac{dn}{dt} = \left(\frac{1}{c}\right) q \tag{55}$$

$$\frac{dq}{dt} = (r+\delta) \cdot q - \pi_n \tag{56}$$

$$\pi_n = \left(\frac{1}{\mu}\right) \cdot f_n(n, 1) - w \tag{57}$$

Firms adjust the ratio of labour to capital in response to the present value of marginal profit, denoted by q. Marginal profit is equal to the marginal revenue product of labour (which is itself equal to the marginal product multiplied by the inverse of the mark-up) minus the wage. In the long run, the marginal product of labour must be equal to the real

wage times the mark-up (equivalently, the marginal revenue product of labour must be equal to the real wage). Denoting steady-state values by a star,

$$f_n(n^*, 1) = \mu \cdot w^* \tag{58}$$

We can note that from the point of view of determining employment, higher mark-up acts like a tax on the marginal product of labour (this is a tax collected by the firm, however, so that its effect on profit is quite different). A higher mark-up induces firms to choose a lower level of employment, and thus leads to a lower ratio of labour to capital. As mentioned, the evolution of the stock of capital comes from the entry and exit of firms. To capture the slow adjustment of capital, I assume costs of adjustment for capital: the relative price of capital is an increasing function of the net rate of entry (equivalently, the net change in the capital stock). Specifically,

$$p_k = 1 + h \cdot \frac{dK}{dt} \tag{59}$$

where *h* is a parameter and *K* denotes the capital stock. Free entry implies that the following condition must hold:

$$v = p_k \tag{60}$$

where *v* is the value of the firm, defined above. If firms could freely choose their initial factor proportions, the model would yield a distribution of factor proportions across firms, with the proportion depending on time of entry. To avoid such heterogeneity, he assumes that new firms enter with the same ratio of labour to capital as existing firms. This keeps the model tractable; but it also eliminates the entry and exit of firms as a candidate channel for change in aggregate factor proportions over time. The value of a new firm must be equal to the price of the machine needed to produce its goods. From the definition of *v* above, *v* is characterized by:

$$\frac{dv}{dt} = (r + \delta) \cdot v - \left[\pi - \left(\frac{c}{2}\right) * \left(\frac{dn}{dt}\right)^2\right] \tag{61}$$

Entry takes place (equivalently, the capital stock increases) when the value of an existing firm is greater than one. In steady state, $\frac{dv}{dt} = \frac{dn}{dt} = \frac{dK}{dt} = 0$, so that the previous equations imply that:

$$\pi^* = p_k^* \cdot (r + \delta) = (r + \delta) \tag{62}$$

Profit per unit of capital is equal to the user cost. This ends the description of the dynamic demands for capital and labour. The aggregate demand for labour is given by *N* = *nK*, the

ratio of labour to capital in each firm times the number of firms. The author specifies the supply of factors as follows. he assumes the real wage to be a constant elasticity function of the ratio of employment to the labour force, $N/\overline{N}$,

$$w = \theta \cdot \left(\frac{N}{\overline{N}}\right)^{\beta} \tag{63}$$

where β , is the elasticity of the wage with respect to employment and θ is a multiplicative constant. In addition, Blanchard assumes r to be exogenous. This is, no doubt, a strong assumption. It implies that the long run supply curve of capital is infinitely elastic and the profit rate always returns to the same value: $r + \delta$.

In his paper, Blanchard continues his analysis making some hypothesis of some changes of variables (i.e. mark-up, technology, user cost, etc.) and shifts in demand or supply of labour.

4.3.6 Productivity Differentials in Mature Economies: a Post-Keynesian point of view

The Italian economists Renato Paniccià, Paolo Piacenti and Stefano Prezioso, in a paper published in 2013 entitled "Total Factor Productivity or Technical Progress Function? Post-Keynesian Insights for the Empirical Analysis of Productivity Differentials in Mature Economies" make some strong assumptions about the interaction between supply-side and demand-side factors in understanding the differential growth record of countries or broader regional blocks.

In their paper, they develop a model that reflects an approach to interpreting differential productivity growth over the long run, and then they present empirical results for several countries. On the supply-side, the model considers the linkage between the intensity and efficacy of the accumulation process and the gains of productivity in terms of a Kaldorian Technical Progress Function. Then, drawing on the Evsey Domar's Keynesian notion of dynamic equilibrium as the growth rate that reconciles additions to capacity with the absorption of aggregate output by demand, they derive a locus for a 'Domar equilibrium path'. Imbalances, caused by excess aggregate supply or demand and by the effects of 'shocks', are presented and discussed using a simple graphical framework. In particular, Nicholas Kaldor's Technical Progress Function (TPF) is here adopted as the basic framework for the explication of the linkage between productivity growth and the intensity of the accumulation process. The heuristic potential of the Kaldorian TPF lies in its ability to encompass and enrich concepts and indexes derived from the standard neoclassical production function. A device of Kaldorian provenance thus captures the supply-side of an economy.

Therefore, they start the analysis with simple accounting identities, if we indicate with *Y* the aggregate income, *L* the level of employment and *K* the economy's capital stock we have:

$$Y = \frac{Y}{L} \cdot L$$

$$\frac{Y}{L} = \frac{Y}{K} \cdot \frac{K}{L} \tag{64}$$

If we consider the variation Δ:

$$\frac{\Delta Y}{\Delta L} = \frac{\Delta Y}{\Delta K} \cdot \frac{\Delta K}{\Delta L} \tag{65}$$

These last two expressions represent the possible decomposition for the levels and the variations of output per worker (*Y/L*) in terms of two components: the reciprocal of the value of capital/output ratio (*Y/K*) and the capital endowment per worker or capital per unit of labour (*K/L*). These are the basic inputs for the evaluation of the growth differentials of the countries.

Even if these expressions are trivial identities, they allow us to investigate many controversial issues that have arisen in the development of empirical research programs on aggregate growth performance. The reciprocal incremental capital output ratio (ICOR), in fact, is a fundamental parameter in the earlier Post-Keynesian formulations of aggregate growth, whose relative stability over time was one of the original stylized facts of growth identified by Kaldor. *Y/K* and its variations is what in many growth models is indicated with A, an important variables which indicates technological progress.

What it is new in the analysis of the three author is that they go on expressing the basic identity in logarithmic terms, so we have:

$$dlog(y) = dlog\left(\frac{y}{k}\right) + dlog(k) \tag{66}$$

This basic decomposition lies at the core of all growth accounting exercises, in which the excess of the growth rate of labour productivity over the rate of growth of capital per unit of labour appears as a ‘residual’ stimulus to growth, broadly due to technological progress. A graph of this relation in Cartesian space would represent a linear Kaldorian Technical Progress Function as in the figure below.

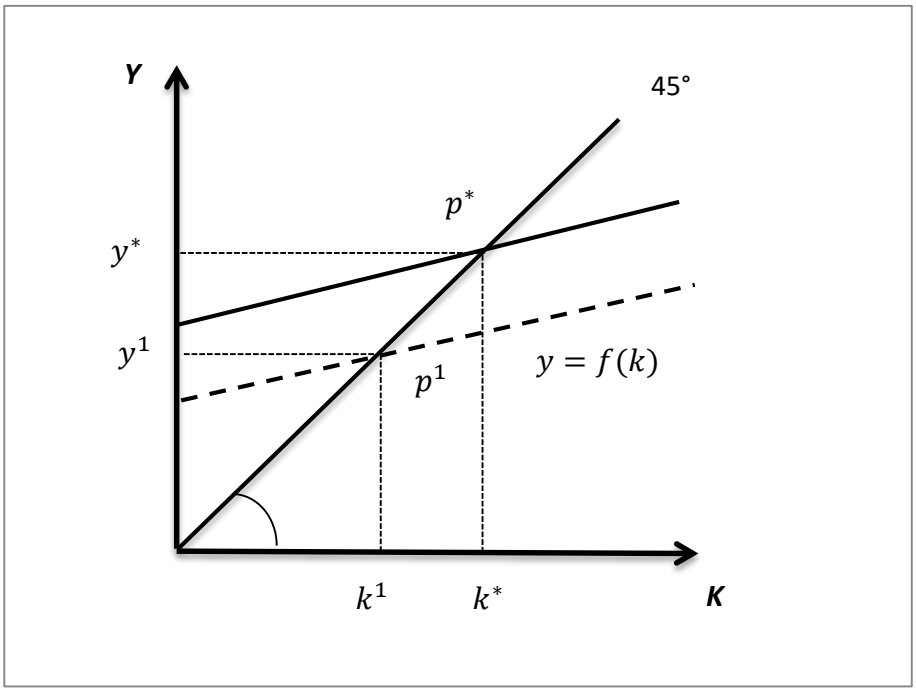


Figure 38

The 45° line identifies the conditions for balanced growth in which a constant output/capital ratio is maintained and labour productivity grows in strict proportion to the increments in the capital/labour ratio. Kaldor would at this point have introduced a decreasing non-linear TPF. The TPF would intersect the 45° line at a point such as p^*, which would define a long run, balanced growth equilibrium outcome for the economy. Along the 45° line, output and capital are growing at the same rate. The slope of the TFP, that is the labour productivity elasticity to capital accumulation process, depends on the economy's ability to incorporate technical progress in the new investments. An economy positioning itself over time rightwards or leftwards of the 45° degree line would show an accumulation path respectively less or more effective in its ability to absorb the flow of innovations that gradually become available; accordingly, increases of value-added per worker, given the rate of accumulation, will be lower or higher. This process, which may broadly be called the structural dynamics of an economic system (as in the analysis proposed by Pasinetti, 1981), is essentially determined by the interaction of two factors: technical progress, and the aggregate demand generated by the growth of per capita income. The changes induced in the economic system do not develop uniformly over time and across geographical regions. The flow of innovations available at a given point in time is in fact 'localized' (Atkinson & Stiglitz, 1969) in particular lines of production. As a result, the upward shift of TPF will involve only a portion of the whole function. The character and magnitude of possible spillovers will determine how broadly the economic system will be affected by the development of new products.

In general, if the economy is able to achieve a sectorial redistribution of employment from industries characterized by a declining demand toward sectors with expanding demand, the time pattern of the TPF shift will be similar, in the medium-long run, to the virtuous case depicted in Figure 40. Otherwise, the accumulation process will

allow the gradual reduction of unit labour requirements through the incremental improvements embodied in the new investments, but it will not provide a sharp stimulus to growth via the production of new products with high value-added and high elasticity of demand. In conclusion, the differential productivity and growth outcomes among countries, or within a particular country in the different phases of its development, can be seen as the result of a complex set of overlapping demand-side, supply-side and structural factors.

Over the longer-run, a further condition for the sustainability of steady rates of productivity growth and output growth period after period must be taken into consideration. They utilize a simple formalization, keeping the framework as simple as possible, and instrumentally adopting familiar formulae from the *AK* approach to describe the supply-side of the economy. Let us write for aggregate supply and aggregate demand at a given *K*:

$$Y^S = AK \tag{67}$$

$$Y^D = m(I + G + X_n) \tag{68}$$

where *m* is the standard aggregate expenditure multiplier, *I* is investment spending, *G* is government demand and X_n represents net exports. From the equilibrium condition between aggregate demand and aggregate supply, $Y^S = Y^D$, they derive the locus, *DS*, that describes the combinations of growth rate g and *A*, that allow the balance between aggregate supply and demand, as we can see in the figure below. The regions above (below) this line represent situations of excess supply, ES, (demand, ED) in the aggregate economy.

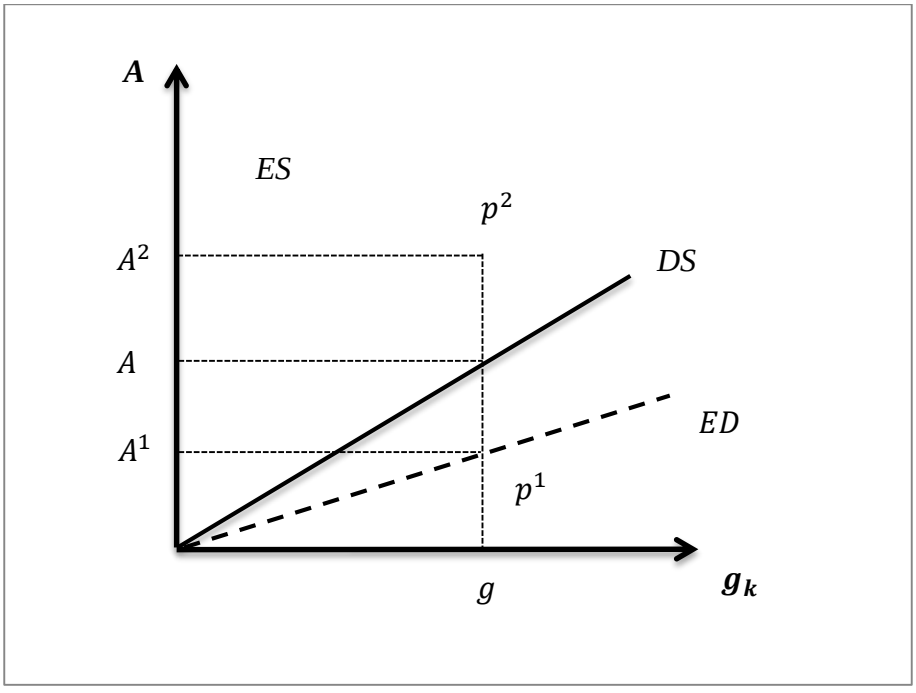


Figure 39

Consider the case, such as point p^1 in Figure 42, in which the value of *A* for the economy is too low given the rate of accumulation g_k. In this situation, the economy will be experiencing excess demand. With open trade, the shortage of domestic supply may in principle be covered through additional imports (this would reduce *m*, lowering the slope of the *DS* curve toward p^1, as depicted by the dotted line). However, without further structural or policy-induced variations in the basic parameters, the persistence of such a situation would imply a continuing imbalance and a persistent deficit of the current accounts. This might not be sustainable indefinitely, in particular for a smaller country with its own currency and no trade barriers.

The three Italian economists continue the last part of their paper with an econometric analysis of the Kaldorian relationship, using the so-called Error Correction Relationship (ECM), which aims at identifying the long run integration norm, and the short-run adjustment coefficients for the dependent variable. They conclude confirming the first hypothesis: supply-side and demand-side factors can interact to reinforce macroeconomic imbalances and render these imbalances more persistent over time.

Fifth Chapter

A Macroeconomic Model of Labour Market

5.1 Introduction to the Model

Whenever we experience a technological innovation, the issue of technological unemployment comes to the fore. In today's debate, there is agreement that there are a number of institutional factors affecting the real wage and, hence, the employment. For example, the unemployment benefits, the minimum wage and the legal protection of labour raise the labour costs for firms, for a given level of employment. Moreover, we know that the growth in activity and employment rates (experienced by European countries during the last fifteen years) is also the result of a more flexible and wage restraint policies. What then is the combined effect of technological and non-technological changes on the relationship between productivity, employment and growth in the long- run? The Solow growth model analysed in the previous chapter shows the central role of technological progress and how, when it slows down, decrease the growth in output and living standards. We have seen that there is no empirical evidence to support the hypothesis that technological progress creates unemployment and reduce the well-being over time. This is why economists and policy makers give such great importance to technical progress and productivity growth. On the other hand, we also know that the institutions of the labour market increase the bargaining power of workers and this in turn affects the real wage and employment.

In the construction of our model, therefore we put the attention on the relationship between technological progress and institutions in the labour market. As in any theoretical model of the labour market, the levels of productivity and employment are determined by the interaction between the demand and the supply curves of labour. We will study how these two curves are influenced by technological progress and by institutions. The model that we present starts from the assumption that the growth of labour productivity and of employment is due to exogenous changes of technological progress and institutions. In the short-run productivity and employment may deviate from their balanced growth path, cause of different shocks, generating fluctuations. After time, however, this initial deviation can have two different effects on the dynamics of the economy. In the long run, it can materialize a permanent change in the long period equilibrium with a transition that pushes the economy toward a new steady state. Alternatively, the initial deviation can only be transient, without permanent effects on the long-term, merely to feed the cyclical components of the productivity and employment.

The theory of economic growth with its major exponents and, in particular, among them, Nicholas Kaldor (1908-1986) will be the theoretical basis on which this project founded and the lever to argue and to build a possible growth model suitable to the current economic events and problems. We agree with the view of the Hungarian economist about the production process and the economic growth. Therefore, in line with the exogenous growth models and starting from the literature described and analysed in the fourth chapter, our intent in this research project is to build a theoretical exogenous growth model that would be coherent, especially, with the current economic cycle, characterized by a phase of post-crisis and mild economic recovery.

As already mentioned, it is crucial to emphasize that the construction of a model that describes the productivity and the economic growth must distinguish between what happens in the short term from what happens in the long run. The two dynamics, indeed,

involve different times, different variables and create different effects in terms of the economic cycle. The base to start is the modern neoclassical model of Blanchard with the definition of Price Setting (*PS*) and Wage Setting (*WS*). So let us start identifying which are in our model the two equation that determine in the short run the level of price and the level of wage, and which are the drivers of the labour market, the fundamental field in which are involved at the same time firms, workers and production process.

5.2 Assumptions

As we have already described in chapter four, until the first years of 1900, the prevalent labour market model was the neoclassical model. According to this model, under perfect competition and full mobility of labour conditions, there is no unemployment, or, rather, unemployment is only voluntary or frictional. The real wages will adjust to the point where the demand for labour equals the supply for labour, for that wage level all those who want to work find a job.

Since the 1980, instead, prevails the labour market model according to the vision of the New Keynesians. They consider two new elements. The first is the bargaining power of the workers. It implies that, when unemployment is low, the bargaining power increases; when unemployment decreases, the firm can raise wages in order to reduce the likelihood that workers will change job. The second element is the efficiency wages, which means that the employers may wish to pay a higher wage to reserve to increase the likelihood that the most productive workers remain in the firm. The model introduces also rigidities including institutional factors in labour protection (z), imperfections in the goods market and imperfect competition (mark-up μ), the exogenous technical progress (A). There are situations of balance of the market, even if there is involuntarily unemployment, so born the concept of natural unemployment.

Starting from the latter model and following the wage-setting and price-setting scheme, we will develop our model, introducing some new elements. Before proceeding to a more detailed analysis, we remember some key features of wage setting and price-setting scheme, representing the assumptions for our model. In the model, the firms set the prices of goods produced, the wages are determined through a bargaining process between firms and workers, the employees and the firms are not so much interested in the level of nominal wages but in the level of the real wage (W/P). Furthermore, because the price level is not generally known at the time the contract stipulation, then the nominal wage is fixed on the basis of the expected prices (P^e).

5.3 Price Setting

The aim of the firms in the production process is the profit and they pursue this aim through the price setting. The price level established by firms, inevitably depend on the costs sustained. The costs, in turn, depend on the nature of the production function (the relationship between the inputs and the output produced) and the prices of inputs. If

we use the simplifying assumption for which the only production factor is the labour, the production function is given by the following equation:

$$Y = AN \tag{69}$$

Where Y is the output, A is the labour productivity and N is the employment. If we consider a further simplification for which $A=1$, the production function become:

$$Y = N \tag{70}$$

In this way, the marginal product is constant and it is equal to one. The cost of producing a unit of output in more is equal to the cost of employing a worker at most, and so it is equal to his wage, W. If we were in a perfect competition condition, then we would have $P = W$. However firms have the market power and they may set a higher price than the cost of production, they may establish, i.e., a mark-up. Therefore, if we consider that μ is the mark-up of price over the cost, we have that:

$$P = (1 + \mu)W \tag{71}$$

The size of the mark-up μ depends on the degree of competition between firms. In particular, if the competition increases, the mark-up decreases and vice versa. In a condition of perfect competition between firms $\mu = 0$. Dividing both sides for the wage and reversing both sides of the equation, we obtain that:

$$\frac{W}{P} = \frac{1}{1 + \mu} \tag{72}$$

With this expression, we can more easily understand that the price decisions determine the real wage paid by firms to the workers and that an increase in the mark-up increases the prices and decreases the real wage. The real wage is an inverse function of the mark-up.

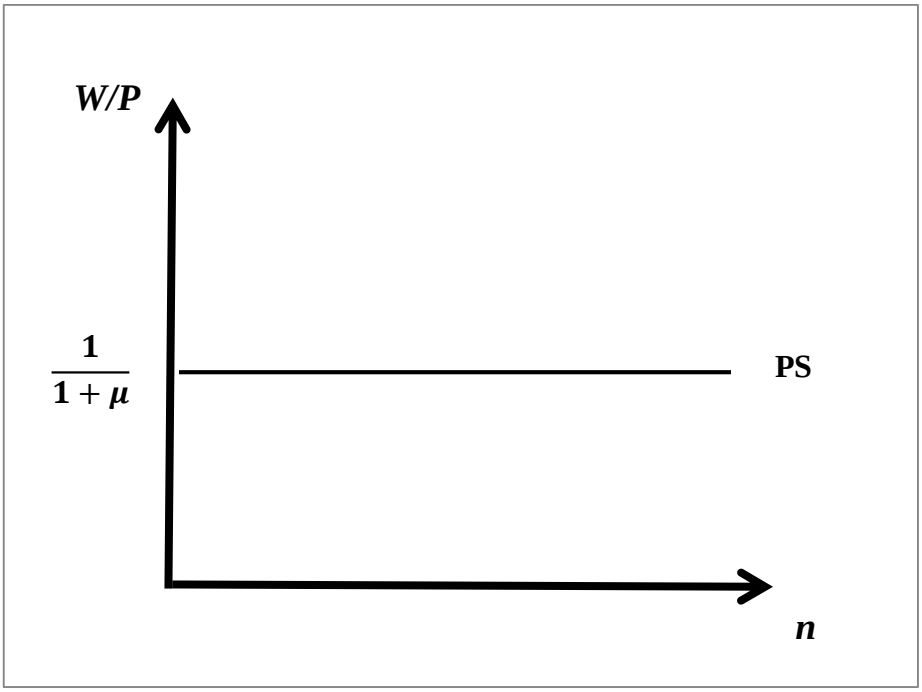


Figure 40. Modern Neoclassical Price Setting Curve

The graph above shows the Price Setting Curve (*PS*) as imagined by the modern neoclassical synthesis: the curve is parallel to the abscissa axis because, for the hypothesis made, the real wage (*W/P*) does not depend on the employment rate (*n*). On the ordinate axis we have the real wage that correspond to the level *1/(1+μ)*, as in the equation above. In the model that we build, the equation for Price Setting is written in this way:

$$p = w^e - a + m_0 + m_1 n \tag{73}$$

Where p is the price level, w^e is the expected nominal wage. Here we introduce some new elements: a is the level of technology, n is the employment rate and m are parameters that represent the mark-up of the price over the cost of production, in particular m_0 is the independent component and m_1 is the component that influences the employment rate. Therefore, we assume that the price level is positively correlated with the expected nominal wage (w^e) and the employment rate (*n*), while it is negatively correlated with the level of technology (*a*). We can rewrite the equation in this way:

$$w^e - p = (a - m_0) - m_1 n \tag{74}$$

We put in evidence the difference expected nominal wage – price, which is the real wage, so that it become our dependent variable. It is easily to see that it is positively correlated with technology (*a*) and it is negatively correlated with employment (*n*).
In equilibrium the expected nominal wage is given, so we can rewrite the difference $w^e - p$ as $w - p$. If we put the difference $w - p$ on the vertical axis and the employment n on the horizontal axis, we can represent the previous relation as follows:

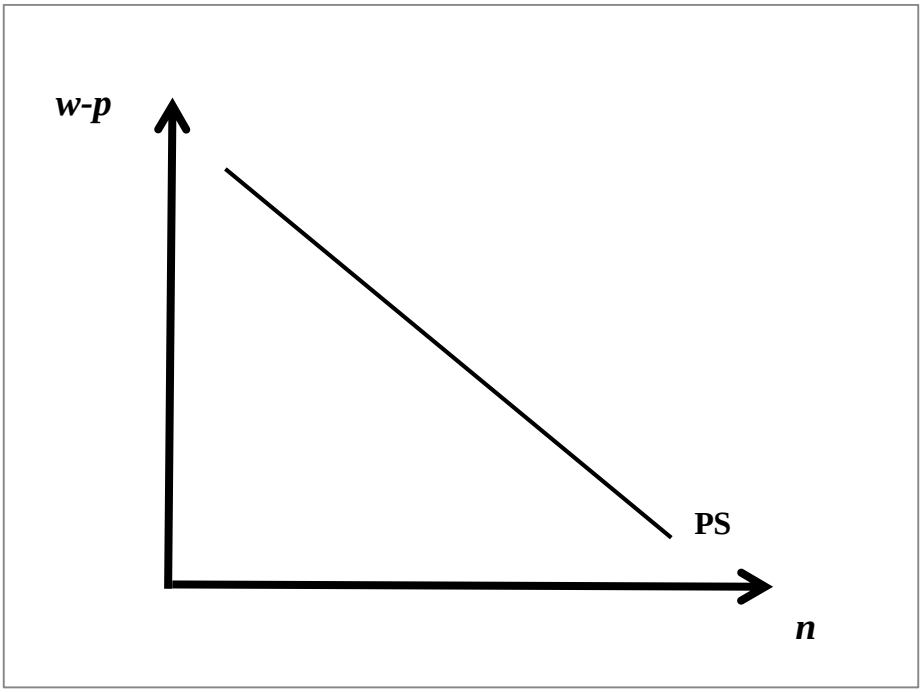


Figure 41. Price Setting Curve

In the graph above, we can see that the Price Setting Curve (*PS*) in our model is downward sloping, in relation to the employment rate (*n*), on the abscissa axis. The relation between the employment rate and the real wage ($w - p$) is confirmed, indeed, they are inversely proportional, if *n* raises, *w-p* decreases and vice versa.

5.4 Wage Setting

If prices are related to the decisions of the firms and the employers, we have to look now at the side of workers that are interested in their wage, in particular in their real wage. The workers, indeed, base their wage's demands on the purchasing power (or real wage, *W/P*). The employers base the salary on the value of the product obtained with that work. Therefore, inevitably, prices (*P*) and wages (*W*) are in relation to each other. Specifically, if prices raise, also wages increase. The bargaining power of a worker depends on several factors: how expensive it would be to replace the worker in the event of termination of the employment relationship, how difficult it would be for the worker to find another job, on the nature of work, on the skills requirements and on the labour market conditions. Moreover, high unemployment rates (u) reduce the bargaining power of workers and therefore the wages. Therefore, there is a reverse relation between wages and unemployment rates, while if we consider, as we do in our model, the employment rates (n), the relation is direct.

To sum up the aggregate nominal wage depends on three factors: the expected prices level (p^e), the unemployment rate (u) and a generic variable *z*, which represent all the other factors that influence the labour market, and so the wage, such as the regulation or the institutional factors on labour protection.
Therefore, the equation for wage is:

$$W = P^e F(u, z) \tag{75}$$

It is assumed that the expectations on prices are correct, so $P^e = P$. The equation can be rewrite in this way:

$$\frac{w}{P} = F(u, z) \tag{76}$$

For the consideration made before, the real wage depends negatively from the unemployment rate (u), while there is a positive correlation with the parameter z.

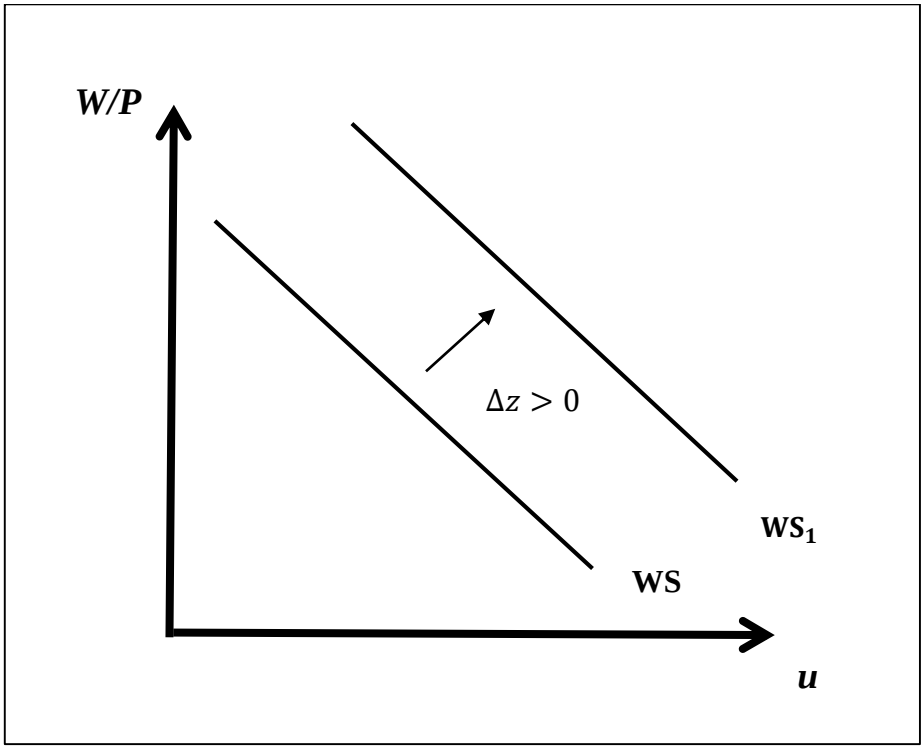


Figure 42. Modern Neoclassical Wage Setting Curve

The graph above shows the Wage Setting Curve (*WS*) assumed by the modern neoclassical synthesis. On the ordinate axis, there is the real wage (*W/P*) and on the abscissa axis, there is the unemployment rate (u). The curve is downward sloping in relation to the unemployment rate, indeed if u increases, *W/P* decreases and vice versa. Furthermore, an improvement of the institutional variables (z), from the point of view of workers, shifts upward the curve WS: so that the employees pursue a higher real wage for the same unemployment rate.

Starting from these considerations that come from the modern neoclassical synthesis of Blanchard, in the model that we built, we assume that the equation for Wage Setting is written in this way:

$$w = p^e + z_0 + z_1 n + \beta a \tag{77}$$

Unlike the previous model, here we consider the employment rate (*n*), which is influenced by the parameter z_1 and which is directly correlated with nominal wage. Furthermore, we introduce a new element, which is βa. β represents the parameter for the technology a , with $0 < \beta < 1$. We can rewrite the equation in this way:

$$w - p^e = z_0 + \beta a + z_1 n \tag{78}$$

Therefore, in this case the difference nominal wage – expected price become our dependent variable. It is directly correlated with the technology (*a*), with the employment rate (*n*) and with the autonomous component of the parameter *z* (z_0). As before, in equilibrium the expected nominal wage is given, so we can rewrite the difference $w^e - p$ as $w - p$. Using the graph with the same characteristics above, putting the real wage ($w - p$) on the vertical axis and the employment rate n on the horizontal axis, we can represent the relation as follows:

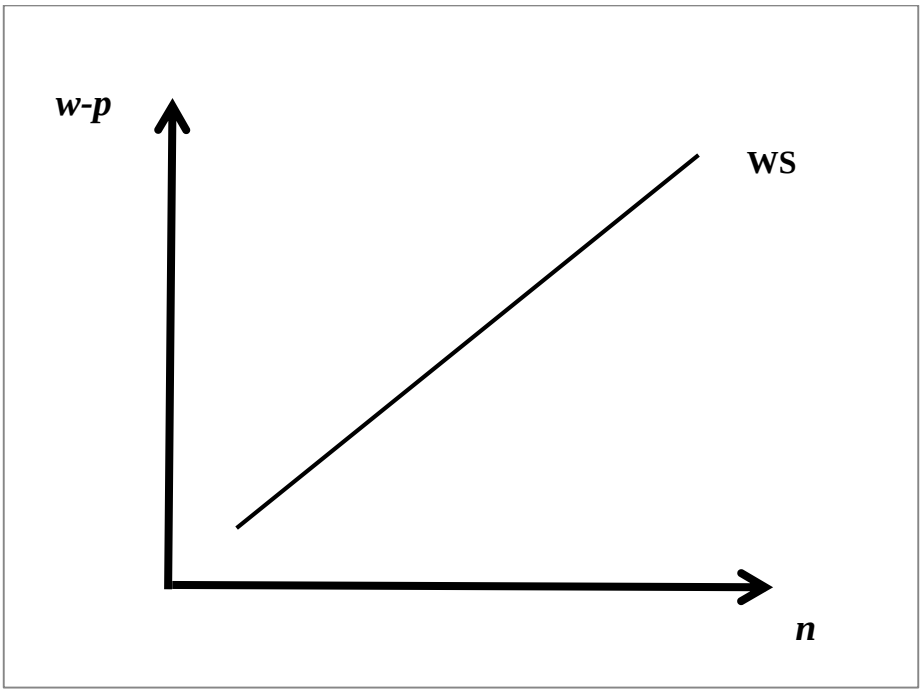


Figure 43. Wage Setting Curve

In the figure above, we can see the Wage Setting Curve (*WS*) that is upward sloping in relation to employment rate (*n*), on the abscissa axis. The relation between the employment rate and the real wage is confirmed; indeed, they are directly proportional, if *n* raises, *w-p* increases and vice versa.

5.5 The Equilibrium

We have examined the two curves that describe the determination of wages (*WS*) and the determination of prices (*PS*). We have illustrated the equations for the modern

neoclassical model and for our model, analysing the differences, even if the assumptions are the same. The workers pursue their goal of real wages through the collective bargaining. The firms pursue their goal of real wages through the price setting. The balance is achieved when the two aims of workers and firms become compatible.

In the modern neoclassical model the equilibrium in the labour market admits the unemployment that is when the real wage, determined with the equation of Price Setting, is set equal to the wage, determined with the equation of Wage Setting. The unemployment rate consistent with this equilibrium is called natural unemployment rate (u_n), which corresponds to the natural product (Y_n).

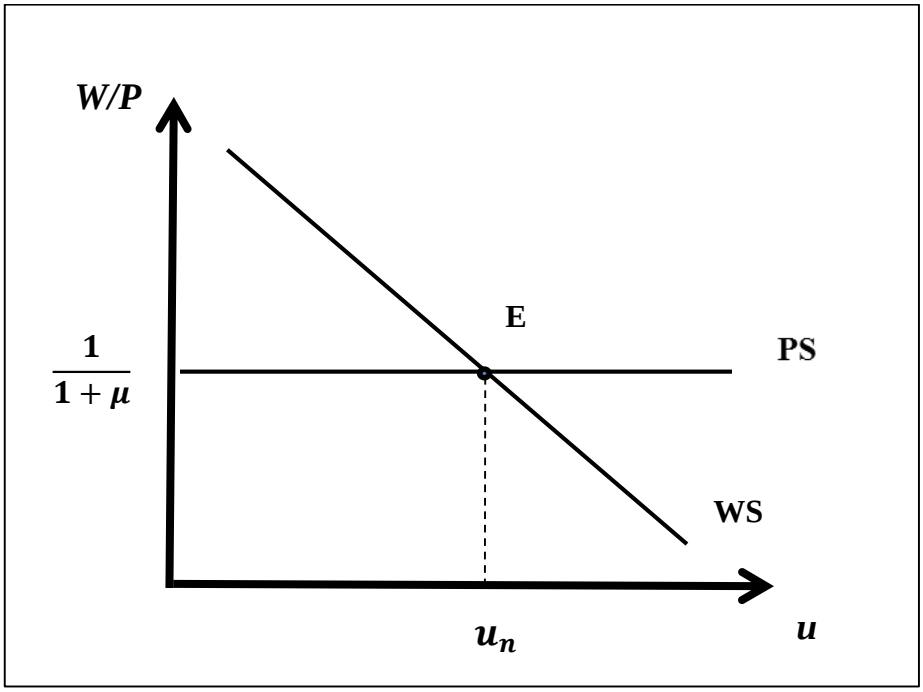


Figure 44. Modern Neoclassical Equilibrium

In point E the two curves of price setting and wage setting intersect, determining the equilibrium. In that point, however, there is unemployment at the level u_n, the natural unemployment. The natural rate of unemployment is the unemployment rate that is compatible with the real wages pursued by workers in the wage bargaining and at the same time with the real wage pursued by firms through price setting. The level of unemployment u_n is influenced by the degree of competition between firms and the institutional features of the labour market.

