The productivity slowdown puzzle of European countries: a focus on Italy

di Germana Giombini[*], Francesco Perugini[•] e Giuseppe Travaglini[◊]

Abstract

With the end of the Twentieth century and the beginning of the new millennium many European countries, especially those of the Southern Europe, experienced a structural economic change. The slowdown of the GDP growth rate, the deterioration of labor productivity, total factor productivity and investments are all common facts. In this paper we use the growth accounting to measure the contribution of different sources to economic growth in some European countries and in U.S.. We attempt to disentangle the determinants of the European slowdown during the Great Recession, with a special focus on Italy. The analysis suggests that the productivity slowdown of the Italian economy is structural. It affects both the non-ICT and ICT sectors.

Keywords: Labor Regulation; Productivity; Competitiveness; Growth Accounting.
JEL classification: E24, E32, J60, O30.

Il puzzle di produttività dei Paesi Europei. Un focus sull'Italia

Sommario

Con la fine del ventesimo secolo e l'inizio del nuovo millennio molti paesi Europei, soprattutto quelli del sud Europa, hanno sperimentato un cambiamento strutturale, i cui elementi comuni sono rallentamento del tasso di crescita del PIL, la riduzione della produttività del lavoro, della produttività totale dei fattori e degli investimenti. In questo saggio utilizziamo la contabilità della crescita per misurare il contributo di diverse componenti alla crescita economica delle principali economie Europee e degli Stati Uniti. L'obiettivo è di identificare le determinanti della crisi europea durante la Grande Recessione, soffermandoci particolarmente sul caso Italia. Per quest'ultimo Paese, l'analisi suggerisce un rallentamento strutturale dell'economia, sia dei settori non ICT sia di quelli ICT.

Parole chiave: Regolamentazione del lavoro; produttività; competitività; contabilità della crescita.
Classificazione JEL: E24, E32, J60, O30.

[*] Università di Urbino "Carlo Bo", Facoltà di Economia, Dipartimento di Economia Società e Politica. E-mail: germana.giombini@uniurb.it

[•] Università Politecnica delle Marche, Dipartimento di Ingegneria dell'Informazione. E-mail: francesco.perugini@yahoo.it

[◊] Università di Urbino "Carlo Bo", Facoltà di Economia, Dipartimento di Economia Società e Politica. E-mail: giuseppe.travaglini@uniurb.it

Introduction

With the end of the Twentieth century and the beginning of the new millennium many European countries, especially those of the Southern Europe, experienced a structural economic change. The slowdown of the GDP growth rate, the deterioration of labor productivity, total factor productivity (TFP) and investments are all common facts (Ciccarone and Saltari 2015; Dew-Becker and Gordon 2012, Saltari and Travaglini 2009).

From the early fifties until mid-nineties, labor productivity growth was more dynamic in European countries than in U.S. However, starting from 1993, productivity growth slowed in Europe while either rising or remaining stable in U.S. economy (Dew-Becker and Gordon 2012). Then, the 2008 financial crisis exacerbated this performance although in a heterogeneous way.

The current European productivity slowdown raises concerns about the risk of a secular stagnation in Europe. Data provide evidence of a clear trade-off between labor productivity and employment across the European countries (Burda and Severgnini 2009, and Dew-Becker and Gordon 2012; Van Ark, 2016). Also, there is evidence of a structural TFP slowdown in some European countries and U.S.. Differences in TFP can be partially explained by the so-called 'deep' determinants of economies (Calcagnini, Giombini and Travaglini 2015).[1] Among these determinants are the rules of labor markets and its regulation.

In this unsettling economic scenario, the Italian economy appears particularly fragile, squeezed between the contradictory effects of labor market reforms and the adoption of euro.[2] Indeed, over the last ten years, Italy lost 9% of its real GDP, and unemployment climbed to 12.7% at the end of 2015. The distribution of income and wealth rewards the share of profits and rents (+10% on an annual average). Importantly, investment in capital goods and innovations retreated, leaving Italy at the bottom among the European countries, far away from the most competitive ones, such as Germany and France.

[1] Such as the presence of efficient mechanisms of creation and transmission of knowledge, international integration, and efficient markets and institutions.

[2] The economic slowdown affected both the North and the South part of the country (for an analysis of the income convergence process across Italian provinces see Calcagnini et al., 2016).

The debate on the feared decline of the Italian economy is at the center of the economic analysis from two decades at least (Barzotto *et al*. 2014, Marra and Turcio 2016, Saltari and Travaglini, 2006; Fadda 2016, Pianta, 2015). We attempt to add some new features to this debate.

The goal of the present paper is twofold.

First, our aim is to shed light on the so-called productivity slowdown puzzle. We start by decomposing the per-capita GDP in the contribution of productivity and labor (Barro, 1999). By means of this decomposition, we show that the TFP growth rate for Italy, Spain, U.K. and France was negative over the last years.

Second, we attempt to provide a plausible explanation of the sources of the Italian productivity slowdown. Precisely, we study the pattern of both labor productivity and TFP growth rate of the ICT and the non-ICT sectors. Surprisingly, for the most recent period, data show that, on average, the ICT sector performed worse than the non-ICT one. We interpret this finding as the unintended result of the labor market deregulation. Precisely, we provide the rational that Italian labor market reforms seem to have negatively affected the growth rate of investment and TFP, slowing down productivity growth and competitiveness in the long run.

