Growth and Unemployment: A bibliometric analysis on mechanisms and methods

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Abstract: The relation between growth and unemployment is being studied throughout a diverse set of contributions over the last years. Taking into account the current economic situation, this topic is regaining attention amongst economists essentially due to the importance of this relationship as a way to overcome the high unemployment rate that has been characterizing the European labour market. In the first part of the paper we provide an analysis and a categorization of the most important contributions on the field until 2000s. In the second part we develop a bibliometric analysis in order to identify the evolution pattern of the main research lines, using a quantitative approach. Then, we provide an update of the literature by describing the new theoretical mechanisms and empirical evidence regarding the relationship between growth and unemployment. A substantial increase of new effects (reallocation effect, leapfrogging effect, disciplinary unemployment effect, minimum wage effect, updating technology effect, schooling and working effect and agglomeration economies effect) and a relative predominance of “formal” and “empirical” methodologies, with a very low weight of articles combining both methods are some of the main findings.

Keywords: long run unemployment, economic growth, survey, bibliometrics
JEL codes: E24, J21, O40, C89.
1. Introduction

The relationship between economic growth and unemployment could be considered a puzzle in economics. It is widely known that unemployment has been rising over the last decades in several developed countries, while the economic growth rate has been falling over the same period. Figure 1 and 2 illustrate these trends by showing the pattern of GDP growth rate and unemployment since the middle sixties. Interestingly, the rise in unemployment has been more pronounced on average in the European countries compared with the United States, although the GDP growth rate has been following a more similar pattern in both economies. Implicitly, this suggests that the relationship between these two variables is not the same among economies (Haruyama and Leith, 2010).

This empirical evidence is reflected in several empirical and econometric studies. On the one hand, Caballero (1993) found a weak positive link between growth and unemployment in US and UK from 1966 to 1989. On the other hand, Bean and Pissarides (1993) performed a cross-country analysis for OECD countries and did not found any relationship between productivity growth and unemployment, except for a negative relationship between 1975 and 1985. In contrast, Aghion and Howitt (1992) developed an empirical analysis based on 20 OECD countries and found what they have called an inverted U-shaped relationship. More recently, Herwartz and Niebuhr (2011) developed an econometric model to study the link between growth and unemployment, taking the Okun’s law as a starting point. In their study, Herwartz and Niebuhr (2011) found out that the relationship between variables changes across countries and crucially depends on labour market framework (unemployment benefits, unions’ bargaining power, etc.). Finally, Carmeci and Mauro’s (2003) empirical analysis concluded that labour market imperfections (measured unemployment replacement ratio and union density) have negative long run growth impacts.
Figure 1: GDP growth rate, moving average, four periods

Source: AMECO database (http://ec.europa.eu/economy_finance/ameco/user/serie/ResultSerie.cfm) and authors own calculations (accessed on May 2013).

Figure 2: Unemployment, moving average, four periods

Source: AMECO database (http://ec.europa.eu/economy_finance/ameco/user/serie/ResultSerie.cfm) and authors own calculations (accessed on May 2013).
On the theoretical side, there seems to be no consensus as well. Pissarides (1990) is consensually identified as the first attempt to study this relationship within a theoretical framework. Combining a standard search and matching model with the possibility of economic growth, the author concluded for a negative correlation between growth and unemployment. This negative relation is known as the capitalization effect.

On the other hand, Aghion and Howitt (1994) developed a new theoretical link between these two variables: the creative destruction effect, which identifies a positive relation between growth and unemployment. Moreover, there is also a pool of saving effect from Bean and Pissarides (1993) that states a negative relationship between unemployment and growth. Finally, Acemoglu (1997) presented the coordination failure effect, which establishes a positive correlation between unemployment and growth without a social planner.

More recently, Lingens (2003) developed a theoretical model based on the link between growth, unemployment and unions. According to him, it is possible to have a positive or a negative relationship between growth and unemployment, depending on the value of the elasticity of substitution between low and high-skilled workers. Finally, Herwartz and Niebuhr (2011) combined an efficiency-wage model with the possibility of an endogenous technological progress. Briefly, based on worker’s incentives to shirk once employed, they concluded that the direction of the link growth-unemployment will crucially depend on the level of unemployment, in a sense that a high unemployment level will work as a disciplinary effect.

Therefore, taking all these different theoretical and empirical contributions into consideration, our aim is to provide a survey of the main mechanisms and links presented in the literature regarding the relationship between growth and unemployment complemented by a bibliometric analysis. We have at least three main motivations for this exercise. Firstly, taking into account the recent economic developments in the Euro area, understanding the relationship between growth and unemployment is crucial in order to promote an adequate economic policy towards a sustainable recovery (Blanchard, 2006); secondly, the existing surveys regarding the link growth-unemployment are from the beginning of the century (e.g. Aricó, 2003), which therefore motivates the existence of a new survey in order to summarize the main new contributions on the field; finally, we are not aware of any bibliometric study regarding this topic.

The paper proceeds as follows. Section 2 provides a literature review based on Aricó’s (2003) approach. Section 3 expands Aricó (2003)’s analysis through a bibliometric exercise in order to identify the evolution pattern of the main research lines in terms of publications.
Section 4 offers a descriptive analysis of the new main mechanisms regarding growth and unemployment, either on the theoretical or empirical side. Finally, Section 5 states some concluding remarks.