The equilibrium in our model is given when the equation of price setting is set equal to the equation of wage setting, so we have with the following condition:

$$PS = WS$$

$$w^e - p = w - p^e$$

Which means that:

$$w = w^e, \qquad p = p^e$$

Therefore, we obtain that:

$$z_0 + \beta a + z_1 n = a - m_0 - m_1 n \tag{79}$$

We develop some steps in order to achieve the optimal point for employment rate n*:

$$n * (z_1 + m_1) = (1 - \beta)a - m_0 - z_0$$

$$n^* = \frac{(1 - \beta)a - m_0 - z_0}{z_1 + m_1} \tag{80}$$

The condition is shown is the graph below.

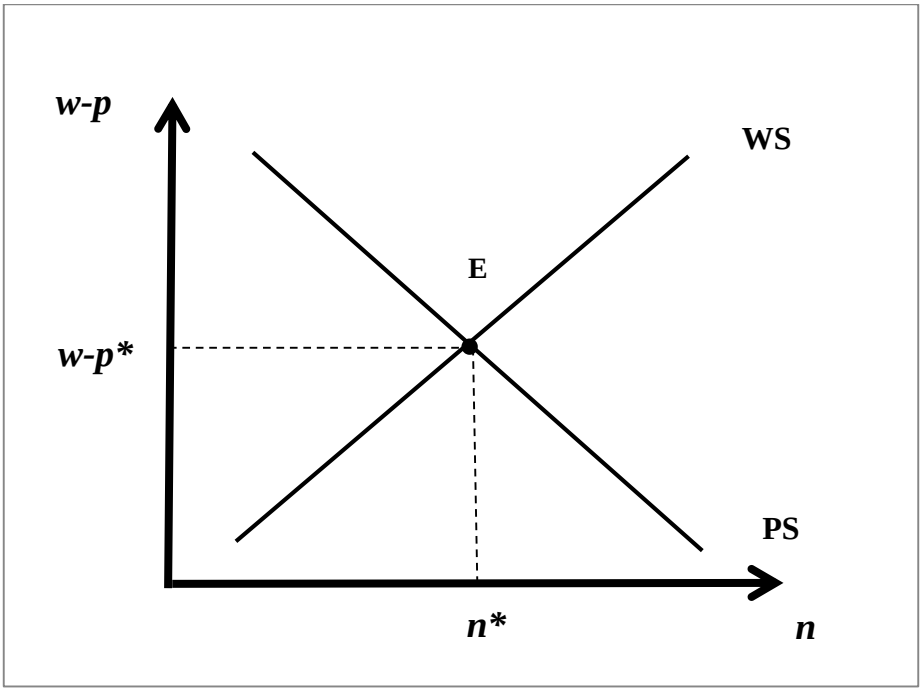


Figure 45. Equilibrium

In the point E the two curves of Wage Setting (*WS*) and Price Setting (*PS*) intersect, determining the two optimal values for employment on the abscissa axis (n*) and for the real wage on the ordinate axis (w-p*).

5.6 The Long Run

As we said before, in order to understand what happen to the system exhaustively along time, we have to look both in a short-run perspective and in a long-term perspective.

In the long run we have to make more assumption, taking in consideration two other important variables, the profit (π) and the capital (K). The profit (π) is a function of capital (K), technology (A) and the employment (N), but it depend also on real wage ($\frac{W}{P}$), as we can see in the equation below:

$$\pi = F(K, AN) - \frac{W}{P}N \tag{81}$$

If we consider the profit rate ($\frac{\pi}{K}$), dividing both sides of the equation for the capital K, we have that:

$$\frac{\pi}{K} = F(1, \frac{AN}{K}) - \frac{W}{P}\frac{N}{K} \tag{82}$$

If we impose that the labour in efficiency units to capital is:

$$X = \frac{AN}{K}$$

We obtain:

$$\frac{\pi}{K} = F(1, X) - \frac{W}{PA}X \tag{83}$$

If we consider the logarithm, we have that:

$$g = f(1, x) - (w - p - a) + x = r + \delta - a \tag{84}$$

Where r is the cost of capital, δ is the depreciation of capital and a represents the level of productivity. The quantity $r + \delta - a$ is what in the investment theory is called *user cost* (*uc*). If a decreases, $r + \delta - a$ increases and $w - p$ decreases in order to maintain the profit. We can see the situation in the graph below.

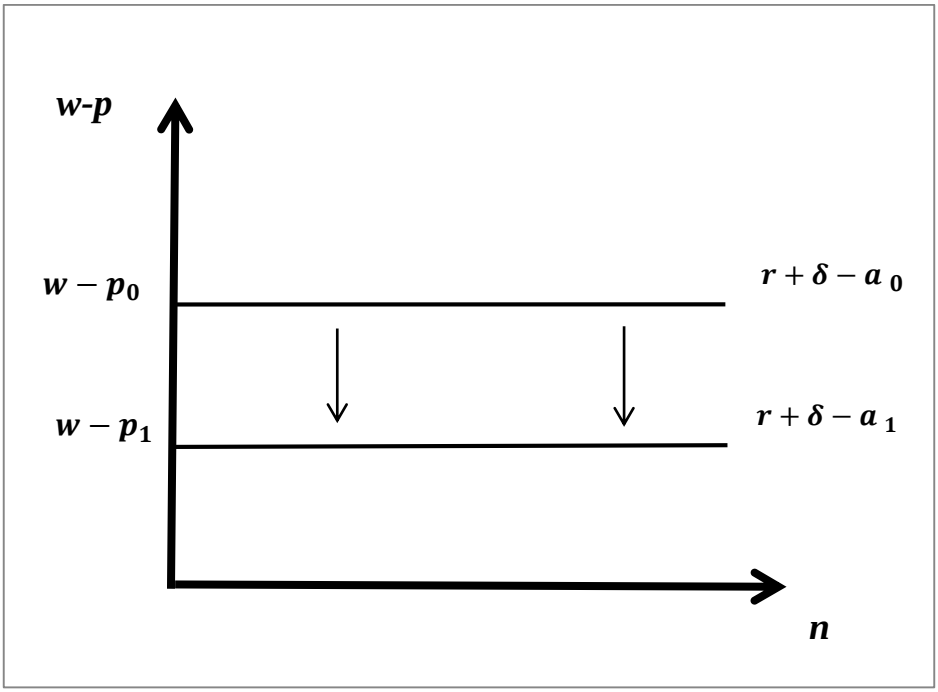


Figure 46. Long Run

Figure 46 shows what happen to the model in the long run. As we said before, when the user cost increases for a decrease of technology (*a*), the real wage decreases. We have a similar situation and the same effects in the cases of an increase of the cost of capital r or an increase the depreciation of capital δ.

5.7 A step back: Kaldor Model and Criticism

Before proceeding with a deeper analysis of our model, making some assumptions of shocks, we should take a step back. We consider the model proposed by Kaldor. Among the leading exponents of post-Keynesian research field as part of the economic studies, the Hungarian economist *Nicholas Kaldor* (Budapest, 1908 – Cambridge, 1986) has made important contributions to the understanding of the mechanisms related to capital formation and the manner of its distribution, the working of the economic system, of firms, of the economic cycle and the development. The model that Kaldor builds is the so-called "Theory of Exogenous Growth," which attributes the economic growth in the long run to technical progress and does not depend, therefore, on other economic variables. The rates of growth of product per capita, however, seem to show significant and stable differences across economies.

He note that it is impossible to distinguish the effects of "economies of plant" linked to the indivisibility of some factors of production (therefore reversible, in the sense that disappear to reduce the scale of production) by irreversible effects due to the improvement of technology associated to the expansion output. Learning is a product of the experience and therefore, as shown by the pioneering contributions of *Arrow* (1962), the higher the growth rate of output and investment, the greater the increase in productivity due to the processes of learning by doing.

For Kaldor does not make sense to distinguish between movements along the production function, caused by the procedure of capital accumulation, which causes a change in the ratio *K/L*, and shifts of the entire production function caused by technological progress, because the accumulation of capital is not neutral with respect to the evolution of technical knowledge.

"The use of more capital per worker […] inevitably entails the introduction of superior techniques which require "inventiveness of some kind" (cfr. Kaldor 1957).

The decision to adopt a different production technique, that is characterized by a different relationship between capital and labour, at a certain "state of knowledge" inevitably leads to a process of innovation that changes the state of knowledge itself, that determines technical progress. The idea that technological progress is incorporated into the capital, did not represent in itself a contradiction to the neoclassical approach, based on the use of a static production function diminishing returns in the individual factors. For Kaldor capital is not homogenous entities, he refuses therefore neoclassical production function. Therefore, he does not speak about the production function but about the function of technological progress:

$$\pi = a + b \cdot g_{K/L} \tag{85}$$

where π is the Labour Productivity, $g_{K/L}$ is the Capital Deepening (or growth rate in capital, growth rate of the capital-labour ratio), *a* is the autonomous component and *b* is the component for Capital Deepening. He defined also the accumulation rate of capital as:

$$g_K = \frac{I_t}{K_t} \tag{86}$$

Where I_t are the investments at time *t* and K_t is the capital at time *t.* The technological progress function, thus, incorporates two distinct ideas: it ties the rate of technological progress directly to the rate of capital accumulation and it implies an idea of technological progress into capital.

In 1966, Kaldor resumed and estimated the Verdoorn Law, which tied the trend in labour productivity to output growth:

$$\pi = a + bg_Y \tag{87}$$

Two basic ideas come from this report:

1. the presence of static and dynamic economies and processes of learning by doing;

2. the endogenity of technical progress, incorporated in the capital.

In his paper (“A model of economic growth”, 1957), Kaldor tries to build a satisfactory model concerning the nature of the growth process in a capitalist economy. The model, which is intended to be a long run model, is based on Keynesian techniques of analysis and follows the well-known "dynamic" approach originally developed by Harrod in regarding the rates of change of income and of capital as the dependent variables of the system. The properties of the model differ, however, in important respects from those of Harrod and other writers, and these differences can be traced to the following: it is assumed here that in a growing economy the general level of output at any one time is limited by available resources, and not by effective demand. The model in other words assumes “full employment " in the strictly Keynesian sense, a state of affairs in which the short-period supply of goods and services in the aggregate is inelastic and irresponsive to further increases in monetary demand. This need not necessarily imply the full employment of labour except in a developed economy, where the available capital equipment is sufficient or more than sufficient to employ the whole of the available working force. However, it does imply that, excepting for periods in which the process of growth through capital accumulation is altogether interrupted, the system cannot long operate in a state of Keynesian under-employment equilibrium. This because at any level of output the aggregate demand associated with that particular level of output will exceed the aggregate supply price of that output, and thus lead to an expansion in output until a state of full employment is reached. In a state of full employment, on the other hand, aggregate demand and aggregate supply in real terms are brought into equality through the movement of prices in relation to prime costs, i.e., the relation of prices to wages. The assumption that there can be no under-employment equilibrium, in periods in which the rate of growth of capital and income is normal,47h is not arbitrary; it is based on the view that an equilibrium of steady growth is inconsistent with under-employment equilibrium.

The second main aspect for which Kaldor model departs from its predecessors is that it eschews any distinction between changes in techniques and in productivity, which are induced by changes in the supply of capital relative to labour and those induced by technical invention or innovation, i.e. the introduction of new knowledge. The use of more capital per worker (whether measured in terms of the value of capital at constant prices, in terms of tons of weight of the equipment, mechanical power, etc.) inevitably entails the introduction of superior techniques which require *"inventiveness"* of some kind, though these need not necessarily represent the application of basically new principles or ideas. On the other hand, most, though not all, technical innovations, which are capable of raising the productivity of labour, require the use of more capital per man, more elaborate equipment and/or more power that is mechanical. Hence, the speed with which a society can “absorb” capital depends on its technical dynamism, its ability to invent and introduce new techniques of production. A society where technical change and adaptation proceed slowly, where producers are reluctant to abandon traditional methods and to adopt new techniques is necessarily one where the rate of capital accumulation is small. The converse of this proposition is also true: the rate at which a society can absorb and exploit new techniques is limited by its ability to accumulate

capital. It follows that any sharp or clear-cut distinction between the movement along a production function with a given state of knowledge, and a shift in the production function caused by a change in the state of knowledge is arbitrary and artificial. Hence, instead of assuming that some given rate of increase in productivity is attributable to technical progress, which is superimposed, so to speak, on the growth of productivity attributable to capital accumulation, Kaldor postulate a single relationship between the growth of capital and the growth of productivity, which incorporates the influence of both factors. The plausible shape of this *"technical progress function"* is that given by the curve *TT'* in the figure below.

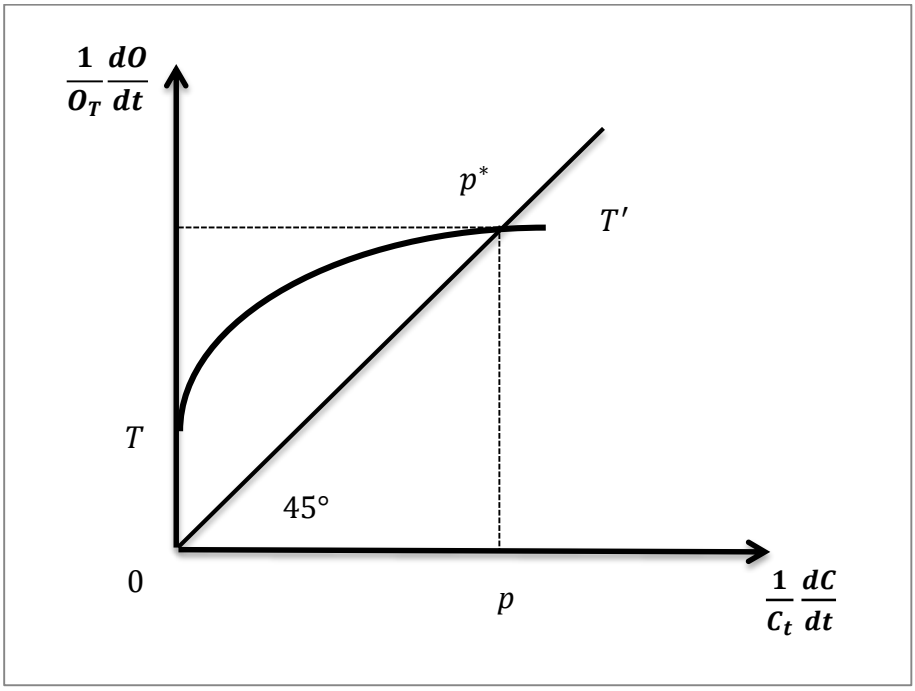


Figure 47. Technical Progress Function

Let C_t and O_T represent the capital per worker and the annual output per worker at time *t*, so that $\frac{1}{C_t}\frac{dC}{dt}$ (measured horizontally) represents the annual percentage growth in capital per worker, and $\frac{1}{O_T}\frac{dO}{dt}$ (measured vertically) the annual percentage growth in output per man. The shape and the position of the curve reflect both the magnitude and the character of technical progress as well as the increasing organisational, etc., difficulties imposed by faster rates of technical change. It may be assumed that some increases in productivity would take place even if capital per man remained constant over time, since there are always some innovations-improvements in factory layout and organisation, for example which enable production to be increased without additional investment. But beyond these the growth in productivity will depend on the rate of growth in the capital stock-clearly the more capital is increased, the more labour-saving technical improvements can be adopted, though there is likely to be some maximum beyond which the rate of growth in productivity could not be raised, however fast capital is being accumulated. Hence the *TT'* curve is likely to be convex upwards and flatten out

altogether beyond a certain point. The postulate of the existence of a given curve presumes, of course, a constant flow in the rate of new ideas over time. Variations in the flow of new ideas, and in the readiness with which they are adopted, are likely to be reflected in shifting the height of the curve rather than in altering its general character. In an unprogressively economy, with a low capacity to absorb technical change the height of the *TT'* curve will be relatively low, whilst important new discoveries (such as the invention of the internal combustion engine or atomic energy) are likely to raise the position of the curve considerably for some time. *P* represents the particular point on the *TT'* curve where it is crossed by a line drawn from the origin at an angle of 45 degrees where, in other words, the percentage rate of growth of capital and the percentage rate of growth of output are equal. When the rate of capital accumulation is less than this rate the percentage rate of growth in output will exceed the growth in capital (involving a fall in the capital/output ratio), and vice versa. As will be shown below, with a given *TT'* curve, the system will always tend towards the point where the growth of capital and the growth in productivity are equal P is therefore the long run equilibrium point and *0-p* the long run equilibrium rate of growth. An upward shift in the *TT'* curve caused by a burst of new inventions will cause (for a time) a falling capital/output ratio; progress will thus appear to take on a predominantly “capital-saving " character. A drying up in the flow of ideas, represented by a downward shift in the *TT'* curve will, on the other hand, cause the growth of productivity to lag behind; the capital/output ratio will rise, and innovation will appear to be predominantly "labour-saving."

Kaldor model, like other macro-economic models, is based on simple aggregative concepts of income, capital, profits, wages, investment and savings, expressed in real terms-i.e., in terms of values of constant purchasing power. The assumptions made before in figure 43 imply an investment function which makes investment of any period partly a function of the change in output in the previous period and partly of the change in the rate of profit on capital in that period. The prime mover in the process of economic growth is the readiness to absorb technical change combined with the willingness to invest capital in business ventures. It is through the continued increase in the amount of machinery, etc., used in combination with labour that the productivity of labour is continuously increased. In addition, in Kaldor model it is assumed that monetary policy plays a purely passive role, which means that interest rates, subject to differences due to borrowers' risks, etc., follow, in the long run, the standard set by the rate of profit obtainable on investments. The operation of the model is consistent with continued price-inflation (with money wages rising faster than productivity) or with a constant price level. It is in principle also consistent with constant money wages (money prices falling with the rise in productivity).

The mechanics of Kaldor model are, thus, consistent both with minor fluctuations in growth rates and with major breakdowns in the process of growth, involving heavy unemployment and temporary stagnation. If the latter occurs, net investment might even become negative, so that eventual revival will be facilitated by the gradual erosion of capital as well as by the rise in the *TT'* function due to the cumulative effect of unexploited new inventions. The system is liable to such major breakdowns in the wake of exploitation of major discoveries. When the economy geared to a higher rate of progress needs to be "switched back" to a more moderate rate of growth. Kaldor

choices to ignore the influence of a change in the share of profits and wages and of a change in rate of profit on capital (or of interest rates) on the choice of techniques adopted which has been the focal point of attention of neo-classical theory. At any one time the individual entrepreneur has, of course, a variety of “techniques " to choose from, and he may be assumed to choose the particular technique which secures the lowest cost, or the highest rate of return, on his investment. It seems reasonable to assume, however, that the choice of technique is far more dependent on the pre-vailing prices of different types of capital goods and on the price of labour in terms of commodities generally (in so far as this reflects the productivity of labour) than on the prevailing rate of profit or the prevailing interest rates.

To sum up, for economies, which are capable of only slow technical progress, whose potential rate of population growth is relatively large, and which are subject to diminishing returns, the long run equilibrium rate of growth and income (and capital) is determined by a different set of conditions. It has to be that rate of population growth, which allows output per head and capital per head to remain constant over time. (Income and capital per head must be low enough to restrict the rate of population growth to that rate; and the higher the degree of medical knowledge which deter-mines infant mortality, the lower this constant level of income per head will have to be.) This is a stable position, since there is only one particular rate of population growth, which enables the rate of growth of income to be equal to it. At any lesser rate productivity per head will rise and the growth of income will exceed the growth of population (causing the latter to in-crease and income per head to cease rising). At any higher rate, productivity will fall and the growth of income will fall short of the growth in population (causing the latter to contract and income per head to cease falling). Long run growth with a rising standard of living necessarily presupposes that there is some check to the rate of population growth, which operates before it reaches the maximum attainable rate of growth of the national income.

5.8 Hypothesis of Shocks

The Kaldor model described in the previous paragraph is the basis of the model that we are building in this paper, so we take some of its implications in order to continue our analysis. A model, in order to be good and consistent with the reality, needs to be subjected to some types of shocks, so that we can test its effectiveness and we can verify the assumptions made previously. This is what we will do in this paragraph.

Now we can see what happen, if we introduce shocks. We will illustrate two case of shocks: the first one related to the labour demand and the second one related to the labour supply. We recall the two equations of our model described and analysed above:

Price Setting: $$w - p = a - m_0 - m_1 n \quad (88)$$

Wage Setting: $$w - p = z_0 + \beta * a + z_1 n \quad (89)$$

A first kind of shocks regards a labour supply shift. We begin with a positive shock of z ($\Delta z_0 > 0$). The parameter *z*, which represents all the institutional factors that influence the labour market, appears in the wage-setting curve, so we will expect a kind of movement of this curve.

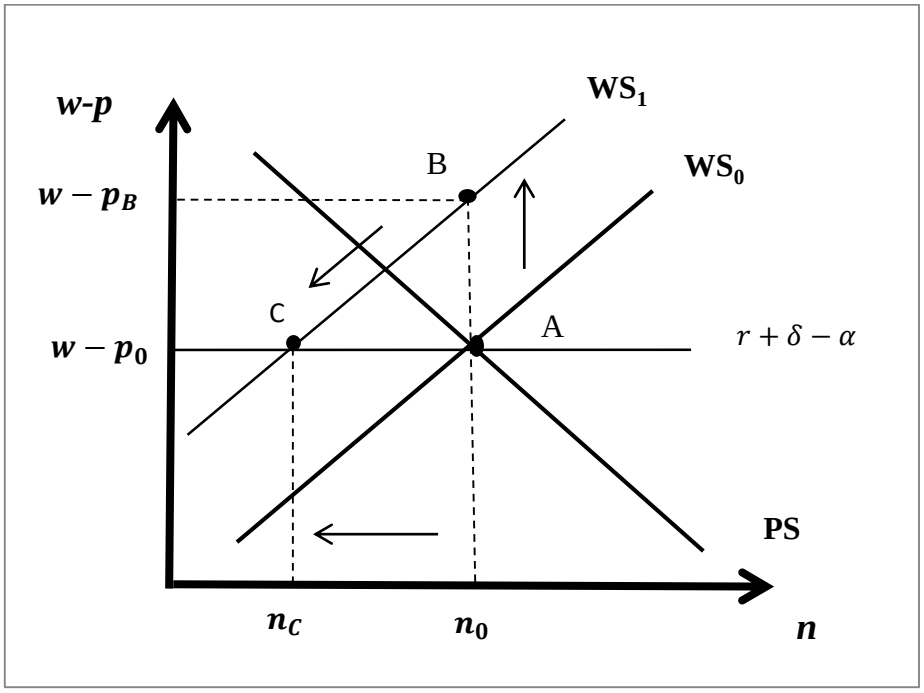


Figure 48. Positive Shock of z

What happen to the equilibrium? Let us see step by step the movements of the curves and of the variables involved. In the short run the amount of capital is given ($\bar{K}$), the wage setting curve (WS_0) shifts up to the left in WS_1, so moving from point A to point B the real wage rises to the level $w - p_B$, while the capital share decreases and the employment rate maintains the same initial value (n_0). In the medium run, moving from point B to point C, the amount of capital decreases, the real wage slows down until the initial level $w - p_0$ and also the employment rate decreases, reaching the lower level n_C. In the long run employment will decreases but it is not certain about what happen to the ratio $\frac{K}{N}$, the effects are ambiguous.

If the shock of z is negative ($\Delta z_0 < 0$), it means that the regulation of labour market become less stringent so we have an higher flexibility, let's see what happen in the graph below. In addition, this time we will have a movement of the wage-setting curve, but on the opposite side respect to the previous shock considered.

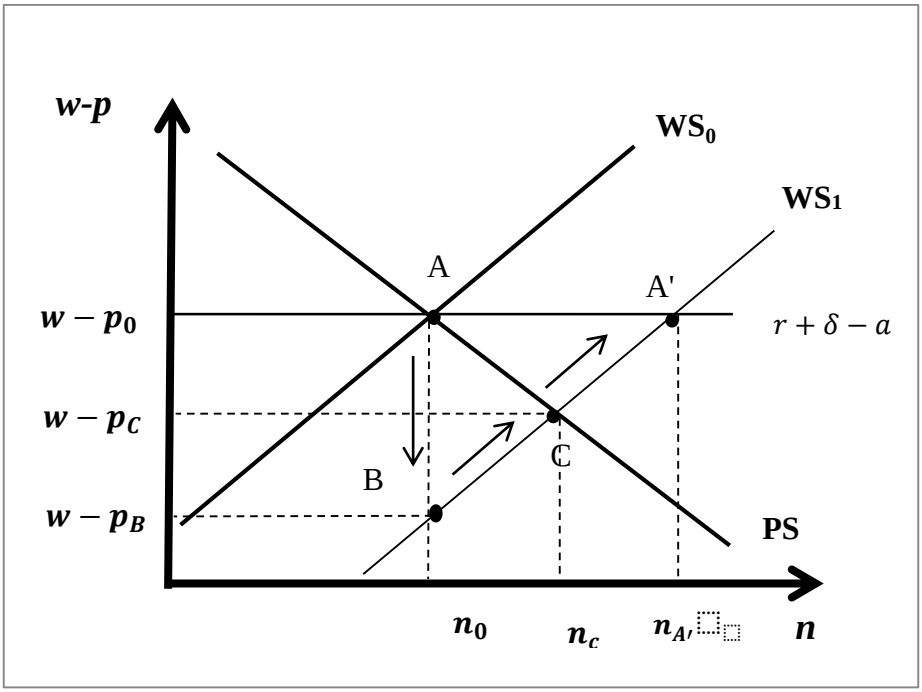


Figure 49. Negative Shock of z

In the short run we move from point A to point B, so the wage setting curve (WS_0) shifts down on the right in WS_1 , the real wage falls starting from the level $w - p_0$ and reaching the lower level $w - p_B$, while *g* and the capital share increase. In the medium run, moving from point B to point C, the employment rate increases until the level n_c and also the real wage rises until the level $w - p_c$, while the capital share decreases. In the long run employment rate increases again until the point $n_{A'}$, also the amount of capital increases, as well as the difference wage - price, which reach the initial value $w - p_0$.

Now we consider a positive shock of the parameter *m* ($m > 0$). The parameter *m*, which represents the mark-up of the price over the cost of production, appears in the price-setting curve, so we will expect a kind of movement of this curve.

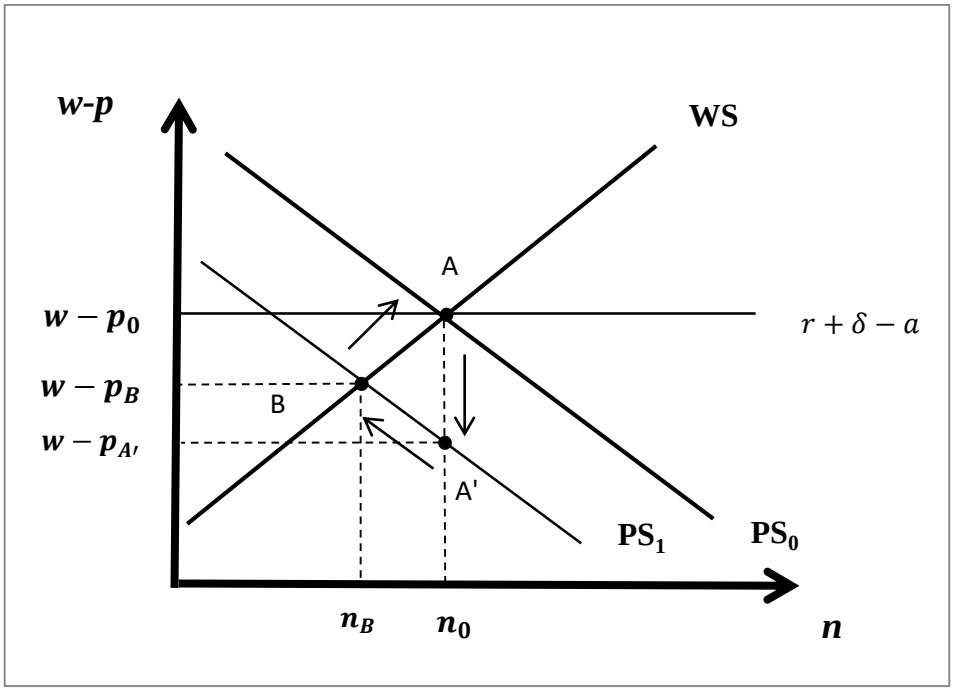


Figure 50. Positive Shock of m

The initial price setting curve PS_0 shifts down on the left in PS_1. So in the short run moving from the point A to the point A', the real wage decreases from the initial value $w - p_0$ until the lower level $w - p_{A'}$, while g increases, *Y* and *K* are constant and the unemployment rate is the same (n_0). In the medium run, moving from point A' to the point B, the capital share and the real wage increase, until the level $w - p_B$, while the employment rate decreases, from the level n_0 to the lower level n_B. In the long run the system come back to the initial point A, where the real wage and the employment rate come back to their initial levels $w - p_0$ and n_0, while the ratio $\frac{K}{N}$, the capital (*K*) increase.

A second kind of shocks that we take in consideration is the shifts in user cost. Let us see what happen, if there is a positive shock of the cost of capital *r* ($r > 0$).

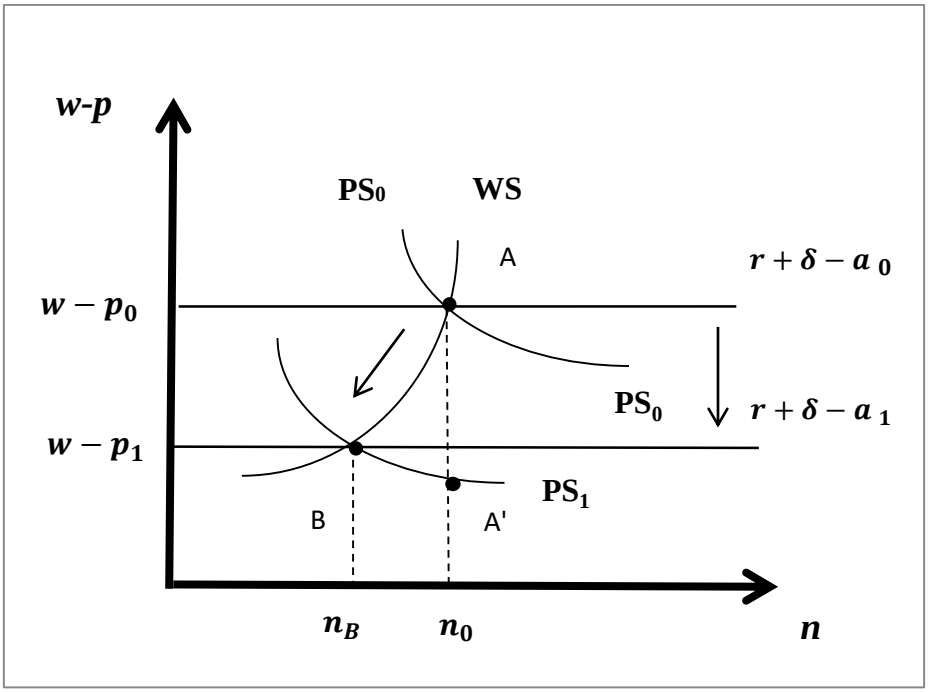


Figure 51. Positive Shock of r

If the cost of capital (r) raises, $r + \delta - a$ increases and so $r + \delta - a > g$. In the short run, moving from point A to the point B, the price setting curve shifts down on the left, from PS_0 to PS_1, the real wage falls from the initial level $w - p_0$ to the lower value $w - p_1$, as well as the employment rate (n) from the initial value n_0, to the lower level n_B. In the medium run we move from point B to the point A', where the employment rate increases and come back to the initial value n_0, while the real wage decreases to the level $w - p_{A'}$.

Let us focus now on the case in which the shock involves the productivity a and it is negative ($\Delta a < 0$).

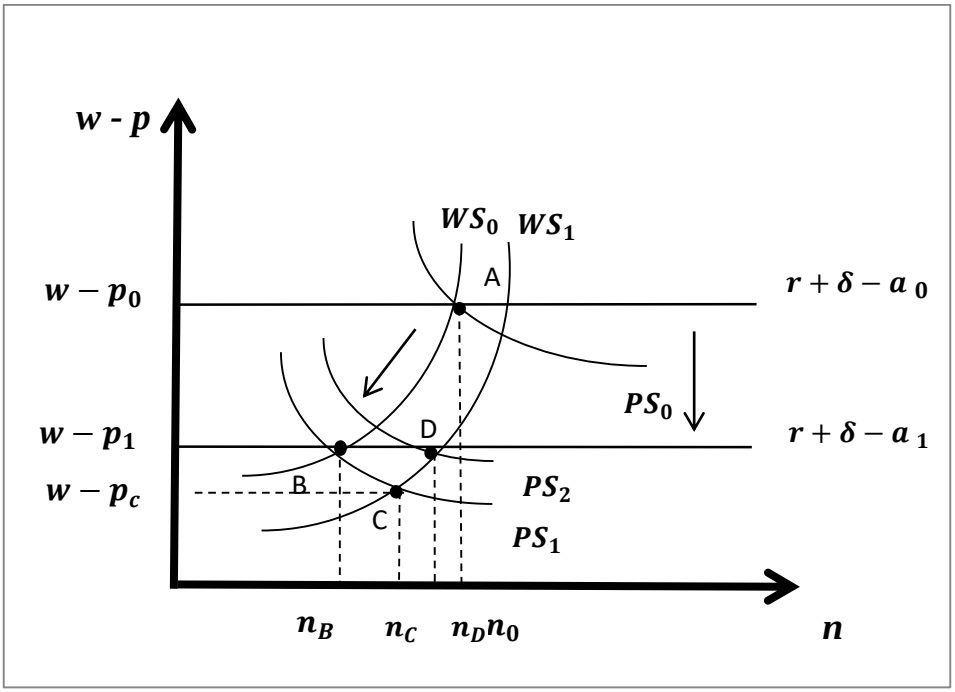


Figure 52. Negative Shock of a.

If the productivity *a* goes down, the line of the user cost increases, moving from the initial value $r + \delta - a_0$ to the lower level $r + \delta - a_1$. In short run, the curve of price setting PS_0 shifts down on the left in PS_1 , so we go from the point A to the point B, where the real wage reduces from the initial value $w - p_0$ to the lower level $w - p_1$, also the amount of capital and the employment rate *n* fall down, from the initial value n_0, to the lower level n_B. In the medium run the curve of wage setting WS_0 moves to right in WS_1 and the system reaches the point C where the real wage is lower ($w - p_c$) and $g > r + \delta - a$, while the amount of capital (*K*) and the employment rate grow (n_C). In the long run the curve of price setting move up to the right (PS_2) and the system reaches the point D, where the employment rate increases again (n_D), as well as the real wage ($w - p_1$), however they are lower than their initial values.

This is what happens to our theoretical model, built with the determining of wage setting and price setting, after the introduction of shocks linked to one of the variables involved. We distinct short, medium and long-term consequences and we have seen how the two curves move, thanks to the graphic representation. The next step is the empirical verification, by building a micro-funded model, in order to have a possible confirmation of the theoretical hypothesis made.

Sixth Chapter

A VAR Analysis

6.1 A Micro - Founded Model

In the previous chapter, we have constructed and described a theoretical model of macroeconomic growth. Using the assumptions of Kaldor model, we built the equations and the corresponding curves of price setting (*PS*) and wage setting (*WS*) and we have seen what happens in the system in the presence of various shocks both in the short time and in the long term.

Now let us take a step forward. From the theoretical model, we build a model that will become empirical and that is micro - founded. We use a two-sector model. In one sector, the output is produced; in the other, the technology advancement is done. We assume that A_t is the shock of technology at time *t.* Then we assume that technology is a by-product of (the share of) output per worker $(\frac{Y_t}{L_t})$, where Y_t is the output and L_t is the number of employees in the economy, and that technology progress has a distinct component which depends on "inventiveness" of some kind. On such assumptions, the technology generating process at time *t* can be written as:

$$A_t = V_t^{\theta}(\frac{Y_t}{L_t})^{\delta} \tag{90}$$

Where θ and δ, which are positive, are the elasticity shares and V_t is the inventiveness (Kaldor,1956; Romer 2005). In the equation, the fact that $\theta > 0$ indicates that technology increases with the stock of new ideas that have been already discovered. Therefore, according to the equation (22), technology progress is positively related to productivity and application of new ideas.

We define the long run (log) level of technology progress a_t^* as:

$$a_t^* = \theta v_t^* + \delta y_t^* \tag{91}$$

where $v_t = \log(V_t)$ and $y_t = \log(Y_t/L_t)$ and where v_t^* and y_t^* are the long run level of inventiveness and productivity, respectively.

