Immigrants and labour productivity: firms evidence from Italy

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The recent positive immigration trend that has characterized Europe over the last three decades and Italy since the 2000s, has generated an ongoing debate on the role played by immigrants on many aspects of the labour markets. This paper offers some new evidence on the role played by immigrants from extra EU at the firm level on labour productivity, one important dimension of firms' performance.

We take advantage of a rich and unique firm level data from the *Rilevazione Imprese e Lavoro* (RIL) conducted by Inapp in 2007, 2010 and 2015, merged with AIDA archive provided by the Bureau Van Dijk. Accounting for both firms observed and unobserved heterogeneity as well as endogeneity issues, results show that a supply-driven increase in the share of immigrants for extra EU in a given firm, decline labour productivity of that firm. Some robustness analysis also reveal that results are mainly driven by small-medium firms operating in the manufacturing sector.

KEYWORDS: labour productivity, immigrants, firm-level analysis

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1.   Introduction

International migration is a global phenomenon and over the last three decades, migration flows have been rising and are unlikely to fall from their current levels, given the large demographic and economic imbalances (OECD, 2018).
There is indeed an ongoing and lively debate on the effects of immigration for the receiving countries as well as on the policies to respond to what are seen as new migratory pressures and challenges. Immigrants tend to expand the workforce, having both direct and indirect effects on economic growth. (OECD Migration Policy Debate, 2012). In the US and Europe, immigrants respectively represent 47/70% of the increase in the labour force (OECD, 2012).

Immigration's effect on economic growth is one of the key factors that determine whether immigration boosts the well-being of the host society. If the growth rate of per-capita income increases thanks to immigrants, the standard of living of the general population can rise. This occurs in countries where the relative human capital of immigrants is higher (Boubtane, Dumont and Rault, 2016). The situation is less clear when it comes to labour productivity. Labour productivity is a function of physical and human capital. Higher levels of human capital lead to higher productivity and to a higher compensation for workers. Therefore, if immigrants raise the level of human capital in the firm, it is likely that average wages increase as well. However, growth in the labour supply could mean more competition, leading to lower wages, especially if immigrants accept lower wages in return for their labour. (OECD, 2018)

The effect of immigrants on a firm's productivity beyond their effect on human and physical capital can be positive or negative and such relationship is quite difficult to capture due to the fact that immigrants are not randomily allocated across firms and hence immigration may also affect productivity through its effects on physical and human capital. Therefore, estimating this relationship is not an easy task and there is need to employ instrumental variable regressions.

Empirical evidence on the overall impacts of immigration on productivity has reached contrasting conclusions. Some studies find positive effects of either the size or the diversity of the immigrant group in the local area or firm (Mitaritonna, *et al.* 2017; Peri, 2012; Trax, Brunow and Suedekum, 2015), in the UK, Ottaviano *et al.* (2018) find that immigrants increase overall productivity. Others find no (Ortega and Peri, 2009) or even negative effects (Ortega and Peri, 2014) or differences by sector (Paserman, 2013) and in the US, Peri (2012) finds that immigration has a strong and positive association with total factor productivity and a negative association with the high skill bias of production technologies. A very recent paper by Brunello *et al*. (2019) for a sample of Italian manufacturing firms, find no effect on immigration on TFP.

The relationship between immigration and productivity takes on a specific connotation in countries characterized by a very fragmented productive structure and by a weak demand for skilled labor, where immigrants can be employed above all as a means to reduce labor costs independently from their skills, with potentially negative effects on economic growth and social cohesion. This is likely to be the case of southern European countries, where, since the middle of the 1990s, productivity growth has been substantially lower than in other developed countries, partly due to inefficient management

practices, which limited Southern Europe's gains from the IT Revolution (see Schivardi and Schmitz, 2018).

Among the Southern European countries, Italy is an interesting case of study. In the last two decades it has experienced a significant increase in inflows of immigrant's workers, mainly young and low-skilled (Del Boca and Venturini 2005), both from EU and extra EU (see Bratti and Conti 2018). In addition, there has been an increasing inefficient allocation of skills associated with a significant productivity stagnation. Since the second half of the 1990s, productivity growth has been feeble both by historical standards and compared with the other main euro area countries and is the main factor holding back long-term economic growth in Italy (Bugamelli and Lotti, 2018).

In such a context, firms might have taken advantage from labour force from immigrants in order to reduce labour cost and hence gain more profits, thus generating possible allocative inefficiency with negative long-term effects on productivity growth and potentially, on social cohesion.

The relationship between immigration and productivity within a country can be examined at the aggregate, sector and firm levels. Because output and input data at these levels are scarce, rather than estimating the exact impact of immigration on productivity, the relationship has been analysed less formally (OECD, 2018a). Most of the literature use firm level data, but information on migration is at a more aggregated level, for instance Mitaritonna *et al*. (2017) use migration in the French department, Brunello *et al.* (2019) for Italy use migration at the Local labour market Level.

The empirical literature on migration for Italy has focused on many aspects of the labour market: immigration on innovation of Italian regions (Bratti and Conti 2018), how immigration shapes the natives' voting behavior (Barone *et al.* 2016), the effect of immigration on public health spending (Bettin and Sacchi 2019), the impact on labor market outcomes of regularizing undocumented migrant workers (Di Porto *et al*. 2018).