The paper is organized as follows. The next Section focuses on some stylized facts of the European economy, comparing the Italian performance to the one of the major European countries (Germany, Spain, France and U.K.) and the U.S.. In Section 3 we use growth accounting to decompose the GDP growth into its sources. Section 4 provides a basic theoretical framework of labor market to explain the stylized facts. Then, Section 5 compares the European and U.S. performance in terms of ICT and the non-ICT sectors, with a special focus for Italy. Section 6 concludes.

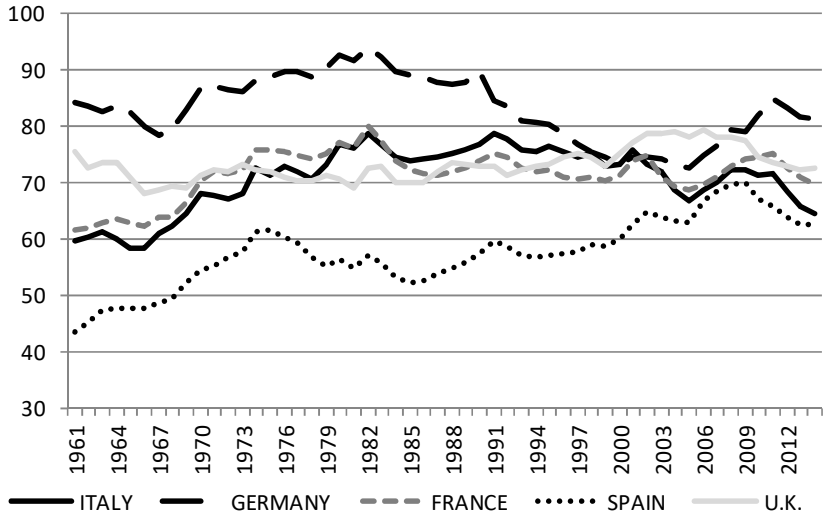
1. The slowdown of European economic growth: stylized facts

We start by analyzing the dynamics of GDP for the main European countries (Italy, France, Germany, Spain, the U.K.) and U.S.. Data on GDP over the period 1961 to 2014 are provided by the annual macroeconomic database (AMECO) of the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN).

From the sixties, the slowdown of the GDP growth rate is a common stylized fact for all countries. The slowdown started at a gradual pace and involved most of the European economies. Indeed, while over the 1961-1970 decade the average GDP growth rate was about 5% per year, it was

3.1% in the subsequent decade; then, it was 2.7% from 1981 to 1990, and 2.4% from 1991 to 2007.[3]

Fig. 1 - Per-capita GDP in selected European countries and the U.S. (=100)



Source: AMECO and European Commission DG ECFIN.

The deceleration of the GDP growth rate has also affected the growth of per-capita income, i.e., the ratio between GDP and population. However, while in the U.K. and the U.S. per-capita GDP growth slowed from the beginning of the last decade, in other European countries the deceleration originated during the mid-eighties, being particularly severe for Italy and Spain.

In Italy, the expansive echo that had fueled the economic boom of the early sixties ended with the beginning of the new millennium: data show that between 2001 and 2014 the Italian per-capita real GDP growth was negative (-0.6%).

Figure 1 shows these dynamics by comparing the patterns of per-capita GDP for Italy and other European countries with that of the U.S.. It shows a converging process during the sixties and the seventies, and then a diverging process that started in the early nineties. At the beginning of our

[3] With the exception of U.K. and U.S., that registered roughly constant GDP growth rate along the decades. Not tabulated data.

period of analysis, the gap of per-capita income for European economies with respect to the U.S. gradually reduced: in the seventies the income of an Italian citizen was about 68% of an analogous U.S. citizen, recovering about 12 points of the initial gap at the end of eighties. The productivity slowdown, as shown in Figure 1, materialized in the following decades: in just about twenty years the gap returned to the levels of the seventies. The slowdown affected all the European countries, but the Italian economy slowed more, with the consequence that the gap with other countries has been growing over time.

1.1 The decomposition of GDP

What are the causes for this negative trend? To provide a preliminary answer, it is useful to decompose the per-capita income (GDP/pop) into its sources, separating the demographic components of growth from the economic ones. Changes in per-capita income can be attributed to three main sources:

(1) the share of the working-age population (i.e., the population between 15 and 64 years, also called the active population) over the total population (active pop/pop);

(2) the employment rate (person employed/active pop), which measures the share of the occupied active population;

(3) the labor productivity (GDP/person employed), i.e. the value of the value added entitled to each person employed.

