

INVESTMENT IN INNOVATION AND THE ITALIAN PRODUCTIVITY SLOWDOWN: AN INDUSTRY PERSPECTIVE

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ABSTRACT

Italian productivity growth experienced a prolonged slowdown over the past two decades. Although the underlying causes of the productivity decline are still a matter of debate, possible explanations are related to the changing nature of production, and to the missing role of innovation in generating sustained output growth in Italy.

This study provides some preliminary evidence on the role of R&D and software as drivers of growth for the Italian economy over the last twenty years. We investigate industry growth accounting data to evaluate the growth contribution of the above intangible assets. Our preliminary findings show that, consistent with the existing literature, the contribution of ICT and intangible capital to labor productivity and value added growth was higher in manufacturing than in services, but relatively small compared to the other EU economies.

As for the industry breakdown, we found that: i) the most “innovative” and “productive” sectors were with few exceptions (textile, clothing and leather) characterized by a relatively larger firm size ii) Italian traditional industries (“made in Italy”) have a rather low propensity to innovate; iii) the introduction of the euro fostered a re-organization of the industrial sectors that in Italy was not accompanied by an increasing role for intangible and ICT capital, iv) R&D activities and production/use of software have been resilient over the financial crisis.

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INTRODUCTION

Italian productivity experienced a prolonged slowdown over the past two decades. In contrast to the 1970s and 1980s, when it was the best growth performer among its major European partners, Italy has suffered a steady and prolonged productivity decline since the 1990s. Combined with the recent financial crisis, this decline has arguably made the Italian recession deeper and more persistent than in many other advanced economies.

The empirical literature shows that the slowdown has been associated with Italy's greater difficulty in taking advantage of the mid-1990s ICT revolution compared to its European partners. Zingales (2014) finds that developed countries differ significantly in their ability to benefit from the ICT revolution with a relative comparative disadvantage for the Italian economy. According to Daveri and Parisi (2015), the latter problem was exacerbated by the old age of the Italian managers, which might have hindered firms' ability to adopt new technologies. Bloom, Sadun, and Van Reenen (2012) show also that management practices greatly affect ICT penetration and exploitation and their empirical investigation seems to prove that the scarce ability of Italian management to adjust to the "new economy" revolution is among the main obstacles hampering firms innovation activity.

Another very debated issue concerns the strong barrier to technology adoption generated by the small size of the Italian firms, often due to family ownership. Schivardi and Schmitz (2016) find that the lower rate of ICT penetration in the Italian firms as compared to the Germans is partially explained by the different size structures in the two countries¹.

An additional feature worsening the capabilities to exploit the gains from the ICT adoption is the limited amount of investment in intangible assets (Corrado et al 2005, 2009). Microeconomic evidence suggests that the link from firm-level ICT adoption to productivity growth depends on co-investments in intangible capital, e.g. training and organizational change (e.g., Bresnahan, Brynjolfsson, and Hitt, 2002; Brynjolfsson, Hitt, and Yang, 2002). From a macroeconomic perspective Corrado, Haskel, and Jona-Lasinio (2017) found the estimated output elasticities of ICT capital in a production function are reduced when intangibles are introduced, suggesting that, as conjectured in much of the pre-intangible data literature, returns to ICT depend crucially on the presence of not yet officially measured intangible assets. Therefore a key characteristic of innovation is the predominance of its "intangible

¹ Recently several other studies – using a variety of approaches at sectoral and firm level – investigate the factors that can support or hinder the innovation propensity of Italian firms. Pellegrino et al. (2012) showed that Italian young innovative companies lack a significant R&D activity and rely more on external sources of innovation. Bugamelli et al. (2011) identified the roots of Italy's productivity stagnation and scarce innovativeness in the persistent smaller size of firms (with respect to European and OECD averages), in the obsolete organizational and managerial routines of firms and in the low quality of labor forces. Bugamelli et al (2011) find also that financing of innovation activity could be challenging for firms for many reasons. For example innovation relies on intangibles assets which cannot be used as collateral. Moreover, innovation is considered risky because the outcome of the "investment" is uncertain.

nature” which makes difficult to measure its amount, quality or effects². They found that productivity growth in ICT intensive industries is relatively higher in countries with fast growing intangible capital accumulation thus corroborating the assumption that ICT and intangibles are complements in production. The data show that Italian investments in intangibles have been well below the EU average in the past decade (see paragraph 2) and that the rate of ICT adoption declined substantially over time thus supporting above empirical evidence.

In this paper, we look at the diffusion of R&D, Software (SW) and ICT across the Italian industries and at their contributions to industry/aggregate productivity growth. The analysis is focused on intangible assets currently measured in national accounts and it is based on data gathered from the Italian Institute of Statistic (Istat) classified according to the Nace Rev.2 classification at 2 digits for manufacturing and services sectors.

The paper is organized as follows: Section 2 provides an analysis of the sectoral distribution intangible investments across industries; section 3 shows industry growth accounting results and section 4 concludes.