As for the effects on labour productivity of migration, previous research on Italy using data at the province level has shown that an increase in the share of immigrants has contributed to raising value added in manufacturing with respect to services (see De Arcangelis, Di Porto and Santoni, 2015). As far as we are aware there is only one very recent contribution by Brunello *et al.* (2019) that investigate the effects of low immigration on firms' performance for firms operating in the manufacturing sector only. The authors study how an increase in the local supply of immigrants at the local labour market effect the average labour costs, capital stock and finally TFP. As for the last outcome, they find no effect, in contrast with Mitaritonna *et al.* (2017) for France.

Our paper contributes to the existing literature by providing first evidence at the firm level, on how immigration (from extra EU), affects labour productivity, measured as value added on labour force. Compared with the recent study of Brunello *et al.* (2019) we analyzes this relationship for all sectors and across all macro areas. Moreover, we are also able to account for firm observed and unobserved heterogenity, exploiting the vast number of variables contained in the RIL archive (for instance: vacancy, product innovation, process innovation, patents, foreign ownership, trade agreements, a well as a number of workforce characteristics).   Last but not least, we employ three different instruments to overcome issues of selection bias: two contained in the RIL archive, and one from ISTAT at the municipality level.

We find that the effects of an increase in the supply of immigrants from extra EU to firms' labour is negative and consistent across all specifications. We observe that a one percentage increase in the share of immigrants from extra EU translates into an average decline in labour productivity of 0.3 percent, once workforce and firm characteristics are included. This effect increase to 0.5 in absolute term, once firm's heterogeneity and endogeneity issues have been taken into account. In addition, taking advantage of the information provided by RIL on firm's characteristics, some robustness analysis reveals that results are mainly driven by small firms operating in the manufacturing sector.

Our findings are in contrast with the evidence for France from Mitaritonna *et al.* (2017) who find a positive effect of immigration on TFP. Brunello *et al*. (2019) for Italy, find instead that immigration exerts no effect on TFP.
It is well known that Italy is mainly characterized by low skilled immigration (see for instance, Bratti and Conti, 2018, and Del Boca and Venturini, 2005 and Brunello *et al*.2019) and even more so by focusing on immigrants from extra EU. By contrast, the study from Mitaritonna *et al.* (2017) is focused on a period characterized by high skilled immigration in France.

The paper is structured as follows. In the next section, we offer an overview of the Italian economy related to its migration flows. Section 3 goes on by describing our dataset. Section 4 follows with a discussion of the econometric strategy, the main results and some robustness analysis. Finally, section 5 draws out some preliminary conclusions.

2. Related Literature

A large body of literature has investigated the labour market effects of immigrants in the US and in other countries with large immigration flows, such as Canada and Australia. A growing literature is also available for Europe; for instance, for the UK (Dustmann *et al*. 2008), Germany (Glitz 2012) and Spain (González and Ortega 2013).
 Immigration has been analyzed in relation with many aspects: cultural environment (Ottaviano and Peri 2006), the crime rate (Moehling and Piehl 2009; Bianchi *et al*. 2012), employment (Ottaviano and Peri 2006; Martins *et al*. 2018; Esposito *et al*. 2019) or the attitudes of natives (Card *et al*. 2012; Mayda 2006). A number of studies have also analysed how immigration affects productivity. Concerning the latter aspect, the empirical evidence gathered so far, have reached contrasting conclusions.
For instance, in the US, Peri (2012) finds that immigration has a strong and positive association with total factor productivity and a negative association with the high skill bias of production technologies. By contrast, a recent a study of the Federal Reserve, conducted by Quispe-Agnoli and Zavodny (2002) for the U.S. manufacturing sector at the state level, indicates that changes in the labour supply due to immigration appear to lower labour productivity in both the low and high-skilled sectors. As for service-producing firms in the UK, Ottaviano *et al*. (2018) find that immigrants increase overall productivity while Kangasniemi *et al*. (2012), find that immigration in the UK exerts a negative but negligible contribution on labour productivity. Mitaritonna *et al*. (2017), using micro-level data for

French manufacturing firms, show that a supply-driven increase in foreign born workers in a department (location) increases the productivity of firms in that department at all percentiles of the distribution and that the effect is significantly stronger for firms with initially zero level of foreign employment. Studies for other countries have reached contrasting conclusions.

As for Spain, using firms and individual level data by sector and municipality for Barcelona and Madrid, Nicodemo (2013) demonstrates that immigration has a negative effect on productivity. Education and occupation are both variables with a positive effect on productivity, while permanent, public or full time contracts do not show any effect. This result is in line with that of Kangasniemi *et al*. (2012) that find that immigration exerts a negative contribution to labor productivity growth in Spain.

A study for Israel (Paserman , 2013), reveals no correlation between high skill immigrant concentration and productivity at the firm level in cross-sectional and pooled regressions, but a negative correlation between the change in output per worker and the change in the immigrant share, via first-differences estimates. Moreover, the immigrant share turns out to be strongly and negatively correlated with productivity in low-tech industries.

Huber et al. (2010) analyze productivity at the sectoral level across 12 EU countries, and find little evidence to suggest that migrants have raised productivity, although high-skilled migrants do appear to play a positive role in productivity developments in skill-intensive industries.