Obviously, the per-capita income is a mixed combination of these three factors, which also determine how an economy grows over time. Per-capita income can be written as follows:

$$\frac{GDP}{pop} = \left(\frac{active\ pop}{pop}\right) * \left(\frac{person\ employed}{active\ pop}\right) * \left(\frac{GDP}{person\ employed}\right) \quad (1)$$

Taking log of Eq (1) and differentiating with respect to time, we obtain that the growth rate of per-capita GDP is given by the sum of the three components as follows:

$$g\left(\frac{GDP}{pop}\right) = g\left(\frac{activepop}{pop}\right) + g\left(\frac{person\ employed}{activepop}\right) + g\left(\frac{GDP}{person\ employed}\right) \quad (2)$$

where *g* refers to rate of growth of each component.

Tab. 1 - Per-capita GDP and its economic and demographic components - average rates of growth (%) 1971-2014

	ITALY			GERMANY*		
	1971-1990	1991-2007	2008-2014	1971-1990	1991-2007	2008-2014
GDP	3.12	1.46	-1.30	2.63	2.46	0.74
population (pop)	0.26	0.21	0.48	0.08	0.21	0.03
per-capita GDP (GDP/pop)	2.85	1.24	-1.77	2.54	2.24	0.71
active population (actpop/pop)	0.30	-0.24	-0.24	0.45	-0.24	0.00
employement rate (pe/actpop)	0.07	0.69	-0.78	0.16	1.88	0.78
productivity per employee (GDP/pe)	2.47	0.81	-0.77	1.93	0.73	-0.07
	SPAIN			U.K.		
	1971-1990	1991-2007	2008-2014	1971-1990	1991-2007	2008-2014
GDP	3.26	3.11	-0.71	2.52	2.61	0.58
population (pop)	0.71	0.90	0.39	0.14	0.40	0.73
per-capita GDP (GDP/pop)	2.53	2.19	-1.09	2.37	2.19	-0.15
active population (actpop/pop)	0.30	0.21	-0.50	0.18	0.10	-0.30
employement rate (pe/actpop)	-0.76	1.36	-2.08	0.16	0.04	0.22
productivity per employee (GDP/pe)	3.03	0.63	1.54	2.03	2.05	-0.08
	FRANCE			U.S.		
	1971-1990	1991-2007	2008-2014	1971-1990	1991-2007	2008-2014
GDP	3.07	2.00	0.33	3.28	3.04	1.15
population (pop)	0.57	0.55	0.49	1.00	1.11	0.81
per-capita GDP (GDP/pop)	2.48	1.44	-0.16	2.26	1.91	0.34
active population (actpop/pop)	0.26	-0.07	-0.40	0.29	0.14	-0.24
employement rate (pe/actpop)	-0.31	0.31	-0.05	0.66	-0.09	-0.51
productivity per employee (GDP/pe)	2.53	1.20	0.29	1.28	1.86	1.10

* West Germany before unification

Source: Authors' elaboration on Ameco data

Source: AMECO and European Commission DG ECFIN.

For each country panel of Table 1, from the first two rows we can compute the growth rate of per-capita GDP, shown in the third row. It is the difference between the rate of growth of GDP and population. In Italy, between 1971 and 1990, the total income and population annual growth rates were 3.12% and 0.26%, respectively. The difference between these two rates gives the rate of growth of per-capita income (+2.85%).[4] During this period, the Italian growth rate was the highest among the selected countries.

The next three lines refer to Equation (2) and show the decomposition of the rate of growth of per-capita GDP into its economic and demographic components. Over the period 1971-1990, the demographic variable 'active population' affected positively the per-capita income growth with similar magnitude in all countries (in Germany the contribution is the highest while in the U.K. is the lowest). The contribution of the employment rate (pe/act pop) and productivity (GDP/pe) is more heterogeneous among countries. In

[4] Due to rounding, some totals (differences) may not correspond with the sum of the separate figures of Table 1, and the following Tables 2, 3, and 4.

Italy, despite a very low growth of the employment (0.07%) there is a high rate of growth of labor productivity (+ 2.47%). In the U.S., the contribution of labor productivity to per-capita income is low (1.28%) while the employment rate records the highest increase (0.66%). In the 1971-1990 period, labor productivity growth is low in Germany and in the U.K. (1.93% and 2.03%, respectively), while it is relatively high in Spain and France.

Between 1991 and 2007, the Italian trend reversed. As said above, all countries recorded a deceleration in the growth rate of per-capita income, but Italy witnessed a dramatic slowdown: growth halved compared to the previous two decades (1.46%), and the share of the working population fell (-0.24%). These dynamics negatively affected the per-capita GDP growth, which was equal to 1.24%, and mainly driven by the contribution of labor productivity (0.81%) and by the significant acceleration of the employment rate (0.69%). Spain also followed a similar trend; while in Germany per-capita GDP growth was above the 2%, and the average employment rate was 1.88%. Differently, in the U.K. and in the U.S. the GDP growth was largely driven by labor productivity.

Finally, with the onset of the current international crisis, the diverging path observed between Italy and the other countries widened further. Table 1 shows that in the 2008-2014 period Italy registered a negative growth of the per-capita GDP, the active population, the employment rate and of the productivity per-worker. In terms of labor productivity Italy had the worst performance among European countries, and also compared to the U.S. where the per-capita income was increasing at an average rate of 0.34%.

In summary, data show that Italy appears as the 'the sick country' of Europe from at least two decades now, characterized by a negative productivity growth, and a weak economic growth (Calcagnini and Travaglini, 2013).