Now let us assume that the natural level of output id determined by technology (A_t), labour (L_t), physical capital (K_t) and human capital (H_t). By using a Cobb-Douglas specification, we write the production function as:

$$Y_t = A_t H_t^{\alpha} K_t^{\beta} L_t^{\gamma} \tag{92}$$

Under the assumption of constant returns to scale, $\alpha + \beta + \gamma = 1$, we derive an expression for productivity Y_t/L_t as a function of capital intensity K_t/L_t and of human capital intensity H_t/L_t. The production function in the intensive form is:

$$\frac{Y_t}{L_t} = A_t \left(\frac{H_t}{L_t}\right)^{\alpha} \left(\frac{K_t}{L_t}\right)^{\beta} \tag{92a}$$

As stated in the equation (92a), long run movement in productivity can be attributed to the changes in (per capita) capital(s) and technology stock.

In the short-run productivity may derive from its long run steady state value. These deviations may arise from permanent shocks to the inputs level, which lead to a translation from one equilibrium to the other, or they may be caused by transitory shocks related to aggregate demand disturbances. Thus, in our model movements in productivity arise from two different sources: supply shocks and demand shocks. The first class of shocks has permanent effects on the level of productivity by changing its secular component; the second one has only temporary effects. As we will explain later, some additional variables (such as the inflation rate) are included in the empirical model to capture the short run components of capital intensity and inventiveness. Two identifying restrictions are used to separate these sources of shocks from a dynamic reduced for model that determines the historical influence of aggregate supply and demand on the variables in the model.

Using the log transformation of (92), the long run (log) level of productivity y_t^* is:

$$y_t^* = a_t^* + \alpha h_t^* + \beta k_t^* \tag{93}$$

where $a_t^* = \log(A_t^*)$, $h_t^* = log\left(\frac{H_t^*}{L_t^*}\right)$ and $k_t^* = log\left(\frac{K_t^*}{L_t^*}\right)$ are the long run levels of technical progress, human capital intensity and capital intensity, respectively.

6.2 Long Run Restriction

The first restriction that characterizes the long run behaviour of output and capital per unit of labour is derived from Solow's growth model. Essentially, under the assumption of constant return to scale, capital(s) per worker and productivity grow at the same rate in the steady state. Therefore, the (log) human capital-output ratio is:

$$h_t^* = y_t^* + \varphi \tag{94}$$

where φ is the steady state (log) value. Substituting the (27) in the (26) yields:

$$y_t^* = c_0 + c_1 k_t^* + c_2 a_t^* \tag{95}$$

where $c_0 = \alpha\varphi/1-\alpha$, $c_1 = \beta/1-\alpha$ and $c_2 = 1/1-\alpha$ are known coefficients (all positive by assumption). Substituting the (95) in the (91) and rearranging yields:

$$a_t^* = f_0 + f_1 k_t^* + f_2 v_t^* \tag{96}$$

where $f_0 = \alpha\delta\varphi/1-\alpha$, $f_1 = \delta\beta/1-\alpha$ and $f_2 = \delta/1-\alpha$.

Hence, inventiveness (new ideas) determines, together with capital intensity k_t^*, the long run dynamics of technology progress a_t^*. This representation captures the Kaldorian idea of technical progress function (Kaldor, 1957).

6.3 Supply Shocks

We assume that in the long run capital intensity k_t and the inventiveness v_t evolve according to:

$$k_t^* = k_{t-1}^* + B_k(L)\varepsilon_t \rightarrow \Delta k_t^* = B_k(L)\varepsilon_t \tag{97}$$

$$v_t^* = v_{t-1}^* + B_v(L)\lambda_t \rightarrow \Delta v_t^* = B_v(L)\lambda_t \tag{98}$$

where ε_t and λ_t are serially and mutually uncorrelated shocks. The log polynomials $B_k(L)$ and $B_v(L)$ are assumed to have roots outside the unit circle. Basically the shocks ε_t and λ_t affect k_t^* and v_t^* and consequently the dynamics of a_t^*.

We label these shocks as "supply shocks" because they have a permanent effect on the k_t^* and v_t^* levels. ε_t and λ_t can be thought as any disturbance that permanently affects the evolution of capital intensity and inventiveness in the long run.

6.4 Demand Shocks

As said above, we close our model by adding demand shocks. These shocks allow capital intensity k_t and technology progress a_t to temporarily deviate from their long run levels. Since these shocks are transitory, their effects tend to disappear over time. They are labelled as d_t. The transitory shocks move the system away from its trend in the short run, independently from the supply shocks ε_t and λ_t. Therefore the effective value of k_t and of a_t can derive from their long run values either because of supply shocks or because of demand shocks. To sum up we have:

$$k_t = k_t^* + \Omega_k(L)[\varepsilon_t, \lambda_t, d_t] \tag{99}$$

$$a_t = a_t^* + \Omega_a(L)[\varepsilon_t, \lambda_t, d_t] \tag{100}$$

The dependence of k_t and of a_t on all the supply and demand shocks $\varepsilon_t, \lambda_t, d_t$ allows a flexible response of the system to long- and short-run disturbances.

6.5 Dynamics

To obtain changes of k_t and of a_t let us differentiate the equations (99) and (100). Then applying the equations (96), (97) and (98) to the previous two equations yields:

$$\Delta k_t = B_k(L)\varepsilon_t + (1-L)\Omega_k(L)[\varepsilon_t, \lambda_t, d_t] \quad (101)$$

$$\Delta a_t = f_1 B_k(L)\varepsilon_t + f_2 B_v(L)\lambda_t + (1-L)\Omega_a(L)[\varepsilon_t, \lambda_t, d_t] \quad (102)$$

That are two of the reduced-form equations, which we will estimate. The first equation (34) states that changes (Δ) of k_t depend on the long run effects of the shocks ε_t and λ_t on all the short-run shocks. The second equation (35) states that the changes (Δ) of a_t depend on both the effects of the supply shocks ε_t and λ_t and on all the demand shocks. Interestingly, the equation (34) implies that also the first supply shock ε_t has long run effect on both capital intensity and inventiveness, while the second supply shock λ_t has no long run effects on capital intensity, but has a long run effect on inventiveness.
Regrettably, the restriction (27) is not sufficient to identify the demand shock d_t in the equation (34) and (35). Indeed, we have three unknowns $(\varepsilon_t, \lambda_t, d_t)$ and only the two equations (34) and (35). Thus, we need one further restriction. Following Blanchard and Quah (1989), we assume that aggregate demand shocks have no long run effect on both capital intensity and technology progress. Hence, in the long run, if these two variables have to be unaffected by the demand shocks, it must be the case in that the cumulated effects of the shocks on the changes (Δ) of capital intensity and technology must be equal to zero.

Since the short-run shocks are not observed, the problem is to recover them from the VAR estimations. To this aim, we employ a stationary time series: the inflation rate π_t. Given its (tested) stationary properties, we can write:

$$\pi_t = \Omega_k(L)[\varepsilon_t, \lambda_t, d_t] \quad (103)$$

Because all shocks have exclusively temporary effects on π_t. In summary, the model can be written as:

$$\begin{bmatrix} \Delta k_t \\ \Delta a_t \\ \pi_t \end{bmatrix} = \sum(L) = \begin{bmatrix} \varepsilon_t \\ \lambda_t \\ d_t \end{bmatrix} \quad (104)$$

The matrix $\sum(L)$ is a function of the polynomials $B_k(L)$, $B_v(L)$, $\Omega_k(L)$, $\Omega_a(L)$. In structural VAR approaches, shocks are identified by imposing different restrictions (Bernanke, 1986; Blanchard and Watson, 1986; Sims, 1986). We follow (Blanchard and Quah, 1989) and (Shapiro and Watson, 1988) whose identification scheme is based on constrained long run multipliers, that are the elements of $\sum(1)$. Indeed setting $L = 1$ in the equations (101) and (102) we obtain that the long run multipliers from d_t to k_t and a_t are zero. Therefore, the long run matrix $\sum(1)$ has the triangular form:

$$\sum(1) = \begin{bmatrix} \sigma_{11} & 0 & 0 \\ \sigma_{21} & \sigma_{22} & 0 \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} \quad (105)$$

We will estimate equations in (104) under (105).

6.6 Estimation

We will follow a few passages in order to reach the estimations described in the previous paragraph. We collect the data of the three variables involved in the model from the database AMECO, of the European Commission, as made before for the other analysis in this project. In this case, we will use in addition the statistical software Gretl, in order to construct our micro founded model, using a structural VAR approach.

We choose to select a group of four European countries, so a smaller statistical sample than previous analysis: France, Germany, Italy and Spain. This will enable us to make more direct comparisons between EU countries and have a more focused synthesis of past, present and future European economic policies. For each of these countries we collect the time series of the three variables considered: the capital intensity for k_t, the total factor productivity as expression of the technological progress a_t and the GDP deflator as expression of the inflation rate, π_t. The period considered starts in 1960 and ends in 2017, so we have fifty-seven annual observations for each countries and each variables.

As stated in the previous paragraphs we consider three kind of shocks. We label two of these shocks as "supply shocks" (ε_t and λ_t), they have a permanent effect on the capital intensity k_t^* and on the inventiveness v_t^* levels. ε_t and λ_t can be thought as any disturbance that permanently affects the evolution of capital intensity and inventiveness in the long run. Moreover we added a demand shock, labelled as d_t. These shocks allow capital intensity k_t and technology progress a_t to temporarily deviate from their long run levels. Since these shocks are transitory, their effects tend to disappear over time. With the estimation we will confirm, as said before, that the dependence of k_t and of a_t on all the supply and demand shocks $\varepsilon_t, \lambda_t, d_t$ allows a flexible response of the system to long- and short-run disturbances. In summary, we have two long run supply shocks, a first supply shock, which comes from capital accumulation, a second supply shock, which comes from the technological progress and a demand shock, which is transitory so it has a short-term effect.

6.7 The Data and the construction of the Structural VAR Model

As said before, we will use the capital intensity for k_t, the total factor productivity as expression of the technological progress a_t and the GDP deflator as expression of the inflation rate, π_t. We collect the time series of the three variables, for each one of the four country considered. Our time period start from 1960 until the estimations for the current year, 2017, for an amount of fifty- seven observations. Using the database AMECO, the annual macro-economic database of the European Commission, we obtain the time series of capital intensity (k_t), total factor productivity (a_t) and GDP deflator (π_t), for France, Germany, Italy and Spain. We use annual data for each country and each variable.

	France			*Germany*		
	Capital Intensity k_t	**Total Factor Productivity a_t**	**Price Deflator Gross Domestic Product π_t**	**Capital Intensity k_t**	**Total Factor Productivity a_t**	**Price Deflator Gross Domestic Product π_t**
1960	68,82	47,12	10,39	NA	54,59	24,03
1961	71,49	48,80	10,73	NA	55,55	25,17
1962	74,41	51,43	11,26	NA	56,94	26,15
1963	77,04	53,56	11,88	NA	57,44	26,96
1964	79,86	55,80	12,36	NA	60,09	27,78
1965	83,47	57,39	12,73	NA	61,94	28,81
1966	86,97	59,05	13,11	NA	62,72	29,80
1967	91,19	60,70	13,51	NA	62,95	30,27
1968	96,30	62,33	14,11	NA	65,48	30,96
1969	100,19	64,88	15,15	NA	68,67	32,25
1970	104,35	66,97	15,98	NA	70,41	34,74
1971	109,58	68,97	16,92	NA	71,22	37,39
1972	114,79	70,45	18,07	NA	72,87	39,08
1973	119,41	72,81	19,49	NA	74,69	41,54
1974	124,21	74,06	21,80	NA	74,97	44,56
1975	130,15	72,49	24,80	NA	74,81	47,09
1976	134,12	74,16	27,46	NA	77,98	48,65
1977	137,58	75,35	29,88	NA	79,71	50,16
1978	140,97	76,99	32,65	NA	80,81	51,93
1979	144,71	78,48	36,02	NA	82,30	54,16
1980	148,60	78,53	40,23	NA	81,75	57,11
1981	152,94	78,57	44,93	NA	81,42	59,49
1982	156,41	79,64	50,37	NA	80,93	62,22
1983	159,99	80,06	55,23	NA	82,10	63,96
1984	163,99	80,95	59,14	NA	83,43	65,24
1985	167,76	81,83	62,36	NA	84,14	66,62
1986	170,44	82,86	65,52	NA	84,54	68,62
1987	172,75	83,83	67,16	NA	84,47	69,50
1988	175,29	86,33	69,31	NA	86,26	70,67
1989	177,01	88,10	71,60	NA	87,92	72,71
1990	180,20	89,09	73,51	NA	90,00	75,18
1991	184,75	89,13	75,40	148,91	92,16	77,50
1992	190,35	90,24	76,90	155,35	93,48	81,60
1993	196,48	89,97	78,16	161,13	92,35	84,97
1994	199,29	91,39	78,89	165,01	93,63	86,81
1995	201,22	92,36	79,80	168,01	94,13	88,52

1996	204,26	93,06	80,89	171,36	94,08	89,07
1997	206,15	94,37	81,60	174,71	95,09	89,31
1998	206,77	96,21	82,38	176,02	95,50	89,85
1999	206,44	97,35	82,56	176,80	95,66	90,14
2000	205,61	98,58	83,83	176,35	96,41	89,73
2001	206,44	98,54	85,51	179,64	97,54	90,88
2002	208,81	98,42	87,28	182,27	97,38	92,10
2003	212,71	98,47	88,92	185,75	96,96	93,22
2004	216,57	100,32	90,38	186,43	97,60	94,24
2005	219,46	100,70	92,13	187,72	98,03	94,82
2006	221,68	101,54	94,13	188,16	100,76	95,11
2007	224,03	102,17	96,54	187,05	102,53	96,72
2008	228,05	101,22	98,84	186,62	102,39	97,53
2009	234,30	98,51	98,93	186,97	96,48	99,25
2010	238,13	100,00	100,00	187,40	100,00	100,00
2011	240,44	101,15	100,94	186,60	102,46	101,07
2012	243,70	100,73	102,11	185,91	101,85	102,59
2013	246,94	100,89	102,89	185,90	101,51	104,73
2014	249,12	100,45	103,47	185,74	102,27	106,55
2015	250,89	100,89	104,54	185,86	103,17	108,77
2016	252,16	101,41	105,56	186,07	104,11	110,45
2017	253,50	102,12	106,58	186,63	105,00	112,40

Table 3. French and German time series for capital intensity, the total factor productivity and the GDP deflator. Sources: AMECO - Annual macro-economic database – European Commission

	Italy			***Spain***		
	Capital Intensity k_t	**Total Factor Productivity a_t**	**Price Deflator Gross Domestic Product π_t**	**Capital Intensity k_t**	**Total Factor Productivity a_t**	**Price Deflator Gross Domestic Product π_t**
1960	58,66	48,37	3,29	42,05	43,91	2,65
1961	61,59	51,26	3,38	42,88	48,64	2,70
1962	65,70	53,68	3,57	43,67	52,34	2,85
1963	70,54	56,04	3,87	44,87	56,04	3,09
1964	74,11	56,78	4,13	46,36	58,45	3,29
1965	77,99	58,49	4,30	48,34	60,80	3,59
1966	82,01	61,79	4,40	50,72	63,68	3,88
1967	84,35	64,75	4,52	53,20	64,70	4,21
1968	88,36	67,89	4,60	55,81	67,13	4,46
1969	92,23	70,53	4,78	58,74	71,06	4,69
1970	96,40	72,92	5,11	61,75	72,17	4,97

1971	100,86	73,05	5,48	64,47	73,88	5,36
1972	105,84	74,78	5,79	68,07	77,99	5,82
1973	108,43	77,69	6,52	71,23	80,98	6,51
1974	111,11	79,62	7,84	75,54	83,01	7,54
1975	114,78	76,90	9,17	81,13	82,51	8,81
1976	116,71	80,61	10,78	86,16	84,16	10,26
1977	119,19	81,19	12,77	90,77	85,40	12,66
1978	122,21	82,58	14,55	96,15	86,23	15,28
1979	124,43	85,59	16,79	101,10	86,04	17,86
1980	126,69	86,24	20,29	107,66	87,72	20,26
1981	130,95	85,89	24,10	113,50	88,00	22,76
1982	133,89	85,04	28,33	117,58	88,69	25,86
1983	136,33	84,88	32,61	120,76	89,68	28,93
1984	139,22	86,58	36,12	125,72	91,99	32,07
1985	141,23	87,73	39,43	129,51	94,06	34,83
1986	143,27	88,98	42,38	129,78	94,88	38,62
1987	145,98	90,69	44,93	127,80	96,16	40,91
1988	148,31	92,94	47,92	128,34	97,50	43,34
1989	151,84	94,91	50,89	129,62	98,28	46,33
1990	154,57	95,26	55,16	130,90	97,92	49,72
1991	157,42	95,29	59,34	135,33	97,99	53,17
1992	162,38	95,71	61,93	142,62	98,34	56,74
1993	169,94	96,29	64,34	151,05	98,03	59,31
1994	173,97	98,53	66,62	155,99	99,61	61,61
1995	176,78	100,79	69,90	157,94	100,01	64,65
1996	178,59	101,14	73,08	160,73	100,73	66,90
1997	180,89	102,21	74,99	160,11	101,02	68,49
1998	182,63	102,75	76,88	159,32	101,29	70,23
1999	184,96	103,33	78,13	158,58	101,35	72,10
2000	185,55	105,20	79,66	157,88	101,95	74,46
2001	186,20	105,10	82,04	159,26	102,09	77,50
2002	188,33	103,84	84,80	162,26	101,72	80,69
2003	190,97	102,85	87,49	165,06	101,36	83,85
2004	193,88	103,40	89,70	168,03	100,99	87,14
2005	197,58	103,57	91,40	170,17	100,61	90,75
2006	198,23	103,74	93,13	172,61	100,54	94,36
2007	200,26	103,84	95,40	175,68	100,37	97,51
2008	204,43	102,35	97,77	182,73	99,76	99,59
2009	212,06	98,09	99,68	199,14	99,05	99,84
2010	215,52	100,00	100,00	208,25	100,00	100,00
2011	216,53	100,27	101,47	216,68	100,25	100,03
2012	219,59	98,27	102,87	229,27	100,41	100,08
2013	224,35	98,17	104,20	238,62	100,77	100,65
2014	222,77	97,80	105,11	237,26	101,27	100,25
2015	219,48	98,11	105,66	232,24	102,28	101,01
2016	216,73	98,95	106,48	228,71	103,05	101,97

2017	214,68	99,64	108,15	227,07	103,81	103,26

Table 4. Italian and Spanish time series for capital intensity, the total factor productivity and the GDP deflator. Sources: AMECO - Annual macro-economic database – European Commission

Table 3 and Table 4 collect the data of the three variable considered for the four countries selected. However, in the construction of our model with the statistical software Gretl, we generate three new variables, labelled as Dk, Da and Dp, that originate from the initial ones in this way:

$$Dk = 100 * logdiff(k) \quad (106)$$

$$Da = 100 * logdiff(a) \quad (107)$$

$$Dp = 100 * logdiff(\pi) \quad (108)$$

We use the logarithmic difference multiplied by one hundred in order to make the scales of the three variables homogeneous and comparable. Therefore, we obtain the new time series:

	France			***Germany***		
	Capital Intensity k_t	**Total Factor Productivity a_t**	**Price Deflator Gross Domestic Product π_t**	**Capital Intensity k_t**	**Total Factor Productivity a_t**	**Price Deflator Gross Domestic Product π_t**
1960	-	-	-	-	-	-
1961	3,80	3,51	3,23	-	1,74	4,62
1962	4,01	5,25	4,79	-	2,47	3,84
1963	3,48	4,06	5,40	-	0,88	3,04
1964	3,59	4,09	3,93	-	4,51	2,98
1965	4,42	2,81	2,97	-	3,03	3,66
1966	4,11	2,84	2,94	-	1,24	3,38
1967	4,74	2,77	3,02	-	0,38	1,55
1968	5,44	2,65	4,32	-	3,93	2,27
1969	3,96	4,01	7,14	-	4,76	4,08
1970	4,07	3,17	5,30	-	2,50	7,42
1971	4,89	2,94	5,73	-	1,15	7,34
1972	4,65	2,12	6,58	-	2,29	4,43
1973	3,95	3,30	7,57	-	2,47	6,11
1974	3,95	1,71	11,17	-	0,36	7,02

1975	4,67	-2,14	12,89	-	-0,22	5,51
1976	3,01	2,27	10,22	-	4,16	3,25
1977	2,54	1,59	8,42	-	2,19	3,05
1978	2,43	2,15	8,88	-	1,37	3,48
1979	2,62	1,91	9,82	-	1,82	4,19
1980	2,65	0,07	11,06	-	-0,67	5,31
1981	2,88	0,05	11,06	-	-0,40	4,09
1982	2,24	1,35	11,42	-	-0,60	4,48
1983	2,27	0,53	9,22	-	1,43	2,77
1984	2,46	1,11	6,83	-	1,61	1,97
1985	2,28	1,08	5,31	-	0,84	2,10
1986	1,59	1,25	4,95	-	0,47	2,96
1987	1,34	1,16	2,46	-	-0,08	1,27
1988	1,46	2,94	3,16	-	2,10	1,68
1989	0,97	2,03	3,25	-	1,91	2,84
1990	1,79	1,11	2,64	-	2,34	3,34
1991	2,49	0,04	2,54	-	2,37	3,04
1992	2,99	1,24	1,97	4,23	1,42	5,15
1993	3,17	-0,30	1,63	3,65	-1,21	4,05
1994	1,42	1,57	0,93	2,38	1,38	2,14
1995	0,96	1,05	1,14	1,80	0,53	1,96
1996	1,50	0,76	1,36	1,97	-0,06	0,62
1997	0,92	1,40	0,88	1,94	1,06	0,26
1998	0,30	1,93	0,95	0,75	0,44	0,61
1999	-0,16	1,18	0,22	0,44	0,17	0,32
2000	-0,40	1,26	1,53	-0,26	0,78	-0,45
2001	0,40	-0,04	1,98	1,85	1,16	1,27
2002	1,15	-0,12	2,05	1,45	-0,17	1,34
2003	1,85	0,05	1,86	1,89	-0,43	1,20
2004	1,80	1,86	1,63	0,37	0,66	1,09
2005	1,33	0,38	1,92	0,69	0,44	0,62
2006	1,01	0,83	2,14	0,24	2,75	0,30
2007	1,05	0,62	2,53	-0,59	1,73	1,68
2008	1,78	-0,93	2,35	-0,23	-0,13	0,84
2009	2,70	-2,71	0,10	0,18	-5,95	1,74
2010	1,62	1,50	1,07	0,23	3,59	0,75
2011	0,97	1,14	0,94	-0,43	2,43	1,06
2012	1,35	-0,42	1,15	-0,37	-0,59	1,49
2013	1,32	0,16	0,76	0,00	-0,34	2,07
2014	0,88	-0,44	0,57	-0,09	0,74	1,72
2015	0,71	0,44	1,03	0,06	0,88	2,06
2016	0,51	0,51	0,96	0,11	0,90	1,54
2017	0,53	0,71	0,97	0,30	0,85	1,74

Figure 5. France and German time series for Structural VAR Model

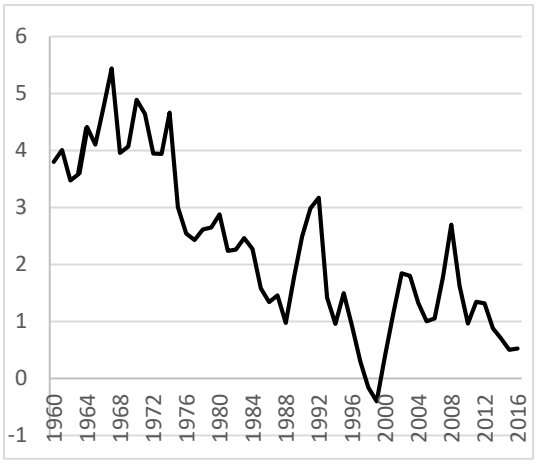
	Italy			*Spain*		
	Capital Intensity k_t	**Total Factor Productivity** a_t	**Price Deflator Gross Domestic Product** π_t	**Capital Intensity** k_t	**Total Factor Productivity** a_t	**Price Deflator Gross Domestic Product** π_t
1960	-	-	-	-	-	-
1961	4,89	5,81	2,74	1,96	10,22	1,83
1962	6,45	4,61	5,63	1,83	7,34	5,56
1963	7,11	4,30	8,12	2,71	6,83	8,17
1964	4,94	1,31	6,29	3,26	4,21	6,13
1965	5,10	2,98	4,11	4,18	3,94	8,78
1966	5,03	5,49	2,21	4,82	4,64	7,85
1967	2,81	4,67	2,74	4,77	1,59	8,18
1968	4,64	4,73	1,72	4,79	3,68	5,74
1969	4,29	3,82	3,97	5,12	5,69	5,01
1970	4,42	3,32	6,64	4,99	1,55	5,78
1971	4,52	0,18	6,93	4,31	2,34	7,55
1972	4,82	2,34	5,48	5,43	5,41	8,18
1973	2,42	3,83	11,99	4,54	3,76	11,19
1974	2,44	2,45	18,44	5,87	2,48	14,80
1975	3,25	-3,47	15,69	7,14	-0,60	15,51
1976	1,66	4,71	16,09	6,01	1,98	15,26
1977	2,11	0,72	16,96	5,21	1,47	21,01
1978	2,50	1,69	13,05	5,76	0,96	18,76
1979	1,80	3,58	14,37	5,02	-0,21	15,64
1980	1,80	0,76	18,91	6,29	1,93	12,60
1981	3,31	-0,42	17,22	5,28	0,32	11,64
1982	2,22	-0,99	16,16	3,53	0,78	12,74
1983	1,80	-0,18	14,06	2,67	1,10	11,23
1984	2,10	1,98	10,22	4,02	2,55	10,32
1985	1,44	1,32	8,78	2,97	2,23	8,25
1986	1,43	1,41	7,22	0,20	0,86	10,33
1987	1,87	1,91	5,84	-1,54	1,34	5,77
1988	1,58	2,45	6,44	0,42	1,38	5,77
1989	2,36	2,10	6,01	0,99	0,80	6,67
1990	1,78	0,37	8,06	0,99	-0,37	7,07
1991	1,82	0,03	7,31	3,33	0,08	6,71
1992	3,10	0,44	4,28	5,25	0,35	6,49
1993	4,56	0,60	3,81	5,74	-0,32	4,44
1994	2,34	2,30	3,48	3,22	1,60	3,81

1995	1,60	2,27	4,81	1,24	0,41	4,82
1996	1,02	0,34	4,45	1,75	0,72	3,41
1997	1,28	1,06	2,57	-0,39	0,29	2,35
1998	0,95	0,53	2,50	-0,49	0,26	2,50
1999	1,27	0,56	1,61	-0,46	0,06	2,63
2000	0,32	1,79	1,95	-0,45	0,59	3,22
2001	0,35	-0,09	2,94	0,87	0,14	4,00
2002	1,14	-1,21	3,30	1,87	-0,36	4,03
2003	1,39	-0,96	3,13	1,71	-0,36	3,84
2004	1,51	0,54	2,49	1,79	-0,36	3,85
2005	1,89	0,16	1,87	1,27	-0,38	4,07
2006	0,33	0,17	1,88	1,42	-0,07	3,90
2007	1,02	0,09	2,41	1,76	-0,17	3,28
2008	2,06	-1,44	2,45	3,94	-0,61	2,11
2009	3,66	-4,25	1,94	8,60	-0,72	0,25
2010	1,62	1,93	0,32	4,47	0,96	0,16
2011	0,47	0,27	1,46	3,97	0,25	0,03
2012	1,41	-2,01	1,37	5,64	0,17	0,05
2013	2,14	-0,10	1,28	4,00	0,35	0,57
2014	-0,70	-0,39	0,88	-0,57	0,50	-0,40
2015	-1,49	0,32	0,52	-2,14	0,99	0,75
2016	-1,26	0,85	0,78	-1,53	0,75	0,95
2017	-0,95	0,70	1,56	-0,72	0,74	1,26

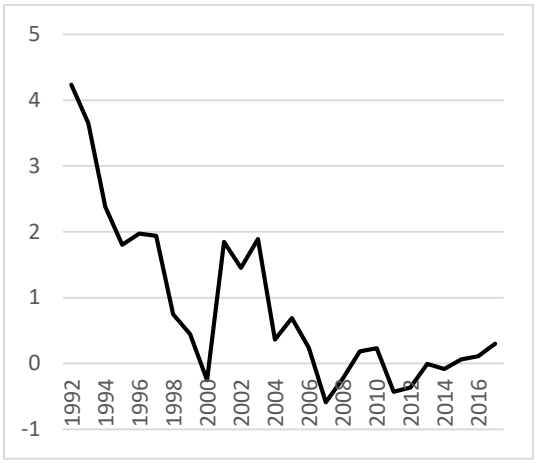
Table 6. Italian and Spanish time series for Structural VAR model

Table 5 and Table 6 show the new time series. We will use these series to make our estimations through the Structural VAR Model.

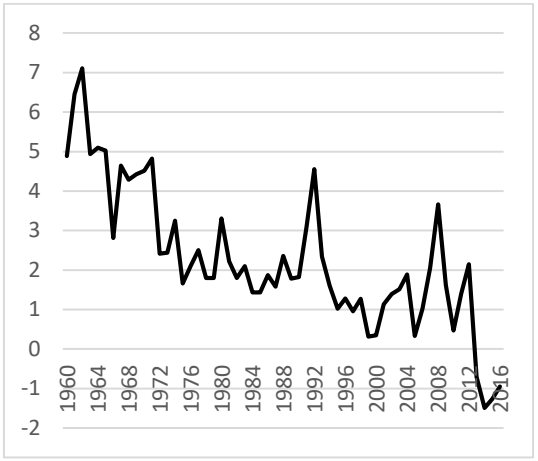
Before proceeding with our estimations, however, we have to ensure that the series used for the three variables considered are stationary. The condition that makes a historical series easier to analyse, in fact, is called stationarity. To check if a series is stationary or not, we have to proceed with the identification of the bottom trend movement. The series has a linear pattern when it grows or decreases steadily or stays on the same level. If we simply look at the graph we could draw some conclusions: if a process is stationary, it cannot show a steady or decreasing regular trend. Therefore, it might be thought to consider stationary a process that oscillates around a constant value, and not stationary otherwise. The graphs of the trends of our three variable, for each country analysed, can help us to make some considerations about their dynamics.



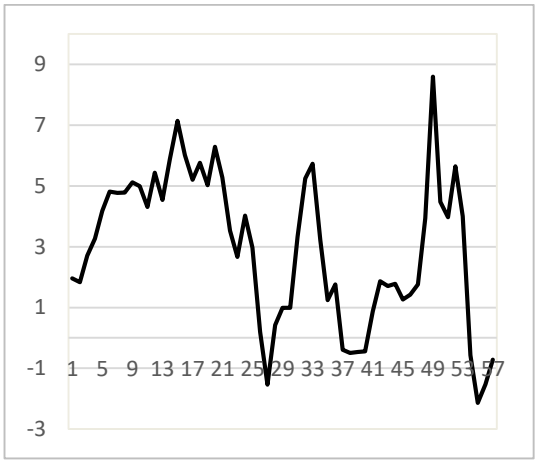
Graph 1. Trend of Dk, France



Graph 2. Trend of Dk, Germany



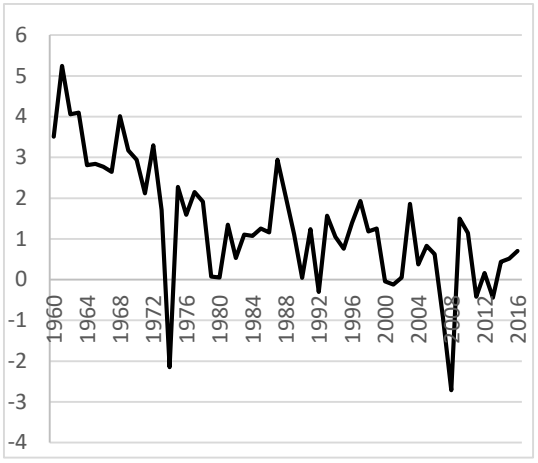
Graph 3. Trend of Dk, Italy



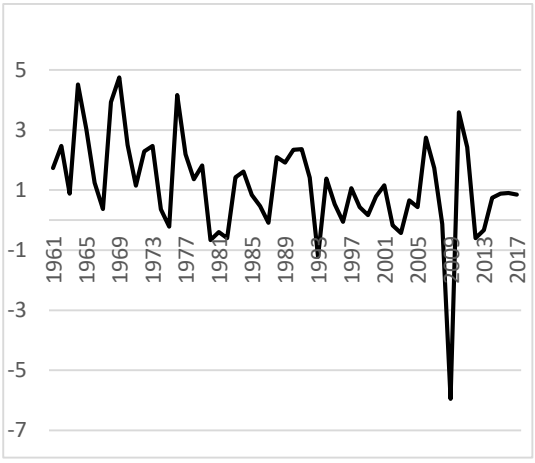
Graph 4. Trend of Dk, Spain

Graphs 1,2,3 and 4 show the dynamics of capital intensity respectively, for France, Germany, Italy and Spain. Considering the definition of stationarity and looking at the charts, we can state that the trend of Dk for France and Italy could be considered stationary around a trend, even if it is downward. For Germany and Spain, it is difficult to notice the stationarity of the historical series. The trend of German capital intensity starts with high value and then it tends to decreases with slightly peaks in 2001 and 2003.

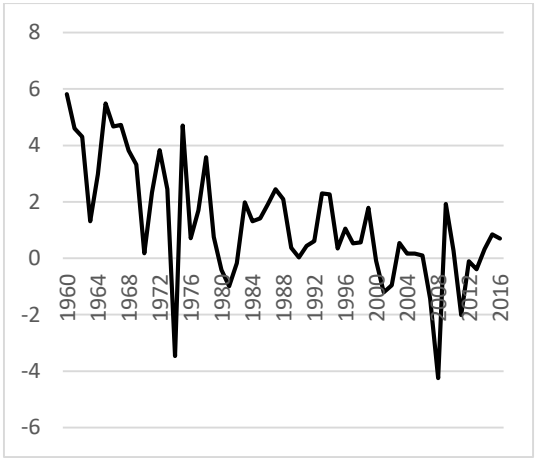
The trend of Spanish capital intensity is very articulated with several up and down, along all the period considered.



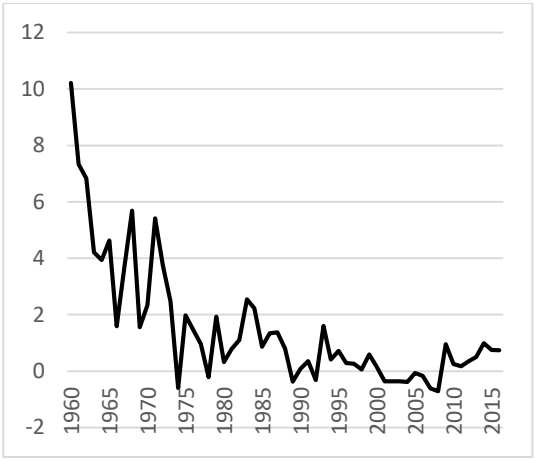
Graph 5. Trend of Da, France



Graph 6. Trend of Da, Germany

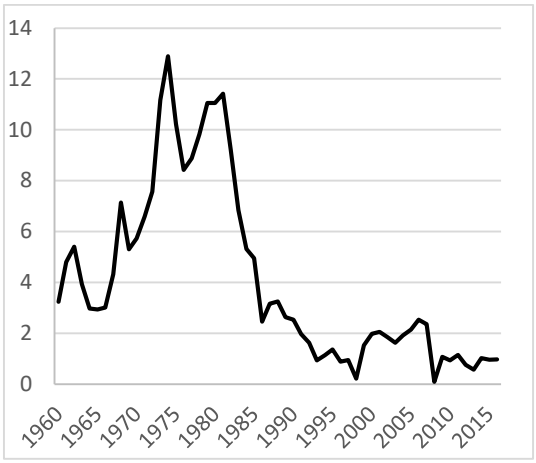


Graph 7. Trend of Da, Italy

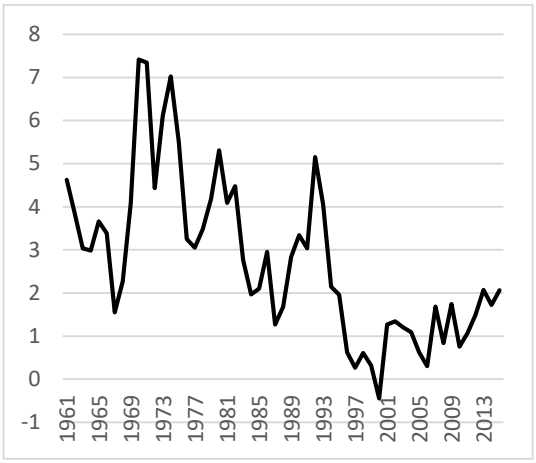


Graph 8. Trend of Da, Spain

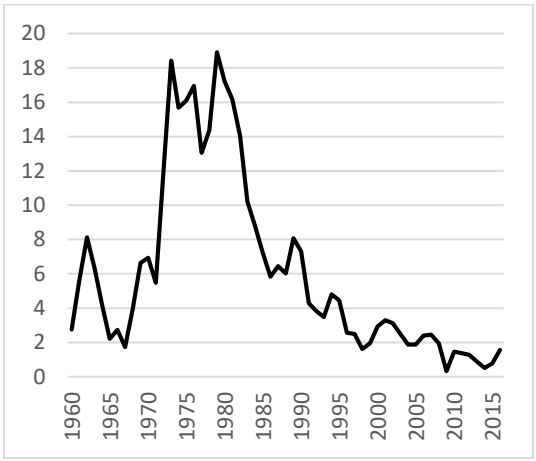
Graphs 5,6,7 and 8 show the dynamics of Total Factor Productivity, respectively for France, Germany, Italy and Spain. The charts of France, Germany and Italy are quite similar and we can hypothesize that there are stationarity in these time series, even if the trends are quite decreasing, especially for France and Italy. The Total Factor Productivity series of Spain, instead, starts with high values and then continues to be low, it seems to be non-stationary.