As for Italy, the literature analyzing the effect of immigration on the Italian labour market has focused on several aspects. For instance, Bratti and Conti (2018), investigate the effect of immigration on the innovation of Italian regions over the period 2003-2008. Using instrumental variables estimation, they show that the overall stock of immigrants did not have any effect on innovation, but an increase of 1 percentage point in the share of low-skilled migrants on the population is found to reduce patent applications by about 0.2%, Barone *et al*. (2016) analyse the role of immigration in shaping natives' voting behavior, using Italian municipality-level data on national elections. Their study reveals that immigration generates a sizable causal increase in votes for the centre-right coalition, which has a political platform less favorable to immigrants. Bettin and Sacchi (2009) study the effect of immigrants on public health spending across Italian regions. Esposito et. al (2019) assess the direction of the impact of immigration on domestic unemployment, in the short and in the long run, for a sample of 15 EU countries between 1997 and 2016.

Regarding the effects on productivity of migration, there are two contributions for Italy. A study at the province level, by De Arcangelis, Di Porto and Santoni, (2015) that shows that an increase in the share of immigrants contributes to raising value added in manufacturing with respect to services and a very recent contribution by Brunello et a. (2019) that, using the variation over time and across local labour markets (LLM) in the supply of immigrants for a sample of manufacturing Italian firms, estimate the effects of immigration on profits, labour costs, the capital stock as well as total factor productivity (TFP) of firms located in these markets. As for TFP, the authors do not find any effect.

3.   The Italian case

Like other European Countries, during the 2000s, Italy was exposed to a very large wave of immigration. According to the Italian National Institute-Istat, the share of legally resident foreign population increased from 2.4% in 2002 to 7.6% in 2010 up to 8.3% in 2015 with the largest growth in Northern and Central Italy and in big cities like Rome and Milan (Bratti and Conti 2018). In absolute terms, data from the Labour Force Survey, reveal that the number of foreign-born people in Italy increased from 1,3 million to 5 million, over the period 2002-2017. Growth was particularly fast after 2001 due to the regularization taking place in 2001-2002, where over 650,000 immigrant workers were involved.

Figure 1.   Absolute number of foreign residents in Italy: 2002-2017
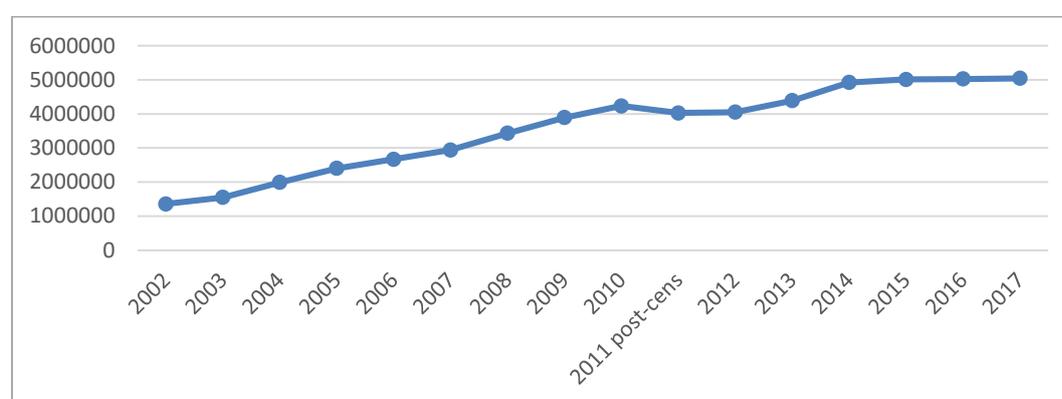
Note: Authors' elaboration based on Istat's "Labour Force Survey" dataset

However, compared with other countries, Italy is mostly characterized by young and low-skilled immigrants (Del Boca and Venturini 2005). As also documented by Bettin and Sacchi (2019), on average, the foreign population is younger with the working–age group being widely over–represented compared to the native population. Furthermore, the country of origin most represented is Eastern Europe, with nearly half of the immigrants coming from Romania and Albania, followed by Maroccans and Chinese immigrants. Focusing on immigrants from extra EU, data from Istat reveals that on the 1st of January 2018 the most representative countries of origin for immigrants from extra EU were Marocco (443.147), Albania (430.340), China (309.110), Ucraina (235.245) and Filippine (161.609).

The lack of attractiveness to highly skilled immigrants can be possibly explained by a productive system mainly characterized by specialization in traditional industries (De Benedictis 2005; Larch, 2005) and it is also due to lower returns to human capital for immigrants than for natives (Bratti and Conti 2018). Using data from Istat for the period 2005, 2007, 2010, 2014 and 2017, figure 2 illustrates the share of employed foreign workers (aged 15-64) from extra EU by ISCO level.

Between 30 and 40% of extra EU foreign born workers turns out to be employed in elementary occupations, while managerial and professional occupations only account for less than 5 percent of the foreign born population.

Figure 2.   Share of foreign born workers from extra EU by ISCO level
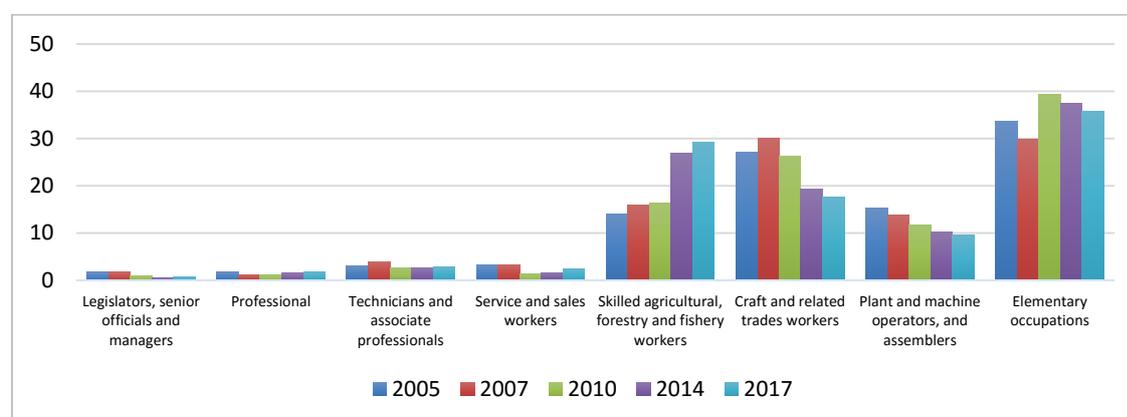
Note: Authors' elaboration based on Istat's "Labour Force Survey" dataset