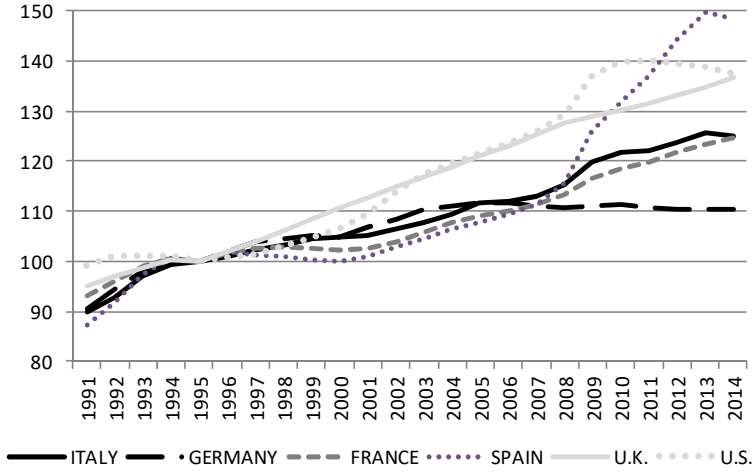
The accounting decomposition shown in Table 1 suggests that per-capita GDP can be the result of different combinations of productivity and labor (Barro, 1999). The increases generated by productivity, however, tend to be more stable than those generated by higher employment. This makes particularly fragile the Italian economy, whose labor market reforms (started in the early nineties) have expanded the share of temporary jobs on total employment, making the contribution of labor to per-capita GDP growth particularly large (Lucidi and Kleinknecht, 2010). The response of the production system to this change in the functioning of the labor market, and to the associated industrial relations, was to increase the share of labor relative to capital, with an overall contraction of capital intensity, and labor productivity. As a consequence, there was also a reduction of the level of employee compensation, of which the productivity is one of the determinants.

1.2 The evolution of capital per-worker

This scenario can be seen as the result of the new economic context caused by the adoption of euro. The less efficient economies, as the Italian one, used internal devaluation in order to recover competitiveness, instead of raising investment and innovation. Capital per-worker reduced; and, as a result, the contribution of technology progress to productivity growth decreased. Figure 2 summarizes the evolution of capital per-worker in European countries and in the U.S. It shows that:

1) from the 1961 until 2007, the capital stock per-worker increased in all countries;
2) during the same period the growth rate of the capital stock per-worker was higher in the U.K. and the U.S. than in the other countries;
3) from the Great Recession the growth of capital stock per-worker has been falling in Italy. In Germany, the accumulation of capital stock per-worker slowed, but it was characterized by a marked shift in investment towards the technology advanced sectors, characterized by high value added and productivity.

Fig. 2 - Stock of capital per person employed in selected European countries and the U.S. (index, 1995=100.). 1991-2014.



Source: AMECO and European Commission DG ECFIN.

Further, in Italy (characterized by low-technology investment mostly in the traditional productive sectors) the new low-skilled employment

negatively affected the growth rate of productivity and wages, and the competitiveness of the productive system[5].

2. Productivity, accumulation and technology progress

'Growth accounting' allows to better characterize the previous stylized facts (Solow, 1957). Theoretically, a low capital-to-labor ratio can be balanced by a positive increase of the share of investment and technology progress (Kaldor, 1957). Indeed, labor productivity is crucially influenced by the accumulation of capital and technology incorporated in the capital input used to produce the final good.

The Solow decomposition allows to obtain a measure of technology progress. Accordingly, the growth rate of per-hour labor productivity *[g(y) - g(n)]* can be written as:

$$[g(y) - g(n)] = \alpha * [g(k) - g(n)] + g(a) \quad (3)$$

where *g(y)*, *g(n)*, *g(k)* denote, respectively, the growth rates of GDP, of the total hours worked and of capital, while α is the income capital share. Finally, *g(a)* is the so-called Solow residual (Solow, 1957) or Total Factor Productivity (TFP). It measures that share of output growth that cannot be accounted for by the growth of the inputs of production, i.e. capital and labor. To identify the sources that determine labor productivity we can rewrite Equation (3) as:

$$g(y) = [g(h) + g(l)] + [\alpha * g(k/n) + g(a)] \quad (4)$$

The terms in the first squared bracket on the right-hand side of the equation define the growth rate of total hours worked *g(n)*, as the sum of the rate of growth of hours worked on average from all employed - *g(h)* - with that of total employment - *g(l)*. Then, α*g(k/n)* measures the capital deepening , that is the growth rate of capital contribution measured by the change in capital per-worker times capital share; finally, *g(a)* captures the contribution of the technical progress to economic growth.