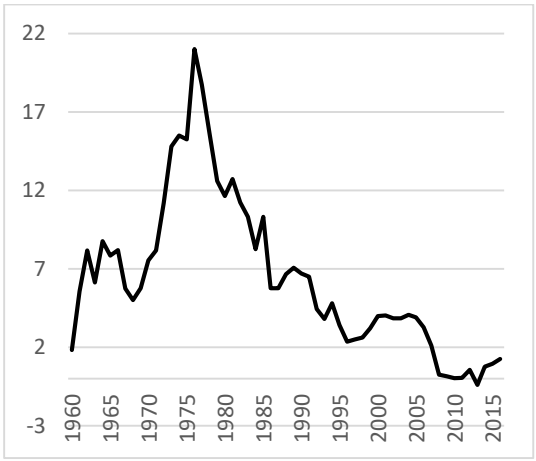
Graph 9. Trend of Dp, France



Graph 10. Trend of Dp, Germany



Graph 11. Trend of Dp, Italy



Graph 12. Trend f Dp, Spain

Graphs 9,10,11 and 12 show the dynamics of GDP Price Deflator, respectively for France, Germany, Italy and Spain. In this case, the charts of France and Italy appear to be similar, with two peaks around 1973 and 1979 and a lower stable trend after 1990. However, considering this trend, the series cannot be stationary. In the chart of Germany, there are more than two peaks, while in the Spanish one, only one peak around 1976, both series cannot be stationary.

By the analysis of the graphs, we would aspect that maybe a variable stationary could be the Total Factor Productivity, while capital intensity and GDP Price Deflator show non-stationary trends. However, to confirm our hypothesis, we have to use statistical tools that allow us to give a certain and truthful answer about statitionarity. Let us study more in depth the stationary condition and the methods for verifying and overcoming it.

6.8 Stationarity of historical series

The aim of the analysis of the historical series is to identify the components of the series trend, so that we can concentrate on the fundamental movement of the series

and use this information to make predictions. We are interested in giving a quantitative explanation of the evolution of a phenomenon, in order to formulate realistic hypotheses on its future course.

The stationary of an historical series refers to the characteristics of the underlying stochastic process that generated the time series. A stationary process is such that its probabilistic structure satisfies certain conditions of temporal invariance. If a series is stationary, we can use its history to predict its future behaviour. If a series is not stationary, we must proceed to a transformation that causes stationary. A stationary series must have constant average and constant variance, the expected value being invariant over time. Stationary on average ensures that the overall level of the series is always the same. Variance stationary ensures that the oscillations always have the same background structure. A stationary series is a series that at any time you observe it always has the same structure, so for example even cyclical movements have a limited impact. In practice, a stationary series is generally easier to analyse and, above all, it makes the forecasts easier and more robust.

Much of the historical series observed is not stationary. However, there are several procedures to make stationary the series, which are not. If we discover that a series is non-stationary, indeed, we can try to make it stationary. A first way is to make a stationary average on a series by subtracting the trend (this is called detractor operation), by making the difference between the observed value of the variable and the value assumed by the trend at the same time. A second way is that a series became stationary on average by differentiation, simply by subtracting to the current value, the value that had the series in the previous time. Unlike the detractor operation, differentiation makes the series more erratic, and it is almost impossible to observe structural movements. The last way to make a series stationary is to apply a filter to the variable in order to remove the cyclical component of a time series from raw data; the most famous filter is the Hodrick-Prescott Filter.

Constructing Structural VAR with historical series, we must ensure that these series are stationary for the correct function of our model. To demonstrate the stationary of a historical series, we use the descriptive statistic, with two types of unit root test. Unit root tests are the types of tests that are used to determine if the time series in question has a unitary root in it, which can be used to determine if the data generating process is either trend-stationary or differential-stationary. The first test, we use, is the Dicky-Fuller test: it imposes as null hypothesis that the series is non-stationary. Therefore, we observe the p-value, if the p-value is less than the critical threshold (5%), we can accept the alternative hypothesis, that is, the series is stationary. The second type of test is the KPSS test: the null hypothesis, this time, is that the series is stationary. This test is "right-handed", so it rejects the null hypothesis when the test statistic is greater than the critical threshold set. Therefore, we observe the p-value, if the p-value is less than the significant level, we can accept the null hypothesis, so the series is stationary. To use a steady-state test as well as a unit root test is rather useful to robust the results. In fact, the null hypothesis of a unit root test may not be rejected for poor test performance. If the KPSS test confirms the non-stationary of the process, our confidence in the presence of a unitary root grows. When the results of the two tests agree, we can consider them rather robust, but it is not always so.

Let us see more in depth these two kind of test and the results obtained for the three variables of our model.

6.8.1 Dicky-Fuller Test

The first test that we use to check the stationarity of our variables is the Dicky-Fuller Test. The name come from the statisticians David Dickey and Wayne Fuller, who developed the test in 1979. In our model, in particular, using the statistical software Gretl, we use the increased Dicky-Fuller Test (ADF). This command requires an entire delay order. If the delay order is zero, a standard Dickey-Fuller test (not increased) is performed. The command calculates a set of Dickey-Fuller tests on the selected variable. The null hypothesis assumes that the variable has a unitary root, so the series is non-stationary; w

hile the alternative hypothesis is that the series is stationary. The critical threshold of the p-value is 0,05 (or 5%). Therefore, if $p - value < 0{,}05$, we reject the null hypothesis and the series is stationary, if $p - value > 0{,}05$, we accept the null hypothesis and the series is non-stationary.

We will use the same characteristic of the test for each variable and each country considered. In particular, we formulate a backward test with a number of delays suggested by the software Gretl, based on the structure of our series and amplitude of the sample. The amplitude of the sample varies based on the data available for each variable. We considered series with a trend and a constant and we apply the AIC criterion. Let us see the results obtained for the three variables for each of the country considered.

First, we make the test for the variables in (39), (40), (41), our variables, made homogeneous through the log differences, Dk, Da and Dp. We look at the p-values and we compare them with the critical value of 0,05.

Variable	***Dk***		***Da***		***Dp***	
Country	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**
P-Value	0,05671	0,1436	***6,68E-05***	***1,56E-09***	0,504	0,09067

Chart 1. ADF Test results for Dk, Da and Dp

Variable	***Dk***		***Da***		***Dp***	
Country	**Italy**	**Spain**	**Italy**	**Spain**	**Italy**	**Spain**
P-Value	0,274	***0,0372***	***1,81E-06***	0,6113	***0,005877***	0,4013

Chart 2. ADF Test results for Dk, Da and Dp

From the values obtained, it is easy to see in which case we have to accept or to reject the null hypothesis of non-stationarity. For the capital intensity, only in the case of Spain, with a p-value of 0,0372, we can reject the null hypothesis and consider the series stationary. The other countries present all a $p - value > 0{,}05$, so their time series are non-stationary. About Total Factor Productivity, the p-values of France, Germany and

Italy are very small (6,68E-05; 1,56E-09; 1,81E-06, respectively) so the series can be considered stationary. However, the Spanish p-value is greater than 0,05, we have to accept the null hypothesis of non-stationarity. The ADF test for the GDP Price Deflator gives us, as results, p-values greater than 0,05 for France, Germany and Spain, so we have to assume the non stationarity of their time series. Only the p-value of Italy, 0,005877, permits us to reject the null hypothesis and to affirm the stationarity of the series.

To sum up none of our three variables has a constant stationarity in all the four countries analysed. Therefore, given the results obtained, we have to proceed with the solutions described in the previous paragraph to overcome the non-stationary condition of the time series. In particular, we will use two methods: the first one consists in calculate the prime differences of our three variables; the second method is to apply to them a particular filter, the Hodrick-Prescott filter.

In the first method, we calculate the prime differences of the variables and we obtain the new variables written in this way:

$$d_{Dk} = prime\ difference\ (Dk) \tag{109}$$

$$d_{Da} = prime\ difference\ (Da) \tag{110}$$

$$d_{Dp} = prime\ difference\ (Dp) \tag{111}$$

Before to apply the ADF Test to the variable (109), (110) and (111), let us look at the values assumed by them and let us analyse their graphs, in order to make an idea about their possible stationarity.

	France			***Germany***		
	Prime Difference Capital Intensity d_{Dk}	***Prime Difference TFP*** d_{Da}	***Prime Difference GDP Price Deflator*** d_{Dp}	***Prime Difference Capital Intensity*** d_{Dk}	***Prime Difference TFP*** d_{Da}	***Prime Difference GDP Price Deflator*** d_{Dp}
1960	-	-	-	-	-	-
1961	-	-	-	-	-	-
1962	0,21	1,74	1,56	-	0,73	-0,78
1963	-0,53	-1,18	0,61	-	-1,58	-0,80
1964	0,11	0,03	-1,47	-	3,63	-0,06
1965	0,82	-1,29	-0,95	-	-1,48	0,68
1966	-0,31	0,04	-0,04	-	-1,79	-0,27
1967	0,64	-0,07	0,08	-	-0,87	-1,83
1968	0,70	-0,13	1,30	-	3,56	0,72
1969	-1,48	1,36	2,82	-	0,82	1,81
1970	0,11	-0,84	-1,84	-	-2,25	3,33
1971	0,82	-0,22	0,44	-	-1,35	-0,07
1972	-0,24	-0,83	0,85	-	1,14	-2,91

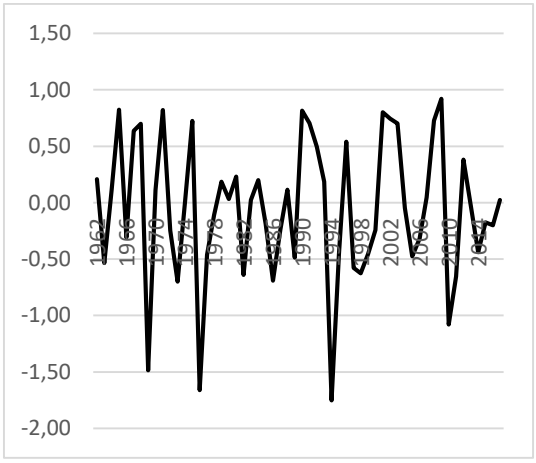
1973	-0,70	1,18	0,99	-	0,18	1,68
1974	0,00	-1,59	3,60	-	-2,10	0,91
1975	0,72	-3,85	1,72	-	-0,58	-1,51
1976	-1,66	4,42	-2,67	-	4,38	-2,26
1977	-0,46	-0,68	-1,80	-	-1,97	-0,20
1978	-0,11	0,56	0,46	-	-0,83	0,43
1979	0,19	-0,24	0,94	-	0,46	0,70
1980	0,03	-1,84	1,24	-	-2,49	1,12
1981	0,23	-0,02	0,00	-	0,27	-1,22
1982	-0,64	1,30	0,36	-	-0,20	0,39
1983	0,02	-0,82	-2,20	-	2,03	-1,71
1984	0,20	0,58	-2,38	-	0,19	-0,80
1985	-0,19	-0,03	-1,52	-	-0,77	0,13
1986	-0,69	0,18	-0,37	-	-0,37	0,85
1987	-0,24	-0,09	-2,49	-	-0,55	-1,68
1988	0,12	1,78	0,70	-	2,18	0,40
1989	-0,49	-0,91	0,09	-	-0,19	1,16
1990	0,81	-0,92	-0,61	-	0,43	0,50
1991	0,70	-1,07	-0,10	-	0,03	-0,30
1992	0,49	1,20	-0,57	-	-0,95	2,11
1993	0,19	-1,54	-0,34	-2,32	-2,63	-1,10
1994	-1,75	1,87	-0,69	-5,09	2,59	-1,91
1995	-0,46	-0,52	0,21	-2,31	-0,85	-0,18
1996	0,54	-0,29	0,22	0,68	-0,59	-1,34
1997	-0,58	0,64	-0,48	-0,14	1,12	-0,36
1998	-0,63	0,53	0,07	-4,76	-0,63	0,34
1999	-0,46	-0,75	-0,73	-1,21	-0,27	-0,29
2000	-0,24	0,08	1,31	-2,80	0,62	-0,77
2001	0,80	-1,30	0,45	8,41	0,38	1,72
2002	0,75	-0,08	0,07	-1,57	-1,33	0,07
2003	0,70	0,17	-0,19	1,75	-0,26	-0,14
2004	-0,05	1,81	-0,22	-6,11	1,09	-0,11
2005	-0,47	-1,49	0,29	1,30	-0,22	-0,47
2006	-0,32	0,45	0,22	-1,82	2,31	-0,32
2007	0,05	-0,21	0,39	-3,31	-1,02	1,38
2008	0,73	-1,56	-0,18	1,45	-1,87	-0,85
2009	0,92	-1,78	-2,25	1,66	-5,82	0,91
2010	-1,08	4,21	0,98	0,19	9,54	-0,99
2011	-0,66	-0,35	-0,13	-2,65	-1,16	0,31
2012	0,38	-1,56	0,21	0,25	-3,02	0,43
2013	-0,03	0,58	-0,40	1,45	0,26	0,58
2014	-0,44	-0,60	-0,19	-0,33	1,08	-0,35
2015	-0,17	0,88	0,46	0,60	0,14	0,34
2016	-0,20	0,07	-0,06	0,19	0,02	-0,52
2017	0,02	0,19	0,01	0,76	-0,05	0,20

Table 5. French and German Prime Differences Time Series

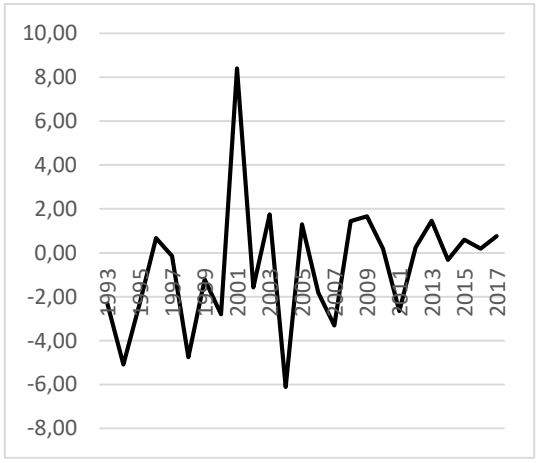
	Italy			*Spain*		
	Prime Difference Capital Intensity d_{Dk}	***Prime Difference TFP*** d_{Da}	***Prime Difference GDP Price Deflator*** d_{Dp}	***Prime Difference Capital Intensity*** d_{Dk}	***Prime Difference TFP*** d_{Da}	***Prime Difference GDP Price Deflator*** d_{Dp}
1960	-	-	-	-	-	-
1961	-	-	-	-	-	-
1962	1,57	-1,21	2,88	-0,13	-2,88	3,73
1963	0,66	-0,30	2,49	0,88	-0,51	2,61
1964	-2,17	-2,99	-1,83	0,56	-2,61	-2,04
1965	0,16	1,66	-2,18	0,92	-0,27	2,64
1966	-0,07	2,51	-1,90	0,63	0,70	-0,92
1967	-2,21	-0,81	0,53	-0,05	-3,05	0,33
1968	1,83	0,06	-1,02	0,02	2,10	-2,44
1969	-0,36	-0,91	2,25	0,34	2,00	-0,73
1970	0,14	-0,50	2,67	-0,13	-4,14	0,77
1971	0,09	-3,15	0,29	-0,68	0,79	1,78
1972	0,31	2,16	-1,45	1,13	3,07	0,63
1973	-2,41	1,49	6,51	-0,90	-1,65	3,01
1974	0,03	-1,38	6,45	1,34	-1,28	3,61
1975	0,81	-5,92	-2,75	1,27	-3,08	0,71
1976	-1,59	8,18	0,40	-1,13	2,58	-0,24
1977	0,44	-3,99	0,87	-0,81	-0,51	5,75
1978	0,40	0,98	-3,90	0,56	-0,51	-2,25
1979	-0,71	1,89	1,31	-0,74	-1,17	-3,12
1980	0,00	-2,83	4,54	1,26	2,14	-3,04
1981	1,51	-1,17	-1,69	-1,00	-1,61	-0,95
1982	-1,09	-0,58	-1,05	-1,75	0,46	1,09
1983	-0,42	0,81	-2,10	-0,86	0,32	-1,51
1984	0,30	2,16	-3,84	1,35	1,45	-0,91
1985	-0,66	-0,66	-1,44	-1,05	-0,32	-2,07
1986	0,00	0,10	-1,56	-2,77	-1,36	2,08
1987	0,43	0,50	-1,39	-1,74	0,48	-4,55
1988	-0,29	0,54	0,60	1,96	0,03	-0,01
1989	0,77	-0,35	-0,43	0,56	-0,58	0,90
1990	-0,57	-1,73	2,05	0,00	-1,17	0,40
1991	0,04	-0,34	-0,75	2,34	0,45	-0,36
1992	1,28	0,41	-3,03	1,92	0,28	-0,21
1993	1,45	0,16	-0,46	0,49	-0,67	-2,06
1994	-2,21	1,69	-0,33	-2,52	1,92	-0,63
1995	-0,74	-0,03	1,33	-1,98	-1,19	1,01
1996	-0,58	-1,92	-0,35	0,51	0,31	-1,40
1997	0,26	0,71	-1,88	-2,14	-0,43	-1,06
1998	-0,32	-0,52	-0,07	-0,11	-0,02	0,15

1999	0,31	0,03	-0,89	0,03	-0,20	0,13
2000	-0,95	1,23	0,34	0,02	0,53	0,59
2001	0,03	-1,88	1,00	1,32	-0,45	0,78
2002	0,79	-1,12	0,36	0,99	-0,49	0,03
2003	0,25	0,25	-0,17	-0,16	-0,01	-0,19
2004	0,12	1,50	-0,64	0,08	0,00	0,00
2005	0,37	-0,38	-0,62	-0,52	-0,02	0,22
2006	-1,56	0,00	0,01	0,15	0,31	-0,16
2007	0,69	-0,07	0,52	0,34	-0,10	-0,62
2008	1,04	-1,53	0,04	2,17	-0,45	-1,16
2009	1,60	-2,81	-0,51	4,66	-0,10	-1,86
2010	-2,04	6,18	-1,62	-4,13	1,67	-0,09
2011	-1,15	-1,65	1,14	-0,51	-0,71	-0,13
2012	0,94	-2,29	-0,09	1,68	-0,08	0,02
2013	0,74	1,91	-0,09	-1,65	0,18	0,52
2014	-2,85	-0,28	-0,40	-4,57	0,15	-0,96
2015	-0,78	0,71	-0,36	-1,57	0,49	1,15
2016	0,23	0,53	0,26	0,61	-0,24	0,19
2017	0,31	-0,15	0,78	0,81	-0,01	0,31

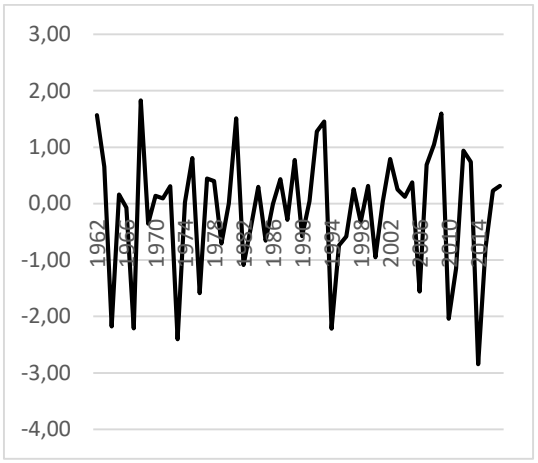
Table 6. Italian and Spainish Prime Differences Time Series



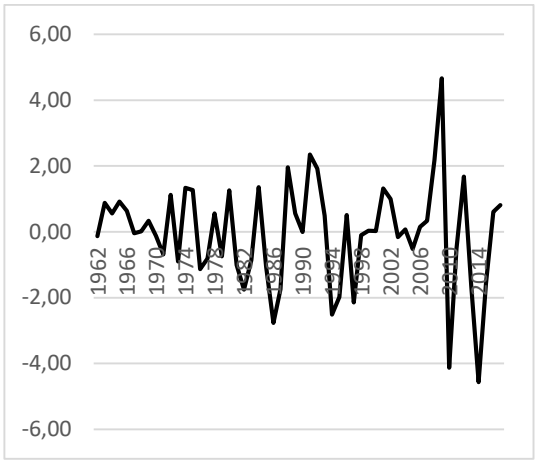
Graph 13. d_{Dk}, France



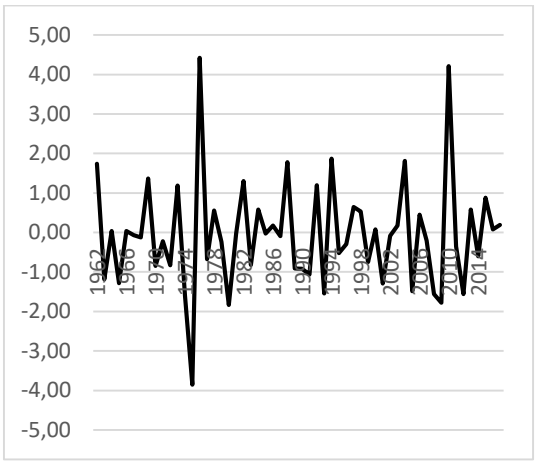
Graph14. d_{Dk}, Germany



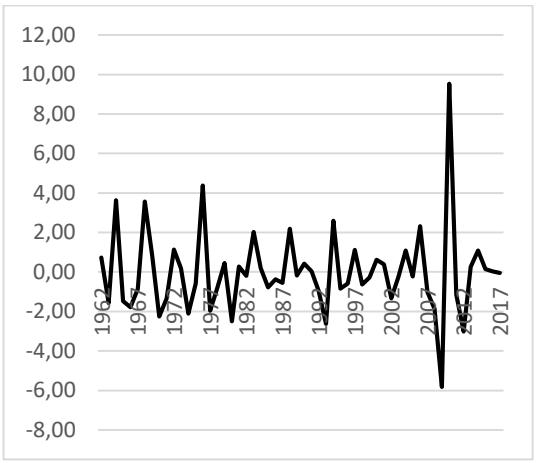
Graph15. d_{Dk}, Italy



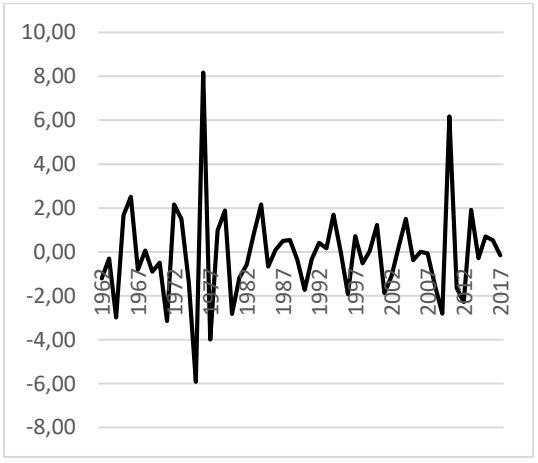
Graph16. d_{Dk}, Spain



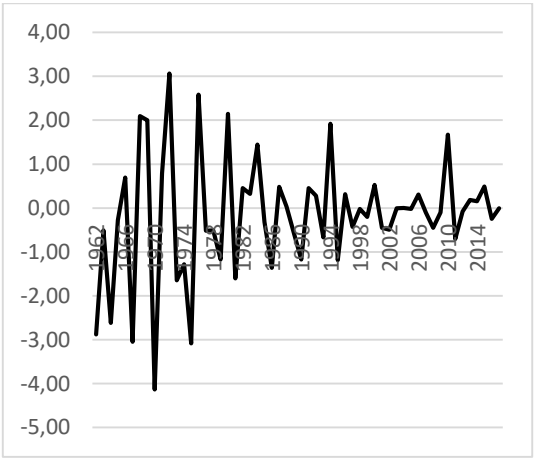
Graph17. d_{Da}, France



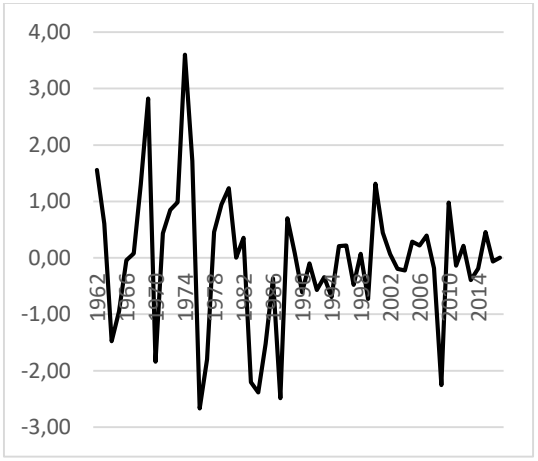
Graph 18. d_{Da}, Germany



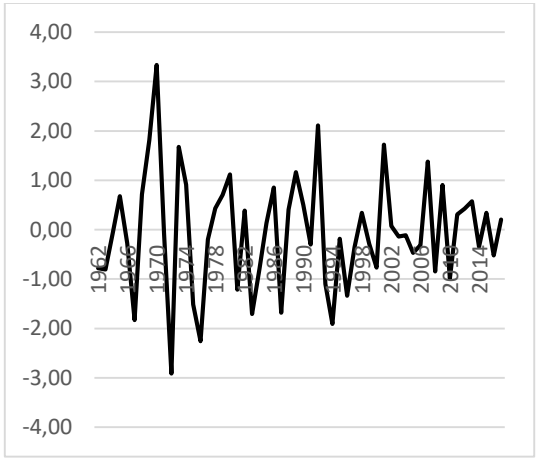
Graph 19. d_{Da}, Italy



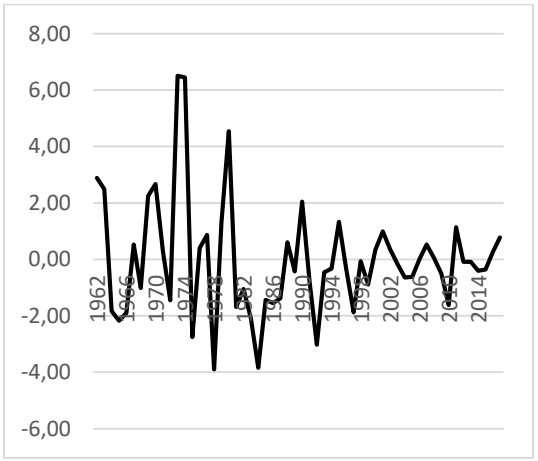
Graph 20. d_{Da}, Spain



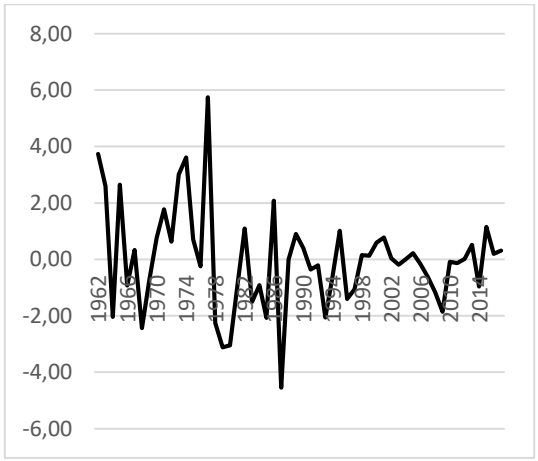
Graph21. d_{Dp}, France



Graph22. d_{Dp}, Germany



Graph23. d_{Dp}, Italy



Graph24. d_{Dp}, Spain

It is easy to see how all the graphs of the three variables, for each analysed country, show steady trends that swing around a central value. We can also notice the difference with the previous graphs of variables before the introduction of prime differences and compare them. All the graphs give us the idea of stationary variables.

Now it is time to see the results obtained with the ADF Test applied to the new time series for each of the country considered.

Variable	d_{Dk}		d_{Da}		d_{Dp}	
Country	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**
P-Value	***1,06E-09***	0,5224	***8,44E-07***	***1,73E-05***	***3,82E-05***	***8,28E-09***

Chart 3. ADF Test results for d_{Dk}, d_{Da} and d_{Dp}

Variable	d_{Dk}		d_{Da}		d_{Dp}	
Country	**Italy**	**Spain**	**Italy**	**Spain**	**Italy**	**Spain**
P-Value	0,07021	***1,36E-07***	***6,35E-03***	***1,05E-05***	***0,007197***	***6,50E-07***

Chart 4. ADF Test results for d_{Dk}, d_{Da} and d_{Dp}

If we look at the values in the tables, we can easily see that for Total Factor Productivity and for the GDP Price Deflator, we can reject the null hypothesis of non-stationarity because all the p-values, for each country, are less than the critical level of 0,05. Therefore, in this case, we can affirm that these two variables are stationary. This certainty is not yet possible for the capital intensity, as the series of Germany and Italy have a p-value greater than 0,05, so we must accept the null hypothesis of non-stationarity. Let us see if the second method can overcome this problem.

In the second method, we will apply the Hodrick- Prescott Filter to our three variables. The filter gives us two series: the one of the trend and the one of the cycle. We will apply the increased Dicky-Fuller Test to the series of the cycle; they are written in this way:

$$hp_{Dk} = \ Hodrick - Prescott\ Filter\ Cycle\ (Dk) \tag{112}$$

$$hp_{Da} = \ Hodrick - Prescott\ Filter\ Cycle\ (Da) \tag{113}$$

$$hp_{Dp} = \ Hodrick - Prescott\ Filter\ Cycle\ (Dp) \tag{114}$$

As before, we look at the values and at the graphs of the variables (112), (113) and (114), in order to have an idea of the possible stationarity of the new series.