In addition, there is some empirical evidence suggesting that foreign born workers are more likely to be overeducated than native Italian and that work experience gained in the country of origin is not valued in the Italian labour market (Dell'Aringa and Pagani ,2011).

In the table 1 that follows, we provide some additional evidence by showing the occupational distribution for graduates across native Italians and immigrants (from EU and extra EU).

Table 1.   Distribution by occupation for graduates native and immigrants from EU and Extra EU (%)

	2007			2010			2014		
	Natives	Immigr. Eu	Immigr. Extra Eu	Natives	Immigr. Eu	Immigr. Extra Eu	Natives	Immigr. Eu	Immigr. Extra Eu
Legislators, senior officials and managers	6.55	11.17	2.97	5.28	5.01	3.22	4.53	1.68	1.31
Professional	52.55	24.33	8.44	50.26	27.49	7.92	54.36	30.08	10.53
Technicians and associate professionals	28.72	29.17	15.56	29.68	32.48	10.62	25.68	26.02	11.65
Service and sales workers	7.15	7.01	5.19	10.03	3.52	2.43	9.63	5.99	3.11
Skilled agricultural, forestry and fishery workers	3.83	12.67	19.51	3.68	8.91	14.66	4.76	16.49	33.47
Craft and related trades workers	0.43	5.8	14.44	0.41	5.22	12.13	0.43	4.39	4.57
Plant and machine operators, and assemblers	0.3	2.5	8.64	0.22	3.36	8.77	0.29	4.02	4.79
Elementary occupations	0.48	7.35	25.24	0.43	14	40.25	0.32	11.32	30.57
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Note: Authors' elaboration based on Istat's "Labour Force Survey" dataset

What clearly emerges is that, across the period considered, while over 50% of the Italian graduates are employed in occupations at the top level (Professional), only around or less than 10 percent of the immigrants for extra EU are employed in the same occupations. The main activities of the former are elementary and agricultural activities, accounting for around 30 percent in 2014. By contrast, only between 0.5% and 0.3% of the natives are employed in the latter occupations. These figures are less striking for immigrants from EU: between 24 and 30 percent of the immigrants coming from the European Union are employed in top level occupations and as far as elementary occupation are concerned, the share ranges between 7 and 14 percent. The just described figures reinforce some evidence on occupational mismatch, affecting in particular immigrants coming from extra EU.

4.   Data

The empirical analysis is focused on the *Rilevazione Imprese e Lavoro* (RIL) conducted by Inapp during 2007, 2010 and 2015 on a representative sample of partnerships and limited liability firms. Each wave of the survey covers over 25000 firms operating in non-agricultural private sector. A subsample of the included firms (around 35%) is followed over time, making the RIL dataset partially panel over the period under study[4].

Each wave of the RIL questionnaire provides a rich set of information about the employment composition and personnel organization (type of contracts, training activities ecc.), industrial relations and other workplace and firms productive characteristics. In particular, for our purpose, the RIL survey provides information on the number of non-native workers (from extra EU) and allows us to identify the share of immigrants employed by each firm over time[5]. Since our main variable of interest is the share of immigrants from extra EU, we exclude from the analysis the first wave of RIL, 2005, because it is not consistent with the definition of immigrants from extra EU in the following years. Indeed, some countries joined the EU from 2007 (Bulgaria and Romania).

The RIL survey contains, however, incomplete information on financial and accounting variables, which had to be recovered from another source. For this purpose, we use the national tax number to merge RIL data with AIDA archive provided by the Bureau Van Dijk for the period 2005-2014.

The AIDA data offers comprehensive information on the balance sheets of almost all the Italian corporations operating in the private sector, except for the agricultural and financial industries. In particular, this dataset contains yearly values of such variables as revenues, added value, net profits,

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[4] The RIL Survey sample is stratified by size, sector, geographic area and the legal form of firms. Inclusion depends on firm size, measured by the total number of employees. This choice has required the construction of a 'direct estimator' to take into account the different probabilities of inclusion of firms belonging to specific strata. In particular, the direct estimator is defined for each sample unit (firm) as the inverse of the probability of inclusion in the sample. For more details on RIL questionnaire, sample design and methodological issues see: http://www.inapp.org/it/ril.

[5] Note that for the main variables the data collected by RIL survey in 2015 really refered to 2014, while those derived from the RIL survey in 2010 are aligned to the same year. Thus in what follows we mention the RIL sample 2007-2010-2015, even though the empirical analysis is based on data 2007-2010-2014. More details are available upon request.

book value of physical capital, total wage bill and raw-material expenditures. Consequently, we are able to use indicators of labour productivity (value added per employee), fixed capital (the total amount of physical asset per employee) and other balance sheet variables (raw material expenditures, net profits ecc.).