Table 2 shows the result of this decomposition for the countries analyzed so far. The data are from the beginning of the seventies, and are

[5] On the role of aggregation of firms on competitiveness see Travaglini (2011).

divided in three periods. Data reported in Table 2 are average values for each period taken into consideration. Using Equation (4) we compute *g(a)* (labeled as TFP in Table 2) as residual:

$$g(a) = g(y) - [g(h) + g(l)] - \alpha * g(k/n) \quad (5)$$

In Italy, during the period 1971-1990, the GDP rate of growth was about 3%, determined by an increase of total hours worked (0.17%) and of labor productivity (2.88%). The latter increased due to a) capital accumulation relative to labor, i.e., capital intensity (1.10%); and b) to technology progress, approximated by the TFP (1.78%) computed by means of equation (5). Data also show that over the period 1971-1990 the Italian dynamics were similar to other European countries, tough the contribution of capital intensity and technology advancement varied across countries. The U.S. displayed a significantly lower rate of growth of labor productivity (1.52%) than that of other countries.

The scenarios change in the second period (1991-2007). In the U.S., labor productivity performed better than all European countries except the U.K.. This was mainly the result of a high rate of growth of capital intensity (0.68%), but also of an acceleration of the rate of growth of TFP (1.21%). By contrast, the contribution of technology slowed down dramatically in Italy and in Spain (from 1.78% to 0.33% in Italy, from 2.15% to 0.10% in Spain), and significantly in France and Germany. Finally, during the recent years of the crisis (2008-2014) the growth rate of labor productivity becomes negative in Italy and in the U.K. (-0.11% and -0.14%, respectively) while reducing significantly in all other countries with the exception of Spain.[6]

The data in Table 2 seem to suggest that the driver of the productivity slowdown is mainly associated to the negative contribution of TFP rather than the one of capital intensity. Specificaly, we find a negative TFP growth rate for all the countries under consideration, with the exception of Germany and the U.S..

[6] From the beginning of 2016 the rate of growth of labor productivity is negative also in the U.S.

Tab. 2 - Decomposing real GDP growth rate. Period average. 1991-2014.

	ITALY			GERMANY*		
	1971-1990	1991-2007	2008-2014	1971-1990	1991-2007	2008-2014
GDP (g(y))	3.05%	1.44%	-1.34%	2.58%	2.36%	0.69%
Total annual hours worked (g(n))	0.17%	0.50%	-1.23%	-0.43%	1.06%	0.26%
Av. annual hours worked per person employed (g(h))	-0.46%	-0.15%	-0.68%	-1.10%	-0.60%	-0.55%
employment, persons (g(l))	0.63%	0.64%	-0.55%	0.67%	1.66%	0.80%
Labor productivity per hour worked (g(y/n))	2.88%	0.95%	-0.11%	3.01%	1.30%	0.44%
TFP (g(a))	1.78%	0.33%	-0.88%	1.94%	0.78%	0.25%
Capital intensity (α*g(k/n))	1.10%	0.62%	0.77%	1.06%	0.52%	0.19%
	SPAIN			U.K.		
	1971-1990	1991-2007	2008-2014	1971-1990	1991-2007	2008-2014
GDP (g(y))	3.18%	3.06%	-0.73%	2.46%	2.57%	0.55%
Total annual hours worked (g(n))	-0.51%	2.28%	-2.38%	-0.05%	0.22%	0.69%
Av. annual hours worked per person employed (g(h))	-0.72%	-0.15%	-0.12%	-0.52%	-0.31%	0.05%
employment, persons (g(l))	0.22%	2.43%	-2.26%	0.47%	0.54%	0.64%
Labor productivity per hour worked (g(y/n))	3.69%	0.77%	1.65%	2.51%	2.35%	-0.14%
TFP (g(a))	2.15%	0.10%	-0.03%	1.67%	1.68%	-0.35%
Capital intensity (α*g(k/n))	1.54%	0.67%	1.68%	0.84%	0.67%	0.21%
	FRANCE			U.S.		
	1971-1990	1991-2007	2008-2014	1971-1990	1991-2007	2008-2014
GDP (g(y))	3.01%	1.98%	0.32%	3.20%	2.98%	1.12%
Total annual hours worked (g(n))	-0.42%	0.17%	-0.04%	1.68%	1.09%	-0.14%
Av. annual hours worked per person employed (g(h))	-0.94%	-0.61%	-0.07%	-0.26%	-0.06%	-0.17%
employment, persons (g(l))	0.52%	0.78%	0.03%	1.93%	1.15%	0.03%
Labor productivity per hour worked (g(y/n))	3.43%	1.81%	0.35%	1.52%	1.90%	1.26%
TFP (g(a))	2.09%	1.03%	-0.30%	1.15%	1.21%	0.67%
Capital intensity (α*g(k/n))	1.34%	0.77%	0.65%	0.37%	0.68%	0.60%

* West Germany before unification

Source: AMECO and European Commission DG ECFIN.

Overall, the analysis suggests that the labor productivity puzzle is eventually a TFP puzzle. Some authors (Summers 2014) have recently advanced the hypothesis of a secular stagnation which would negatively affect productivity growth because of a global slowdown in innovation or, possibly, inadequate spending on the demand side. According to others (Eichengreen, Park and Shin 2016; Acemoglu, 2008) TFP slumps seem to be determined by country specific factors (educational attainment, weak political systems) and global factors (higher risk, higher energy prices). Others (Guarascio et al 2017, Saltari and Travaglini 2008; Vanreenen and Pessoa 2014) have argued that the changes of labor market regulation in European countries, over the last twenty years, have negatively affected the capacity of the firms to sustain over time labor productivity and capital accumulation by means of innovation. In the next Section, we use a simple labor market model in order provide a coherent simple explanation for the above stylized facts.