	France			***Germany***		
	Hodrick-Prescott Filter (Dk) hp_{Dk}	***Hodrick-Prescott Filter (Da)*** hp_{Da}	***Hodrick-Prescott Filter (Dp)*** hp_{Dp}	***Hodrick-Prescott Filter (Dk)*** hp_{Dk}	***Hodrick-Prescott Filter (Da)*** hp_{Da}	***Hodrick-Prescott Filter (Dp)*** hp_{Dp}
1960	-	-	-	-	-	-
1961	-0,76	-0,34	-1,84	-	-0,46	1,19
1962	-0,47	1,54	-0,45	-	0,20	0,38
1963	-0,93	0,49	-0,02	-	-1,46	-0,45
1964	-0,74	0,67	-1,67	-	2,10	-0,57
1965	0,16	-0,48	-2,79	-	0,58	0,00
1966	-0,07	-0,31	-3,00	-	-1,23	-0,42
1967	0,65	-0,24	-3,09	-	-2,10	-2,44
1968	1,43	-0,23	-1,95	-	1,46	-1,97
1969	0,03	1,27	0,72	-	2,32	-0,43

1970	0,23	0,56	-1,27	-	0,16	2,65
1971	1,15	0,46	-0,96	-	-1,08	2,38
1972	1,00	-0,24	-0,23	-	0,20	-0,65
1973	0,40	1,06	0,67	-	0,53	1,00
1974	0,50	-0,41	4,21	-	-1,43	1,96
1975	1,33	-4,15	5,88	-	-1,87	0,58
1976	-0,23	0,37	3,20	-	2,65	-1,50
1977	-0,58	-0,21	1,42	-	0,83	-1,50
1978	-0,59	0,44	1,93	-	0,16	-0,87
1979	-0,29	0,29	2,95	-	0,77	0,03
1980	-0,15	-1,47	4,31	-	-1,59	1,36
1981	0,18	-1,41	4,45	-	-1,23	0,36
1982	-0,35	-0,05	4,99	-	-1,40	0,98
1983	-0,23	-0,80	2,98	-	0,62	-0,51
1984	0,07	-0,17	0,82	-	0,76	-1,12
1985	-0,02	-0,15	-0,46	-	-0,07	-0,83
1986	-0,62	0,08	-0,57	-	-0,51	0,14
1987	-0,77	0,03	-2,79	-	-1,14	-1,48
1988	-0,56	1,86	-1,82	-	0,97	-1,04
1989	-0,97	0,99	-1,46	-	0,74	0,13
1990	-0,07	0,11	-1,79	-	1,17	0,65
1991	0,71	-0,92	-1,62	-	1,24	0,40
1992	1,27	0,32	-1,93	0,74	0,36	2,62
1993	1,53	-1,19	-2,02	0,56	-2,17	1,70
1994	-0,16	0,72	-2,47	-0,33	0,52	0,03
1995	-0,56	0,23	-2,02	-0,54	-0,24	0,11
1996	0,04	-0,02	-1,59	-0,04	-0,75	-0,95
1997	-0,48	0,65	-1,86	0,23	0,43	-1,06
1998	-1,06	1,23	-1,59	-0,70	-0,14	-0,51
1999	-1,47	0,51	-2,14	-0,78	-0,37	-0,64
2000	-1,67	0,63	-0,66	-1,31	0,27	-1,31
2001	-0,84	-0,63	-0,05	0,93	0,68	0,47
2002	-0,06	-0,67	0,16	0,67	-0,64	0,55
2003	0,67	-0,46	0,11	1,23	-0,89	0,41
2004	0,64	1,38	0,01	-0,16	0,20	0,27
2005	0,19	-0,06	0,43	0,30	-0,01	-0,24
2006	-0,11	0,43	0,76	-0,03	2,32	-0,62
2007	-0,04	0,26	1,27	-0,75	1,34	0,69
2008	0,71	-1,26	1,20	-0,30	-0,49	-0,24
2009	1,65	-3,01	-0,95	0,18	-6,30	0,58
2010	0,59	1,24	0,13	0,28	3,21	-0,50
2011	-0,04	0,91	0,09	-0,35	2,01	-0,29
2012	0,36	-0,62	0,40	-0,28	-1,05	0,04
2013	0,36	-0,01	0,10	0,07	-0,84	0,52
2014	-0,05	-0,59	0,01	-0,03	0,17	0,07
2015	-0,20	0,32	0,56	0,08	0,23	0,33
2016	-0,38	0,42	0,59	0,09	0,18	-0,27

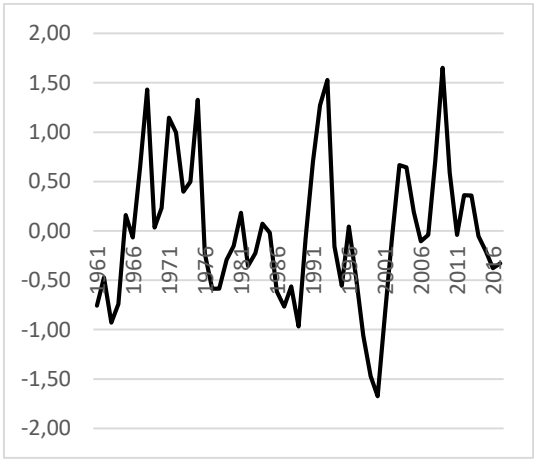
2017	-0,33	0,64	0,70	0,24	0,06	-0,15

Table 7. French and German Hodrick-Prescott Cycle Time Series

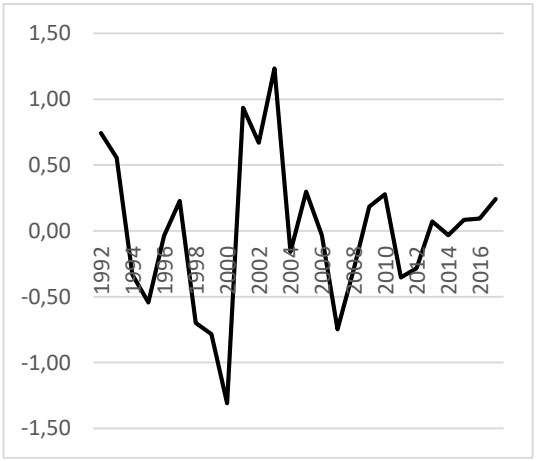
	Italy			***Spain***		
	Hodrick Prescott Filter (Dk) hp_{Dk}	***Hodrick Prescott Filter (Da)*** hp_{Da}	***Hodrick Prescott Filter (Dp)*** hp_{Dp}	***Hodrick Prescott Filter (Dk)*** hp_{Dk}	***Hodrick Prescott Filter (Da)*** hp_{Da}	***Hodrick Prescott Filter (Dp)*** hp_{Dp}
1960	-	-	-	-	-	-
1961	-0,60	1,47	-2,70	-2,10	4,15	-5,27
1962	1,14	0,43	-0,19	-2,28	1,56	-1,84
1963	1,97	0,29	1,92	-1,46	1,34	0,46
1964	-0,04	-2,53	-0,29	-0,94	-0,98	-1,88
1965	0,30	-0,70	-2,84	-0,07	-0,97	0,47
1966	0,40	1,97	-5,12	0,52	0,00	-0,74
1967	-1,65	1,32	-4,96	0,44	-2,77	-0,69
1968	0,35	1,53	-6,34	0,43	-0,40	-3,41
1969	0,16	0,79	-4,45	0,74	1,86	-4,40
1970	0,46	0,45	-2,13	0,61	-2,02	-3,89
1971	0,71	-2,55	-2,17	-0,08	-0,99	-2,34
1972	1,17	-0,24	-3,93	1,05	2,32	-1,92
1973	-1,08	1,40	2,30	0,18	0,90	0,91
1974	-0,91	0,15	8,50	1,55	-0,17	4,36
1975	0,04	-5,63	5,54	2,86	-3,04	4,95
1976	-1,42	2,68	5,78	1,79	-0,26	4,63
1977	-0,85	-1,20	6,54	1,05	-0,59	10,35
1978	-0,34	-0,10	2,58	1,70	-0,93	8,11
1979	-0,93	1,89	3,88	1,05	-1,94	5,05
1980	-0,82	-0,83	8,47	2,42	0,36	2,11
1981	0,78	-1,91	6,87	1,53	-1,11	1,31
1982	-0,22	-2,40	5,97	-0,10	-0,52	2,58
1983	-0,55	-1,51	4,06	-0,84	-0,08	1,30
1984	-0,18	0,73	0,46	0,64	1,48	0,63
1985	-0,76	0,13	-0,72	-0,28	1,26	-1,16
1986	-0,70	0,30	-1,97	-2,93	0,00	1,23
1987	-0,20	0,86	-3,03	-4,55	0,57	-3,00
1988	-0,43	1,46	-2,08	-2,47	0,69	-2,68
1989	0,40	1,17	-2,14	-1,80	0,19	-1,43
1990	-0,12	-0,50	0,28	-1,70	-0,91	-0,67
1991	-0,03	-0,78	-0,09	0,74	-0,39	-0,67
1992	1,30	-0,31	-2,73	2,75	-0,06	-0,52
1993	2,80	-0,09	-2,81	3,32	-0,67	-2,22
1994	0,64	1,66	-2,75	0,89	1,29	-2,49
1995	-0,04	1,69	-1,05	-1,02	0,15	-1,12
1996	-0,57	-0,18	-1,03	-0,44	0,50	-2,18
1997	-0,26	0,60	-2,55	-2,52	0,10	-2,89

1998	-0,53	0,13	-2,27	-2,57	0,11	-2,41
1999	-0,16	0,22	-2,82	-2,50	-0,07	-1,95
2000	-1,06	1,51	-2,15	-2,44	0,49	-1,04
2001	-0,97	-0,31	-0,84	-1,10	0,05	0,05
2002	-0,13	-1,38	-0,17	-0,08	-0,43	0,38
2003	0,19	-1,07	-0,05	-0,22	-0,42	0,50
2004	0,37	0,48	-0,40	-0,13	-0,42	0,79
2005	0,80	0,15	-0,75	-0,63	-0,44	1,30
2006	-0,69	0,20	-0,47	-0,46	-0,13	1,43
2007	0,07	0,17	0,31	-0,10	-0,23	1,09
2008	1,19	-1,32	0,60	2,10	-0,69	0,21
2009	2,87	-4,10	0,33	6,79	-0,81	-1,37
2010	0,91	2,11	-1,05	2,71	0,84	-1,19
2011	-0,16	0,49	0,32	2,25	0,11	-1,05
2012	0,87	-1,77	0,47	3,98	0,01	-0,76
2013	1,71	0,17	0,60	2,40	0,17	0,02
2014	-1,04	-0,09	0,42	-2,10	0,29	-0,68
2015	-1,73	0,63	0,29	-3,60	0,76	0,73
2016	-1,40	1,19	0,77	-2,92	0,49	1,18
2017	-0,99	1,05	1,77	-2,04	0,45	1,75

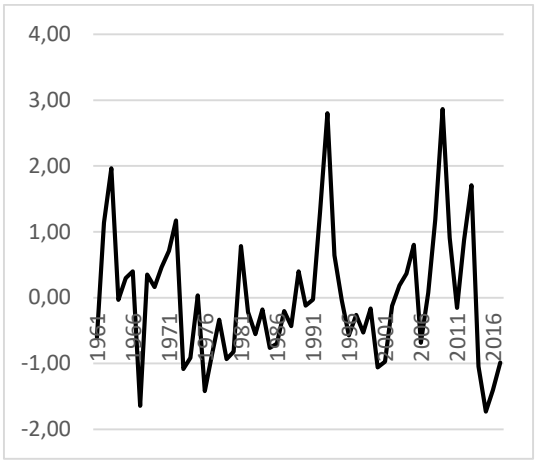
Table 8. Italian and Spanish Hodrick-Prescott Cycle Time Series



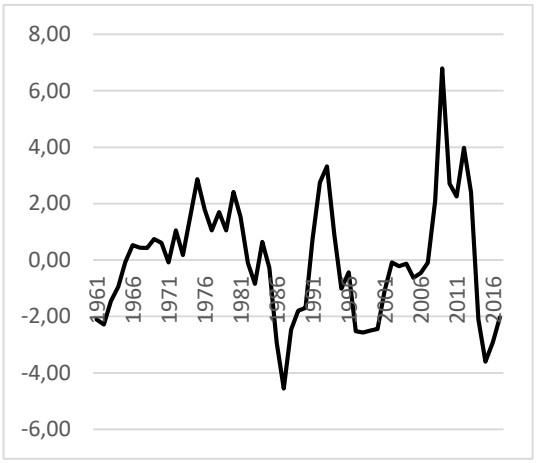
Graph24. hp_{Dk}, France



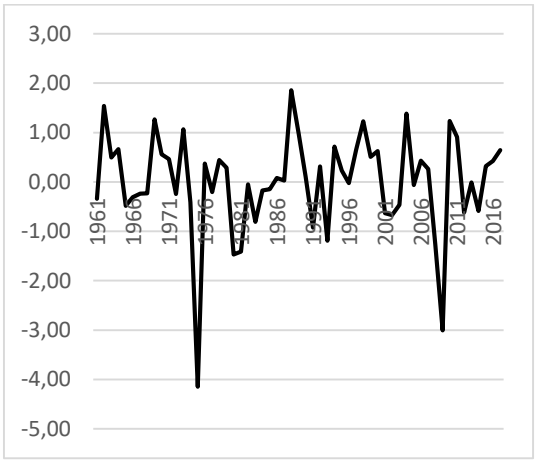
Graph25. hp_{Dk}, Germany



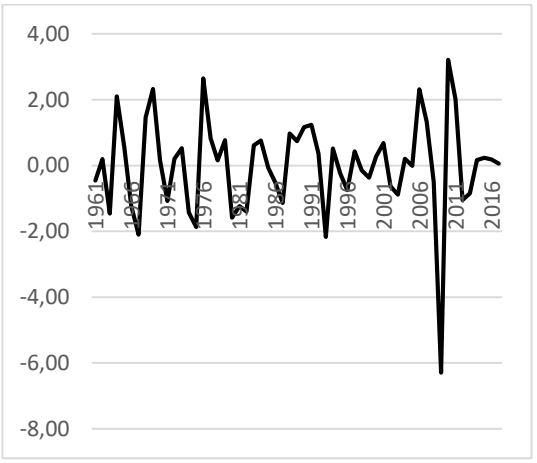
Graph26. hp_{Dk}, Italy



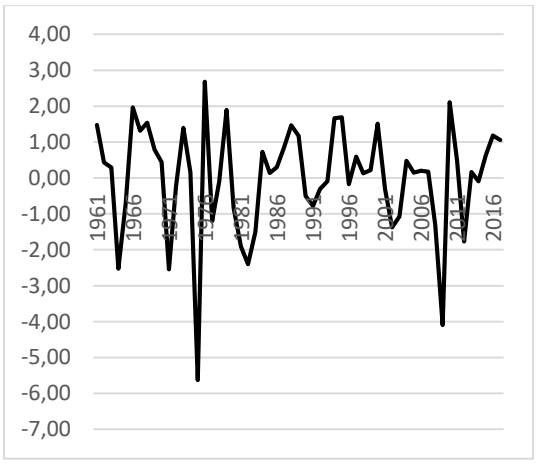
Graph27. hp_{Dk}, Spain



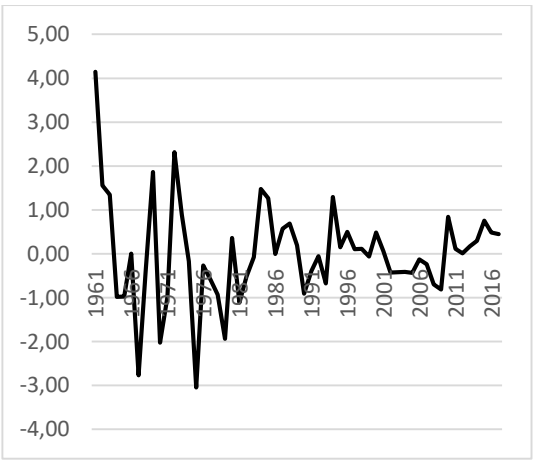
Graph28. hp_{Da}, France



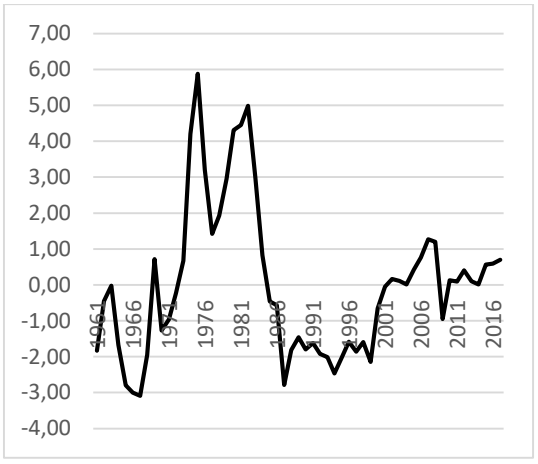
Graph29. hp_{Da}, Germany



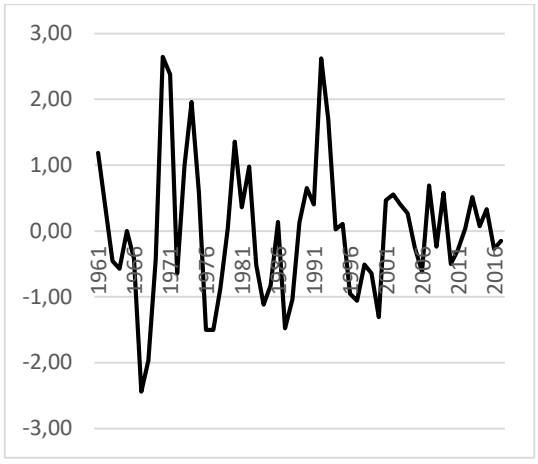
Graph30. hp_{Da}, Italy



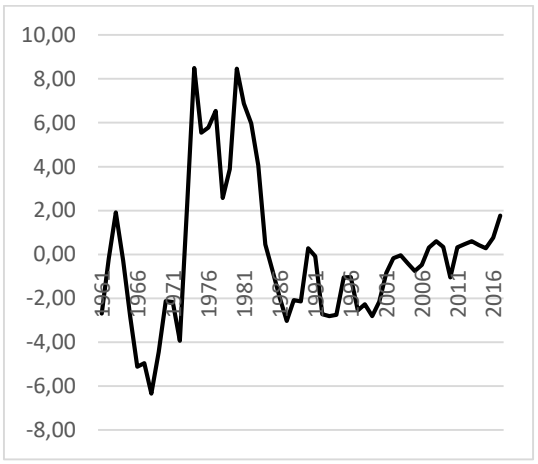
Graph31. hp_{Da}, Spain



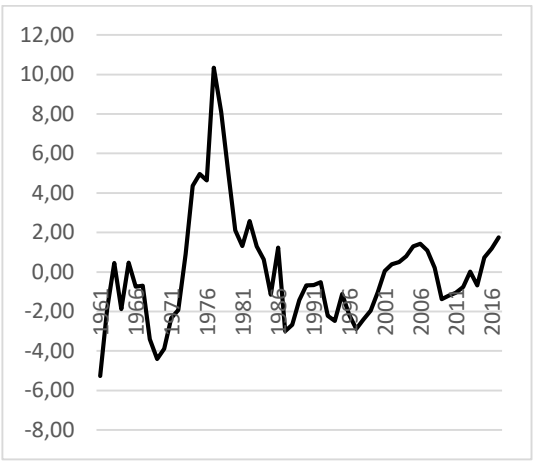
Graph32. hp_{Dp}, France



Graph33. hp_{Dp} , Germany



Graph34. hp_{Dp}, Italy



Graph35. hp_{Dp}, Spain

Also in this case, as for the graphs of the prime differences time series before, the graphs show trends quite stationary that fluctuate around a central value. Maybe there some exceptions, as in the graphs of Hodrick-Prescott Filter cycle for France, Italy and Spain. There we can notice a peak around 1980, which can deviate us from the hypothesis of stationarity. In any case, to have an empirical certainty of the stationary of the time series, we apply them the ADF test.

Let look now at the charts below, in order to study the results after the application of the ADF test to the variables in (45), (46) and (47) for each country.

.

Variable	hp_{Dk}		hp_{Da}		hp_{Dp}	
Country	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**
P-Value	***6,96E-03***	***9,17E-05***	***3,36E-06***	***1,88E-05***	2,97E-01	***2,46E-06***

Chart 5. ADF Test results for hp_{Dk}, hp_{Da} and hp_{Dp}

Variable	hp_{Dk}		hp_{Da}		hp_{Dp}	
Country	**Italy**	**Spain**	**Italy**	**Spain**	**Italy**	**Spain**
P-Value	***0,04661***	***0,01753***	***3,44E-07***	0,8183	***0,02687***	0,2173

Chart 6. ADF Test results for hp_{Dk}, hp_{Da} and hp_{Dp}

The results we look in the tables could be quite surprising and, maybe, contradictory respect to the previous ADF test with the prime differences. This time, indeed, we can affirm that the variable of capital intensity is stationary: all the p-values are less than 0,05. For the Total Factor Productivity, only the Spanish p-value is greater than the critical level, so we have to accept the null hypothesis of non-stationarity, while for the GDP Price Deflator, the time series of France and Spain cannot be considered stationary.

To sum up, applying the increased Dicky-Fuller test to the three variables for each country, we cannot have the absolute certainty of the stationarity of the series, also after modifying the series through the prime differences and the Hodrick-Prescott Filter. Let us see if the second kind of test, the KPSS Test, can give us results that are more robust.

6.8.2 KPSS Test

The second kind of test used in our model is the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) Test. It is used for testing the null hypothesis that an observable time series is stationary around a deterministic trend. The test has a non-standard distribution and the software is usually unable to calculate p-values, but only provide critical thresholds for different amplitudes of the test. We remember that the test is "right-handed", so we accept the null hypothesis when the test statistic is greater than the critical threshold set. In particular if $p - value > critical\ level$, we accept the null hypothesis so the series is stationary, if $p - value < critical\ level$, we reject the null hypothesis so the series is non-stationary. As in the previous test we impose as our critical threshold the value of 0,05.

About the general test characteristics, in this case we leave the parameters suggested by the Gretl software: a delay order of three and we do not include trend or seasonal dummy. In the results graph, the test provides us a test statistic and three confidence intervals (10%, 5% and 1%). In any case, just look at the p-value, which is already indicated with the mark $> 0{,}10$ or $< 0{,}01$. In the first case, we will accept the null hypothesis of stationarity; in the second case, we should refuse it and accept the alternative hypothesis of non-stationarity.

Let look at the results for our initial variables (39), (40) and (41), for each one of the country analysed, in the charts below.

Variable	*Dk*		*Da*		*Dp*	
Country	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**
P-Value	$< 0{,}01$	$< 0{,}01$	$< 0{,}01$	$< 0{,}01$	$< 0{,}01$	$< 0{,}01$

Chart 7. KPSS Test results for Dk, Da and Dp

Variable	*Dk*		*Da*		*Dp*	
Country	**Italy**	**Spain**	**Italy**	**Spain**	**Italy**	**Spain**
P-Value	$< 0{,}01$	0,05	$< 0{,}01$	$< 0{,}01$	0,022	$< 0{,}01$

Chart 8. KPSS Test results for Dk, Da and Dp

Most of the results obtained show a $p - value < 0{,}01$. This means that we have to reject the null hypothesis of stationarity and to affirm the non-stationarity of the series. We could have some doubts about the stationarity of the capital intensity series of Spain, cause the results is 0,05, equal to the critical value. The p-value of the GDP Price Deflator of Italy is 0,022, which is always less than the threshold value, so we can't accept the null hypothesis of stationarity.

As made before with ADF Test, we will proceed to check the stationarity of the prime differences of our variables, in order to overcome the non-stationarity of the initial variables. Therefore, we will apply the KPSS Test to the variables (42), (43) and (44). Let look at the results in the charts below.

Variable	d_{Dk}		d_{Da}		d_{Dp}	
Country	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**
P-Value	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$

Chart 9. KPSS Test results for d_{Dk}, d_{Da} and d_{Dp}

Variable	d_{Dk}		d_{Da}		d_{Dp}	
Country	**Italy**	**Spain**	**Italy**	**Spain**	**Italy**	**Spain**
P-Value	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	0,068	$> 0{,}10$	$> 0{,}10$

Chart 10. KPSS Test results for d_{Dk}, d_{Da} and d_{Dp}

Unlike the previous results, the situation seems to be overturned. Most of the results obtained show a $p - value > 0{,}10$. This means that we can accept the null hypothesis of stationarity. The p-value of the prime difference of Total Factor Productivity for Spain is 0,068, which is always greater than 0,05, the critical value, so also this time series can be considered stationary.

Even if we have obtained from the results the stationarity of all the time series of the prime differences of our three variables, in order to have a more test robustness,

we will apply the KPSS Test also to the Hodrick-Prescott cycle of our variables, calculated as in (45), (46), (47). Let look at the results obtained in the charts below.

Variable	hp_{Dk}		hp_{Da}		hp_{Dp}	
Country	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**
P-Value	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$

Chart 11. KPSS Test results for hp_{Dk}, hp_{Da} and hp_{Dp}

Variable	hp_{Dk}		hp_{Da}		hp_{Dp}	
Country	**Italy**	**Spain**	**Italy**	**Spain**	**Italy**	**Spain**
P-Value	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$	$> 0{,}10$

Chart 12. KPSS Test results for hp_{Dk}, hp_{Da} and hp_{Dp}

The results confirmed the previous conclusions. Also in the case all the p-value obtained are greater than 0,10, so they are greater than the critical value and we can confirm the stationarity of the time series.

To sum up, our initial variables Dk, Da and Dp cannot be considered stationary for all the countries analysed: the ADF Test shows the stationarity of some of them, while KPSS Test considers all of them non-stationary. Therefore, we will inevitably construct our Structural VAR model in some ways that can overcome this problem. The first way will be the introduction of trend in the model where the variable are Dk, Da and Dp. In the second model we will use as variables d_{Dk}, d_{Da} and d_{Dp}. The time series of these last variables are considered all stationary by the KPSS Test, while in only two case, in chart (3) and (4), the ADF Test accept the null hypothesis of non-stationarity. Cause of these variables are prime differences, we will cumulate the results with the use of matrix $\sum(1)$. In the last Structural VAR model we will use as variables hp_{Dk}, hp_{Da} and hp_{Dp}. The time series of these last variables are considered all stationary by the KPSS Test, while in only three case, in chart (5) and (6), the ADF Test accept the null hypothesis of non-stationarity.

6.9 Analysis of Shocks

After making all the necessary considerations about the robustness of the test results, in order to verify the stationarity of the time series of our three model variables, we can proceed with the construction and estimation of the Structural VAR models.

Since we use the long run matrix $\sum(1)$, which has the triangular form has in expression (38), we obtain, from the estimations through the application of a Structural VAR model, nine kind of responses to the shocks. These responses correspond to the number of combinations between the three variable, capital intensity, Total Factor

Productivity and GDP Deflator and the three shocks involved in the model: capital shock ε_t, technological shock λ_t and demand shock d_t, as in expression (37).

We choose to use three different Structural VAR model, in order to overcoming the problem of non-stationary series and to get responses more coherent and closer to reality. The three different models, indeed, are useful for making comparisons of reliability and correctness of responses.

In the first kind of model, we use the three initial variables as in Table 3 and in Table 4 and the peculiarity is the introduction of the time trend. In the second kind of model, we use the prime differences of the three variables described in (42), (43) and (44), cumulating the results. In the last model, we use the Hodrick-Prescott Filter cycle series described in (45), (46) and (47). There are some common features in the three kind of Structural VAR used. We choose to use the C-Model with constant, two lags, a time horizon of ten, two thousand bootstrap replications, a long run restriction with the triangular matrix as in (38). Let us see more in depth how these different methods work and which are the responses obtained by the different models.

6.10 Time Trend

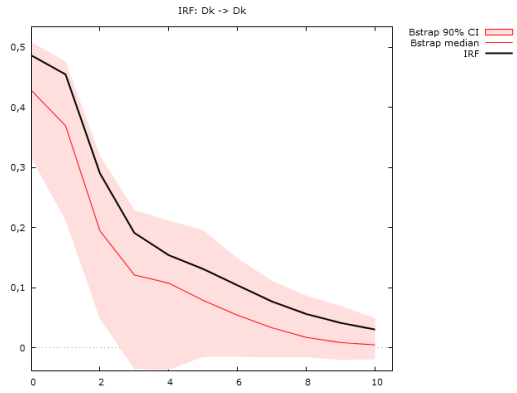
The first Structural VAR model is the one in which we introduce the time trend. The trend is the course in a time series. Ultimately, it is what determines the future. Seasons and cycles are transitory (though still present), the trend much less. By subtracting the trend, making the difference between the observed value of the variable and the value assumed by the trend at the same time, the time series became stationary on average. The detractor operation allows observing clearly the cyclical movements. The three variables involved in this kind of Structural VAR model are those in expression (39), (40), (41).

Let us see below the results obtained as responses by our three variables (capital intensity, Total Factor Productivity and Price Deflator Gross Domestic Product) to the three shocks (capital shock, technological shock and demand shock).

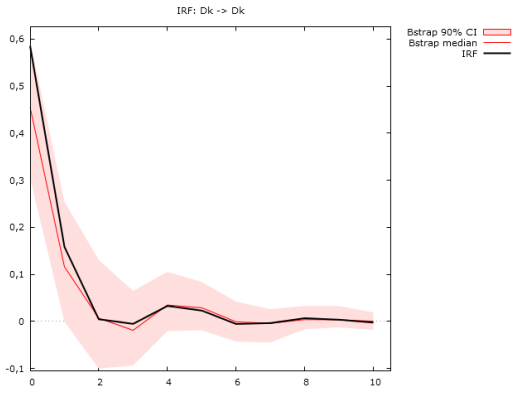
6.10.1 Capital shock on capital intensity

Let us see the response of a capital shock to the capital intensity. Below there are the graphs with the responses for the four countries analysed.

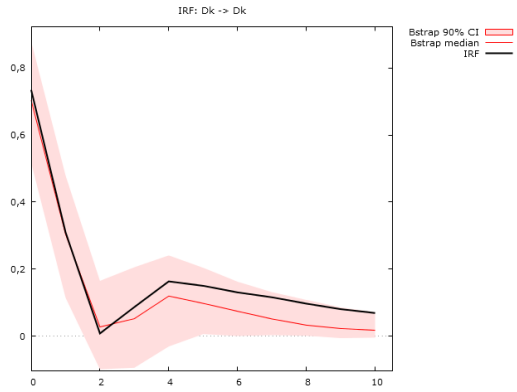
Graph 36. France



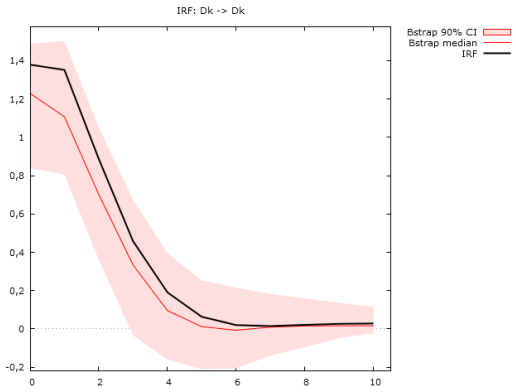
Graph 37. Germany



Graph 38. Italy



Graph 39. Spain

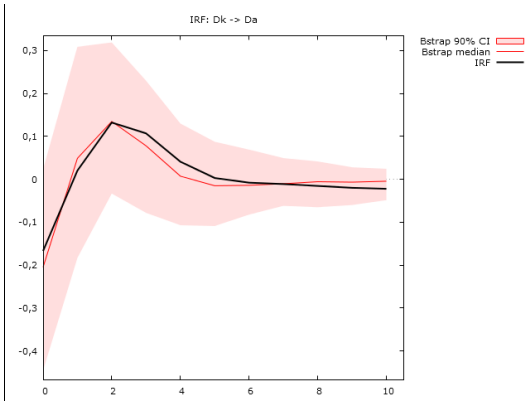


The responses of capital intensity to a capital shock are all positive. The positive values are all around 0,4-0,6, it is higher in Spain (1,2-1,4). After the positive initial values, the trends slow down sharply, until it settle towards the zero In the long run, indeed, the system moves to the zero equilibrium in all countries so the effect is cancelled.

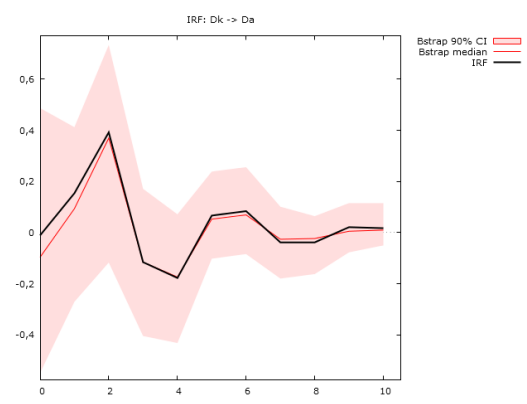
6.10.2 Capital shock on the level of technology

Let us see the response of a capital shocks on the technological level. Below there are the graphs with the responses for the four countries analysed.

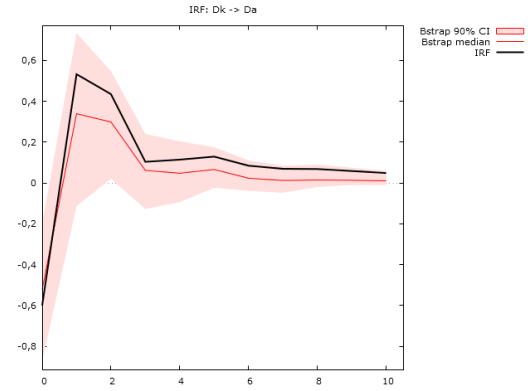
Graph 40. France



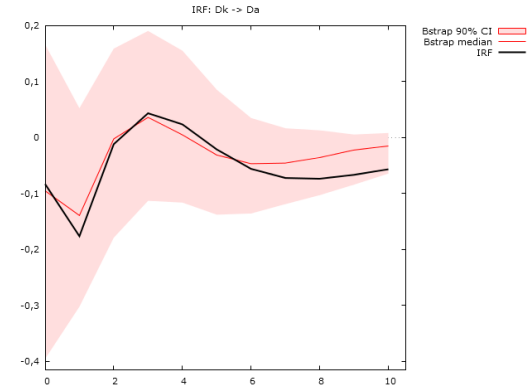
Graph 41. Germany



Graph 42. Italy



Graph 43. Spain

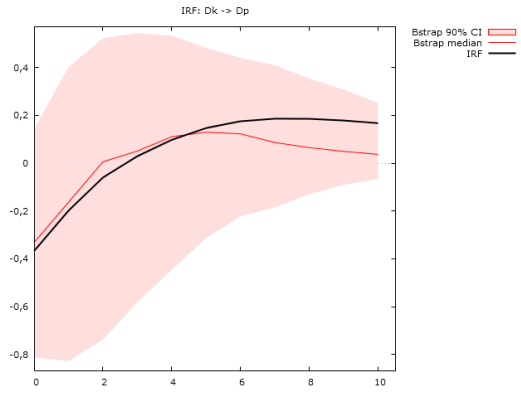


A capital shock has a negative effect on technology in all countries analysed. All the initial values, indeed, are below the zero (around 0 and -0,2, it reaches –0,5 in Italy). It the long run the effect is annulled, all the systems come back to the zero equilibrium.

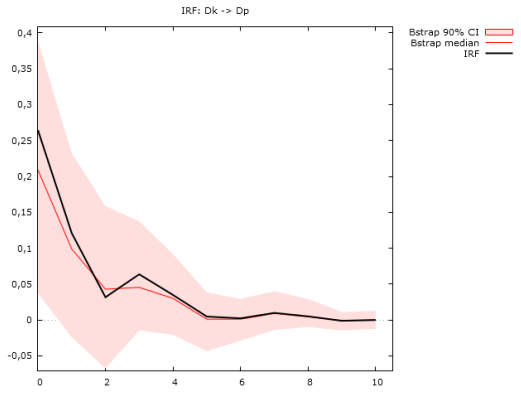
6.10.3 Capital shocks on inflation

Let us see the response of a capital shocks on the inflation. Below there are the graphs with the responses for the four countries analysed.

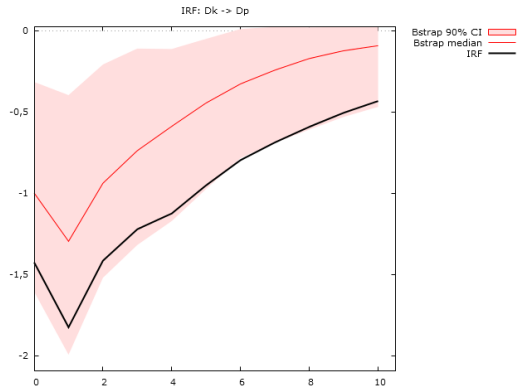
Graph 44. France



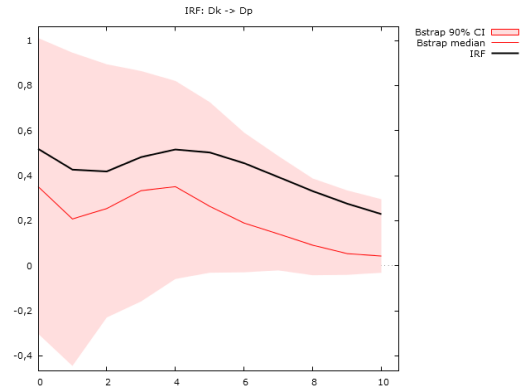
Graph 45. Germany



Graph 46. Italy



Graph 47. Spain

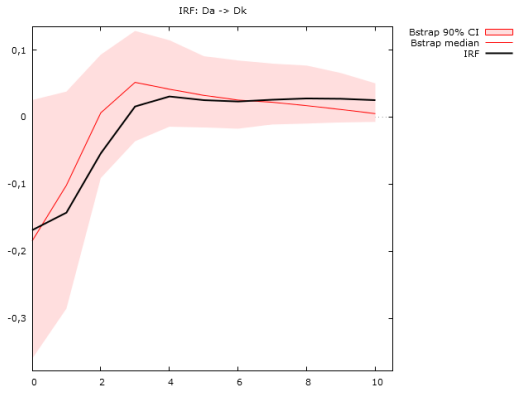


The responses of inflation to a capital shock is quite uncertain. For France and Italy, the initial values are negative and then, in both countries, the system come back to the zero equilibrium. Even if in Italy, in the medium run, the values become lower and then start the rise, while in France the values rise immediately after the shock. In Germany, the shock is positive; the values slow down rapidly after the shock, until the trend comes back to the zero in the long run. In Spain, the shock is positive too, however, the system come back to the zero in a less linear way respect to Germany.

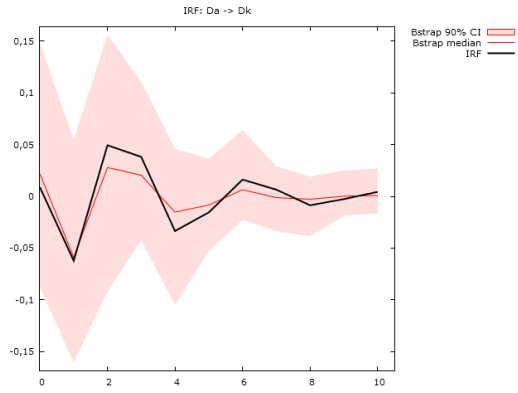
6.10.4 Technological shock on capital intensity

Let us see the response of a technological shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

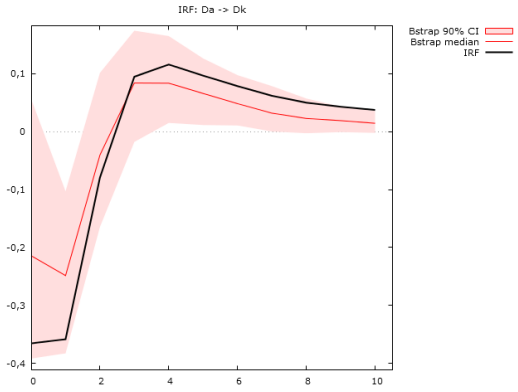
Graph 48. France



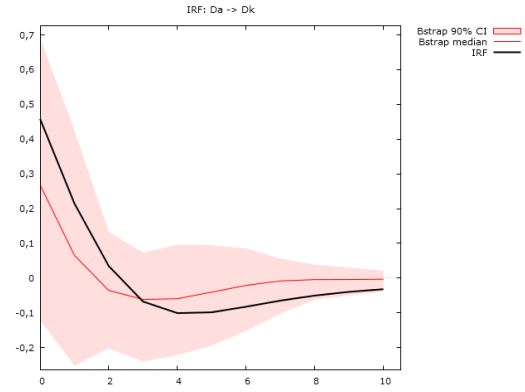
Graph 49. Germany



Graph 50. Italy



Graph 51. Spain

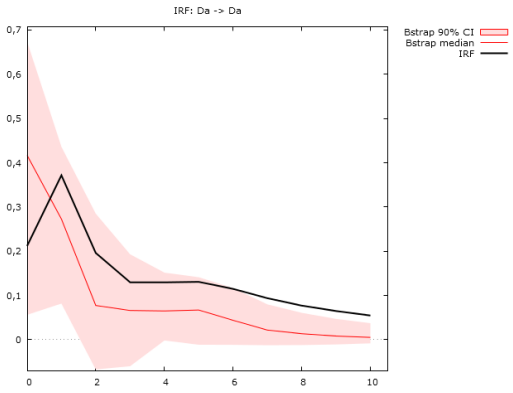


Also in this case, the responses to a technological shock by capital intensity are not uniform. In France and in Italy the trend is similar: we have an initial negative effect, then the values started to rise sharply, they become a bit positive and then they tend to zero equilibrium in the long run. In Germany, the shock is positive and it seems to oscillate around the zero; the oscillations are far less wide, until the shock, in the long run, is annulled. In Spain, the shock is positive, the values decrease sharply, they become a bit negative and in the long run they tend to zero.