As for sample selection, we excluded firms with less than ten employees to retain only those productive units characterized by a minimum level of organizational structure. After excluding also firms with missing information for the key variables, the RIL-AIDA longitudinal sample is made up of approximately 1800 limited liability firms observed in 2007, 2010 and 2015.

To deflate our monetary variables we relied on sectoral deflators (NACE 2 digit) provided by the National Statistical Institute (base year 2010) based on industrial production prices (see http://dati.istat.it/#).

3.1 Descriptive statistics

Table 2 shows the descriptive statistics for labour productivity and labour costs distributions in each sample year as well as the share of workforce and firm specific characteristics[6].

To begin with, we observe that on average the (log of) labour productivity declines over the period, ranging from 10.8 in 2007-2010 to 10.7 in 2014; this pattern pairs with the reduction of the (log of) number of employees while the intensity of physical capital increases over time.

Table 2.   Descriptive statistics

	2007		2010		2014	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Ln (value added per employee)	10.81	0.58	10.80	0.51	10.71	0.64
Ln (physical capital per employee)	9.90	1.39	10.13	1.56	10.08	1.72
Workforce characteristics						
Presence of immigrants (0/1)	0.46	0.50	0.38	0.49	0.36	0.48
Share of immigrants (total empl)	0.05	0.09	0.04	0.08	0.04	0.08
Share of immigrants (on employees)	0.07	0.12	0.05	0.11	0.05	0.10
Share of executives	0.03	0.06	0.04	0.07	0.04	0.09
Share of white collars	0.33	0.27	0.37	0.28	0.41	0.29
Share of blue collars	0.63	0.29	0.59	0.30	0.55	0.31
Share of female	0.30	0.24	0.34	0.25	0.34	0.25
Share of temporary contracts	0.11	0.18	0.11	0.17	0.08	0.17
Share of trained	0.20	0.33	0.28	0.36	0.40	0.41
Share of new hirings	0.16	0.22	0.12	0.22	0.09	0.17
Vacancy	0.21	0.41	0.13	0.33	0.12	0.33
Second level bargaining	0.14	0.34	0.13	0.34	0.12	0.33
Union	0.23	0.42	0.25	0.43	0.23	0.42
Firms characteristics						
Mergers & acquisitons	0.03	0.16	0.08	0.27	0.06	0.24
Process innovation	0.47	0.50	0.43	0.50	0.35	0.48
Product innovation	0.62	0.49	0.52	0.50	0.42	0.49
Multinational	0.03	0.16	0.03	0.16	0.02	0.15
Trade agreements	0.24	0.43	0.16	0.37	0.16	0.37

[6] The complete description of the entire set of variables used in the analysis is available upon request.

| N. of obs | 1,771 | 1,877 | 1,800 |

Note: Authors' elaboration based on the RIL-AIDA merged dataset 2007-2010-2015. Sampling weights applied

As for the workforce composition, note that the incidence of firms employing extra-EU immigrants reduced significantly from 46% in 2007, to 38% in 2010 and 36% in 2014, a feature that mirrors in a negative evolution of the share of extra-EU workers over the total employment, from 0.5% to 0.4% over the period under study. Further, we observe an increase of the average professional level of the workforce as a result of a rise of the share of both executives (from 0.3% to 0.4%) and white collars (form 33% to 41%) and a decline of the blue collars (63% in 2007 and 55% in 2014). As well, average share of employees undergoing some workplace training grows from 20% in 2007 to 40% in 2014, while the reduction of fixed term contracts (from 11% to 8%) may be associated with the break down in the propensity to hire new workers under temporary contractual arrangements in a period of economic downturn. This may suggest that firms faced the economic crisis protecting workplace specific competencies of "insiders" rather than recovering to general skills and/or new competencies with strategic hiring plans (Dosi *et al.*2018).

Our sample provides information on a set of firms' characteristics. In particular table 2 indicates that the incidence of firms that have undertaken product (process) innovation in the three years preceding each RIL survey reduced form 62% (47%) in 2007, to 52% (43%) in 2010 and 42% (35%) in 2014. As well, the incidence of firms with trade agreements on foreign markets decreased from 24% in 2007 to 16% in 2010-2014. Finally, to save space we do not report summary statistics about the distribution of our sample across regions and sector of activities. These are however available upon request.

5. Econometric analysis

In order to investigate the relationship between the share of immigrants and firms' productivity, our econometric specification is as follows. Labour productivity $ln(lab\ prod)_{i,t}$ defined as the (log of) values added per employee, is expressed as a function of the share of immigrants from extra EU $IMM_{i,t}$ (number of immigrants over total employment), a vector $X_{i,t}$ including a wide set of control variables at the firm level (physical capital, age, sector of activity, size, macro-region ecc.) and employment composition (gender, education, age, contractual arrangement). Furthermore, for a specific sub period, 2010-2014, we are also able to include variables related with the level of management (results are shown in the robustness checks section).

$$ln(lab\ prod)_{i,t} = \alpha \cdot IMM_{i,t} + \beta \cdot X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \tag{1}$$

The model is estimated using pooled ordinary least squares, while controlling for time dummies, μ_t. Moreover, in order to account for unobserved individual firms' specific heterogeneity, we additionally include firm fixed effects η_i. Finally, we perform instrumental variable regressions to deal with endogeneity issues. Indeed, it is well known that estimating equation (1) with least squares, even in the presence of several fixed effects and controls, leaves open the possibility that some omitted local conditions may affect simultaneously the demand of immigrants and the productivity of firms as well as labour costs (see for instance Mitaritonna *et al.* 2017 for a discussion). Hence, we devote section 4.2 to identification issues and a description of our instrumental variable approach.