2. A literature review on economic growth and unemployment: Aricó (2003) as a departing point

The research about the relationship between economic growth and unemployment has started in the 1950s (Aricó, 2003). Harrod (1939) and Domar (1947) are the two most visible earlier contributions regarding this topic. However, following Arico’s (2003) approach, these two contributions represent an isolated work in the sense that the emergence of the Solow’s (1956) model brought into the economic growth debate a new branch of questions that deviated the attention from the growth-unemployment relationship. Therefore, only after about 40 years the theme regained attention amongst economists, mostly due to the publication of Pissarides’ (1990) model, which is broadly considered “one of the first attempts to explain the presence of unemployment in a growing economy” (Aricò, 2003, p. 423). By combining a standard matching function within a neoclassical growth model, Pissarides (1990) established a link between growth and unemployment through profits and hiring costs. Since, in steady-state, both hiring costs and profits rise at the same rate, a higher (lower) growth rate has two effects: increases (decreases) future profits and increases (decreases) future hiring costs. Thus, facing an increase in the growth rate, the firm’s optimal choice will be hiring more today (by opening new vacancies) in order to save in future hiring costs. In other words, a higher growth rate implies a lower rate of unemployment and a higher rate of opening vacancies. Aghion and Howitt (1994) identified this process as the capitalization effect. In their paper, they reinterpreted this effect by arguing that a higher growth rate will affect the “effective discount rate”, which is given by the difference between the interest and the growth rate. Intuitively, an increase in the growth rate will raise the investment return rate (by lowering the “effective discount rate”), encouraging new firms to enter the market, leading to an increase in the number of job openings and, thus, reducing unemployment.

In their paper, Aghion and Howitt (1994) have also identified another effect concerning the relation growth-unemployment in the long run, the so-called creative destruction effect as an opposite effect to the Pissarides (1990) capitalization effect. Although this concept goes back to Schumpeter’s (1943) work, Aghion and Howitt (1994) “are the first to introduce a creative destruction mechanism in a dynamic model of growth in order to study labor turnover and unemployment” (Sener, 2000, p. 562). Aghion and Howitt (1994) presented a “neo-
Shumpeterian approach” where each firm should be interpreted as an “institutional embodiment of knowledge” (Aghion and Howitt, 1994, p. 478). In other words, firms are basically a centre of research, a place where innovations and knowledge are generated. However, in order to step-up a research centre it is necessary to bear a sunk cost. Every time an innovation occurs, the innovator firm will pay a fixed cost to construct a new machine and open a “production unit”. Notice that this machine is only one of the three components that are necessary to produce the final good – the other two are (a) an “appropriate” worker, in a sense that the firm must incur into a matching process (deterministic, by assumption, in this model) in order to find a worker that matches with the machine; and (b) a fixed amount of human capital whose price increases at the average growth rate of the economy. In other words, this means that the production unit faces increasing fixed costs independently of its internal situation. Thus, a production unit with a fixed technology (meaning that the firm is not innovating) could, at a certain moment of time, not be able to cover its fixed costs, meaning that it will have to be closed, driving the worker into unemployment. Taking into account this framework, an increase in the growth rate will trigger the capitalization effect (by lowering the “effective discount rate” and, thus, increasing the firm’s incentives to enter the market) and the proposed creative destruction effect in two different ways. On the one hand, an increase in the growth rate will also increase the price growth rate of human capital, reducing the life-time of production units and, therefore, increases the job-destruction rate. On the other hand, this increase in the growth rate will discourage firms to enter the market in the sense that it decreases the return profits of opening a new production unit (and a new vacancy) since the life-time of the production function will be lower. The first effect is called the direct creative destruction effect while the second one is the indirect creative destruction effect. The total overall effect on unemployment will depend on the model parameterization. However, there are only two possible results: “a reverse U-shaped relation between growth and unemployment [meaning that the creative destruction effect dominates at low growth rates whereas the capitalization effect dominates at high growth rates] or a monotone increasing relation between growth and unemployment” (Aricó, 2003, p. 433).

The capitalization effect and the creative destruction effect are the most widely used mechanisms in the growth-unemployment literature. Several subsequent works (Meckl, 2001; Lingens, 2003; Moreno-Galbis, 2012) take these effects as a starting point for their own analysis. Some of them will be explored in the next sections. However, there are, at least, two more effects that must be addressed.
The first one is proposed by Bean and Pissarides (1993) and emerges as a “critique” to the previous ones. According to the authors, the relationship between growth and unemployment can be set in both directions: from growth to unemployment or from unemployment to growth. Therefore, in Bean and Pissarides’ (1993) model, both growth and unemployment are considered as endogenous variables, in contrast with Pissarides (1990) and Aghion and Howitt (1994) where the growth rate is considered an exogenous variable. Bean and Pissarides presented the pool of savings effect – an increase in the unemployment rate will imply a decrease in the total amount of savings (of the economy as a whole) available for investment, which therefore leads to a decrease in the growth rate. By combining an overlapping generations endogenous growth model with matching frictions in the labour market, Bean and Pissarides (1993) were able to analyze a set of new relations, namely the impact of a change in the propensity to save or consume on the growth rate or on (un)employment. However, one of the limitations of this framework is that it does not consider the capitalization or the creative destruction effects.

The last effect that must be considered is based on Acemoglu’s (1997) work and corresponds to the coordination failure effect. According to Aricó (2003) approach, this work is one of the first attempts to describe labour supply in a growth-unemployment framework. Acemoglu (1997) takes the typical search and matching model as a starting point and introduces a potential heterogeneity by considering the existence of two types of workers (skilled and unskilled) and also the possibility of firms to possess or not the new technology. Notice that there is no education system or learning-by-doing mechanism in this model, which means that an unskilled worker can only become a skilled worker if: (a) is hired by a firm and (b) the firm decides to train the worker. The relationship between unemployment and growth arises from the relationship between unemployment, entrepreneurs’ expectations and productivity. Facing a higher unemployment rate, entrepreneurs’ expectations of hiring an unskilled worker in the search and matching process are also higher, resulting in lower incentives to innovate (and hire) since total return profits will incorporate a higher probability of having to train the worker. Thus, this results in a lower growth rate and an even higher unemployment rate, which implies that the agent’s expectations are self-fulfilled. Inverting the causality (i.e. the link is now growth-unemployment) will not change the main results. If each firm expects that all the other firms will not incorporate the new innovation/technology, none of the firms will adopt the new technology – the anticipation of training costs is taken into consideration in the profit maximization problem, reducing the incentives to innovate (and hire). Therefore, once again the expectations are self-fulfilled and the result is a lower
growth rate and a higher unemployment rate. Depending on the entrepreneurs’ expectations, there are two possible equilibriums: one when the new technology is adopted by all the firms, implying a lower unemployment rate; and a second equilibrium when the new technology is not adopted, leading to a higher unemployment rate. Acemoglu (1997) concludes his analysis by introducing a “social planner” into the model. Intuitively, the incentives for the social planner to adopt the new technology are higher than the firm’s incentives – a firm that adopted the new technology will incur into training costs and will only beneficiate from the skilled worker during a specific period of time; however, the social planner considers the economy as a whole and, thus, the training of unskilled workers will beneficiate not only one firm but all the firms, in the sense that rises the average skill level of workers. Therefore, the introduction of a social planner will compensate the coordination failure effect, leading to an efficient allocation of resources. In Figure 3 we offer a schematic representation of the four main effects above described as presented by Aricó (2003).