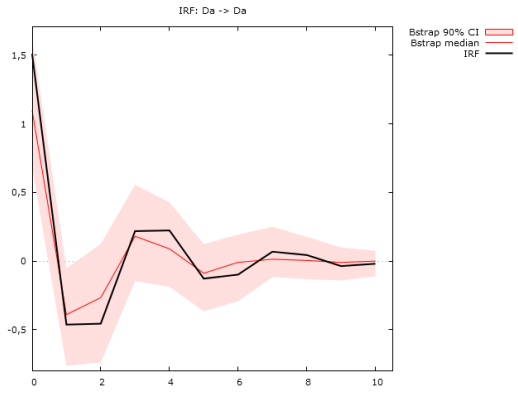
6.10.5 Technological shock on the level of technology

Let us see the response of a technological shock on the technological level. Below there are the graphs with the responses for the four countries analysed.

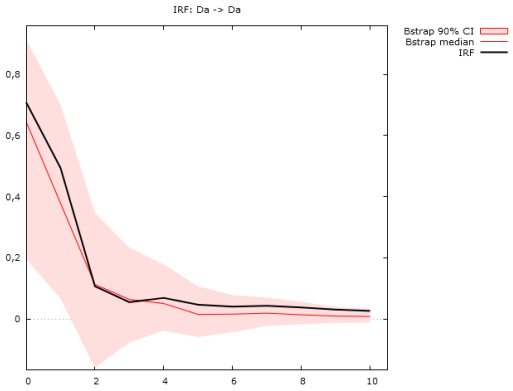
Graph 52. France



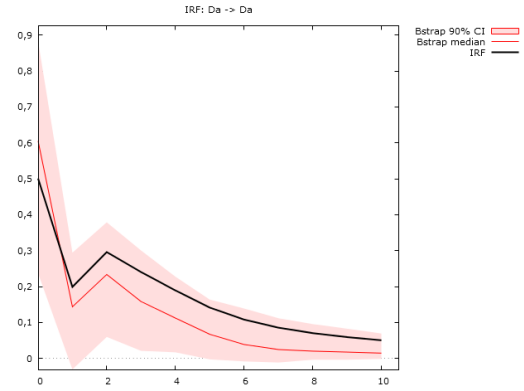
Graph 53. Germany



Graph 54. Italy



Graph 55. Spain

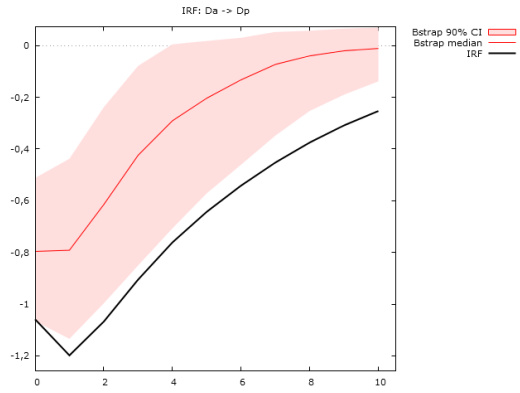


All the responses to a technological shock by the level of technology are positive. In Italy and Spain the initial values are around 0,5-0,6, they decrease fast and in the long run they tend to the zero equilibrium. In France, the initial value is around 0,2, it then increases, but in the long run the shock is annulled. In Germany, the initial value is very high, it decreases sharply and then it seems to oscillate around the zero, until the shock is annulled in the long run.

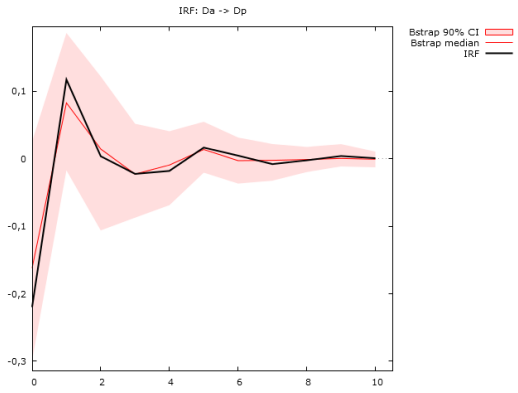
6.10.6 Technological shock on inflation

Let us see the response of a technological shock on the inflation. Below there are the graphs with the responses for the four countries analysed.

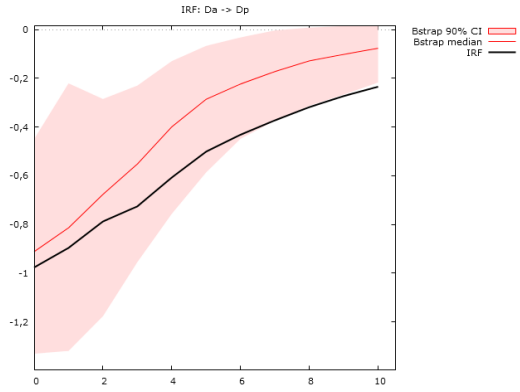
Graph 56. France



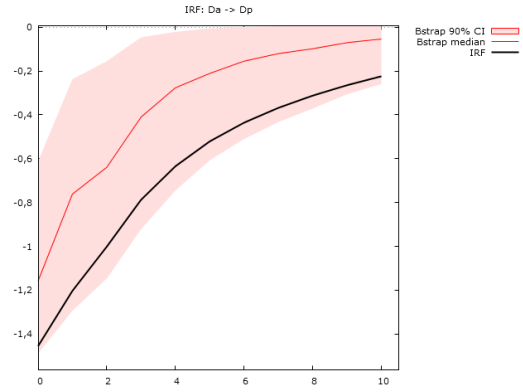
Graph 57. Germany



Graph 58. Italy



Graph 59. Spain

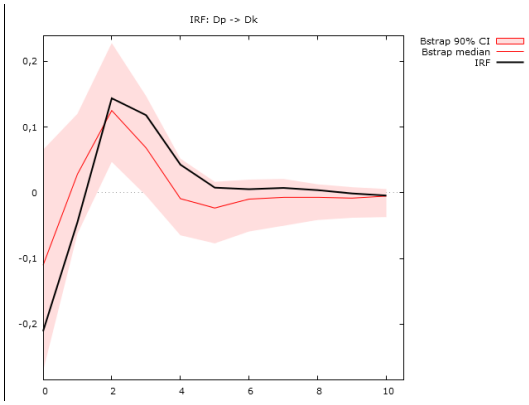


A technological shock on inflation give us negative responses in all the countries analysed. In France, Italy and Spain the initial values are around –0,08 and -1,4, they increase mildly and they come back to the zero equilibrium in the long run. In Germany, the initial value is around -0,2, it increase sharply and it becomes positive; in the long run, however the shock is annulled.

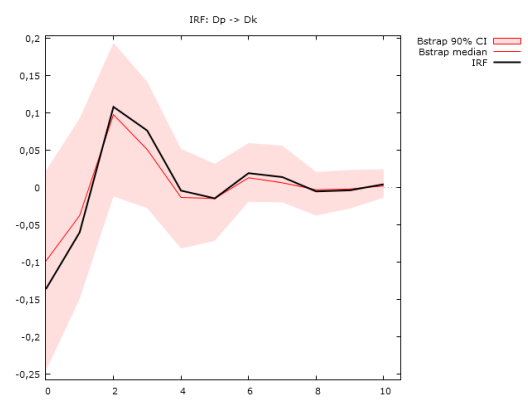
6.10.7 Demand shocks on capital intensity

Let us see the response of a demand shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

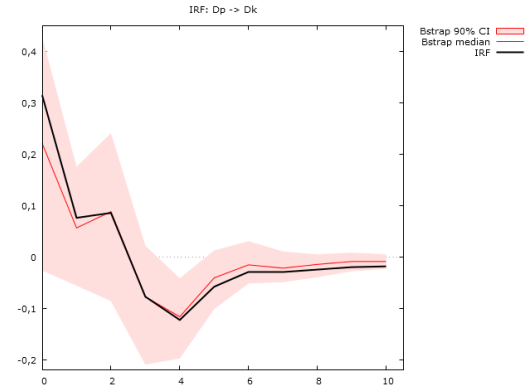
Graph 60. France



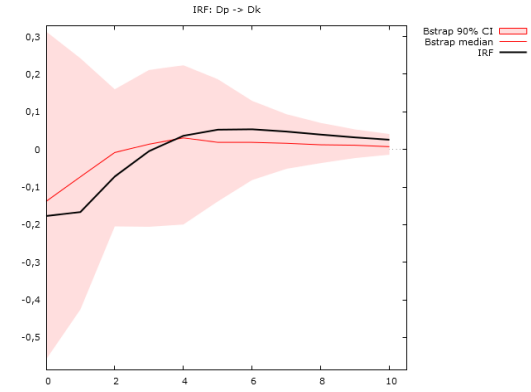
Graph 61. Germany



Graph 62. Italy



Graph 63. Spain

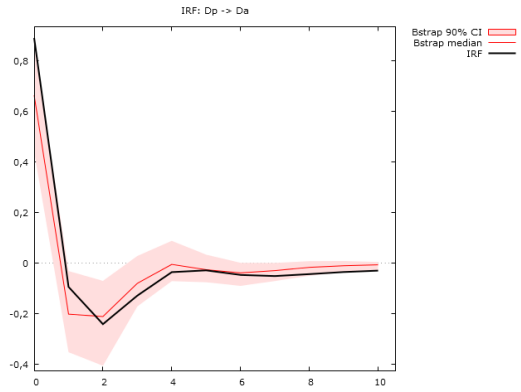


A demand shock on capital intensity gives no clear responses. In France, Germany and Spain, indeed, the responses is negative. In France and in Germany, the initial values are around -0,1 and -0,2, then they increase rapidly and become positive; however, in the long run the shock is annulled. In Spain, the initial value is more or less the same, but it then tends slowly to zero equilibrium in the long run. In Italy the situation is almost opposite: the shock is positive, the initial value is around 0,2 and 0,3, it become negative sharply and then it tends to zero equilibrium in the long run.

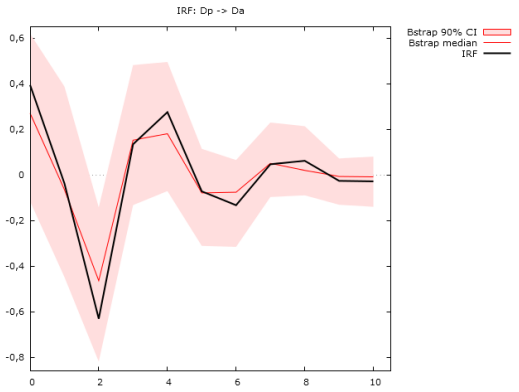
6.10.8 Demand shocks on the level of technology

Let us see the response of a demand shock on the level of technology. Below there are the graphs with the responses for the four countries analysed.

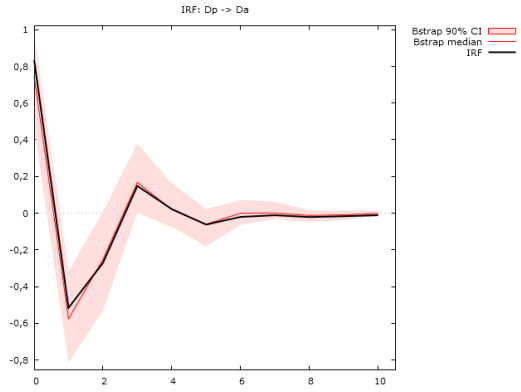
Graph 64. France



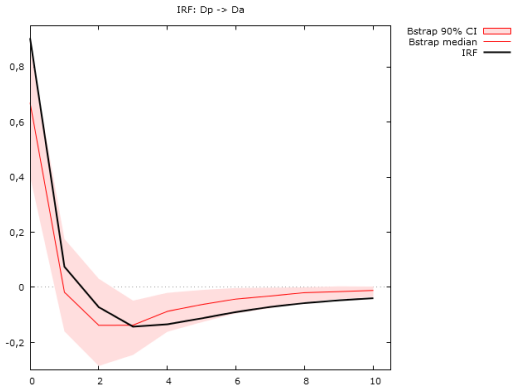
Graph 65. Germany



Graph 66. Italy



Graph 67. Spain

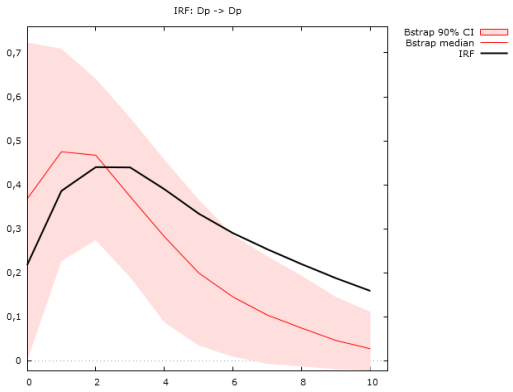


Demand shock on the level of technology generates positive responses in all countries analysed. In France and in Spain, the trend is similar: the initial values are around 0,6 and 0,8, they slow down sharply and they become a bit negative, until the shock is annulled in the long run. Germany and Italy, indeed, show a more articulated trend: the positive initial values decrease rapidly, reaching negative values, they come back positive in the medium run, and then the trends seem to oscillate around the zero until the shock is annulated.

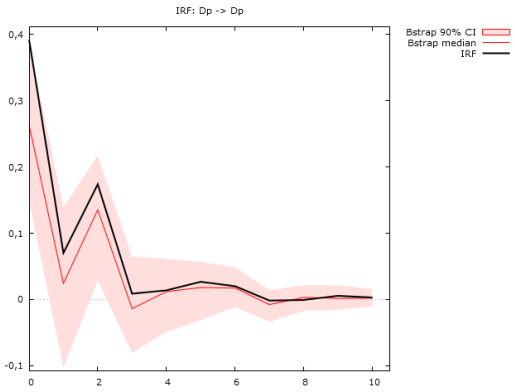
6.10.9 Demand shocks on inflation

Let us see the response of a demand shock on the inflation. Below there are the graphs with the responses for the four countries analysed.

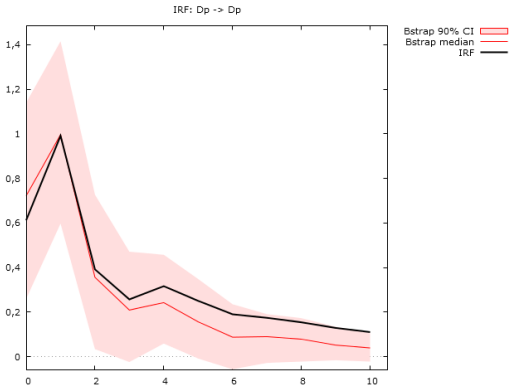
Graph 68. France



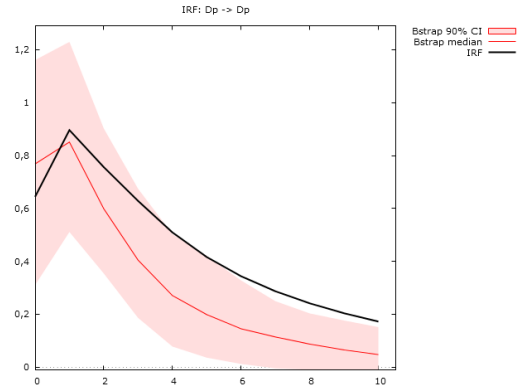
Graph 69. Germany



Graph 70. Italy



Graph 71. Spain



The responses to a demand shock by the inflation are all positive in the countries analysed. In France, Italy and Spain, they initial values are around 0,2 and 0,8, they increase a bit immediately afterwards and then they tend to zero equilibrium in the long run. In Germany, the initial value is around 0,2 and 0,4, it decreases sharply and then it seems to oscillate around the zero, until the shock is annulated.

Below we include the matrix of shock responses by the three variables (capital intensity, Total Factor Productivity and inflation) to the three shock (capital shock, technological shock and demand shock), in order to sum up our conclusions.

	Dk	***Da***	***Dp***
$\boldsymbol{\varepsilon_t}$	*positive*	*negative*	*positive/negative*
$\boldsymbol{\lambda_t}$	*positive/negative*	*positive*	*negative*
$\boldsymbol{d_t}$	*positive/negative*	*positive*	*positive*

Table 9. Matrix of Shock Responses, Time Trend Structural VAR

Table 12 shows that there are three situations of uncertainty (capital shock on inflation, technological shock on capital intensity, demand shock on capital intensity) as we have described above. Before discussing the macroeconomic implications of these system responses, let us see which conclusions we can reach whit the use of the other Structural VAR models.

6.11 Prime Differences

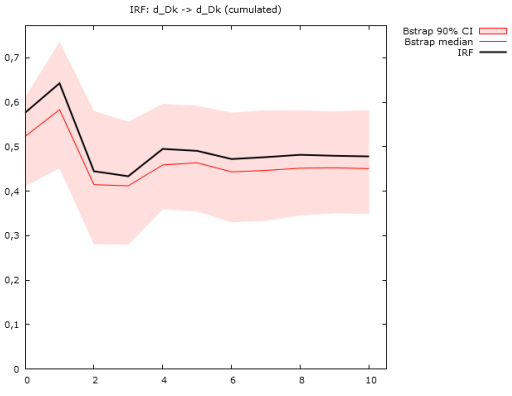
In the second Structural VAR model, we introduce the prime difference of our three initial variables, which, we have seen with the application of ADF Test and of KPSS Test, cannot be considered stationary. The prime differences can overcome this problem and can give us more robust and coherent results for our model. Therefore, the model include the prime differences described in (42), (43) and (44).

Let us see below the results obtained as responses by our three variables (capital intensity, Total Factor Productivity and Price Deflator Gross Domestic Product) to the three shocks (capital shock, technological shock and demand shock).

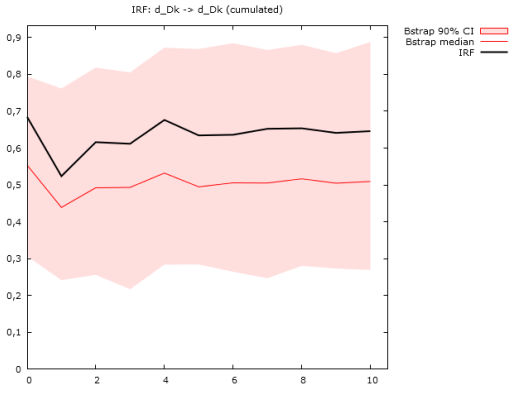
6.11.1 Capital shock on capital intensity

Let us see the response of a capital shock to the capital intensity. Below there are the graphs with the responses for the four countries analysed.

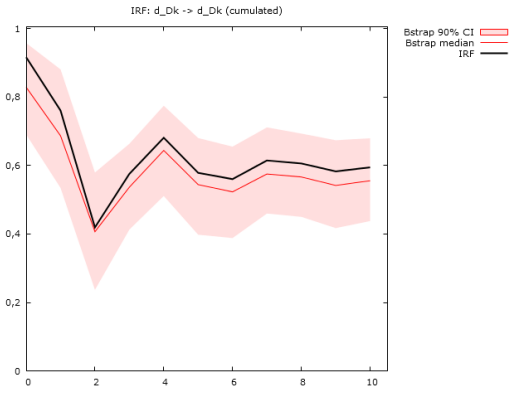
Graph 72. France



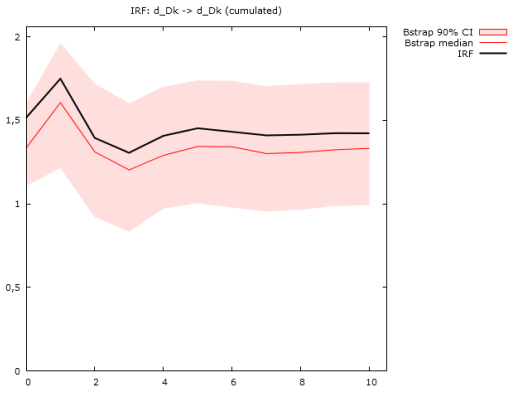
Graph 73. Germany



Graph 74. Italy



Graph 75. Spain

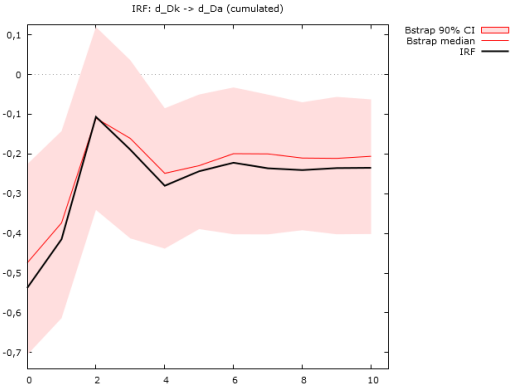


A capital shock on capital intensity generates positive responses on all the countries considered. In France and in Spain, the values continue to raise a bit time later and then decreases until a stationary state in the long run. The trends of Germany and Italy, after the initial positive shock, slow down, immediately afterwards, and then they raise again in order to settle in long run trend. In all the graphs, indeed, there is the peculiarity that in the long run the trends do not tend to the zero, but they tend to a value greater than zero. This means that there is a shifting from a state of stationary (in the long-term) to another equilibrium. In this case, we have to affirm that the economy moves with permanent and, therefore, structural effects, changing its fundamental characteristics in response to the initial shock.

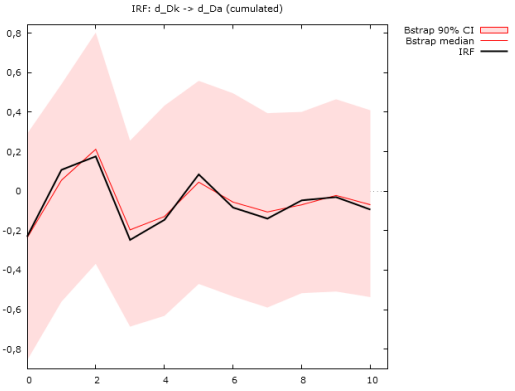
6.11.2 Capital shock on the level of technology

Let us see the response of a capital shock to the technological level. Below there are the graphs with the responses for the four countries analysed.

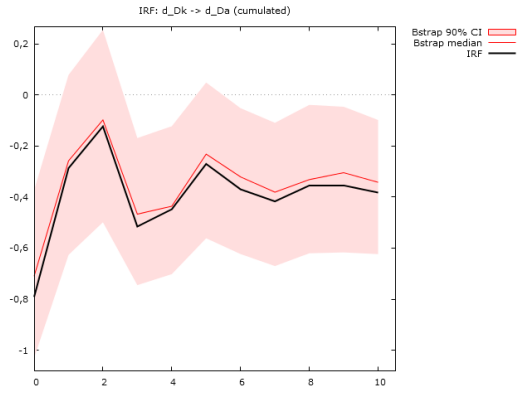
Graph 76. France



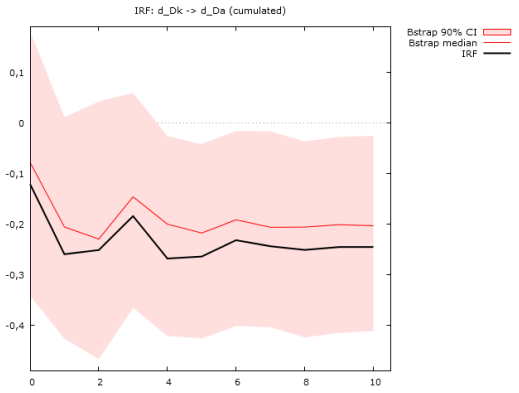
Graph 77. Germany



Graph 78. Italy



Graph 79. Spain

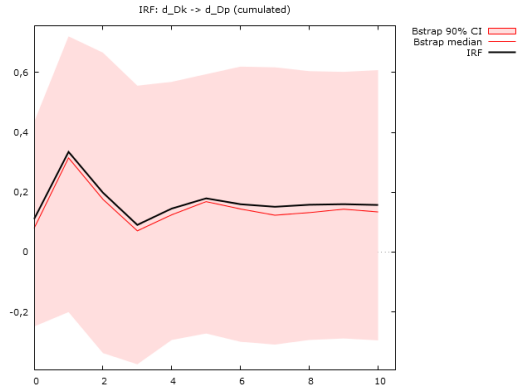


All the countries considered show negative responses of the level of technology to a capital shock. The trends of France and Italy have negative initial values around -0,08 and -0,04, immediately afterwards they raise sharply and then they seem to oscillate around a long run trend, which, also in this case, is different from zero, in particular, it is less than zero. The trend of Germany is similar to these last trends, however, in the long run it tend to zero, so the shock is annulated. The Spain has a trend quite different: the negative initial values slows down and then it settles in a long run negative trend, generating a new equilibrium.

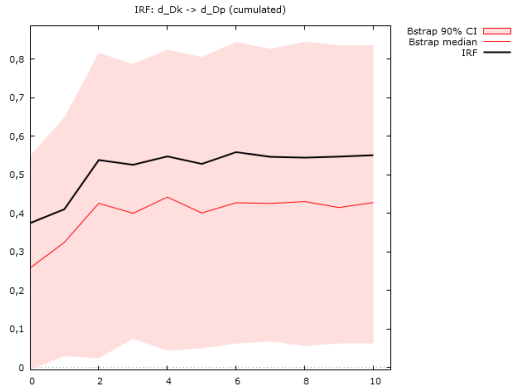
6.11.3 Capital shock on inflation

Let us see the response of a capital shock to the inflation. Below there are the graphs with the responses for the four countries analysed.

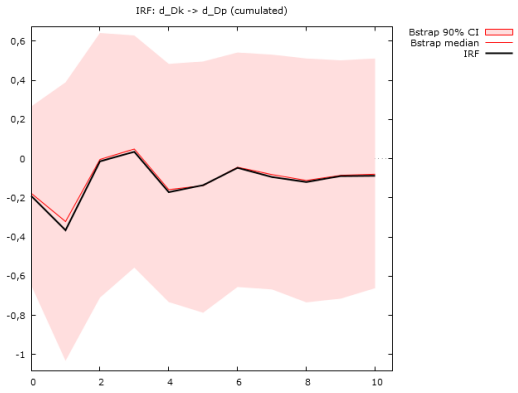
Graph 80. France



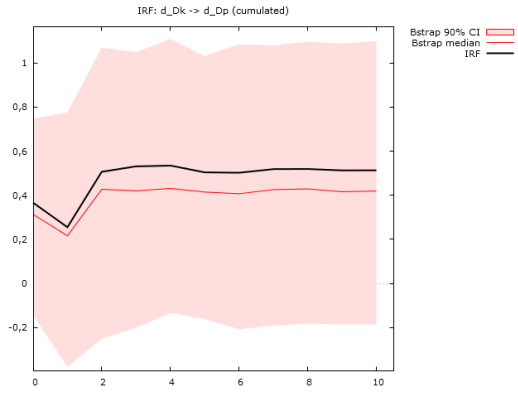
Graph 81. Germany



Graph 82. Italy



Graph 83. Spain

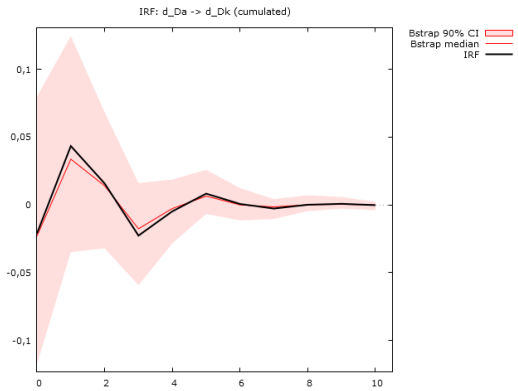


The responses of inflation to capital shock is not univocal. If we look at the graphs of Italy and Spain, the trends seem to be similar. However in Italy the response is negative, the trend slows down a bit later and then rise again until it tends to zero in the long run; in Spain, the response is positive and the trend in the long run tends to a positive value. The trends of France and Germany too, after a positive responses and an increase immediately afterwards, tend to a new positive equilibrium.

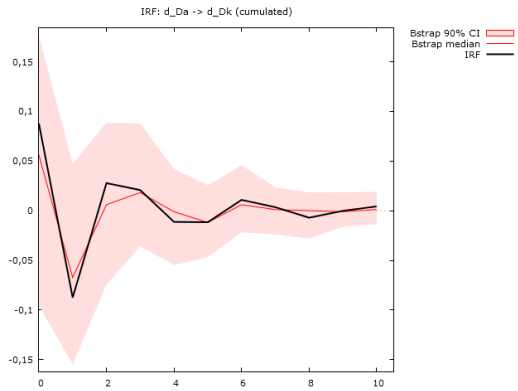
6.11.4 Technological shock on capital intensity

Let us see the response of a technological shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

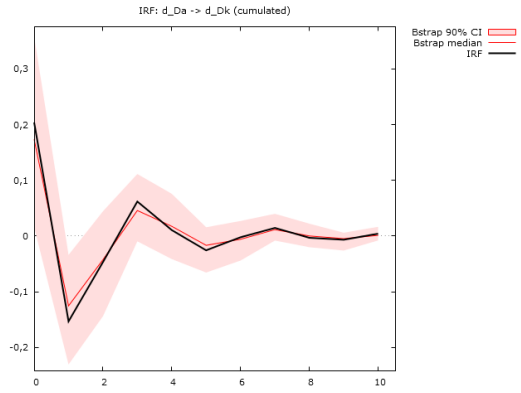
Graph 84. France



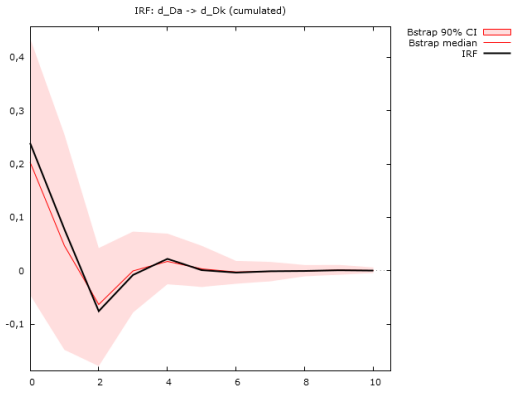
Graph 85. Germany



Graph 86. Italy



Graph 87. Spain

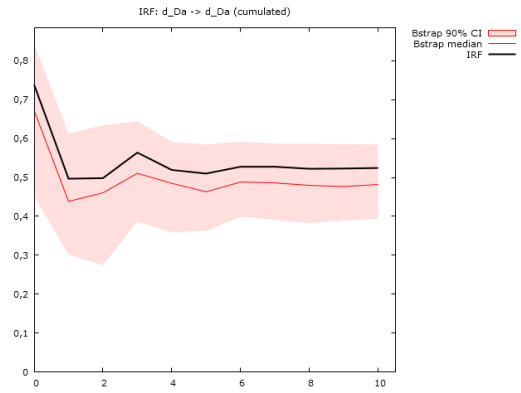


The response of capital intensity to technological shock is not certain. The trend of Germany, Italy and Spain are very similar: the initial values are around 0,05 and 0,25, immediately afterwards, the trends slow down sharply, assuming negative values, and they raise again until they tends to the zero long run equilibrium. In France the response is negative, the trend raise sharply a bit later, then it tends to the zero, reaching a long run equilibrium.

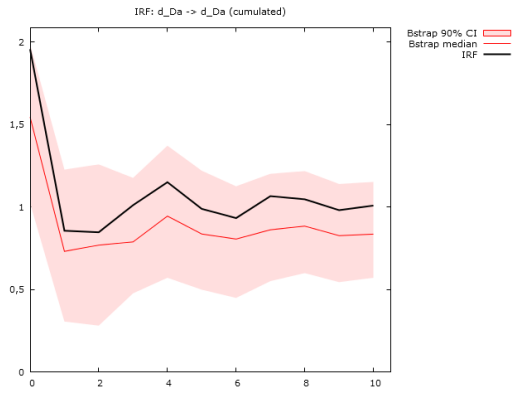
6.11.5 Technological shock on the level of technology

Let us see the response of a technological shock on the technological level. Below there are the graphs with the responses for the four countries analysed.

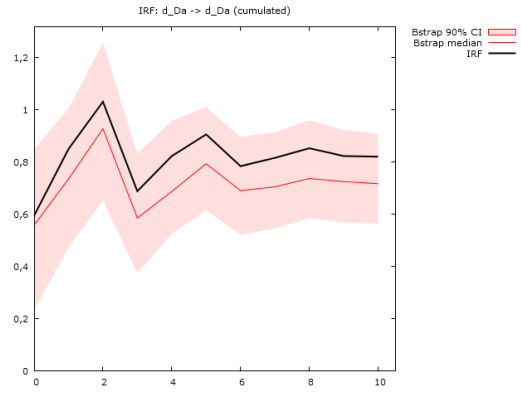
Graph 88. France



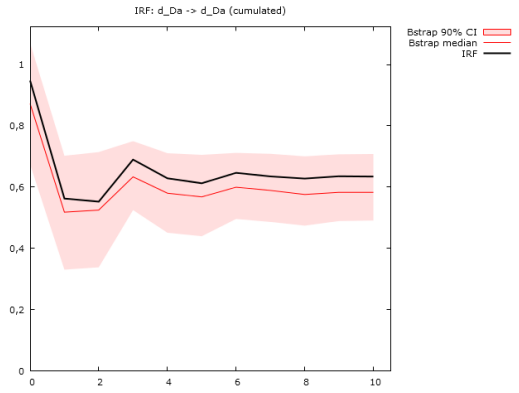
Graph 89. Germany



Graph 90. Italy



Graph 91. Spain

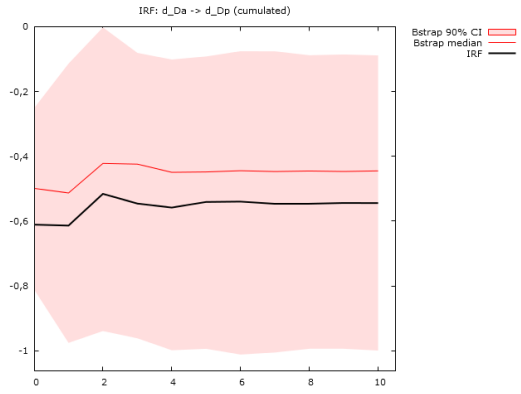


All the responses to a technological shock by the level of technology are positive for the countries analysed. The graphs of France, Germany and Spain are similar: after positive initial values, the trends slow down rapidly, until they settle a positive long run equilibrium. The trend of Italy, instead, after initial positive values, increase sharply and then it tends to oscillate around a positive long run equilibrium. Therefore, in all the countries new positive equilibrium are generated in the long run.

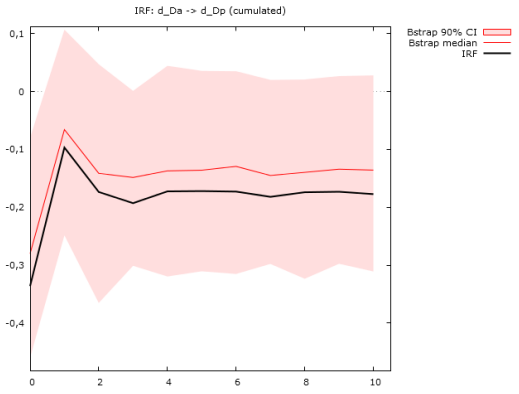
6.11.6 Technological shock on inflation

Let us see the response of a technological shock on the inflation. Below there are the graphs with the responses for the four countries analysed.