3. A basic model

How much does the slowdown in labor productivity growth reflect a decrease of technology progress and capital intensity? And how much might it reflect either a transitory or permanent change?

The following exercise might help in providing an answer to the previous questions. If we are willing to assume that multiple shocks affect any equilibrium in the labor market, then we can provide an explanation of the productivity slowdown, which depends on the (unexpected) changes in labor supply and demand. In other words, our explanation focuses on the possible interactions between technology and non-technology shocks that we may interpret as shocks in technology and in labor regulations, respectively. The following analysis emphasizes the effects of labor flexibility and changes in capital intensity as possible sources of the productivity slowdown discussed above. Our hypothesis is that labor and productivity might be affected by technology and non-technology shocks, which determine the long run equilibrium.

To this aim, we assume that firms react to deregulation in labor market (non-technology shocks) raising employment and reducing capital intensity, so moving the economy towards less capital-intensive technology. The initial response of the economy to this institutional shock is to raise capital share in the short run, and decrease the growth rate of labor productivity (Blanchard, 1997; Saltari and Travaglini, 2009). Labor supply curve shifts downwards along the labor demand curve, cutting both real wage and productivity. But, a falling capital intensity may imply a corresponding slowdown in innovation and technology progress. This happens because an important share of innovation is traditionally embodied in new capital goods (Kaldor, 1956, 1966; Kleinknecht, 1998); and because new ideas and discoveries often come into the production process by investing (Aghion and Howitt 2009).

Actually, the stylized facts of the previous Sections seem to confirm this scenario. Precisely, from mid 1990s the European labor market has been characterized by adverse shifts in labor demand. One clue of this negative shift is the deceleration in the growth rate of TFP and capital intensity, with a permanent negative impact on labor productivity growth.

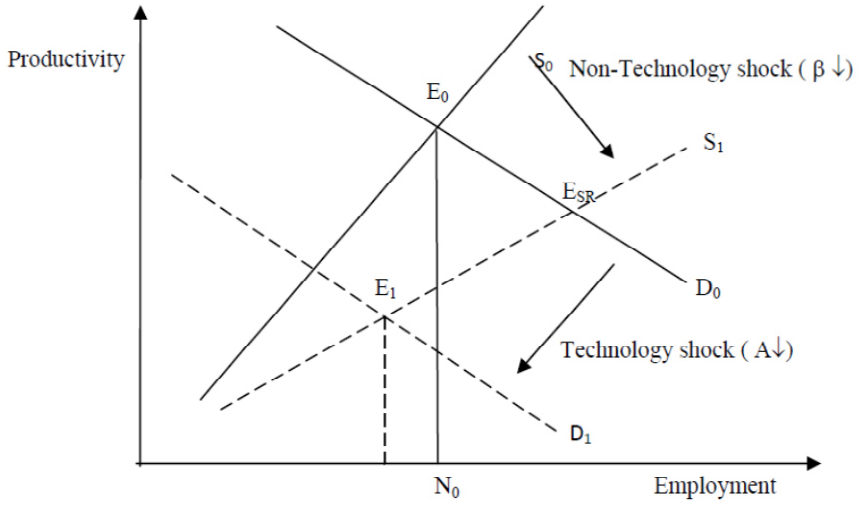
To formalize this relation, we use a labor market model with shifts in labor supply and demand. It is based on two main assumptions. First, as in the Solow model, we assume that the rate of technology progress affects labor productivity and capital intensity. Second, we assume that the

equilibrium in labor market is also affected by changes in its institutions (Blanchard and Wolfers 2000; Drew Becker and Gordon 2012).

The functioning of this economy is presented in Figure 3. Consider a representative firm with a constant return-to-scale production function of the form $Y = AK^{\alpha}N^{1-\alpha}$, where *Y* is output, *L* is labor, *K* is capital and *A* is TFP. From the first-order condition, labor productivity is related to the real wage $A(1-\alpha)K^{\alpha}N^{-\alpha} = W$, where *A* and *K* are fixed inputs in the short run. Thus, we obtain a conventional downward sloping labor demand curve (D_0) as illustrated in Figure 3. Then, for sake of simplicity, we consider a labor supply curve (S_0) $w = \beta N$, where β is a black box representing the institutional factors of labor market. Finally, we assume that technology progress depends on both the arrival of new ideas A_0 and the stock of capital per-worker $\frac{K}{N}$, so that the technology function is $A = A_0 + \gamma(\frac{K}{N})$.

In this scenario a non-technology shock (a smaller β) affects the position of the labor supply curve, which shifts down to the right from S_0 to S_1 moving along the demand curve. In the short run, unemployment and labor productivity decrease, moving the equilibrium towards point E_{SR}.