![Figure 3](image.png)

**Fig. 3** Main mechanisms regarding the relation between economic growth and unemployment

The previous four effects (Figure 2) are considered the most widespread mechanisms that emerge from the literature on the relationship between growth and unemployment. Nevertheless, following Aricó’s (2003) approach, several other authors have also given important contributions into this research field. In the remaining of the section we will briefly summarize some of these contributions. Eriksson (1997) developed the demand-side, combining the Ramsey’s (1928) model, with the Pissarides’ (1990) framework. By using the market tightness as an intermediary between growth rate and unemployment, Eriksson (1997) established a positive relationship between economic growth and unemployment. King and
Welling (1995), on the other hand, extended the Pissaride’s (1990) model by (1) assuming that, instead of firms, workers are the ones who bear the cost of searching for a new job; and (2) introducing the concept of “different spatial locations”. In other words, firms can be located, for example, in different regions of a country with different levels of productivity. Although both models (Pissarides, 1990; and King and Welling, 1995) concluded that there is a negative correlation between growth and unemployment, in the King and Welling’s (1995) framework the growth rate affects positively the searching rate parameter. Notice that in the Pissarides (1990) model, an increase in the growth rate leads to an increase in the number of vacancies, while in the King and Welling’s (1995) framework this increase in growth leads to an increase in workers’ search effort in order to move to more productivity regions. Stokey (1991) considered the impacts of international trade in the patterns of goods production and human capital specialization: on the one hand, by becoming more specialized in a specific type of goods to export, a country may increase its growth rate; on the other hand, it will be more exposed to adverse external demand shocks, which could lead to higher unemployment. This type of relation between growth and unemployment is also known as “lock-in mechanisms”.

Finally, Lucas (1993) introduced the “learning-by-doing” mechanism as the primarily process to accumulate skills over time. Taking into consideration some of the Stokey’s contributions, Lucas (1993) stated a trade-off between “higher and faster growth with unbalanced distribution of labour and lower growth with balanced distribution of labour” (Aricò, 2003, pp. 441).

Despite the richness of the overview provided by Aricò (2003), a deep analysis of the literature on economic growth and unemployment demands an update of the main contributions. The aim is to identify the state of art. Hence, in the next section we propose a bibliometric exercise based on Scopus database.

3. The evolution of growth-unemployment related literature after 2000
3.1 Methodological considerations

Our bibliometric exercise attempts to capture the evolution of growth-unemployment related literature after Aricó’s (2003) paper. This analysis is based on a review of the abstracts from articles published in all economic journals gathered from the Scopus database since

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1 Notice that the workers are “locked-in” in the sense that they are too specialized, meaning that a reduction in the external demand will affect a substantial part of the workers.

2 There has been an increasing recognition in the use of bibliometric data for the quantitative analysis of research fields. For a detailed guidance on this issue see, for example, Osareh (1996a,b).
2000. The record was obtained using the terms “growth” and “unemployment” as the search keywords. The search by subject/keywords, title, abstract and main text of the articles resulted in a considerable number of articles that did not focus on the specific relationship between growth and unemployment. Therefore, we limited our search procedure only to subject/keywords in order to minimize the number of “not related articles”.

The total number of analysed papers was 224 and the articles that did not specifically treat the growth-unemployment question were disqualified from the bibliometric exercise. In the end, 84 papers remained. These publications were categorized in terms of main mechanism and methodology. Regarding the methodology, we consider five possible alternatives: “formal” (F) if the main purpose of the paper is to build a theoretical, abstract model/argument that attempts to explain the relation between growth and unemployment; “empirical” (E) if an econometric and/or statistical analysis is applied; “formal and empirical” (F+E) if there is a theoretical model/argument and an econometric/statistical application of the model/argument; “appreciative” (AP) if the paper develops an argumentative analysis without any abstract model or econometric analysis; and “survey” if a literature review or an appraisal is presented (Nelson and Winter, 1982; Silva and Teixeira, 2009).

Notice that our main purpose is to identify the new mechanisms and links that emerged after Aricó’s (2003) survey. Thus, to better organize our analysis, we propose a simple structure based on the main effect(s) tackled in the article. For instance, if the creative destruction is the growth-unemployment main effect described in the paper, then this paper is categorized under the label “creative destruction” effect. Thus, we suggest six categories: “Okun’s law”, “capitalization” effect (CE); “creative destruction” effect (CD); “pool of savings” effect (PSE); “coordination failure” effect (CF) and, finally, the “new” effects (NE). This last category includes all the novel effects proposed after Aricó’s (2003) paper to explain the link between growth and unemployment. To better understand these new effects, we have divided this category into several subcategories. Based on the number of related articles (meaning articles that describe similar effects), we thus propose six different subcategories: (i) “policy maker effects”, if the paper describes a effect triggered by a policy maker; (ii) “labour market institutions” when the main effect is related with the role of institutions; (iii) “bargaining structure”, if the effect is directly related with the collective bargaining structure;