LABOR PRODUCTIVITY AND INTANGIBLE INVESTMENT: THE ITALIAN GROWTH GAP

Last released Istat data show that over the past decade, Italian labor productivity growth has been one of the lowest in the EU area. The Italian productivity became sluggish in the second half of the 90s and stagnant after the crisis, with total factor productivity providing a negative contribution well in advance of the financial crisis. Chart 1 shows the index of GDP per hours worked (base year = 2007) for the Euro Area, Germany, Italy, Spain and France over per period 1995-2015. The productivity growth gap experienced by the Italian economy widened over time particularly after the crisis. The other EU economies instead, two years after the shock in 2009 started to recover even to a different pace.

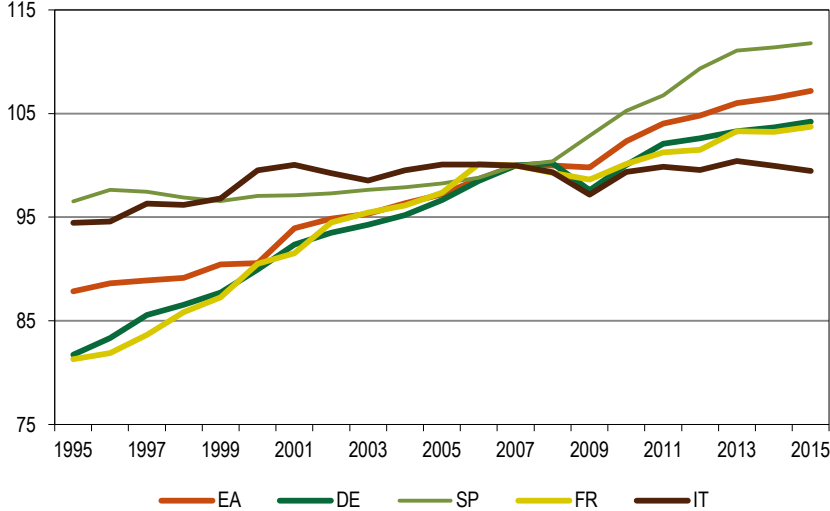
Chart 2 shows the patterns of investment in intellectual property products in Italy, the Euro area, Germany, France and Spain. The gap between Italy and the other EU economies increased over time supporting the assumption that the Italian economy did not catch the changing nature of innovation thus lagging behind the other advanced economies.

Comparing Charts 1 and 2 suggests that the increasing productivity gap might be partly linked to the innovation gap experienced by the Italian economy compared to the other EU countries.

² In a recent work, Corrado et al. (2005, 2009) propose how to define and measure intangible assets. They distinguish three broad categories of intangibles: Business investment in computerized information, innovative property and economic competencies.

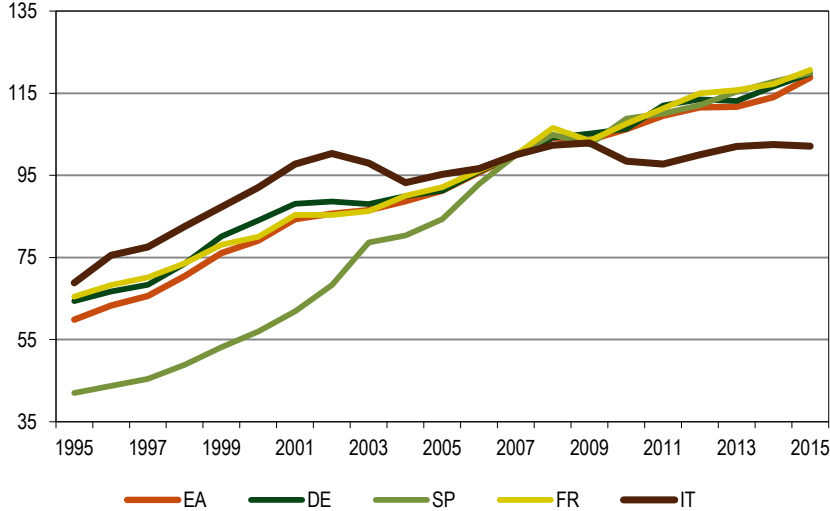
economic focus

Chart. 1 - Labour productivity in EU countries: 1995-2015
(index 2007=100, chain-linked data)



Source: Istat (May, 2016).