Fig. 3 - The effects of Technology and Non-Technology shocks on Productivity



However, E_{SR} cannot be a long-run equilibrium. Indeed, in response to a lower capital intensity, adverse technology shocks affect the position of the labor demand curve, which shifts permanently down to the left, from D_0 to D_1 along the supply curve S_1. Eventually, the long run equilibrium shifts from E_0 to E_1, where the level of employment can be either higher or

smaller than the initial value, depending on the magnitude of the parameters, but labor productivity is permanently reduced. Therefore, the two shifts originating in technology and non-technology shocks can explain the measured negative correlation between labor productivity and employment observed in the European economy during the last twenty years, and the current slowdown of labor productivity, TFP and capital intensity shown by our data.

The main implication of this basic model is that an institutional shock can affect the pattern of innovation and technology progress in the long run.[7] In our framework, technology progress affects permanently the steady state, affecting both the growth rates of labor productivity and employment. However, this permanent change in the growth rate of productivity originates by changes in labor regulation.

4. The two macro-sectors of European countries: ICT and non-ICT

The picture that emerges from the previous data and the theoretical model can be summarized as follows: compared to the previous decades, the slowdown in labor productivity is driven by the decreasing contribution of capital per-worker, and by the sharp slowdown of technology progress. In other words, the weak dynamics in the per-capita GDP can be explained by the marginal contribution of investment and innovation.

For some countries, as Italy, these adverse shocks have been particularly negative. Thus, how can we explain the weak performances of the Italian economy? According to a traditional explanation the Italian productivity slowdown is strictly related to the fragile performance of its small-sized firms, and to the specialization in traditional sectors with low added value per-worker (Calcagnini and Favaretto, 2011).

To explore this issue, we compare the relative size of the productive ICT and non-ICT (aggregate) sectors. Then, we focus on Italy to analyze how much its productive structure may affect the dynamics of the labor productivity in the long run.

Using data from EU-Klems database, we divide the economy in two main aggregate sectors: in the first sector, we collect the firms that produce

[7] For the impact of multiple market imperfections on firm performance see Calcagnini, Ferrando and Giombini (2015).

and use information and communication technologies (ICT sectors); in the second one, there are all other firms (non-ICT sectors).[8]

Data show that over the last decades Italy, as the other European countries and the U.S., the share of GDP produced in the ICT sector has increased (see Table 3).

Table 3: Sector shares on VA in various years (at 2005 price). 1970-2009.

	ICT			non-ICT		
	1970^	1990	2009	1970^	1990	2009
ITALY	31%	33%	35%	69%	67%	65%
SPAIN	23%	26%	31%	77%	74%	69%
FRANCE	27%	32%	35%	73%	68%	65%
GERMANY*	35%	38%	40%	65%	62%	60%
U.K.	30%	34%	41%	70%	66%	59%
U.S.	30%	34%	42%	70%	66%	58%

^ 1977 for the US

* West Germany before unification

Source: EU-Klems.

However, in Italy the increasing contribution of the ICT sector occurred at a slower rate than in Germany, the U.K. and the U.S. As a result, over the years, the gap between Italy and the other countries measured in terms of ICT accumulation widened (Saltari and Travaglini, 2009).

Table 3 also shows that in the U.S, in 2009, the ICT activities, measured as a share of income, are much higher than 20 years ago. Most importantly, this share is the highest among the countries that we analyze. Finally, from the mid-nineties, Germany, the U.K. and the U.S. have rapidly converted their production sectors toward the ICT ones, increasing the distance from the remaining countries.

4.1 ICT and non-ICT Sectors: a focus on Italy

To provide an analytical explanation of the transformation occurred in Italy, we apply the growth accounting to the ICT and the non-ICT sectors.

Table 4 shows the results of this decomposition[9]. The slowdown in labor productivity is associated not only to a negative shock occurred to

[8] Available data cover the 1970-2009 period.

technology progress in the traditional sectors, but also to the negative contribution of technology in the more advanced sectors. The data show that until 2007 the growth of the value added in the ICT sector (1.99%) was on average higher than that of the non-ICT sector (1.0%).

Tab. 4 - Italy - Growth accounting by sector. Period average. 1996-2014.

	ICT		
rates of growth	1996-2014	1996-2007	2008-2014
Value Added (g(y))	0.70%	1.99%	-1.51%
Total annual hours worked (g(n))	0.67%	1.56%	-0.84%
Av. annual hours worked per person employed (g(h))	-0.45%	-0.39%	-0.54%
employment, persons (g(l))	1.10%	1.99%	-0.30%
Labor productivity per hour worked (g(y/n))	0.03%	0.43%	-0.67%
TFP (g(a))	-0.60%	-0.36%	-1.01%
Capital intensity (α*g(k/n))	0.63%	0.79%	0.34%
	NICT		
rates of growth	1996-2014	1996-2007	2008-2014
Value Added (g(y))	0.26%	1.00%	-1.00%
Total annual hours worked (g(n))	-0.10%	0.70%	-1.48%
Av. annual hours worked per person employed (g(h))	-0.33%	-0.07%	-0.78%
employment, persons (g(l))	0.23%	0.77%	-0.70%
Labor productivity per hour worked (g(y/n))	0.36%	0.30%	0.47%
TFP (g(a))	-0.19%	-0.07%	-0.39%
Capital intensity (α*g(k/n))	0.55%	0.37%	0.87%

Source: ISTAT.