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3 Scopus is considered one of the world’s largest abstract and citation database of peer-reviewed literature with smart tools that track, analyze and visualize research.
4 Since it is possible that some published papers do not have any keywords, limiting the bibliometric analysis to only “subject/keywords” does present somehow a limitation in our analysis since these papers will not be considered in the database.
5 We have also excluded seven articles due to the lack of abstract or being repeated.
(iv) “structural change, productivity growth, education and training” when the paper describes an effect mostly associated with innovation processes; (v) “inequality and income distribution”, if the papers focus a specific type of imbalance; and (vi) “technological skills and agglomeration economies” when the link is generated by an efficiency gain. We also considered a “residual category” that includes all the other new effects that cannot be included in the previous categories. In the remained of the section, we present our main findings regarding the evolution on growth-unemployment related literature.

3.2. Main Findings

After Aricó’s (2003) survey, growth-unemployment research has continued to grow, essentially through the introduction of new effects. Almost three quarters of the articles mentioned at least one effect different from the effects previously analysed (see Figure 4). The pool of savings effect and the coordination failure effect are not directly mentioned in any of the analysed articles, which could suggest that: 1) these two effects lost importance over the last few years; or 2) they were incorporated or reinterpreted into a different new effect.

![Fig. 4 General distribution of published papers (%) by mechanism, 2000-2012](image)

Taking into consideration the number of the relevant articles regarding the relationship between growth and unemployment and the total gathered number of articles, it is possible to track the evolution of the published papers on growth-unemployment related research. On average, approximately 40% of the articles that present “growth” and “unemployment” as keywords are directly related with the growth-unemployment relationship. From Figure 5 it is
also possible to identify two phases in this evolution pattern: a decrease of the published articles from 2003-2005 (in 2005, only approximately 17% of the articles are directly related with the link between growth and unemployment); and a steady recovery henceforward – in 2012, more than 45% of the articles are directly associated with growth-unemployment relationship).

![Graph showing the evolution of published papers on growth-unemployment related research in relation to the total number of articles obtained, 2000-2012](image)

**Fig. 5** Evolution of published papers on growth-unemployment related research in relation to the total number of articles obtained, 2000-2012

A deeper analysis led us to conclude that this steady recovery is mainly due to the increase of published papers that present at least one new effect. Nevertheless, it is also visible a small increase in all other types of papers, with especial attention to the *capitalization* effect (Figure 6).

![Graph showing the evolution of published papers (number) by mechanism, 2000-2012](image)

**Fig. 6** Evolution of published papers (number) by mechanism, 2000-2012
Regarding the method, Figure 7 show us that the categories “formal” and “empirical” together account for more than 80% of the papers. Nevertheless, the category “formal and empirical” also represents an important part (16%) of the growth-unemployment related research. Finally, the category “appreciative” does not seem to play an important role, with only 1.19%.

![Fig. 7 General distribution of published papers (%) by methodology, 2000-2012](image)

Taking into account the evolution pattern over time (Figure 8), it seems that the “empirical” category has been playing a significant role over the last few years, whereas the “formal” category has played a relatively more important role from 2000-2005. Notice also that there is an increase in the “formal and empirical” category, which could be interpreted as recognition that it is necessary to fill the existent gap between theoretical models without a concrete empirical application and empirical analysis without a solid theoretical support.

![Fig. 8 Evolution of published papers (number) by methodology, 2000-2012](image)
The next step is to analyze the published papers combining the categories “mechanism” and “methodology”. The following figure (Figure 9) presents the four methodology categories (without taking into consideration the “survey” category since this category represents a literature review rather than a concrete analysis of a specific effect) distributed by the four main mechanism categories. The main interesting results are the following: regarding the capitalization effect and the Okun’s law, the empirical analysis is the most used approach; on the other hand, the formal methodology seems to be preferable when we are dealing with new effects; finally, the “formal and empirical” approach seems to be equally distributed through all the categories.

![Bar chart showing the distribution of published papers by mechanism and methodology, 2000-2012](chart.png)

**Fig. 9 General distribution of published papers by mechanism and methodology, 2000-2012**

Finally, considering the new effects, Figure 10 shows us the main subcategories. The effects triggered by a policy maker seem to be the most relevant, as well as the effects related with labour market institutions. On the other hand, it seems that the category “technological skills and agglomeration economies” does not play an important role.
We have also combined the “mechanism” and “methodology” for the new effects. The main findings are the following: the “formal” approach is mainly used in papers related with the collective bargaining structure, policy makers and efficiency effects; on the other hand, the “empirical” analysis seems to be the common approach when we are working on questions regarding imbalances and labour market institutions; finally, the “theoretical and empirical” approach seems to play a somehow important role on the articles related with innovation. In fact, without taking into consideration the category “labour market institutions”, this last approach does not represent an important type of research in all the other subcategories (see Figure 11).

Fig. 10 Distribution of published papers related with “new effects” by subcategory, 2000-2012
(1) “policy maker effects”; (2) “labor market institutions”; (3) “bargaining structure”; (4) “structure change, productivity growth, education and training”; (5) “inequality and income distribution”; (6) “technological skills and agglomeration economies”; (7) “other effects”
In sum, the capitalization effect and the creative destruction effect only account for approximately 15% of all the papers. Thus, the introduction of new effects into the growth-unemployment research field seems to be the main cause for the increasing number of papers. Within this category, the ones associated with policy maker and the effects related with labour market institutions appear to be the most relevant. Finally, although the formal analysis is the most common approach regarding the new effects, the empirical perspective seems to play a role in the effects associated with inequality and income distribution.