4.1   Main results

Table 3 reports pooled ols estimates for different specification of labour productivity equation for the period 2007, 2010 and 2015.

In column [1] we include the share of immigrants, time dummies and other basic controls for physical capital intensity, firms' size, sectoral 2 specialization and geographical location; in columns [2] we include workface composition and industrial relations while estimates in columns [3] also take into account a wide set of firms' characteristics. Labour productivity responds negatively to increases in the share of immigrants, across all specifications.

However, it is important to bear in mind that the share of immigrants is defined over total employment so it does also include any form of contractual arrangement and it is therefore likely to dampen the coefficient.

The observed correlation ranges between 0.6 and 0.3 (in absolute terms), when the model is fully specified. Hence, one percent increase in the share of immigrants reduces labour productivity by 0.3 percentage points, when workforce and firm characteristics are included (see colum [3] Table 3).

Table 3.   Pooled ols estimates. Dep Var: Labour productivity

	[1]	[2]	[3]
Immigr share	-0.584***	-0.302***	-0.324***
	[0.093]	[0.081]	[0.081
Ln (physical capital per employee)	0.122***	0.113***	0.111***
	[0.007]	[0.006]	[0.006]
Year 2010	-0.060***	-0.061***	-0.053***
	[0.01]	[0.01]	[0.011]
Year 2014	-0.082***	-0.102***	-0.092***
	[0.011]	[0.013]	[0.014]
Workforce characteristics	No	Yes	Yes
Firms' characteristics	No	No	Yes
2 digit sector	Yes	Yes	Yes
Constant	9.608***	10.886***	10.835***
	[0.092]	[0.173]	[0.169]
N. of obs	5683	5550	5449
R2	0.268	0.367	0.371

Note: Authors' elaboration based on the RIL-AIDA merged dataset 2007-2010-2015. Workforce characteristics: executives, white collar, blue collar, temporary workers, female, trained, share of hirings, second level bargaining, unions' presence. Firms characteristics: vacancy, product innovation, process innovation, patents, foreign ownership, trade agreements. All regression includes controls for firms size, ln (physical capital pc) and fixed effect for nuts_2 regions and sector of activity. Robust (boostrapped) standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4 replicates the same results when individual firms' specific heterogeneity, firm fixed effects η_i, are taken into account.

The share of immigrants turns out to be non-significant in column [1], but columns [2] and [3] confirm the presence of a negative and not negligible relationship between the share of immigrants and labour productivity.

Indeed, comparing column [3] across table 3 and 4, we observe only a small drop in the estimated coefficients that also accounts for firms' fixed effects: the reduction in productivity of labour is now around 0.23 percentage points as a response to a one percent increase in the share of immigrants from extra EU (see colum [3] Table 4).

Table 4. Fixed effect estimates. Dep Var: Labour productivity

	[1]	[2]	[3]
Immigr share	-0.136	-0.195*	-0.228**
	[0.099]	[0.102]	[0.103]
Ln (physical capital per employee)	0.066***	0.065***	0.066***
	[0.009]	[0.009	[0.01]
Year 2010	-0.043***	-0.041***	-0.040***
	[0.009]	[0.009]	[0.009]
Year 2014	-0.073***	-0.071***	-0.066***
	[0.01]	[0.011]	[0.012]
Workforce characteristics	No	Yes	Yes
Firms' characteristics	No	No	Yes
2 digit sector	Yes	Yes	Yes
Constant	11.194***	11.138***	11.140***
	[0.170]	[0.193]	[0.188]
N. of obs	5683	5539	5445
R2	0.107	0.119	0.126

Note: Authors' elaboration based on the RIL-AIDA merged dataset 2007-2010-2015. Workforce characteristics: executive, white collar, blue collar, temporary workers, female, trained, share of, hiring second level bargaining, unions' presence. Firms characteristics: vacancy, product innovation, process innovation, patents, foreign ownership, trade agreements. All regression includes controls for firms size, ln (physical capital pc) and fixed effects for nuts_2 regions and sector of activity. Robust (boostrapped) standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

4.2   Identification issues and Instrumental Variables

In order to identify the part of the change in the immigration share that is driven by supply changes rather than by local productivity shocks, the standard approach in literature consists in using the shift-share instrument based on initial spatial distribution of immigrants. This approach has been pioneered by Altonji and Card (1991) and then used in several studies since (among others see Card 2001; Card 2009; Peri and Sparber 2009; Lewis 2011).

The underlining idea is that new immigrants (especially with lower levels of schooling) tend to move to the same area where previous immigrants from the same country of origin already live and have established a community. For instance, Mitaritonna *et al.* (2017) in analysing the effect of immigration on firms' productivity and wages in France, deal with endogeneity by using as instrument the share of immigrants in each French department in the first year of their data, assuming that the distribution of immigrants in the first year across department is uncorrelated or has a rather week correlation with the distribution of demand shocks in the department after that year, once controlling for firm effects, region and sector specific trend.