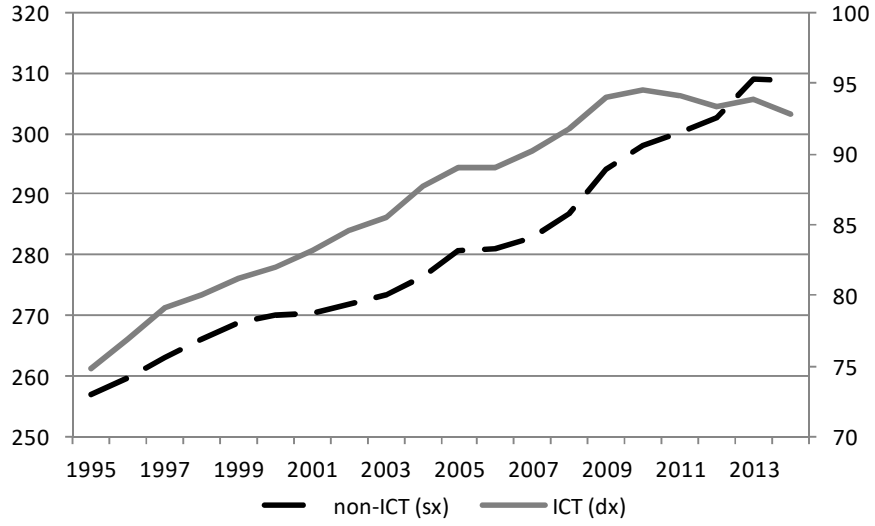
While in the ICT sector the rate of growth is mainly determined by employment, in the non-ICT it is driven by the positive contribution of labor productivity, which offsets the fall in the rate of growth of the labor

[9] The data used for the analysis of Table 4 are from the Italian national accounts, provided by ISTAT. Unlike the EU-Klems database used for the construction of Table 3, these data allow us to extend the analysis until 2014, so we are also able to understand what happens during the crisis period in the two sectors.

force. Table 4 also reveals that capital intensity in the ICT sector grows at a low rate until the 2007 (0.79%) but halves (0.34%) afterwards. In the non-ICT sector instead, capital intensity grows at a slower pace during the 1990-2007 period, but almost triple during the crisis. These trends mirror the evolution of capital and labor. It should also be noted that in both sectors the investments per-worker follow the sluggish evolution of TFP.

Figure 4 shows the Italian capital-to-labor ratio in the two aggregate sectors. It suggests that in Italy labor market reforms favored the employment growth within the ICT sector more than in the non-ICT sector. These reforms have also reduced the amount of capital per-worker, lowering productivity and capital intensity. Overall, the growth accounting analysis provides an additional element: also the ICT sectors' labor productivity is decreasing. The negative trends of both the capital-to-labor ratio and TFP appear to be the main responsible of this deceleration. Hence, the labor market reforms have increased employment in the short run, but they have also negatively affected the evolution of labor productivity, capital intensity and the TFP in the long run.

Fig. 4 - Italy - Capital-Labor ratio by sector (in 000 €). 1995-2013.*



* Labor measured as person employed

Source: ISTAT.

Conclusions

The analysis presented in this paper investigates the causes of the productivity slowdown puzzle that characterized the Italian economy and major European countries and provides a novel interpretation of the declining observed trends. We argued that labour market reforms in Italy had a negative impact on capital accumulation and technology progress.

Specifically, the analyses presented in the previous Sections offered a complex picture of the ongoing Italian transformation. Between the nineties and 2008, in the ICT sectors the rate of growth of the capital-to-labor ratio increased at a very moderate pace and decelerated afterward. During the same period, the growth of labor productivity, the rate of employment and technology progress also slowed.

The data show that before the mid-nineties, productivity and capital intensity growths of the non-ICT sectors were declining, but between the nineties and 2008 there has been an apparent turnaround. The latter seems to be the result of two opposite trends: added value increased while the total number of hours worked declined.

Moreover, during the Great Recession the fall in the total number of hours worked was so high to offset the fall in value added, so that after 2008 labor productivity increased within the non-ICT sectors. Overall, TFP growth was negative also in the non-ICT sectors.

For many years, European countries have not provided industrial policies to identify and strengthen the sectors towards which a country should converge (Antonelli, 2015). A concrete European industrial policy should 'steer the evolution of the economy towards activities that are desirable in economic terms (improving efficiency), in social terms (addressing needs and reducing inequality), in environmental terms (assuring sustainability) and in political terms (protecting key national interests)' (Pianta, 2015). But, the resources invested by the Italian economy in the industrial policy (*Industria 4.0*) and the recent European *Industrial Compact* are definitely too limited in goals and funds (Liberati and Travaglini, 2014) to restart capital accumulation and new technology. Besides, in Italy spending commitments for R&D, for training and innovations are the lowest among all the European countries (Lucchese *et al.*, 2016). Finally, the efforts to sustain education, school and university have been even fewer.

As a result, the ongoing deterioration in labor productivity requires targeted and immediate interventions, and should make firms, unions, and mainly politicians accountable for their (in)actions.

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