4. New effects

The main findings presented in the last section reveal a gap in the literature in the sense that, to the best of our knowledge, there is not a single paper after Aricó’s (2003) survey that summarizes and describes the new effects founded in the bibliometric analysis regarding the relationship between growth and unemployment. Thus, in this section we make an effort to fulfill this gap. After identifying and reading all the papers that are specific related with the link growth-unemployment, we now present a summary of the main contributions.6 As in Section 2, we follow a descriptive analysis, focusing on the mechanisms identified as relevant to explain the link growth-unemployment. A schematic representation is offered at the end of this Section in order to summarize all the tackled mechanisms.

4.1. Bargaining structure

Lingens (2003) presented a theoretical model focusing on the role of unions and bargaining between firms and workers. Taking the model proposed by Aghion and Howitt (1994) as a starting point, Linges (2003) assumed that low-skilled labour wages are determined by a bargaining process between the new monopolistic firm in the intermediate sector and the union. Since high-skilled labour can be employed either in the intermediate sector or in the research sector, the resulting bargaining wage will influence the high-skilled labour decision of being employed in the intermediate sector or in the research sector.

Thus, there are two straightforward consequences. First, we have the demand effect: a higher low-skilled wage implies a lower demand for this type of labour; on the other hand, if both types of labour are very good substitutes, this lower demand for lower-skilled labour will be substituted by an increase in the demand for high-skilled labour in the intermediate sector leading to a reallocation effect. At the same time, there will be a lower high-skilled

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6 After completely reading the papers found in Section 2, we concluded that the subcategory “Inequality and income distribution” is not strictly related with the relationship growth-unemployment as it could be suggested by just reading the abstracts. Thus, the provided summary in this section regarding the “new effects” does not include this subcategory.
employment in the research sector and, therefore, lower growth. Notice that this reallocation effect is subject to the assumption that lower and higher-skilled labour are very good substitutes. What would happen in the opposite case? Intuitively, what is really happening is the following: a wage increase in the low-skilled labour will influence marginal productivity of the higher-skilled labour in the intermediate sector since it leads to less low-skilled workers, which implies a decrease in marginal productivity of high-skilled labour. Hence, the final effect will crucially depend on the elasticity of substitution between low and high-skilled workers. A higher elasticity of substitution will lead to a reallocation effect from the research sector to the intermediate sector via the wage increase of low-skilled workers in the intermediate sector. Nevertheless, a lower elasticity implies an opposite reallocation effect (intermediate sector to research sector) via the decreasing in marginal productivity of high-skilled workers in the intermediate sector.

Therefore, due to potentially distinct reallocation effects, we can have a negative relationship between unemployment-growth in the case of high elasticity of substitution (higher wage of low-skilled workers induces higher unemployment for these workers and lower growth); or a positive relationship in the opposite case (higher wage of low-skilled workers induces higher unemployment and higher growth).

On the other hand, Zagler (2005) provided a different type of approach. Based in Calmfors and Driffill’s (1988) paper, the author developed a model in order to analyse the impacts of wage pacts on economic growth. Briefly, the key question in the model is related with the bargaining process. Unions negotiate over the current wages and aim to maximize the welfare of their members. As standard, this welfare is a positive function of wages and a negative function of the level of unemployment. Thus, unions will demand higher wages depending on the respectively probability of an increase in the unemployment. In order words, unions will negotiate taking into consideration the outside option, which means the alternatives that a worker who leaves a firm has. This outside option will depend on the probability of finding a new job in the consumption good sector or in the innovation sector, or having to rely on unemployment benefits. In other words, a union will negotiate a wage increase more aggressively if a worker who leaves a firm has (1) higher probability of finding a job in the consumption good sector; (2) higher probability of going to the research sector; and (3) higher unemployment benefits.

7 Calmfors and Driffill’s (1988) paper is considered one of the main references in collective bargaining structure. Briefly, they have analysed the impacts of different type of bargaining structures on wages, prices, unemployment and output. The main conclusion is that highly centralized systems (such as in the Northern Countries) and highly decentralized systems (such as in Japan and US) seem to perform better than the intermediated systems (such as in Belgium and Netherlands) in terms of real wage, prices and level of unemployment. For a general description, see Mares (2006).
Zagler (2005) assumed that this bargaining process may take place at firm-level (unions versus firms) or at the centralized-level (an national union versus a national employer association) and compared the two possible outcomes in terms of wages and growth. At the firm-level, unemployment rate depends on growth through two mechanisms.

First, a growth rate increase leads to a higher demand in the innovation sector, raising innovations. However, this increase in demand for workers in this sector will affect the outside option of a worker in the consumption good sector, increasing the probability of finding a job there. This increase in the outside option gives incentives to unions to demand higher wages, therefore rendering more people to unemployment. “As the unions push up wages when wages in other sectors increase, we may refer to this effect as the intersectoral leapfrogging effect” (Zagler, 2005, p. 429). Second, this growth rate increase will attract new firms to the consumption good sector, increasing once again the outside option of a worker since the probability of finding a new job once fired is now higher. Thus, higher growth rate will lead to higher unemployment.

On the other hand, at the centralized-level bargaining, we do not have the second effect. Since the increase in wages due to an increase in growth is the same to all the firms in the consumption good sector, a fired worker can only expect to find a new job on the innovation sector. This lowers the increase in the outside option due to the increase in growth rate, limiting therefore the raising of unemployment.

Therefore, the comparison in terms of wages and unemployment between the market solution (without unions), the firm-level bargaining and the centralized-level leads to results similar to those found by Calmfors and Driffl (1988) – the intermediate case of centralization (the firm-level bargaining) leads to the worst outcomes in terms of wages, unemployment and growth.

4.2. Labour Market Institutions

Haruyama and Leith (2010) based their theoretical work on the empirical evidence that the relationship between growth and unemployment may not be necessarily the same among all economies. Specifically, there seems to exist a positive relationship between growth and unemployment for the US data and a negative relationship for the European data. According to the authors, differences in the employment protection legislation could be a possible explanation for these differences in the link growth-unemployment. Thus, they developed a theoretical model to understand the impact of economic growth on workers incentives
(meaning searching for a job, shirking, etc.) and on the unemployment rate, taking into consideration the institutional environment.