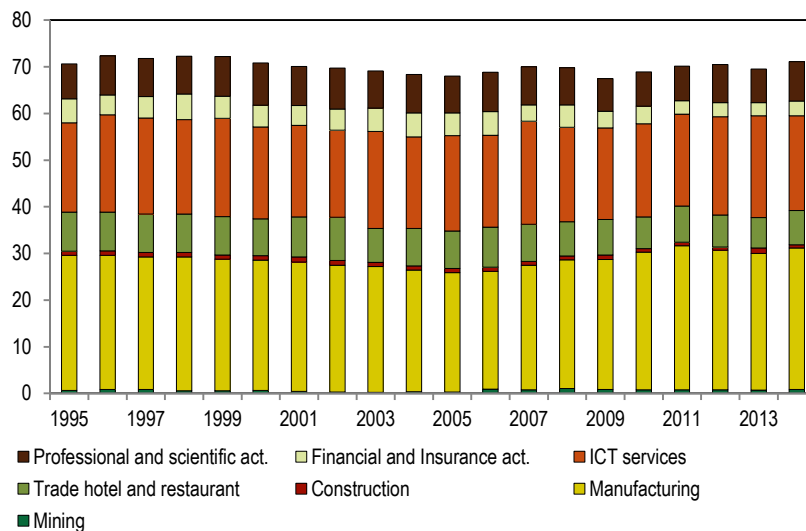
Chart. 2 - Investments in intellectual property products
(index 2007=100, chain-linked data)



Source: Istat (May, 2016).

Thus a deeper investigation of the diffusion of intangible investment across Italian industries is warranted. Chart 3 shows that the share of intangibles over total investment is relatively higher in manufacturing and particularly in information and communication industry.

Chart. 3 - Investment in intangibles across sectors
(% of total investment)



Source: authors elaboration on Istat data.

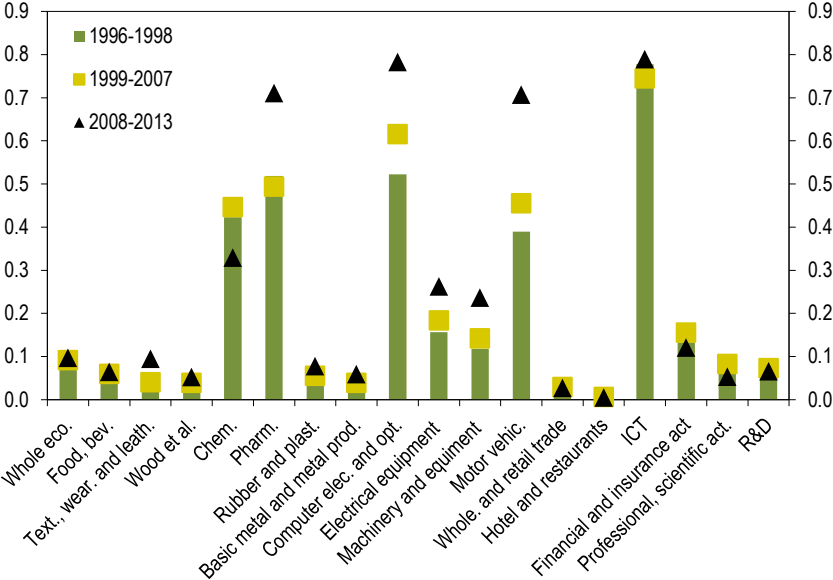
The data reveal that intangible intensity across sectors (calculated as the ratio between intangible investment and total investment by industry) has been overall resilient in the aftermath of the crisis with the indexes being relatively stable over the whole sample period.

Among manufacturing industries, electrical equipment and rubber and plastic are the most intangible intensive. The propensity to invest in intangible assets is instead rather low in services with hotels and restaurant, wholesale trade and commission trade and other business activities the lowest intangible intensive over the period. In the financial sector, contrary to what happened in other EU economies (Niebel et al. 2013), ICT and Intangible intensities are relatively small and characterized by a decreasing trend since the adoption of the euro. Thus despite the rationalization and several M&A³, the Italian banking system lags behind the other EU economies in terms of innovative investment.

Chart 4 shows the share of intangible investment over hours worked in three sub samples: pre (1996-1998), and post (1999-2007) the adoption of the euro and the aftermath of the financial crisis (2008-2013). The distinction between pre and post creation of the euro area aims at verifying whether the adoption of the common currency affected the Italian propensity to innovate (Bugamelli et al 2012). The underlying assumption is that the abandonment of currency depreciation as a mean to offset productivity differences in tradable sectors across countries might have negatively affected productivity growth over time.

³ <http://www.prometeia.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/546>

Chart. 4 - Innovation intensity index
(investments in intangible assets /hours worked)



Source: authors elaboration on Istat data.

The adoption of the common currency did not affect intangible expenditure across industries with the post euro shares uniformly higher than the pre euro years. On the other hand, after the crisis, the dynamics of the shares is rather heterogeneous across industries. Most manufacturing sectors (Pharmaceuticals, Computer electronics, Motor vehicles et al) increased their intangible shares also in 2008-2013 suggesting a certain degree of resilience to the financial shock. In the service sectors (ICT, R&D, Financial and Insurance and Professional) instead, the trend of the index deteriorated over time with hotel and restaurant and whole and retail trade experiencing the lowest share since the beginning of the sample period.

To add another piece of evidence to the whole picture, table 1 shows the average size of Italian firms. Data corroborate the findings of Calligaris et al (2016) that industries characterized by the lower innovation intensity index are also those with the smallest firm size.