In our setting, we adopt three different instruments. The first is based on information directly provided by RIL, and it is a subjective measure indicating the reason why firms employ foreigner workers (from extra EU), rather than native Italians. The question reads as follows: "Are there specific reasons why the firm has employed workers from extra EU?". Among the possible answers, we select two, reflecting that the firm has no other choice but to rely on foreigners rather than native Italians, because the former workers are either not willing to work in that occupation or task, or are considered not very professional. We then construct a dummy variable taking the value of one if the response is exclusively related to the following two answers: "Italian workers are not very professional" or "Italian workers are not interested or willing to work in some of the occupations and tasks of the firm". The

so obtained variable is likely to be strongly correlated with the share of immigrants employed by the firm, while at the same time, being uncorrelated with other omitted factors related with the share of immigrants, such as a productivity demand shocks. Our IV approach first relies on this instrument only.

Second, we combine the latter instrument using data on immigrants by municipality and country of origin estimated combining information on immigrants by municipality and area of the world provided by ISTAT, following Barone *et al*. (2016).[7] This instrument is defined as the difference in the share of immigrants (from extra EU) at the municipality level across the period 2002-2004 and thus capturing the increase in the share of immigrants associated with an important immigration that took place in 2002: the "Bossi-Fini".[8] The data reveal that over the period considered, around 89 percent of the municipalities are characterized by an increase in the absolute number of immigrants (from extra EU).

Table 5.   IV-2SLS second stage estimates. Dep var: labour productivity

	[1]	[2]	[3]
Immigr share	-0.557***	-0.556**	-0.546**
	[0.214]	[0.222]	[0.277]
Ln (physical capital per employee)	0.137***	0.138***	0.127***
	[0.052]	[0.053]	[0.026]
Year 2010	-0.052***	-0.054***	-0.043**
	[0.018]	[0.018]	[0.018]
Year 2014	-0.101***	-0.103***	-0.092***
	[0.018]	[0.019]	[0.023]
Workforce characteristics	Yes	Yes	Yes
Firms' characteristics	Yes	Yes	Yes
2 digit sector	Yes	Yes	Yes
Constant	10.429***	10.456***	10.982***
	[0.602]	[0.613]	[0.394]
N. of obs	3442	3301	2108
First stage statistics			
Subjective measure (RIL): natives not available to be hired 2004-05	0.114***		
	[0.000]	[0.000]	[0.000]
Change of immigrant share at municipality level 2002-2003		0.720***	
		[0.000]	[0.000]
Firm level regularization 2004-05			0.012***
			[0.000]
Ln (physical capital per employee) t-1	Yes	Yes	Yes
Weak identification test (Kleibergen-Paap rk Wald F statistics)	13.333	8.63	21.25

Note: Authors' elaboration based on the RIL-AIDA merged dataset 2007-2010-2015. Workforce characteristics: executive, white collar, blue collar, temporary workers, female, trained, share of hirings, second level bargaining, unions' presence. Firms characteristics: vacancy, product innovation, process innovation, patents, foreign ownership, trade agreements. All regression includes controls for firms size, ln (physical capital pc) and fixed effect for nuts_2 regions and sector of activity. Robust (boostrapped) standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

[7] We thank the authors for sharing the data.

Finally, we also consider a third instrument provided by RIL, which indicates if the firm has actually regularized foreigner workers according to the 2002 policy (objective measure). This is a dummy variable available in RIL at the panel level. We combine this information with the instrument based on a subjective measure related with the reason for employing foreigner rather than native Italian workers.

Table 5 reports estimates obtained using instrumental variable regression. Colum [1] displays results based on the first described instrument (subjective measure from RIL: natives not available to be hired 2004-05), column [2] shows results combining the first instrument with that based on the change of the share of immigrants at the municipality level (2002-2004), and finally, column [3], reports estimates obtained combining the information on the first instrument and the objective measure available in RIL on firm level regularization (2004-2005). Results confirm the previous evidence and reveal the presence of a stronger negative correlation between immigration and our outcome variable. Across all three specifications, we observe that a one percent increase in the share of immigrants reduces labour productivity by around 0.5 percentage points. The fact that controlling for firm fixed effects and instrumenting the inflow of immigrants produces a larger point estimate of this effect, relative to OLS estimates, indicates the presence of omitted variable bias in the OLS specification attenuating the effect.

4.3 Robustness checks: firms' size and sector of activity

This section provides some robustness checks. We first explore if there emerge some differences based on firms' size. Indeed, we replicate our estimates distinguishing between small-medium (below 100 employees) and large (above 100 employees) firms. Results are thereby reported in table 6 where we show pooled ols, fixed effect and 2-SLS-IV estimates of equation (1) obtained for separate regressions across the two samples.

Table 6.   Pooled ols, FE and IV-2SLS estimates by firm size

	n of employees<=100			n of employees>100		
	OLS	FE	IV-2SLS	OLS	FE	IV-2SLS
Immigr share	-0.369***	-0.195*	-0.507**	0.011	-0.322	-0.899
	[0.082]	[0.116]	[0.221]	[0.265]	[0.253]	[1.050]
Ln (physical capital per emp)	0.096***	0.060***	0.132***	0.096***	0.051**	0.193**
	[0.006]	[0.011]	[0.048]	[0.015]	[0.022]	[0.097]
Year 2010	-0.040***	-0.026***	-0.045**	-0.054**	-0.066***	-0.107***
	[0.012]	[0.010]	[0.019]	[0.023]	[0.023]	[0.038]
Year 2014	-0.074***	-0.048***	-0.088***	-0.117***	-0.096***	-0.187***
	[0.014]	[0.012]	[0.020]	[0.033]	[0.029]	[0.057]
Workforce characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Firms' characteristics	Yes	Yes	Yes	Yes	Yes	Yes
2 digit sector	Yes	Yes	Yes	Yes	Yes	Yes
Constant	10.823***	10.581***	7.379***	10.649***	11.593***	11.909***
	[0.151]	[0.277]	[0.525]	[0.470]	[0.593]	[0.972]
N. of obs	4396	4396	2839	1037	1037	457
R2	0.373	0.093	0.368	0.545	0.150	0.505

Likewise, table 7 displays the pooled ols, fixed effect and 2-SLS-IV estimates of equation (1) obtained for separate regressions by sector of activity. Here we distinguish between manufacturing firms and those operating in the nonmanufacturing sector.