Briefly, they combined a standard efficiency-wage model with endogenous technological progress based on a creative destruction dynamics, with innovations destroying jobs in old varieties and, at the same time, creating jobs in the new ones. In other words, the flow of workers into and out the unemployment pool will not only depend on the typical exogenous work-job separation rate but also on the endogenous job destruction and exiting unemployment rates, which crucially depends on technological progress. As in the typical efficiency-wage model, workers can exert effort or shirk, in which case workers will not produce anything. Thus, in order to prevent shirking, the present value of a worker who exert effort and a worker who shirks must be the same. This implies the standard non-shirking condition that will also depend on technological progress via job destruction and exiting unemployment rates. Hence, the relationship between growth and unemployment is linked by variations in the workers’ incentives to exert effort.

Intuitively, a change in the growth rate has two opposing effects. First, the capitalization effect, where a lower growth rate reduces the returns to employment, increasing workers’ incentives to shirk instead of exerting effort. This implies a rise in wages to keep the present value of shirking equal to the present value of exerting effort, increasing therefore the unemployment level. Second, there is a reallocation effect – a lower growth rate will decrease the rate of reallocation through the dynamics of job destruction/creation. In other words, with a lower technical progress, innovations will be less common, meaning that workers are more likely to keep their jobs. This means that once unemployed, it will be more difficult to get a job. This decreases the outside option value and increases workers incentives to exert effort, leading to a lower wage and lower unemployment level. This is considered the disciplinary effect of unemployment. Therefore, whereas the capitalization effect leads to a negative relationship between growth and unemployment, the reallocation effect establishes an opposite relationship.

According to the authors, the final result will crucially depend on the combination between these two effects and on the level of unemployment, in a sense that the disciplinary effect of unemployment resulting from the reallocation effect will be reduced if unemployment is high since incentives to exert effort are already high. Following this reasoning, the authors proved that there exists a “threshold level of unemployment below (above) which wages fall (rise) as the rate of productivity growth falls” (Haruyama and Leith, 2010, p. 310). In other words, below this threshold, the reallocation effect will dominate the capitalization effect (with a
productivity slowdown workers are aware that is more difficult to find a job once unemployed). Nevertheless, above this threshold, the *capitalization* effect will dominate the *reallocating* effect – a decrease in productivity will not change the “awareness” of workers in relation of unemployment simply because they already know that once unemployed it will be very difficult to get a job again.

Moreover, notice that the existence of an unemployment threshold that changes the relationship between growth and unemployment could be one of the reasons to explain why similar slowdowns in productivity are producing different results on unemployment in US and Europe. One good explanation is that the threshold is not the same for both economies due to labour market institutions (employment protection legislation, unemployment benefits, centralization, etc.). Following this reasoning, the authors proved that an increase in the unemployment benefits will lower the workers’ incentives to exert effort, leading to an increase in the unemployment rate. Thus, if an economy is below the threshold (meaning a positive relationship between growth and unemployment), this type of policy could raise the unemployment level and lead the economy to an unemployment rate above the threshold, meaning a negative relationship between the two variables.

On the empirical side, Herwartz and Niebuhr (2011) developed an econometric model to study the link between growth and unemployment. Taking the Okun’s law as a starting point, the authors have considered several factors that could influence the response of unemployment rate to a change in output growth. Briefly, they are (1) labour market legislation, which may increase the cost of adjusting employment; (2) sectoral structure of an economy, meaning that an economy highly specialized might be more vulnerable to adverse shocks; (3) agglomeration economies, that may decrease existing search frictions; and (4) regional characteristics, such as the age structure of the labour force or the education attainment of the population. Within the labour market legislation, the authors took into consideration: (a) unemployment benefit system, which includes active labour market polices, unemployment benefit replacement ratio and the duration of entitlement; (b) wage determination, including union density and collective bargaining coverage, among others; and (c) employment protection legislation (EPL) measured by an index of strictness of EPL.

The authors concluded that “at the regional level, 1% of output growth reduces the unemployment rate by approximately 0.14 percentage point” (Herwartz and Niebuhr, 2011, p. 4671). Nevertheless, this estimated impact varies across regions, from a positive impact to a negative impact, depending on the regions that are considered in the analysis. In other words, this implies that firstly, national and regional features do affect the sign and the size of the
link growth-unemployment; and secondly, labour market institutions do matter for this relationship. The authors stated that the unemployment benefit system tends to raise the Okun’s coefficient, which implies a value closer to zero and, therefore, a reduction in the correlation between growth and unemployment: Moreover, they stress that EPL does not seem to play a role in this relationship in a sense that its significance is low and marginal.

Finally, Carmeci and Mauro (2003) presented also an empirical analysis regarding labour market institutions and economic growth for the period 1960-1990. They found out that unemployment replacement ratio (the ration of unemployment benefits over wages) and union density (the ration of unionized workers over workforce) – two standard proxies of labour market imperfection and, especially for the mark-up of wages over the reservation wage – have negative long run growth impacts. They have also proposed a different type of mark-up proxy, the ratio of per worker wage on per capita consumption, which results in a negative relationship between growth rate and the rigidity of labour market institutions.

4.3. Policy Maker effects

Regarding this topic, Meckl (2001) combined the Aghion and Howitt (1994) approach with the hypothesis of efficiency wages as an alternative explanation for unemployment. Differently from the efficiency model proposed by Haruyama and Leith (2010), the author assumed that (1) the decision of exerting effort depends not only on the employee’s wage but also on the average labour income; and (2) the productivity of labour is affected by wages. Notice that this average labour income will depend on the sectoral structure of the economy. In other words, the relative size of high-wage sectors in relation to low-wage sectors will crucially influence workers’ incentives to shirk or exert effort by changing the average labour income, which will thus influence the productivity of labour and the unemployment level.