Table 1 - Average firm size 2005-2013
(number of employee / number of firms)

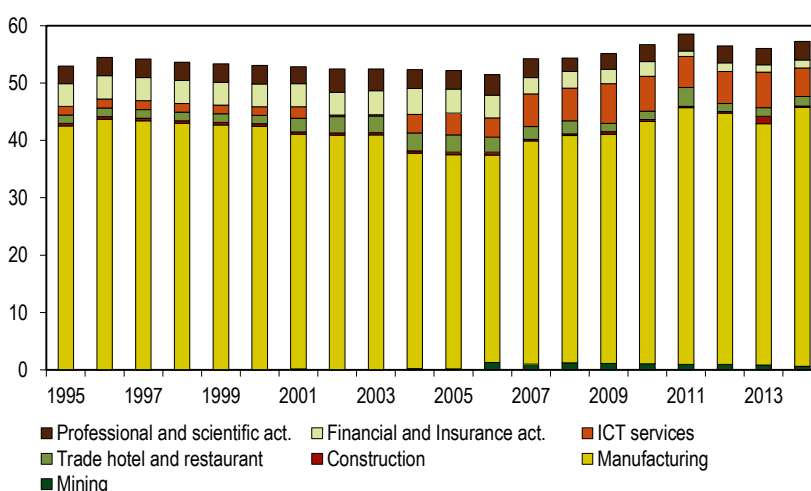
Food, beverages and tobacco	10.0
Textile, wearing and leather	9.5
Wood and related; pulp and paper; printing and publishing	4.1
Chemicals	25.3
Pharmaceuticals	129.4
Rubber and plastic products	16.9
Basic metal; fabricated metal products	20.7
Computer electronic and optical products	19.2
Electrical equipment	19.1
Machinery and equipment	19.1
Motor vehicles; other transports equipment	73.3
Whol. and retail trade, auto and mot. repair	2.9
Hotel and restaurants	4.2
ICT services	5.7
Prof., scientific activities and support services	1.7

Source: Istat, *Rapporto sulla competitività dei settori* (2016).

The above descriptive evidence shows that in Italy manufacturing is relatively more intangible intensive compared to services and that the less innovative industries are characterized by relatively smaller firm size.

To better characterize the degree of innovative activities in the Italian industries we further decompose intangible investment into its main components: R&D and Software. On average, manufacturing is the more R&D intensive (42% in 2013 latest available year) and relatively more dynamic compared to services. However, R&D share increased significantly in information and communication services (from 1.5 to 6.2% in 2013) and decreased substantially in financial and insurance services especially after the financial crisis (Chart 5).

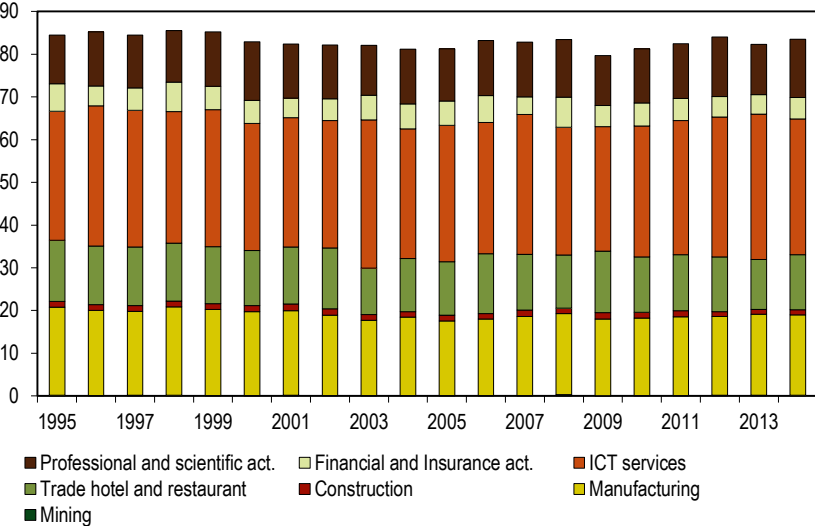
Chart. 5 - Industry composition of R&D investment
(as % of total R&D investments)



Source: authors elaboration on Istat data.

The industry composition of software investment expenditure is rather stable over the sample period, with the only exception of professional and scientific activities showing a more dynamic trend compared to the other sectors (Chart 6).

Chart. 6 - Investment in software
(% of total software investment)



Source: authors elaboration on Istat data.

Table 2 provides evidence of the extent of R&D and Software intensities across industries in the three sample periods. As mentioned above, Manufacturing is highly R&D intensive with Computer and electronics, Pharmaceuticals and Motor vehicles being the leading industries, particularly in 2008-2013. Notice that these latter industries are characterized by medium to high firm size thus corroborating the evidence that bigger firms have relatively higher propensity to invest in R&D. Besides Information and communication (IC) services all services sectors are below the average for the total economy in the most recent years. On the other hand, as expected, the IC industry shows the highest propensity to invest in software over the whole time period. The propensity to invest in R&D is rather dynamic across all industries over the sample periods with few exceptions mostly in services (research and development chemicals, financial intermediations and hotels and restaurants).