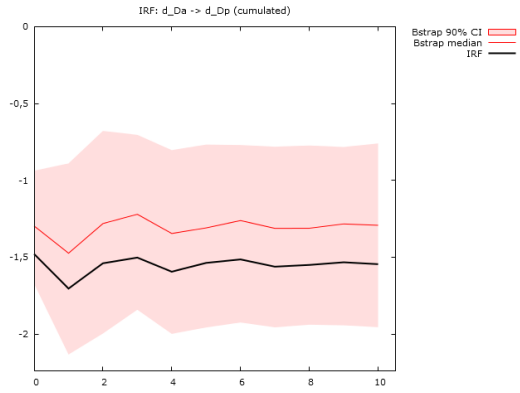
Graph 92. France



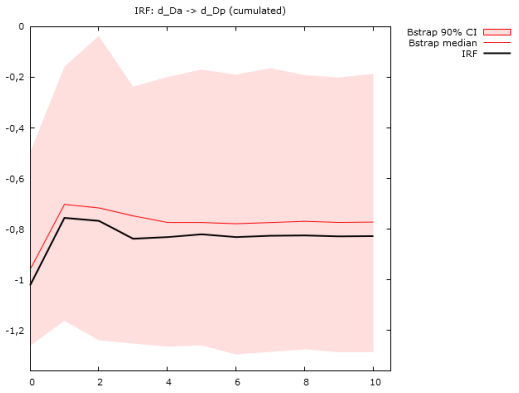
Graph 93. Germany



Graph 94. Italy



Graph 95. Spain

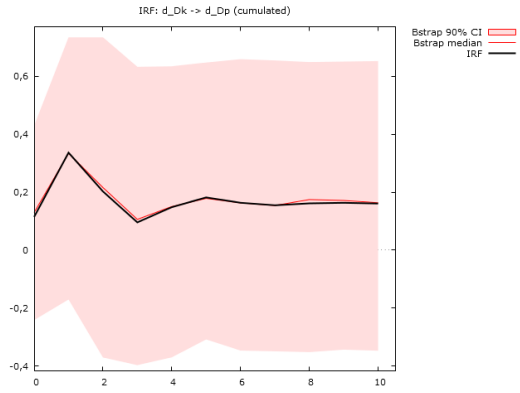


The responses to a technological shock by inflation are negative in all the countries considered. The graphs of France, Germany and Spain are similar: after negative initial values, the trends raise a bit later and then they tends to a negative long run equilibrium. In Italy, the trend slows down a bit, immediately afterwards, then it tends a negative long run equilibrium, as the other countries.

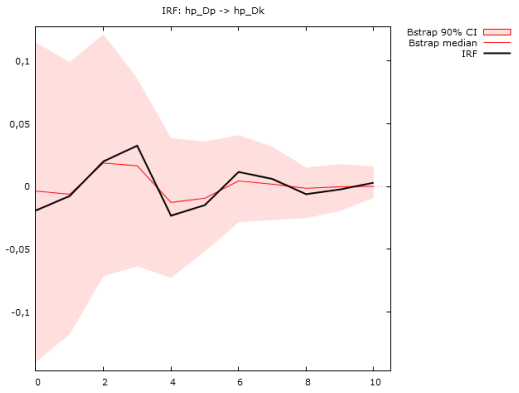
6.11.7 Demand shock on capital intensity

Let us see the response of a demand shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

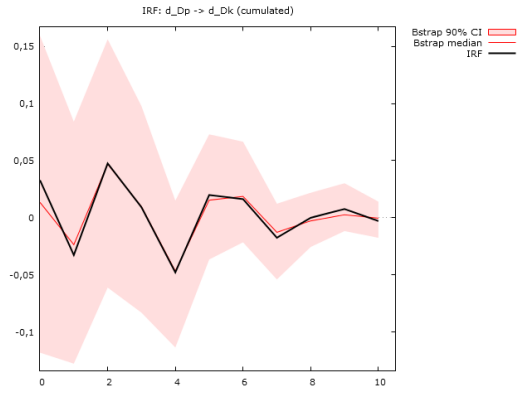
Graph 96. France



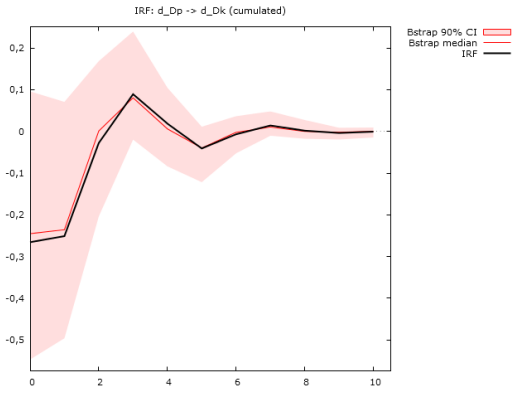
Graph 97. Germany



Graph 98. Italy



Graph 99. Spain

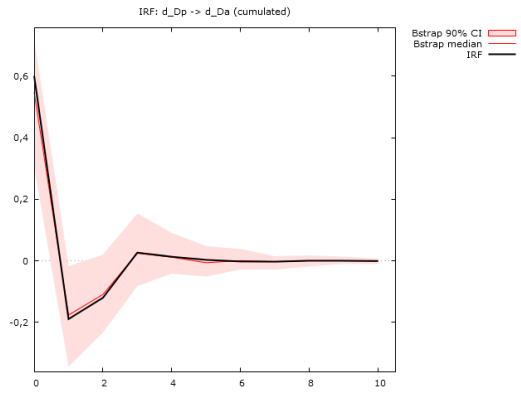


There are not a unique response to the demand shock on capital intensity for the countries considered. The graphs of Germany and of Spain are quite similar: even if in Spain the initial values are lower, the responses are both negative. The trends rise immediately afterwards and then they tend to the zero in the long- run. In France the response is positive, it rise a bit later and then it tend to a long run value, which is a bit greater than zero; therefore, there is a new positive equilibrium. The response in Italy is positive too, however, in this case, the trend oscillates around the value of zero and the shock is annulated in the long run.

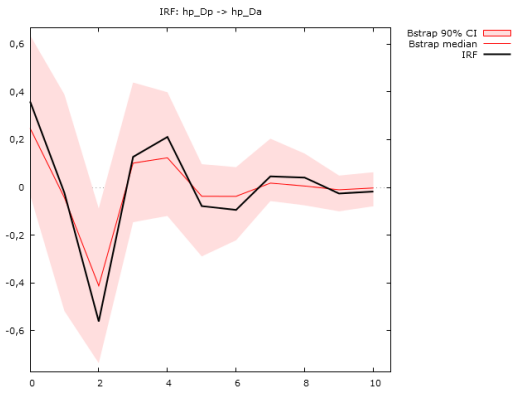
6.11.8 Demand shock on the level of technology

Let us see the response of a demand shock on the technological level. Below there are the graphs with the responses for the four countries analysed.

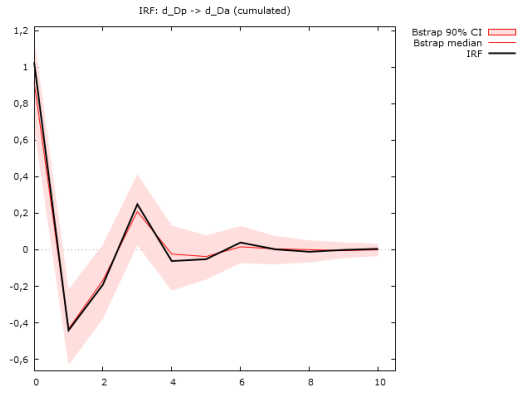
Graph 100. France



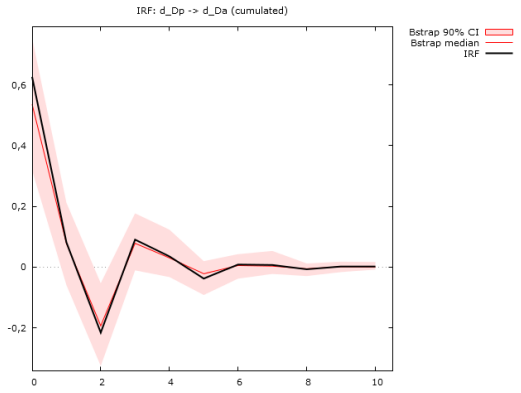
Graph 101. Germany



Graph 102. Italy



Graph 103. Spain

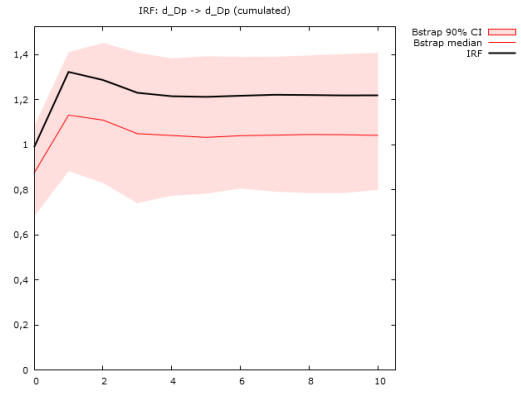


The responses of technology to a demand shock are positive in all the countries considered. In this case, if we look at the graphs, we can note that they are all similar. The initial positive values are around 0,2 and 1, immediately afterwards, the trends slow down, more sharply in Germany, then they tend to the zero in the long run.

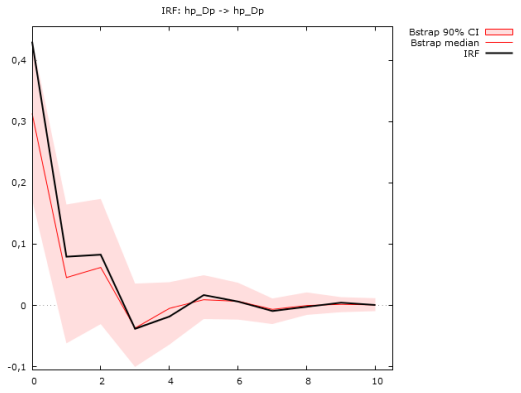
6.11.9 Demand shock on inflation

Let us see the response of a demand shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

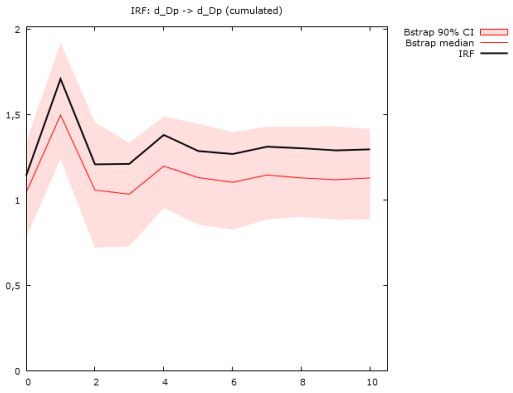
Graph 104. France



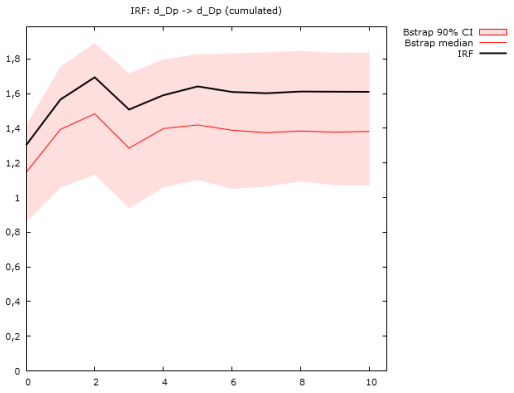
Graph 105. Germany



Graph 106. Italy



Graph 107. Spain



There are positive responses of inflation to the demand shock. In France, Italy and Spain, the graphs are similar: the initial values are between 1 and 1,4, the trends rise a bit later and then they tend to settle towards a new positive equilibrium. In the graph of Germany, indeed, the trend slows down rapidly, after the positive initial value, and then it tends to the zero in the long run, therefore the shock is annulated.

Let us analysed the responses obtained by our three variables to the three shocks, applying the Structural VAR model with the prime differences of our variables.

	Dk	***Da***	***Dp***
$\boldsymbol{\varepsilon_t}$	*positive*	*negative*	*positive/negative*
$\boldsymbol{\lambda_t}$	*positive/negative*	*positive*	*negative*
$\boldsymbol{d_t}$	*positive/negative*	*positive*	*positive*

Table 10. Matrix of Shock Responses, Prime Differences Structural VAR

Table 13 sums up the responses obtained to the shocks just studied above. We could already do some comparisons between the results obtained with the first Structural VAR model used and those of this second model. However, it is important to complete our analysis with the results of all the three Structural VAR models that we choose to apply, in order to make some considerations about macroeconomic implications. Therefore, let us apply the last Structural VAR model, with the use of Hodrick-Prescott cycle variables.

6.12 Hodrick- Prescott Filter

The Hodrick–Prescott filter (also known as Hodrick–Prescott decomposition) is a mathematical tool used in macroeconomics, especially in real business cycle theory, to remove the cyclical component of a time series from raw data. It is used to obtain a smoothed-curve representation of a time series, which is more sensitive to long-term than to short-term fluctuations. The adjustment of the sensitivity of the trend to short-term fluctuations is achieved by modifying a multiplier, λ. The filter was popularized in the

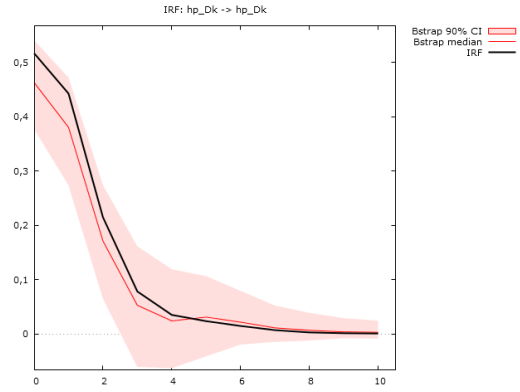
field of economics in the 1990s by economists Robert J. Hodrick and by the Nobel Memorial Prize winner Edward C. Prescott. However, E. T. Whittaker first proposed it much earlier in 1923. We have already applied it to our initial variables and we have obtained new expressions of them as in (45), (46) and (47). This time series will be the variables of this third type of Structural VAR model.

Let us see below the results obtained as responses by our three variables (capital intensity, Total Factor Productivity and Price Deflator Gross Domestic Product) to the three shocks (capital shock, technological shock and demand shock).

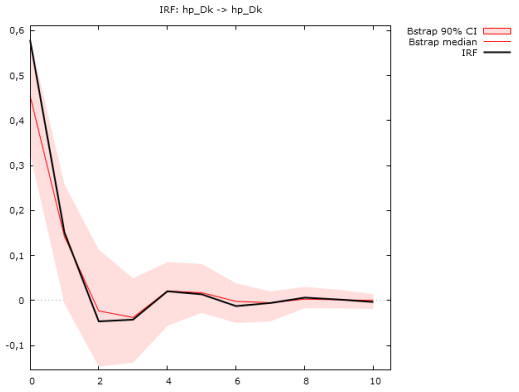
6.12.1 Capital shock on capital intensity

Let us see the response of a capital shock on the capital intensity. Below there are the graphs with the responses of the four countries analysed.

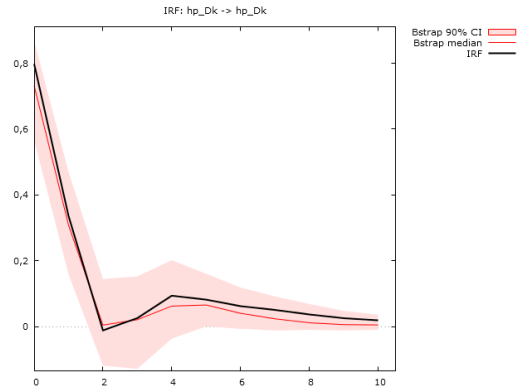
Graph 108. France



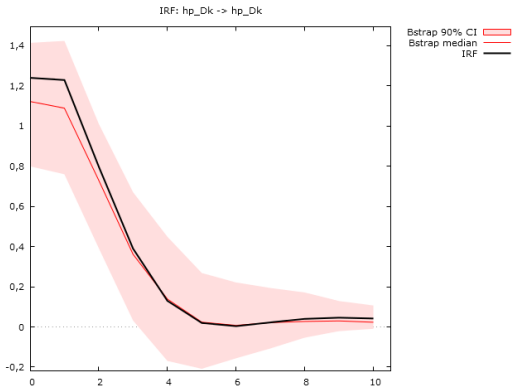
Graph 109. Germany



Graph 110. Italy



Graph 111. Spain



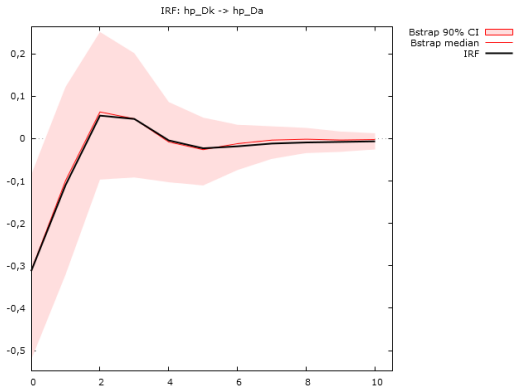
The response of capital intensity to a capital shock is clearly visible as positive in the four graphs. They are, indeed, similar for the four countries analysed. The positive initial

values are between 0,4 and 1,2, the trends slow down rapidly immediately afterwards, and they settle towards the zero equilibrium in the long run, so the shock is annulated.

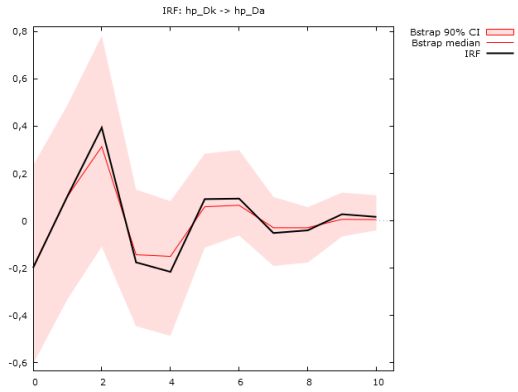
6.12.2 Capital shock on the level of technology

Let us see the response of a capital shock on the technological level. Below there are the graphs with the responses for the four countries analysed.

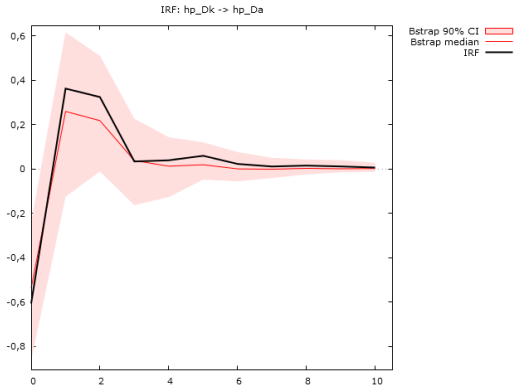
Graph 112. France



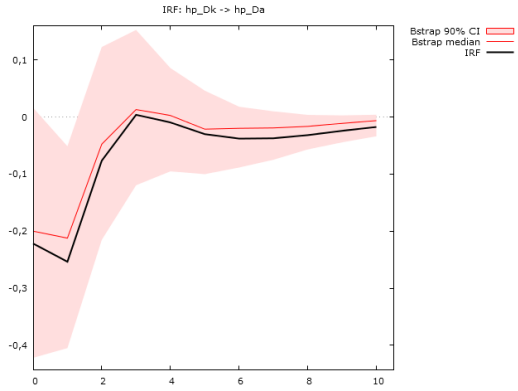
Graph 113. Germany



Graph 114. Italy



Graph 115. Spain

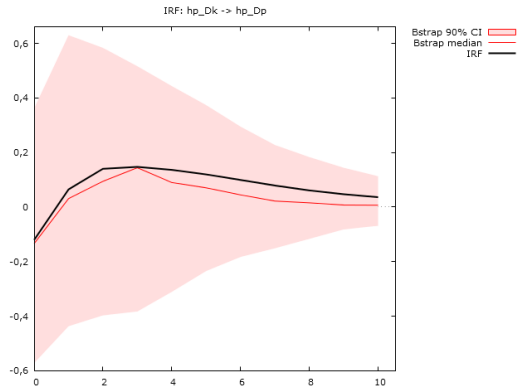


The responses of the level of technology to a capital shock are clearly visible as negative. The graphs are, indeed, similar for the four countries analysed. The negative initial values are between -0,6 and -0,2, the trends raise sharply immediately afterwards. After assuming also positive values in the medium run, the trends settle towards the zero equilibrium in the long run, so the shock is annulated.

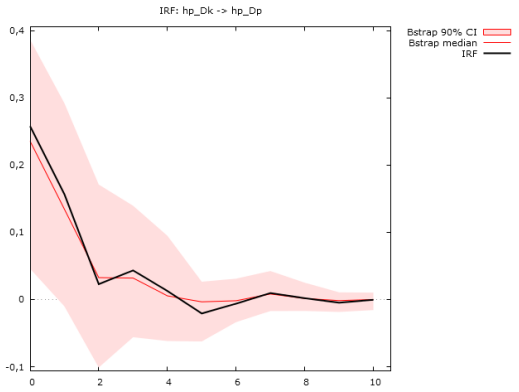
6.12.3 Capital shock on inflation

Let us see the response of a capital shock on the inflation. Below there are the graphs with the responses for the four countries analysed.

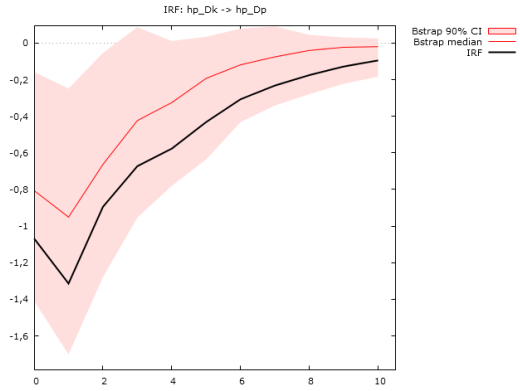
Graph 116. France



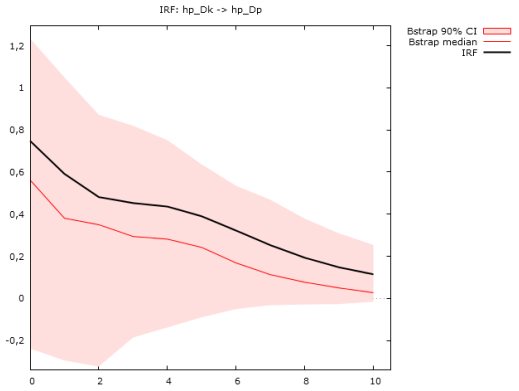
Graph 117. Germany



Graph 118. Italy



Graph 119. Spain

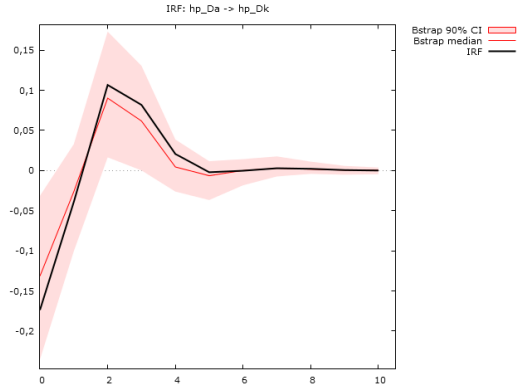


We cannot affirm a unique response of inflation to a capital shock. In France and in Italy, the responses are negative: in France, the trend increases slowly, it become a bit positive and then it tends to the zero in the long run; in Italy, the trend has always negative values, it increases towards the zero equilibrium in the long run. Both in Germany and in Spain, the responses are positive: after the initial positive values, the trend decrease rapidly in Germany, more slowly in Spain, in order to reach the zero equilibrium in the long run. Therefore, in all the countries, even if with different dynamics, the shock is annulated.

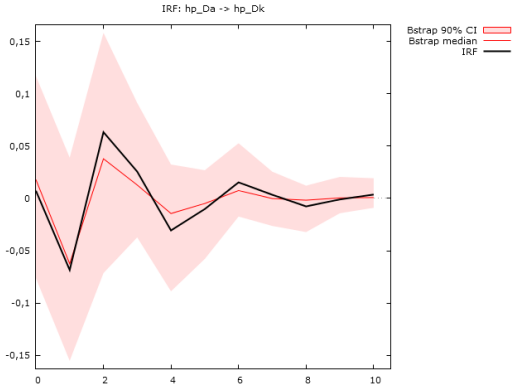
6.12.4 Technological shock on capital intensity

Let us see the response of a technological shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

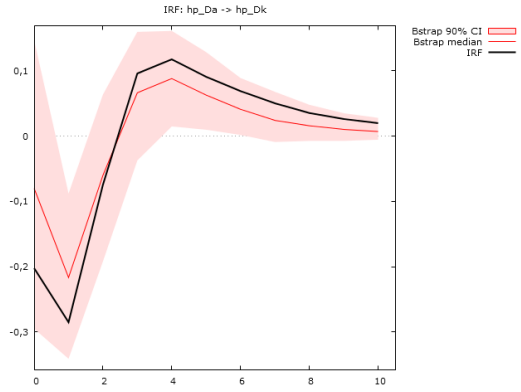
Graph 120. France



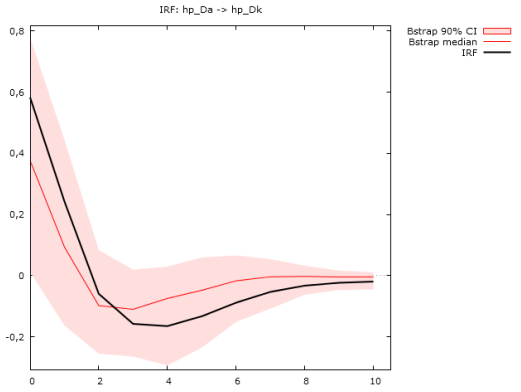
Graph 121. Germany



Graph 122. Italy



Graph 123. Spain

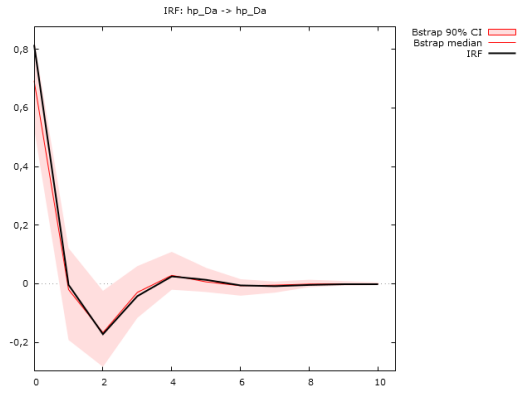


Also in this case, there is not a unique response of capital intensity to a technological shock. In France and in Italy the responses are negative: after the initial negative values, the trends increase sharply, reaching positive values, until they settle towards the zero equilibrium in the long run. The German response is positive, a bit greater than zero, the trend oscillates around the zero point, until the shock is annulated in the long run. In Spain the response is positive: after the initial positive values, the trend slows down, reaching negative values and then it tend to the zero equilibrium in the long run.

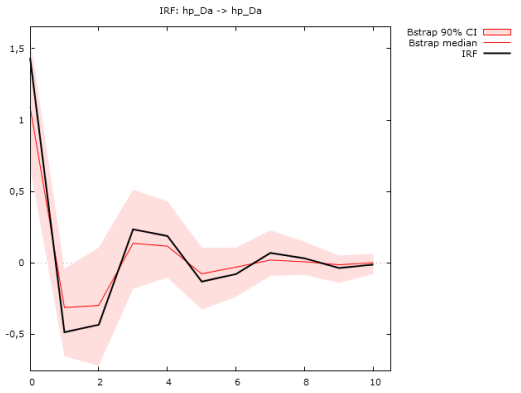
6.12.5 Technological shock on the level of technology

Let us see the response of a technological shock on the technological level. Below there are the graphs with the responses for the four countries analysed.

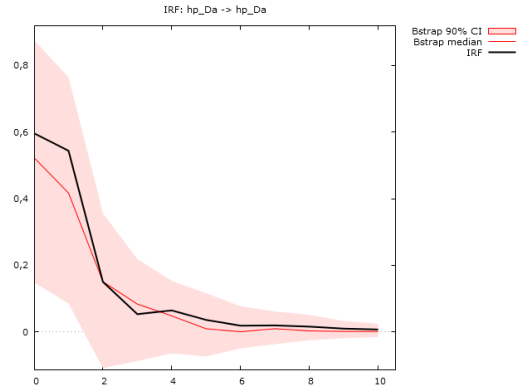
Graph 124. France



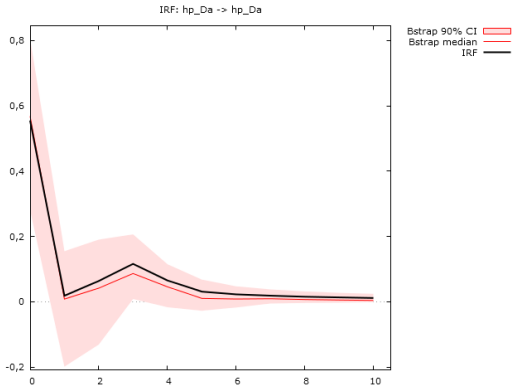
Graph 125. Germany



Graph 126. Italy



Graph 127. Spain

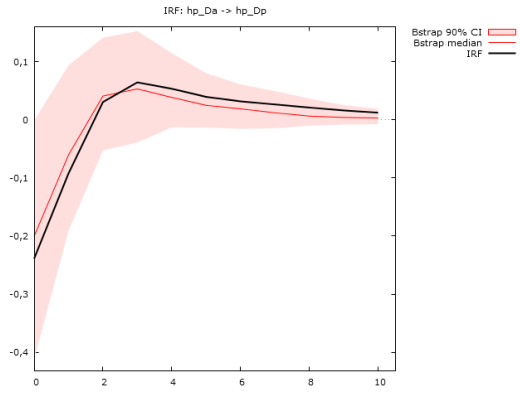


The responses of the level of technology to a technological shock are all positive in the countries analysed. It is easy to see, indeed, how the four graphs are similar. After the initial positive values, the trends slow down. In France and in Germany they reach negative values, in Italy and in Spain, they are always above the zero. All the trends tend in the long run to the zero equilibrium, so the shock is annulated.

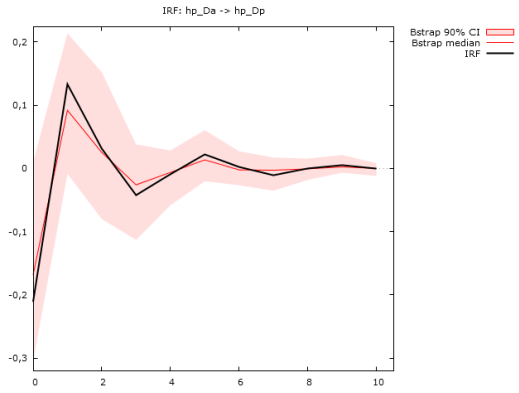
6.12.6 Technological shock on inflation

Let us see the response of a technological shock on the inflation. Below there are the graphs with the responses for the four countries analysed.

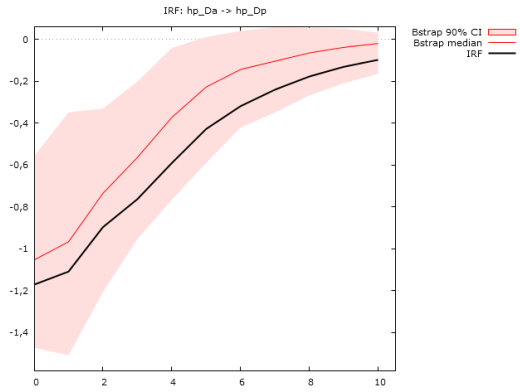
Graph 128. France



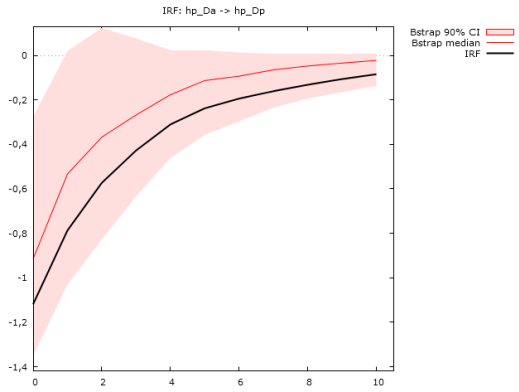
Graph 129. Germany



Graph 130. Italy



Graph 131. Spain

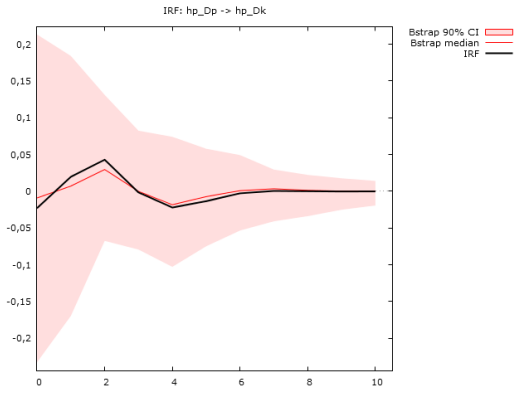


The responses of inflation to a technological shock are all negative in the four countries considered. In France and in Germany, after the negative initial values, the trends increase sharply, reaching positive values, then they tends to the zero equilibrium in the long run. The trends of Italy and of Spain are quite similar: after the negative initial values, the trends increase slowly below the zero, until they tend to the zero equilibrium in the long run. Therefore, in all the countries, in the long run the shock is annulated.

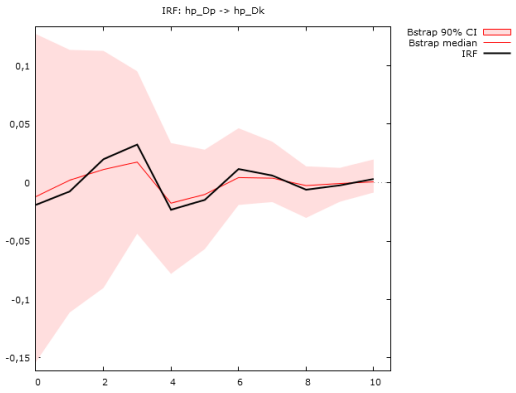
6.12.7 Demand shock on capital intensity

Let us see the response of a demand shock on the capital intensity. Below there are the graphs with the responses for the four countries analysed.

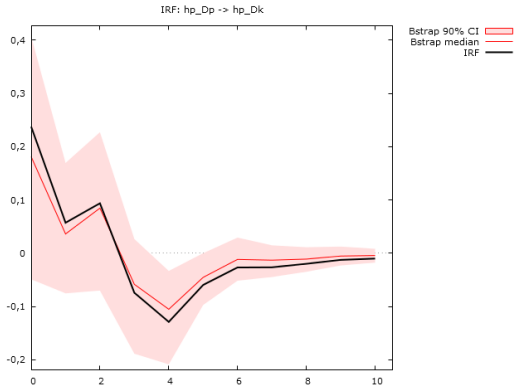
Graph 132. France



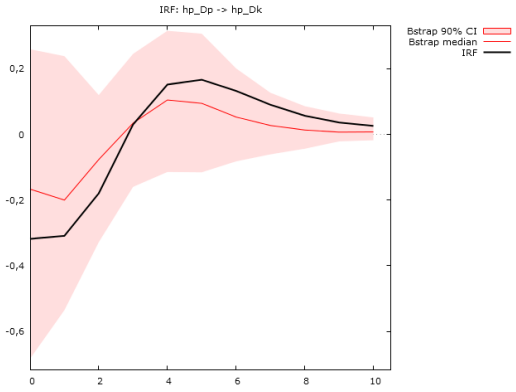
Graph 133. Germany



Graph 134. Italy



Graph 135. Spain

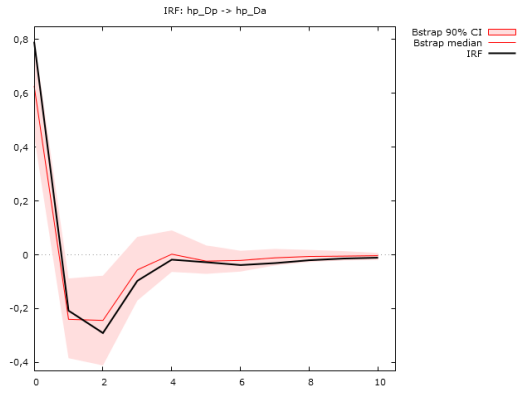


The response of capital intensity to a demand shock is not certain. The graphs of France and of Spain are similar: the initial value are a bit negative, the trends raise above the zero and then in the long run they tend to the zero equilibrium. In Italy, the response is positive: the trend slows down, assuming negative values and it tends to the zero equilibrium in the long run. The response of Spain is negative: the trend raise, assuming positive values and it tends to the zero equilibrium in the long run. Therefore, also in this case, the shock is annulated in all the countries.