As in the Aghion and Howitt (1994) model, the economic growth rate will positively depend on the level of workers employed in the research sector, which per si depends positively on the size of innovations and negatively on the interest rate. However, in this case there is an incentive problem that may affect the growth-unemployment link – if the research sector is the high-wage sector, an increase in its employment level leads to an increase in the unemployment rate. This occurs because the received wage also depends on the average level of wages in the economy. Therefore, if the size of the high-wage sector is relatively higher than the low-wage sector, the average wage will be higher, leading thus to higher unemployment. “Hence, growth and unemployment will be positively correlated if the
research sector is the high-wage sector, and will be negatively correlated otherwise” (Meckl, 2001, p. 592).

Nevertheless, in contrast with Aghion and Howitt (1994) approach, in this model unemployment emerges by an intersectoral allocation of labour, meaning that workers are reallocated from the research sector to the production sector, instead of an intrasectoral allocation of labour (where workers are reallocated within the production sector), which effect has no impacts in Meckl (2001) framework.

Finally, the author analyzes the impact of wages subsidies on growth and unemployment. Firstly, wage subsidies do not change workers’ incentives, although they do have an impact on labour costs for firms, changing the equilibrium condition of the model. Moreover, subsidies will only affect equilibrium if they are different among firms, otherwise they will affect profitability of all firms in the same way. Thus, in order to promote growth, subsidizing only the R&D sector is the best strategy (the author proved that subsidizing the intermediate sector has not effect on growth). Nevertheless, the effect on unemployment is ambiguous, depending on the sectoral structural of the economy.

On the other hand, Fanti and Gori (2011) proposed a different exercise based on the effect of a minimum wage on economic growth. They combined a standard overlapping generations model (OLG) with a closed economy and a typical Cobb-Douglas production function, and a government that incurs on expenditures with unemployment benefits, entirely financed with ad valorem taxes.

Within this framework, a rise in the minimum wage has two different effects. On the one hand, there is a positive effect on savings through an increase on income of employed workers (wage effect). On the other hand, there is a negative effect on savings due to an increasing on unemployment by two channels of opposite sign (unemployment effect). First, the amount of resources decreases due to a decrease in the number of employed workers; however, the workers who keep their job are now saving a greater amount of resources, which positively affects savings. Thus, the overall effect on savings is uncertain.

According to the authors, this final result will crucially depend on two variables: the replacement rate and the weight of the labour input in production. In other words, the wage effect dominates the unemployment effect if the replacement rate is higher than the relative weight of the labour input. Intuitively, this means that the negative effect of a decrease in employed workers on the produced output is more than compensated by the unemployment benefits through a positive effect on savings. This result implies the introduction of a minimum wage might foster economic growth.
Finally, they have also analyzed the impacts of this minimum wage policy in terms of welfare. These will “generically depend on (i) the growth rate of per capita income and (ii) the initial consumption levels” (Fanti and Gori, 2011, p. 69). Briefly, on the one hand, a rise in the minimum wage will positively affect welfare through the increase in the growth rate of per capita income. However, this rise will mean an increase in the disposable income of the young generation, which may raise consumption, but it will also imply a higher consumption tax rate due to the need to support the raise of unemployment benefits. Hence, once again, the net impact is ambiguous.

4.4. Structural change, productivity growth and education

Moreno-Galbis (2012) explored the traditional Mortensen and Pissarides (1998) model and introduced the possibility of heterogeneous skilled workers, training for unskilled workers, a complementary relation between human capital and technological change, and risk of human capital depreciation during a period of unemployment. According to this author, in the typical search and matching models with economic growth, once an innovation occurs, the only option of a (unskilled) worker is simply waiting until he gets fired. Hence, unskilled workers do have the opportunity to receive training (where the costs are supported by workers) and thus avoid unemployment. Nevertheless, this decision is not straightforward, depending on several factors. First, it only makes sense to incur in training costs if the worker expects a new innovation, otherwise the acquired skills during the training process will not be productive. Second, since different individuals have different levels of ability, these training costs are not the same for all unskilled workers. Finally, workers have also to take into consideration that once unemployed, there is a specific probability of losing their skills.

Firms do also have the possibility of updating their technology. This decision is made once a job is created, and if a firm decides to update the technology it will have to pay a fixed renovation cost. Moreover, the author also assumes that there are two different matching processes – one for skilled workers and another one for unskilled workers. This implicitly states that a variation in growth rate might have different unemployment effects on skilled and unskilled workers.

The worker’s decision process of getting trained is well detailed in the paper. However, our main interesting is to understand the relationship between growth and unemployment and possible the relationship between growth and training. Thus, we will focus on these links rather than on the workers’ decision process.
Concerning the relationship between growth and unemployment, highly related with the relationship between growth and training, the main novelty in Moreno-Galbis (2012) is on the possibility of firms to update their technology, limiting therefore the creative-destruction effect and extending the capitalization effect. However, this updating possibility is a “necessary condition but not a sufficiency condition for the capitalization effect to dominate the creative destruction effect” (Moreno-Galbis, 2012, p. 1702). Notice that this technological renovation depends on two different effects. First, there is a wage increase, in a sense that wages rise at the same pace as the technological frontier (labour cost effect). Second, this technological renovation implies an increase in productivity due to the technological updating (actualization effect). Therefore, if the actualization effect dominates the labour cost effect, the capitalization effect is dominant. In the opposite case, an increase in growth rate implies a reduction on firm’s profits net of renovation costs, leading to a decrease in the number of vacancies.

Regarding the relationship between growth and the decision to train, a higher growth rate will lead to an increase in training by unskilled workers depending on the probability of human capital depreciation: it should be smaller than the exogenous probability of the shock at which jobs may be destroyed; or very high “so that firms have an incentive to renovate positions occupied by unskilled workers receiving training since they pay low wages for skilled positions (Moreno-Galbis, 2012, p. 1703).