In 2008-2013, software capital accumulation has been particularly dynamic in Motor vehicles, Wood and related and Other business activities (Table 2). In the remaining sectors, the propensity to invest in Software has been positive with the exception of R&D and Wholesale Trade and Food and beverages recording negative rates of growth.

Table 2- R&D and software intensity indexes

List of industries	Intensity index											
	Levels						% Change					
	R&D/HW		Software/HW		R&D/HW		Software/HW		R&D/HW		Software/HW	
1996-1998	1999-2007	2008-2013	1996-1998	1999-2007	2008-2013	1996-1998	1999-2007	2008-2013	1996-1998	1999-2007	2008-2013	
Computer electronic and optical products;	0.36	0.42	0.57	0.17	0.20	0.22	6.67	3.45	3.22	9.84	1.37	5.83
R&D	0.18	0.16	0.14	0.32	0.40	0.30	2.09	-2.91	2.24	3.99	2.91	-8.38
Other business activities	0.06	0.05	0.02	0.03	0.03	0.03	2.24	-8.74	13.91	1.55	-0.81	9.61
Machinery and equipment;	0.06	0.08	0.17	0.06	0.07	0.07	2.33	8.92	8.35	5.18	-0.62	8.40
Chemicals	0.33	0.34	0.23	0.09	0.11	0.10	5.06	-4.14	-0.54	7.19	2.01	2.34
Pharmaceuticals	0.45	0.41	0.61	0.07	0.08	0.10	3.75	2.67	4.99	5.88	3.98	5.22
Electrical equipment	0.09	0.11	0.18	0.07	0.08	0.08	3.38	2.16	12.13	6.25	1.78	1.18
Rubber and plastic products;	0.02	0.03	0.04	0.03	0.03	0.03	4.12	6.86	7.90	6.26	1.29	4.87
Basic metals;fabricated metal products;	0.01	0.01	0.03	0.03	0.03	0.03	2.70	5.52	15.60	5.21	0.69	2.63
Motor vehicles; other transport equipment	0.31	0.37	0.60	0.08	0.09	0.10	4.45	4.05	8.65	10.75	-0.55	14.25
Information and communications services;	0.02	0.04	0.11	0.67	0.64	0.59	0.79	146.06	5.12	4.55	0.10	1.34
Financial intermediation;	0.05	0.06	0.03	0.09	0.10	0.09	4.86	-0.31	-2.27	12.89	-3.41	5.23
Wholesale trade and commission trade;	0.00	0.00	0.00	0.02	0.02	0.02	4.73	15.33	14.90	5.97	1.14	-1.37
Food and beverages;	0.02	0.02	0.03	0.04	0.04	0.03	4.31	8.49	4.21	7.58	0.73	-2.75
Textiles;wearing,leather	0.00	0.01	0.06	0.02	0.03	0.04	6.36	33.65	15.26	9.89	3.25	1.02
Wood and related; pulp and paper ;printing and publishing	0.00	0.01	0.02	0.03	0.03	0.04	5.81	16.03	8.07	6.44	1.76	10.18
Hotels and restaurants	0.00	0.00	0.00	0.01	0.01	0.00	5.55	-5.74	2.48	5.91	2.50	1.43
Total Economy	0.03	0.04	0.05	0.04	0.05	0.05	3.49	2.13	3.26	6.76	0.51	1.03

Source: Istat Rapporto sulla competitività dei settori (2016)

Note: Intensity indexes are calculated as the ratio of R&D or SW investment and hours worked.

ICT AND R&D CONTRIBUTIONS TO PRODUCTIVITY GROWTH

In this section we use data provided by Istat (2016)⁴ to assess the contribution of ICT and intangible capital both at the aggregate and industry level over the years 1996-2015. Our aim is to evaluate, from a descriptive point of view, to what extent the Italian slowdown can be attributed to the lack of ICT and intangible capital accumulation in key productivity driving sectors.

Over the last thirty years, the growth rate of Italian labour productivity averaged 0.3%⁵ while value added grew at 0.5%. Capital deepening has been the main driver of productivity growth (0.4 percentage points) while total factor productivity provided a negative contribution (-0.1 percentage points). Decomposing the contribution of capital deepening into its main components reveals that tangible capital is the primary source of growth (0.3 percentage points), while non-ICT intangible capital (research and development, mineral exploration and artistic originals) and ICT capital (i.e computer hardware, communications equipment and computer software) provide a negligible contribution (0.1 percentage points).

The same holds before and after the financial crisis confirming that the Italian economy is relatively more tangible than intangible intensive and that non technological capital deepening has been and remains the main source of growth since the mid of the nineties (Table 3). The prolonged lack of investment in innovation associated to a negative contribution of technological progress (TFP) and to a tangible-driven capital deepening had a detrimental effect on Italian productivity.

In the other EU advanced economies, R&D investment has fared better than investment in fixed tangible capital, particularly after 2008, thus fostering capital deepening and consequently productivity growth (EIB, 2016).