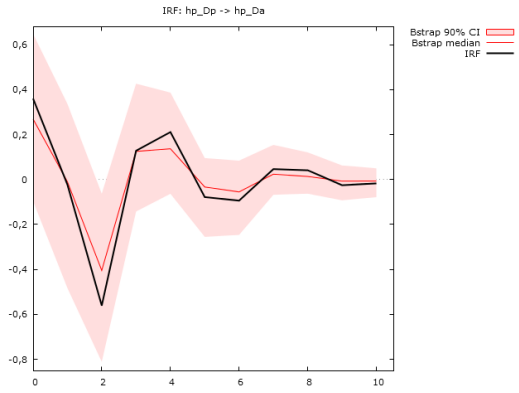
6.12.8 Demand shock on the level of technology

Let us see the response of a demand shock on the technological level. Below there are the graphs with the responses for the four countries analysed.

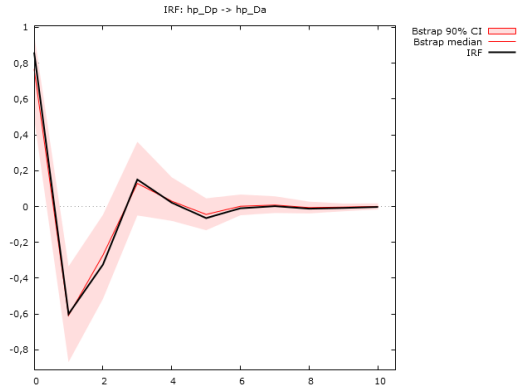
Graph 136. France



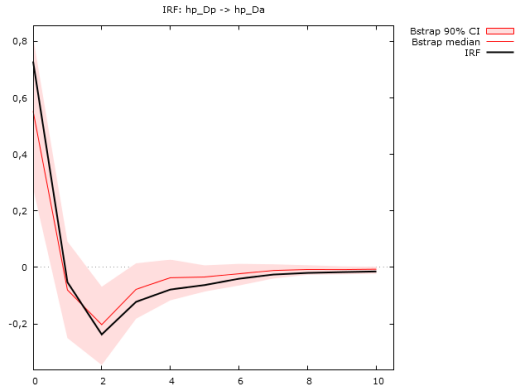
Graph 137. Germany



Graph 138. Italy



Graph 139. Spain

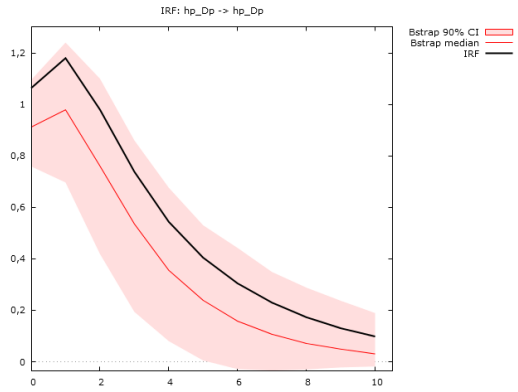


All the responses of the level of technology to a demand shock are positive in the countries analysed. The graphs of France and of Spain are similar: after the initial positive values, they slow down rapidly, assuming negative values, and then they tend to the zero equilibrium in the long run. Moreover, the graphs are similar for Germany and Italy: the trends slow down rapidly under the zero, then they oscillate around this point and they tend to it in the long run. Also in this case, the shock is annulated in all countries.

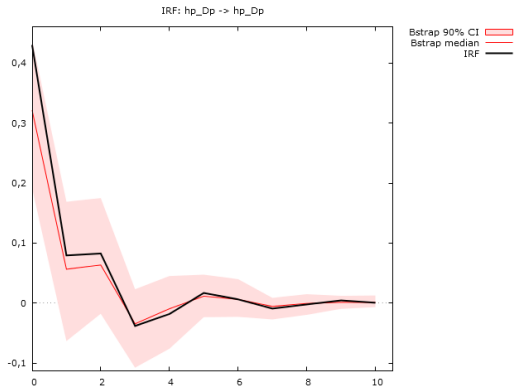
6.12.9 Demand shock on inflation

Let us see the response of a demand shock on the inflation. Below there are the graphs with the responses for the four countries analysed.

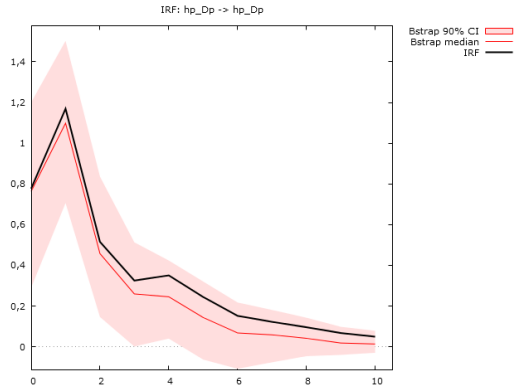
Graph 140. France



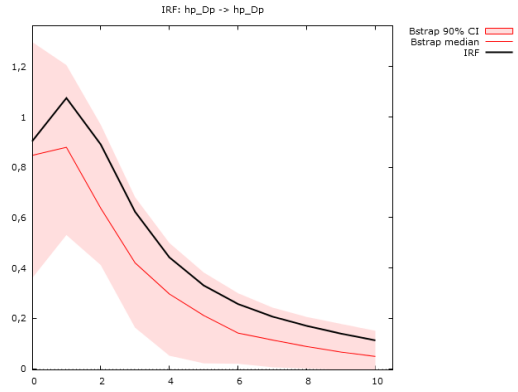
Graph 141. Germany



Graph 142. Italy



Graph 143. Spain



The responses of inflation to a demand shock is all positive in the four countries. France, Italy and Spain have similar graphs: after the initial positive values, the trends increase a bit and slow down rapidly until the zero point, to which they tend in the long run. In Germany, the trend decreases sharply, it oscillate a bit around the zero and it tends to it in the long run. In all countries, the shock is annulated.

To sum up the results we construct also in this third case our matrix of responses.

	Dk	***Da***	***Dp***
$\boldsymbol{\varepsilon_t}$	*positive*	*negative*	*positive/negative*
$\boldsymbol{\lambda_t}$	*positive/negative*	*positive*	*negative*
$\boldsymbol{d_t}$	*positive/negative*	*positive*	*positive*

Table 11. Matrix of Shock Responses, Hodrick-Prescott Filter Structural VAR

Table 14 shows the final responses of the three variables to our three shocks, with the application of a Structural VAR model, which has as variables the Hodrick-Prescott cycle of our initial variables.

We can conclude that the three kind of Structural VAR model used give us the same results. If we compare, indeed, table 9, 10 and 11, we can easily see that the combination of shock and variables responses are the same in each table. This can be consider a good general result for our analysis. This, indeed, permits us to draw unique conclusions about the functioning of the economic system in the countries analysed, and, therefore, make some assumptions too about the macroeconomic implications. Let us discuss about it in the following and last chapter.

Seventh Chapter

Conclusions

7.1 Responses interpretation and macroeconomic implications

Our intention in the building of an empirical micro-founded model is to understand the macroeconomic implications, in which the system is involved, following the responses of key variables to supply and demand shocks. The final aim is to confirm the hypothesis made in chapter five with the construction of the theoretical exogenous growth model.

Our model involves three driver variables and three shocks, which can be represented as follow:

$$\begin{bmatrix} \boldsymbol{\Delta k_t} \\ \boldsymbol{\Delta a_t} \\ \boldsymbol{\pi_t} \end{bmatrix} = \sum(\boldsymbol{L}) = \begin{bmatrix} \boldsymbol{\varepsilon_t} \\ \boldsymbol{\lambda_t} \\ \boldsymbol{d_t} \end{bmatrix}$$

In the first column, there are our three variables. $\boldsymbol{k_t}$ is the driver variable of capital and we choose to use in the Structural VAR the capital intensity. $\boldsymbol{a_t}$ is the driver variable for technology and we choose to use the Total Factor Productivity. $\boldsymbol{\pi_t}$ is the driver variable for the price level and we choose to use the Price Deflator Gross Domestic Product. In the second column, there are our shocks. $\boldsymbol{\varepsilon_t}$ and $\boldsymbol{\lambda_t}$ are supply shocks, the first a capital shock, the second a technological shock. $\boldsymbol{d_t}$ is a demand shock. Therefore, we have constructed the matrix $\sum(\boldsymbol{L})$**,** which has necessary a triangular form:

$$\sum(1) = \begin{bmatrix} \sigma_{11} & 0 & 0 \\ \sigma_{21} & \sigma_{22} & 0 \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix}$$

With the use of Structural VAR, we have tested the responses of the driver variables to the shocks. Inevitably, considering the 3X3 dimension of the matrix, we obtain nine combinations of variable and shock. The variables are introduced in the model as time series, with a period of observation from 1960 to 2017. In order to overcome the problem of non-stationarity of the time series, we have chosen to use three types of Structural VAR. The first with the introduction of a time trend. The second with the use of the prime differences of the variables. The third with the use of Hodrick-Prescott filter cycle of the variables. We tested the responses of the nine combinations shock-variable, with the use of the software Gretl and the construction of the three Structural VAR. Therefore, we obtained the three matrices of responses (Table 9,10 and 11), which are the same for the three types of Structural VAR:

	Dk	***Da***	***Dp***
$\boldsymbol{\varepsilon_t}$	*positive*	*negative*	*positive/negative*
$\boldsymbol{\lambda_t}$	*positive/negative*	*positive*	*negative*
$\boldsymbol{d_t}$	*positive/negative*	*positive*	*positive*

The fact that the three matrices give us the same conclusions about the shock-variable responses is a good result, in order to make unique considerations about macroeconomic implications. Let us analyse more in depth, which means these responses from a macroeconomic point of view.

The first supply shock is a capital shock. The capital increase from the supply side generates a positive response of capital intensity. This is coherent with could happen in the reality. Since capital intensity is the effect of the capital factor in the production process, in relation to the degree of use of other productive factors, an increase in the capital supply increases the capital intensity in the short term. This increase is annulated in the long run, returning to a situation of equilibrium. The response of the level of technology, instead, is negative. In the medium run, however, most of the trend shows a rapidly increase, until the shock is annulated in the long run. The level of technology is a variable that operate in a longer time horizon, therefore, it is like that the supply shock of capital is absorbed not immediately but a bit later, with the rapidly increase of the trends. The effect of the capital shock on the price level is not certain. An increase in the capital supply, indeed, could generates an increase in the capital price, for the general demand and supply law. However, here, we have to look at the general price level, which is affected by other variables like interest rate, money supply, demand and supply of the other labour factors… etc. Therefore, the response, in this case, depends on which variables and which internal dynamic prevails, it can be different in the different countries.

The second supply shock is a technological shock. An increase in the level of technology has no certain response by capital intensity. We know that an increase in the level of technology shifts the production curve upward, so it generates a major level of output. Even if we would expect that more technology mean more capital intensity, it is not always true. In this case, indeed, we have to consider the internal dynamics of the production process and, especially, the composition between capital and human labour. Innovation enhances capital productivity, but not surely capital intensity. The response of Total Factor Productivity, almost obviously, is positive to a technological shock. In this case, indeed, we consider both the contribution of capital and of labour to the final product. We know that the driver variable (TFP) includes also the level of technology as contribution to the production. Therefore, we have the typical trend in which the initial positive values are absorbed by a rapidly decrease, until the system come back to the long run zero equilibrium. The general price level, represented in our model by the GDP Price Deflator, has a negative response to supply technological shock. After the initial negative values, however, most of trend increase sharply in the medium run, until the effects are annulated in the long run, when the system settles towards the zero equilibrium.

The third type of shock that involved our economic system is the demand shock. The response of capital intensity to a demand shock is uncertain. A positive demand shock could increase investments so, as consequence the capital accumulation and the capital intensity. This dynamics, however, could not happen in all the economic system of the countries analysed. We have to consider also the other variables involved in the demand, not only investments. The responses derive from which variables involved in the demand prevails. The response of Total Factor Productivity to a demand shock is positive. This

could be explain with the fact that a positive shock of demand means more investments; investments can be connected with an increase in technological progress, so in TFP. Our driver of inflation, GDP Price Deflator has a positive response to the demand shock. This is coherent with what happen in the reality. For example, an increase in the money supply shifts the aggregate demand curve (AD) upward in the right, generating an increase in the price level, with constant output.

The fact that the responses to the shock along the right diagonal of the matrix are all positive is good for our conclusions; this confirms, indeed, the consistency and robustness of our estimation through Structural VAR models and with the use of the statistical software Gretl.

However, we can make also a deeper analysis, looking at the responses in the single country and we can make comparisons among the countries considered. We can look at the responses in the different structural VAR models used too and understand which approach is more consistent with the assumptions initially made.

We can affirm that the responses obtained with the construction of structural VAR model are largely consistent and coherent with what is stated in the theoretical model, after the introduction of shocks. By reading the matrix of responses, it is possible to understand, in summary, how the economic system moves after demand and supply shocks. Both the theoretical and the empirical models presented have been built following the current economic cycle, characterized by a post-crisis phase. Precisely for this reason, we believe that the matrix is a good starting point for understanding the economic phenomena that surround us nowadays and, with its application, we could be able to prevent future negative events and make predictions, even in the long term.

7.2 Concluding Remarks and Extensions

Our work started by asking a challenging question: what are the causes of the fall in productivity over the last fifteen years around the world but, especially, in European countries? What lies behind this worrying economic phenomenon?

The current crisis, although it was triggered by events in the financial sphere, might be seen in its real effects as having inflicted a powerful negative demand shock on the global economy. Profound uncertainty remains about how and when a full recovery will be achieved, even if we currently have some signals.

In this historical moment, in which mature economies have only marginally recovered the output, lost after the global financial crisis, and with the employment that shows few signs of significant improvement, most economists remain committed to an orthodox view. That view links economic growth to supply-side factors such as technical change and the accumulation of human and physical capital. Technology has a central role in the current economic system and we have considered it a key variable in the development of our work. With the analysis of the Growth Accounting, indeed, in chapter two, we were able derive the driver variable of technological progress, which is the Total Factor Productivity (TFP). TFP is the part of output growth, not attributed to the use of factors of production such capital or labour, but to technical change. A strong positive TFP is regarded as a desirable characteristic of the growth process. Therefore, we choose to derive the TFP in a sample of European (France, Germany, Greece, Italy, Spain, UK) and non-European (USA, Australia) countries. The results obtained with the collection, the analysis and the discussion of the data, which come from the database AMECO, confirm the important role of the Total Factor Productivity. The analysis of the TFP trend make us aware that one of the causes of the slowdown in productivity is that most of the European countries, among them especially Italy, show deep lacks in technological progress in the last fifteen years.

The figure below shows the Italian TFP Growth Rate, from 1960 until 2016.

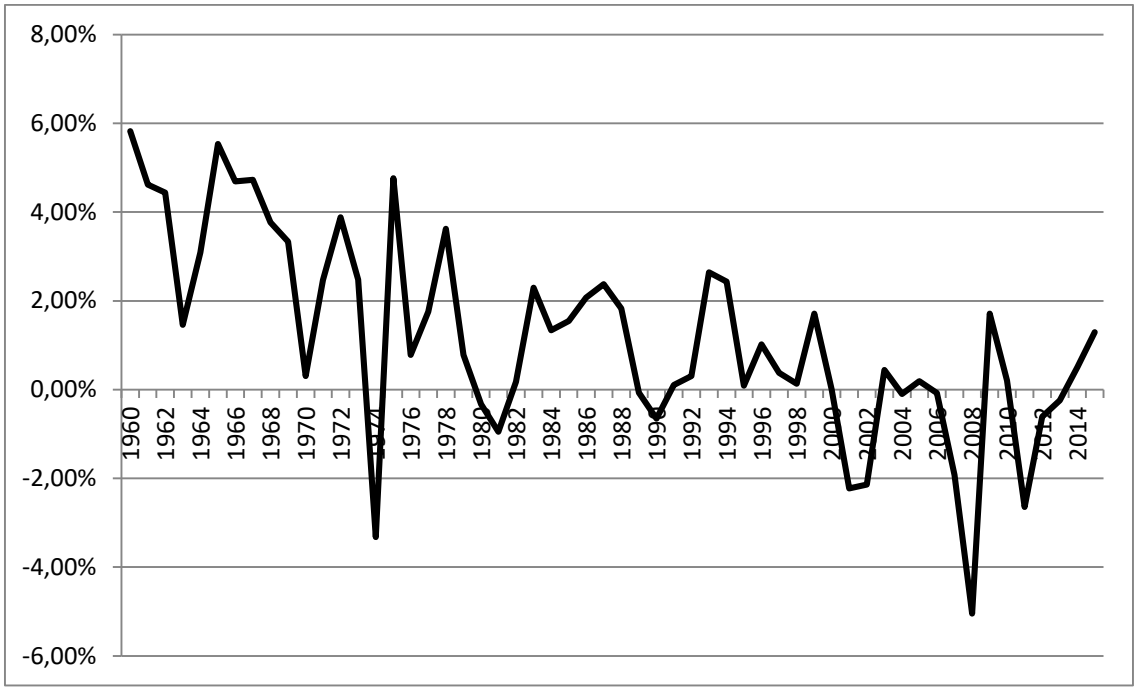


Figure 53. Italian TFP Growth Rate

However, the attribution of the cause of low growth to TFP is not enough. We searched other causes. Growth means more output produced; the output comes from the production process; the production process starts in the labour market contest. Inevitably, we introduced the labour market and we studied its dynamics. Employment, unemployment, wage determination, capital, labour, firms, general price level, indeed, are all important variables connected with the production. In particular, we asked another challenging question: how and in which way labour flexibility influence production and, therefore, the economic growth? We said that nowadays labour market flexibility can be seen as the firm's ability to make changes to their workforce, in terms of the number of employees they hire and the number of hours worked by the employees. A flexible labour market is one where firms are under fewer regulations regarding the labour force and therefore, they can set wages (i.e. no minimum wage), they can fire employees and they can change their work hours. A labour market with low flexibility is bound by rules and regulations such as minimum wage restrictions and requirements from trade unions. We tried to make some connections about the introduction of regulation in the labour market and the innovation. We studied the thesis that sustain a positive correlation and those who sustain a negative correlation. However, in order to understand the effects of flexibility in the labour market we studied the trend of employment and unemployment in our sample of countries. Data show that in the Euro Area, much of unemployment is attributed to the financial crisis after 2008; however, from 2013 circa, the trend is inverted.

After TFP and flexibility, we consider also another variable as driver of economic growth the Gross Domestic Product Per Capita (GDP per capita). Also in this case, we studied the data and the trends in our sample of countries. The graphs of the countries show increasing trend from 1960 until the crisis in 2008, then there is a stop and an inversion. The Euro Area GDP per capita trend, instead, in slowly downward sloping until recent years. Therefore, we can catch better the slowdown in productivity in this last

graph, which evidences the fact that a decreasing GDP per capita confirm a slowdown in productivity.

The figure below shows the annual variation of GDP trends in the last twenty years in the Euro Area and in the sample countries considered in our analysis.

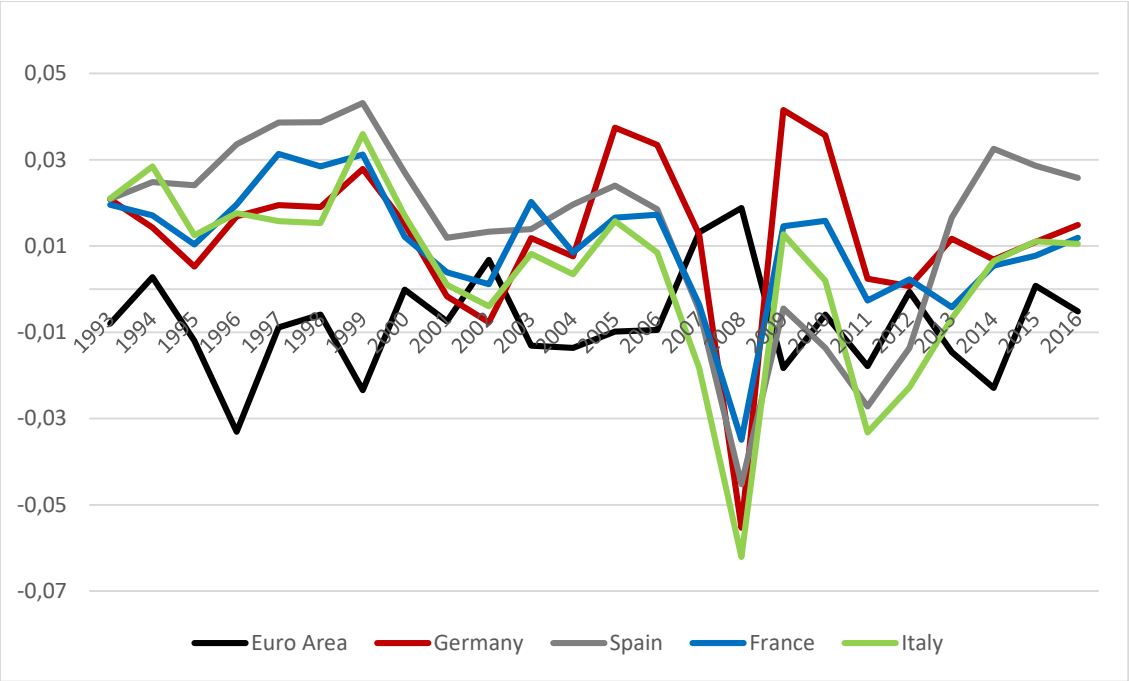


Figure 54. Annual Variations of GDP Per Capita

In all the countries, the variations are positive from the beginning of the period until 2005. Then the trends slope downward significantly with the most negative peak in 2008, the year of the financial crisis. In most recent years the variations are partially positive and in part negative: if we consider the GDP per capita a driver variable of productivity, this is a sign that the recovery in economic growth is still uncertain and to be consolidated.

The analysis of the three different possible driver variables of economic growth is not sufficient to have a clear idea of the phenomenon of the slowdown in productivity and to draw certain conclusions. Therefore, in chapter four, in order to have a complete panoramic, we introduced and discussed the main labour market models, developed over time, within the economic theory. We start describing the known labour market models model of classical, neoclassical and of the Keynesian Theory. We have then introduced a brief review of the main growth exogenous model to resume some specific features of the labour market and to create the basis to build a model that could be able to explain better, how the macro-economic variables related to productivity and to the labour market play the most important roles. There are various models of economic growth and there are many differences between them. The most important and significant economic growth model is the neoclassical model attributed to Robert Solow (1956). It allows demonstrating how capital stock growth, labour force growth and technological progress interact with the economic system by influencing the growth of aggregate production of goods and services. The Solow model considers technological progress to be an

exogenously determined phenomenon and it demonstrates how the economic system converges towards a steady state path. After reaching it, per capita income increase at a rate equal to the growth rate of technical skills. Once the economic system has reached the steady state, there can be no growth, unless it is the exogenous growth of an external aggregate: growth tends to be exhausted. The process for which economies continue to grow in spite of declining returns is exogenous. It is given by the creation of new technologies (technological advances) that allow producing more with fewer resources. Indeed, empirical analyses have shown that the GDP growth could not be attributed solely to the increase in labour and capital but there was an unexplained part, defined as Solow's residual, which was assumed to be caused by technological advances innovation. Solow's residual is nothing but the TFP we have studied and analysed to look for the causes of productivity decline.

In chapter five, we tried to build a macroeconomic growth model, related to the labour market and based on the price setting and wage setting. We have seen what happen to this model if we introduce shocks: this bring us closer to reality and able to understand the dynamic of the macroeconomic variables. In constructing our macroeconomic growth model, in addition to the Solow growth model, we refer to the model of Nicholas Kaldor. He has made important contributions to the understanding of the mechanisms related to capital formation and the manner of its distribution, the working of the economic system, of firms, of the economic cycle and the development. The model that Kaldor builds is the so-called "Theory of Exogenous Growth," which attributes the economic growth in the long-run to technical progress and does not depend, therefore, on other economic variables. Kaldor postulate a single relationship between the growth of capital and the growth of productivity, which incorporates the influence of both factors. He called this relationship "technical progress function". Therefore, finally, it is from the Kaldor model and from his assumptions that we constructed and described in chapter six an empirical and micro-founded model. With the software Gretl, we construct Structural VAR models and we obtain responses of three driver variables (capital intensity, Total Factor Productivity and GDP Price Deflator, as driver of inflation) to three shocks (two supply shocks, capital and technological shocks, and a demand shocks). In order to overcome the stationarity of the time series used in the Structural VAR model, we choose to use three types of model. The responses are sometimes contradictory among the different models and among the different countries. However, the results obtained are the same in all kind of the Structural VAR used. This has permits us to describe, in the last chapter, with more robustness the macroeconomic implications that arise from the model. Let us summarize them.

From what emerged from our empirical analysis, undoubtedly, the shortage of technological development, which has a profound impact on the productivity of the countries analysed, needs to be filled through greater awareness of the concepts of innovation and internalization. The strong acceleration of product and service changes, due to global competition, imposes a consistent commitment to updating and a continually introduction of innovations. Information, knowledge and innovation are strategic elements on which Italian and European firms, including the smaller ones, have to aim in order to achieve the essential "leap of quality", adding more value to their products. The concrete application of new ideas covers all phases of various economic

activities. It may take the form of a better product / service, or it may relate more simply to a single aspect of the process considered, by increasing the value of the product / service in terms of design or market-related content or marketing costs (optimizing production processes, management, and communication). Innovation can and must also cover the so-called "mature technology" sectors and can be introduced not only in the actual production processes, even in phases of research that precede production. It is essential, based on these considerations, to evaluate the propensity to innovate of the productive system also by reading indicators, both in input and in outputs, in order to understand how Italy or any other country is located in the European or worldwide framework. The problem of how to set up their own development strategies lies with small and medium-sized Italian firms. They would try to overcome the many obstacles to the introduction of innovations such as the reduced availability of capital needed to invest in research and development; the difficulty to access to strategically relevant information, the legal and regulatory environment and so on. Moreover, the new phenomenon of globalization leads inevitably firms to deal with foreign countries. Internalization implies greater competitiveness. Therefore, innovation and competitiveness are to be considered as two essential elements in formulating a development strategy for the firms that want to be affirmed in the global economy. There is the need for industrial and research policies that, in addition to providing the reinforcement of internal resources, aim to the capacity to affirm the presence of firms both in a domestically and in an internationally contest.

What we understand in a general way is that it is in times of economic suffering that a country should invest in the future. If we consider that the current national crisis is longer and deeper than the one in the 1930s, the absence of an industrial, research and development strategy, coupled with the continued contraction of financial resources for innovation, becomes a constraint that could position the country on the margins of development and the international labour division. The crisis in productivity is traveling parallel to the lack of new investments and, at the same time, with the weak trend of the GDP at least after 2008, while many have refers to a possible secular stagnation and while they stand some authoritative voices to signal a next possible new crisis. Supply-side and demand-side factors can interact to reinforce macroeconomic imbalances and render these imbalances more persistent over time. Against this background, a measure that appears even technically obvious would be to increase investment both public and private. Governments, leaving the pressure of austerity policies or pushed too budgetary control, should invest more, and simultaneously with appropriate policies should encourage private investment. Moreover, it should focus more on human capital, on a more complete education system and better quality, more on research credits, on a financial system able to direct resources to the most productive uses. These measures should be pursued, based on the suggestions mentioned above, with the appropriate anti-trust policies and with the reduction of inequalities. A work that is certainly of long breath and that requires commitment and perseverance.

Appendix

The AD–AS or aggregate demand-supply model is a macroeconomic model that explains price level and output through the relationship of the aggregate demand and the aggregate supply. This model allows us to do an analysis of general equilibrium. Its fundamental characteristic is that the price level is considered an endogenous variable.

AS indicates the relationship of *aggregate supply*, which describes the effects of production on the price level. It is derived from the behaviour of wages and prices; we consider, therefore, the equations for the determination of wages and prices:

$$W = P^e \cdot F(u, z) \tag{33}$$

$$P = (1 + u) \cdot W \tag{34}$$

The first step is to eliminate the nominal wage *W* by the two equations. Replacing the wages in the second with its expression in before you get:

$$P = P^e \cdot (1 + u) \cdot F(u, z) \tag{35}$$

The second step is to replace the unemployment rate *u* with its expression in terms of production:

$$u = \frac{U}{L} = \frac{L - N}{N} = 1 - \frac{N}{L} = 1 - \frac{Y}{L}$$

The aggregate supply curve, AS, will be defined as:

$$P = P^e \cdot (1 + u) \cdot F(1 - \frac{Y}{L}, z) \tag{36}$$

The actual price level *P* depends on expected price level P^e and the level of output *Y* (and from the mark-up, the variable *z* and the work force, here taken as data). The AS curve has three properties:

1. It is increasing.

2. Passes through the point at which $Y = Y_n$ and $P = P^e$.

3. An increase in the expected price level P^e shifts the aggregate supply curve upward. Conversely, a reduction in the expected price level shifts the curve down.

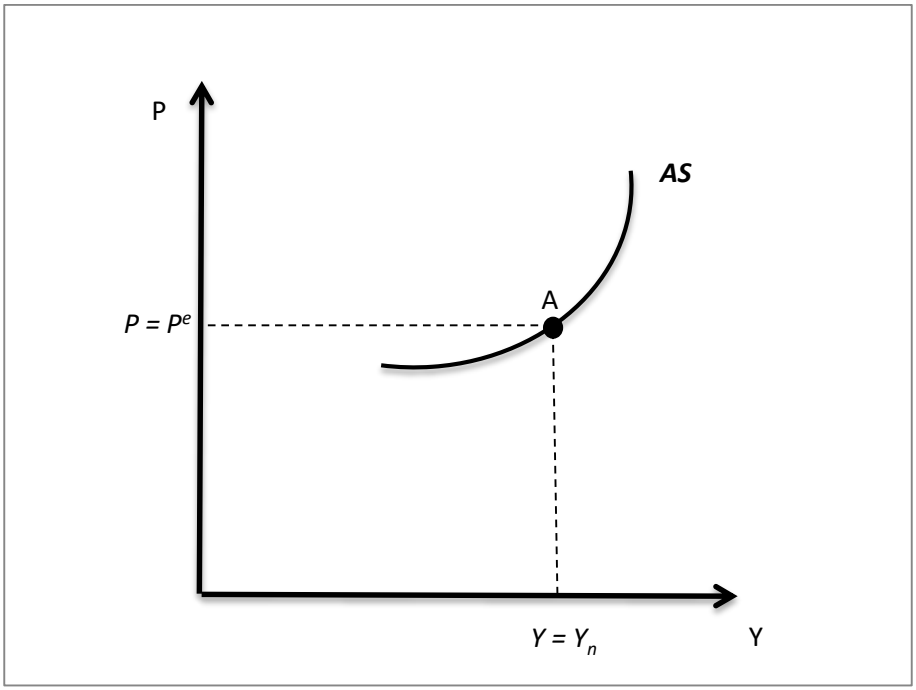


Figure 55. AS Curve

Given the expected price level, an increase in production increases the price level. If production is equal to its natural level, the price level is equal to that expected. An increase in the expected price level shifts the aggregate supply curve upward.

The negative relationship between production and price level is represented by the downward-sloping curve *AD*. The AD curve describes the effects of aggregate demand in the price level on output. It is derived from the condition of equilibrium in the real and financial markets. The higher the level of prices, real money balances decline. This monetary contraction raises the interest rate, which in turn causes a reduction in demand for goods and thus production. This curve is called the *aggregate demand* curve and is represented by the following relation:

$$Y = F\left(\frac{M}{P}, G, T\right) \qquad (37)$$
$$(+,+,-)$$

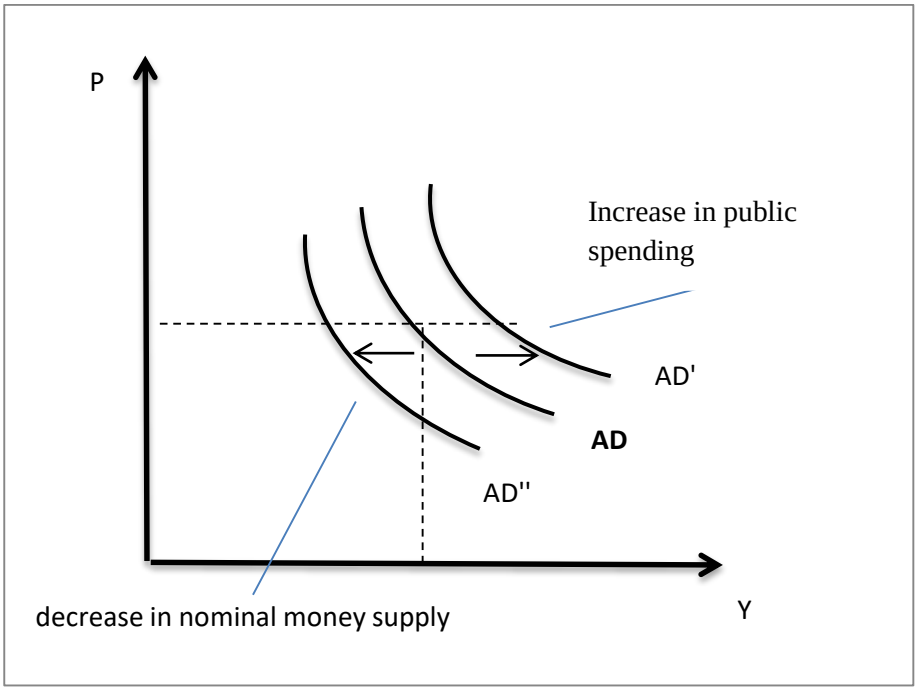


Figure 56. AD Curve

For any given price level, an increase in government spending increases production, shifting the aggregate demand curve to the right. For any given level of prices, a decrease in the nominal money stock decreases the production, shifting the aggregate demand curve to the left. Consider jointly the two equations of aggregate supply curve (*AS*) and aggregate demand curve (*AD*):

$$P = P^e \cdot (1 + u) \cdot F(1 - \frac{Y}{L}, z)$$

$$Y = F\left(\frac{M}{P}, G, T\right)$$

For a given value of P^e and for given values of the variables of fiscal and monetary policy, these relations determine the equilibrium values of production *Y* and the price level. The balance is the intersection between the aggregate demand curve and the aggregate supply.

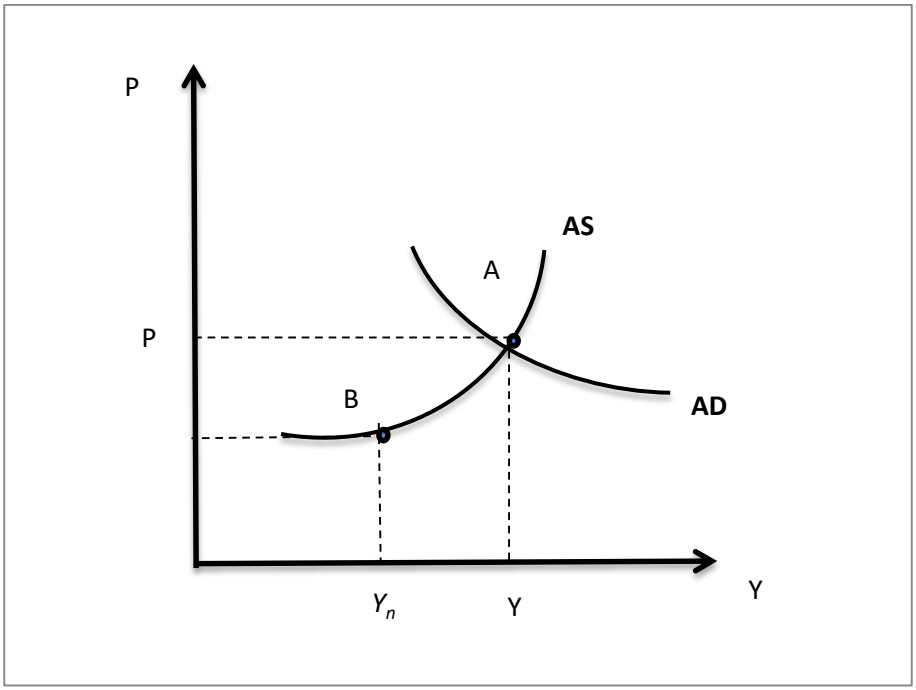


Figure 57. Equilibrium AS-AD

The aggregate supply curve AS is drawn for a given value of P^e and is a rising curve. The aggregate demand curve AD is drawn for given values of G, T and M and is a falling curve. The balance is located at the intersection between the curves AD and AS. By construction, the point at the goods market, the financial markets and the labour market are all in balance.

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