Therefore, under heterogeneous skills, the author shows that the capitalization effect is usually the dominant effect, leading to a negative relationship between growth and unemployment.

On the other hand, Mauro and Carmeci (2003) propose a different type of approach. Based on the idea that schooling knowledge must be combined with working experience in order to efficiently promote economic growth, the authors made a distinction between schooling human capital and firm-specific human capital. In other words, they suggest that schooling human capital will only be productive human capital if it is combined with working experience, transforming schooling knowledge into firm-specific human capital. This implies that unemployment rate does have a role in economic growth in a sense that it can influence negatively the link between schooling and working, limiting the positive effects of higher education levels, and finally impinging negatively on the growth rate.

Thus, this growth rate will be a positive function of (1) the level of schooling human capital, which crucially depends on the efficiency of the scholastic system; and (2) the level of
employment rate, which directly influence the link between schooling and working and hence, the level of productive human capital.

Mauro and Carmeci (2001) also perform an empirical exercise which shows that, controlling for unemployment, there seems to be a positive and significant impact of higher education in the long run economic growth.

Finally, Zagler (2009) develops a theoretical model based on the idea that economic growth is driven by structural change, which has a direct cost – high and persistent unemployment. Briefly, he assumes that, initially, workers are employed in the manufacturing sector. Once the number of services increases, consumers will increase the demand for this type of goods, decreasing therefore the demand for manufacturing products. This process is called endogenous separation. This increase in the flow of unemployed workers will be partially compensated by job creation effect in the innovation sector as a mean to create new types of services. This new services will be imperfect substitutions of the existing services, meaning that the profits of a new service depends on the elasticity of substitution between services. Notice that this elasticity will influence growth rate through two channels. Firstly, a higher elasticity reduces the impact of an innovation; and secondly it reduces the innovation stream of profits.

Thus, during the transition path, meaning from the initial situation highly concentrated in manufacturing to the new economy mainly composed by highly innovative services, the level of unemployment will overshot its equilibrium level. Intuitively, more than the typical fluctuation within the service sector, there is also “search unemployment” in a sense that workers from manufacturing sector need to be allocated to the service firms and innovation sector. In the new equilibrium, the new economy will also be characterized by a higher unemployment rate due to the increase in the number of fluctuations in the economy.

4.5. Technological Skills and Agglomeration Economies

Mitra and Sato (2007) present an empirical analysis in order to understand the impact of agglomeration economies on efficiency and, therefore, on economic growth and unemployment. They use total manufacturing employment and total population density as two different proxies.

Using empirical data for Japan, they perform the analysis in two steps. First, they estimate the technical efficiency of the manufacturing sectors by industry groups. Then, they use this variable as a linker between per capita income, unemployment and agglomeration economies.
As main results, the authors conclude for a positive (but relatively lower) effect of agglomeration economies on efficiency. Nevertheless, there is a positive impact of agglomeration economies on growth and unemployment, which means that the technical efficiency is only one of the linkers between agglomeration economies and economic growth, since it cannot fully explain the positive relation between these two variables.

As a sum up, we offer a schematic representation of the new effects in Figure 12.

5. Conclusions

In the context of an overview on the growth-unemployment relationship, the purpose of this paper was to identify the main related mechanisms and to explore the main paths and contributions of this theorizing framework using bibliometric methods. The main advantage of combining our review with such methods is that they provide objectivity to the analysis (Di Stefano et al., 2010).

Regarding the links between growth and unemployment, we have stated the four main approaches associated with main explanatory mechanisms: *capitalization* effect (describes a
negative correlation between growth and unemployment; creative destruction effect (identifies a positive relation between growth and unemployment); pool of saving effects (states a negative relationship between unemployment and growth); and finally coordination failure effect (establishing a negative correlation between unemployment and growth). The impacts of international trade in the patterns of goods’ production and human capital specialization and of the learning-by-doing mechanisms are some of the other theoretical effects that are also considered in our analysis.

From all the evidence we have collected for the period 2000-2012, concerning published related literature, some important results emerged. First, growth-unemployment research is growing essentially through the introduction of “new effects” – almost 75% of the papers describe at least one mechanism that is not identified in Aricó’s (2003) survey. Secondly, although the formal and empirical analysis are the most common approaches, the amount of papers that combine a formal model with an empirical analysis has increased significantly since 2006, which could be interpreted as a concern to establish a link between theoretical models without a concrete empirical application and empirical analysis without a solid theoretical support. Nevertheless, the methodology approach is not equally distributed along the different effects. Regarding “Okun’s law”, the empirical approach is definitely the most used – 75% of the total published papers in this topic present an empirical analysis; on the other hand, the formal approach accounts for more than 50% of the published papers directly related with “new effects”.

Finally, regarding the new mechanisms, our analysis suggested that the effects triggered by a policy maker and the effects related with labour market institutions are the most analysed in published research. More precisely, we have identified at least seven main links: reallocation effect (under certain conditions, it is possible to obtain higher growth and lower unemployment rate through a reallocation of workers); leapfrogging effect (due to a rise in growth rate, a wage increase in one sector is driven by a wage increase in other sectors, leading to higher unemployment); disciplinary unemployment effect (higher unemployment levels will prevent workers from shirk, which leads to higher growth rates); minimum wage effect (an increase in the minimum wage increases the disposable income, which could foster economic growth in some situations); updating technology effect (the possibility of firms to update their technology once a innovation arrives amplifies under certain conditions the capitalization effect, leading therefore to higher growth and lower unemployment); schooling and working effect (the distinction between schooling human capital and productive human capital implies a negative relationship between unemployment and growth); and
agglomeration effect (associated in some sectors with efficiency, implying higher growth rates and lower unemployment levels).

Hence, from our analysis, the relevance of defining a new theoretical framework able to include these most relevant new effects and fulfill new empirical findings crucially emerges as a decisive challenge on the future research agenda on the topic under study.

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