Table 3 - Contributions to labor productivity growth. Total economy
(% change and percentage points)

	1996-2007	2008-2015	1996-2015
Labour productivity (% change)	0.6	0.0	0.3
Contribution to labour productivity growth (percentage points)			
Capital Input	0.5	0.3	0.4
ICT Capital Input	0.1	0.1	0.1
Tangibles Capital Input	0.4	0.2	0.3
Intangibles non-ICT capital Input	0.1	0.1	0.1
Total Factor Productivity	0.0	-0.3	-0.1

Discrepancies, if any, are due to roundings.

Source: our elaboration on Istat data

⁴ See Misure di Produttività, (Istat, 2016).

⁵ Over the period 1996-2015, the average Italian labour productivity growth was lower than those of EU (1.6%) and Eurozone (1.3%). At country level Italy performed worse than Germany (1.5%), France (1.6%), UK (1.5%) and even Spain (0.6%).

Productivity growth is rather heterogeneous across sectors over the whole period (Table 4).

Table 4 - Industry labor productivity growth.
(average yearly percentage changes)

	1996-2007	2008-2013	1996-2013
Food, beverages and tobacco	0.1	0.6	0.2
Textile, wearing and leather	0.7	2.6	1.3
Wood and related; pulp and paper; printing and publishing	1.5	2.4	1.8
Chemicals	-7.3	0.7	0.8
Pharmaceuticals	0.9	4.6	4.3
Rubber and plastic products	4.1	1.7	1.6
Basic metal; fabricated metal products	1.6	1.1	1.1
Computer electronic and optical products	1.2	-1.6	0.6
Electrical equipment	1.7	1.4	1.5
Machinery and equipment	1.6	1.5	1.3
Motor vehicles; other transports equipment	1.1	-0.6	0.5
Wholesale and retail trade, auto and motovehicle repair	1.1	-0.3	0.4
Hotel and restaurants	0.6	-0.2	-0.5
ICT services	4.3	1.2	2.7
Financial and insurance activities	-3.5	1.9	1.7
Professional, scientific activities and support services	-1.1	-2.3	-2.6
R&D	0.4	2.2	0.5

Source: own elaboration on Istat data

Among services, besides ICT services (2.7%) and Financial services (1.7%), most sectors grew at rates below 1% with Professional, scientific activity and support slowing down significantly to -2.6%. In manufacturing only Food, beverages and tobacco and computer products are below 1% of average productivity growth over the whole period.

Table 5 - Contributions of non-ICT intangible capital to industry labor productivity growth.
(percentage points)

	1996-2007	2008-2013	1996-2013
Food, beverages and tobacco	0.1	0.1	0.1
Textile, wearing and leather	0.1	0.3	0.2
Wood and related; pulp and paper; printing and publishing	0.0	0.0	0.0
Chemicals	-0.2	-0.2	0.0
Pharmaceuticals	0.1	0.7	0.4
Rubber and plastic products	0.2	0.1	0.1
Basic metal; fabricated metal products	0.1	0.1	0.0
Computer electronic and optical products	0.0	0.6	0.4
Electrical equipment	0.4	0.4	0.3
Machinery and equipment	0.2	0.4	0.3
Motor vehicles; other transports equipment	0.2	1.0	0.6
Wholesale and retail trade, auto and motovehicle repair	0.4	0.0	0.0
Hotel and restaurants	-0.1	0.0	0.0
ICT services	0.0	0.4	0.1
Financial and insurance activities	0.0	-0.1	0.0
Professional, scientific activities and support services	0.0	0.0	0.0
R&D	0.0	0.1	0.1

Source: own elaboration on Istat data

The better performance of manufacturing has been partly driven by intangible capital providing the highest contribution (0.6 percentage points) in motor vehicles and other equipment and a slightly smaller contribution in pharmaceuticals and computer electronics. In the remaining sectors the contribution of intangibles is rather small both in the whole period and in the two sub-periods (Table 5).

In 1996-2013, ICT capital accounted for 0.5 percentage points of labor productivity in ICT services and a small 0.1 on average in most of the other sectors. The ICT contribution was slightly higher in 1996-2007 both in manufacturing and services. After the crisis the contribution remained low in most of the industries and negative in R&D, Professional and scientific activities and in Hotel and restaurants (Table 6).

Table 6- Contributions of ICT capital to industry labor productivity growth. (percentage points)

	1996-2007	2008-2013	1996-2013
Food, beverages and tobacco	0.1	0.0	0.1
Textile, wearing and leather	0.2	0.1	0.2
Wood and related; pulp and paper; printing and publishing	0.0	0.1	0.1
Chemicals	0.1	0.0	0.1
Pharmaceuticals	0.2	0.1	0.1
Rubber and plastic products	0.1	0.1	0.1
Basic metal; fabricated metal products	0.1	0.1	0.1
Computer electronic and optical products	0.1	0.2	0.2
Electrical equipment	0.2	0.1	0.1
Machinery and equipment	0.1	0.1	0.1
Motor vehicles; other transports equipment	0.1	0.2	0.1
Wholesale and retail trade, auto and motovehicle repair	0.1	0.0	0.1
Hotel and restaurants	0.1	-0.1	0.1
ICT services	0.3	0.4	0.5
Financial and insurance activities	0.0	0.0	0.1
Professional, scientific activities and support services	0.0	-0.1	0.0
R&D	0.2	-0.2	0.0

Source: our elaboration on Istat data

Non-ICT tangible capital instead provided a heterogeneous contribution across sectors in the whole period as well as in the two sub-periods. In 1996-2013, it has been the main driver of growth in pharmaceuticals (2.8 percentage points) and ICT services (1.9 percentage points) while it accounted for a negative share in Professional and scientific activities (-2.5 percentage points) and in most of the service industries (Table 7).

Table 7 - Contributions of non ICT tangible capital to industry labor productivity growth. (percentage points)

	1996-2007	2008-2013	1996-2013
Food, beverages and tobacco	0.7	0.3	0.6
Textile, wearing and leather	0.9	0.8	0.8
Wood and related; pulp and paper; printing and publishing	-0.4	0.9	0.0
Chemicals	2.7	0.5	1.1
Pharmaceuticals	1.5	1.0	1.0
Rubber and plastic products	0.9	1.3	-0.1
Basic metal; fabricated metal products	-0.7	0.9	0.4
Computer electronic and optical products	0.2	0.4	0.4
Electrical equipment	0.4	1.1	1.1
Machinery and equipment	1.2	0.6	0.3
Motor vehicles; other transports equipment	0.1	1.4	0.6
Wholesale and retail trade, auto and motovehicle repair	0.2	0.0	0.5
Hotel and restaurants	0.1	0.1	0.1
ICT services	4.9	0.5	0.4
Financial and insurance activities	-0.3	0.5	0.4
Professional, scientific activities and support services	-0.4	-0.1	-0.3
R&D	0.4	0.1	-0.1

Source: own elaboration on Istat data

The contribution of Total factor productivity is rather mixed across sectors with the most negative values in Professional and scientific services (-2.5 percentage points) and Chemicals and Hotels and restaurant (-0.7) in 1996-2013 (Table 8).

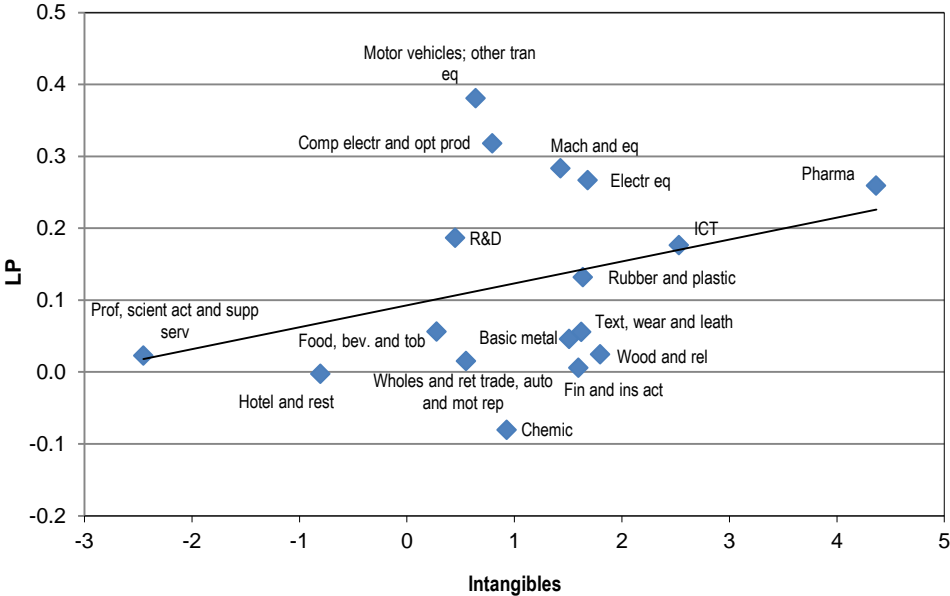
Table 8 - Contributions of Total factor productivity to industry labor productivity growth. (percentage points)

	1996-2007	2008-2013	1996-2013
Food, beverages and tobacco	-0.7	-0.3	-0.5
Textile, wearing and leather	-0.5	1.2	0.1
Wood and related; pulp and paper; printing and publishing	1.8	1.1	1.6
Chemicals	-10.9	-0.3	-0.7
Pharmaceuticals	-0.9	2.2	2.8
Rubber and plastic products	3.0	-0.2	1.6
Basic metal; fabricated metal products	2.5	-0.2	0.5
Computer electronic and optical products	0.8	-1.9	-0.3
Electrical equipment	0.5	-0.9	-0.3
Machinery and equipment	0.0	1.0	0.6
Motor vehicles; other transports equipment	0.4	-2.1	-0.7
Wholesale and retail trade, auto and motovehicle repair	0.1	-0.7	-0.4
Hotel and restaurants	0.2	-0.4	-0.6
ICT services	-0.7	0.9	1.9
Financial and insurance activities	-3.2	2.2	1.4
Professional, scientific activities and support services	-0.4	-2.7	-2.5
R&D	-0.2	1.9	0.6

Source: own elaboration on Istat data

These findings suggest that there are various factors affecting low industry productivity. A first look at the sources of growth results support the assumption that Italian industries encountered many difficulties in taking advantage of the mid-1990s ICT revolution compared to their European partners. But to disentangle the main drivers of the slowdown a deeper analysis of the determinants of the sources of growth at the industry level is warranted.

Chart 7 - Labour productivity growth and intangible contribution to labour productivity (1997-2013)



Source: our elaboration on Istat data.

However, a first look at the correlations between intangible capital and labour productivity growth reveals a positive correlation over the whole sample period corroborating the evidence of a relevant role of intangibles as a source of growth to be taken into account in future investigations.

CONCLUSIONS AND POLICY IMPLICATIONS

Knowledge investment has become a key factor for firms around the world to gain competitive advantage and firms across different sectors are likely to differ in their strategies to invest in intangible capital. We explore, from a purely descriptive perspective, the diffusion of R&D and Software and ICT as a whole across the Italian industries and their contribution to productivity growth.

The analysis shows that ICT and intangible capital provided a relatively higher contribution to productivity growth in manufacturing than in services. In particular, data show that: i) the most “innovative” and “productive” sectors were with few exceptions characterized by relatively higher firm size (i.e Computer electronic and optical products,

electrical equipment and rubber and plastic product) ii) traditional Italian industries (“made in Italy”) are less innovative as they are those exhibiting the lowest ICT and intangible intensities; they are also the less dynamic over the sample period; iii) in association with the introduction of the euro there was a re-organization of industrial sectors that have decreased the innovative role of intangibles and ICT capital in most sectors; iv) R&D and software have been relatively resilient to the financial crisis v) differently from many European countries the role of ICT and intangibles capital in the financial sector in Italy was marginal and became negative after the financial crisis.

As for the policy implications, the Italian Government recognizes that Italy’s progress in ICT and intangibles assets has lagged behind that of the ICT leaders in the EU, US, and Asia. However, despite of several hot topics that have become popular especially in the aftermath of the crisis such as support to ‘high growth enterprises’ or demand-side innovation policies, the research and innovation policy shows more rigidity to changes than might be expected and the measures implemented have been still fragmented. The size distribution of Italian’s firms might partly explain the low innovation propensity and consequently, at least in part, the Italian productivity gap.

In this challenging context, a step in the right direction might be the new national plan “Industry 4.0” aimed at stimulating the adoption of new technologies. More specifically the following measures are deemed to impact on stimulating investments in intangibles in Italy: i) extension of the super amortization; ii) introduction of an iper amortization for I4.0 goods; iii) tax credit on expenditure in R&D, iv) incentives for startup and innovative SMEs; v) refinancing of the Guarantee Fund for SMEs with a focus on I4.0 investments; vi) creation of the Digital Innovation Hub and the I4.0 Competence Center; vii) strengthening of public investments in I4.0 education and research; viii) measures to reinforce technological clusters; ix) progress in the Ultra Broadband Plan; x) Extraordinary Plan for Made in Italy; xi) assignment of resources from development contracts to I4.0 projects; xii) measures to incentivize the change between wage and productivity. Moreover additional provisions have been approved in order to stimulate R&D in SMEs ⁶.

⁶ To support the access of young people to research, the Fund for the financing of the universities (FFO) has been equipped with €47 million in 2016 and €50.5 million from 2017 and the Ordinary Fund for research bodies (FOE) with €8 million in 2016 and €9.5 in 2017. The allocation of funds to universities and research bodies takes into account the quality of research results from 2004 to 2010 for universities and the FOE allocation criteria for research institutions. An amount of €120 million allocated to support important projects in R&D in the information and communication technologies area for the implementation of the Digital Agenda. To benefit from Sustainable Industry €410 million have been allocated for relevant projects in R&D for environmental sustainable growth. Resources in R&D. A first tranche of €20 million allocated for the promotion of 230 innovative PhDs with strong industrial vocation. A budget of €30 million provided for the attraction of researchers of excellence to support measures for Italian researchers who intend to participate in European tenders for the European Research Council (ERC). In addition, resources for €3 million from FISIR Fund assigned to the creation of 4 new clusters (Made in Italy, Culture, Energy and Blue Growth) which together with the other 8 that already exist, could participate to the call of about €400 million earmarked for industrial research and public-private cooperation between the end of 2016 and early 2017 215 researchers in public research bodies has been recruited, with an allocation estimated of €8 million for 2016

All in all, aggregate external shocks like the acceleration of economic integration and the ICT/ intangible revolution call for adjustments in the production structure and the allocation of resources. It seems that the Italian economy has been unable to adequately react to such shocks and reallocate its resources accordingly. A process of structural reforms with a better focus on intangible investment is key to reducing the Italian productivity gap.

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