Both robustness (table 6, 7) confirm our findings: the presence of a negative and non-negligible relationship between the share of immigrants and labour productivity. Nevertheless, some important remarks are in order. Our results are definitively driven by small-medium firms and those operating in the manufacturing sectors. Indeed, the "immigr share" coefficient across almost all specifications, turns out to be significant for small-medium and manufacturing firms (as we can observe by looking at the first three columns of table 6 and 7). This is simply the result of the structure of the Italian labour market, mainly characterized by those kind of firms. However, it is interesting to notice that fixed effects estimates reported in column [2] of table 7 are not significant. This can instead be suggesting that the negative relationship between the share of immigrants and labour productivity in the manufacturing sector might be driven by firms' unobserved heterogeneity[9]. By looking at table 6, we can observe that the estimates obtained by the IV-FE model are perfectly in line with those obtained from the full sample (-0.507 for the small-medium firms versus -0.546 for the whole sample). Indeed, by controlling for unobserved heterogeneity as well as selection bias, we see a decline in labour productivity of about 0.5 percent as a response to an increase in the share of immigrants from extra eu by one percent. As for the firms operating in the manufacturing sector, the IV-FE estimates reported in column [6] of table 7, show an even stronger effect, of about 0.8 percentage points negative response of labour productivity to immigration.

Table 7. Pooled ols, FE and IV-2SLS estimates by sector

	Manufacturing			non Manufacturing		
	OLS	FE	IV-2SLS	OLS	FE	IV-2SLS
Immigr share	-0.258**	-0.227	-0.779**	-0.340***	-0.225	-0.453
	[0.113]	[0.159]	[0.337]	[0.108]	[0.143]	[0.291]
Ln (physical capital per emp)	0.097***	0.062***	0.185*	0.098***	0.061***	0.119*
	[0.010]	[0.016]	[0.108]	[0.007]	[0.012]	[0.064]
Year 2010	-0.055***	-0.060***	-0.067*	-0.035**	-0.013	-0.045**
	[0.015]	[0.014]	[0.040]	[0.016]	[0.012]	[0.023]
Year 2014	-0.064***	-0.053***	-0.083*	-0.099***	-0.061***	-0.125***
	[0.019]	[0.017]	[0.043]	[0.019]	[0.015]	[0.023]

[9] In an extended version of the paper, we also carry out the same regressions by focusing the analysis on the last two waves of RIL (2010-2015). This exercise allows us to include some additional covariates in our regressions, like for instance the managerial characteristics, available only in the last two waves of the survey. The inclusion of these covariates might improve the accuracy of our model and some parts of the unobserved, firm specific, heterogeneity. Again, these results are available upon request.

Workforce characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Firms' characteristics	Yes	Yes	Yes	Yes	Yes	Yes
2 digit sector	Yes	Yes	Yes	Yes	Yes	Yes
Constant	10.735***	10.764***	10.047***	10.252***	11.072***	10.527***
	[0.230]	[0.367]	[1.041]	[0.227]	[0.282]	[0.873]
N. of obs	2508	2508	1367	2925	2925	1929
R2	0.340	0.076	0.237	0.454	0.185	0.437

Note: Authors' elaboration based on the RIL-AIDA merged dataset 2007-2010-2015.Workforce characteristcs: executive, white collar, blue collar, temporary workers, female, trained, share of hirings, second level bargaining, unions' presence. Firms' characteristics: vacancy, product innovation, process innovation, patents, foreign ownership, trade agreements. All regression includes controls for firms size, ln (physical capital pc) and fixed efffect for nuts_2 regions and sector of activity. Robust (boostrapped) standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

6. Conclusions

In this paper we try to shed some light on a very important dimension of Italian firms: productivity of labour. We analyse it in relationship with immigration. It is well known that the recent immigration trend, in Europe as well as in Italy, has been positive and there is an ongoing debate on the role played by immigrants on the labour markets. However, Italy shows some important peculiarities.

We employ a unique and very rich firm level data from the *Rilevazione Imprese e Lavoro* (RIL) conducted by Inapp in 2007, 2010 and 2015 on a representative sample of Italian firms. We perform OLS regressions, fixed effects estimates to account for unobserved firm's specific heterogeneity and finally, we deal with endogeneity by employing three different instruments. Indeed, there are likely to be omitted local conditions that may simultaneously affect the demand of immigrants and the productivity of firms as well as labour costs (see for instance Mitaritonna *et al*. 2017 for a discussion). Results are consistent across all specifications and reveal that hiring more immigrants from extra EU exerts a negative effect on labour productivity. We verify that the negative impact of immigrants on the productivity holds for both ols and IV–2SLS regressions, as well as using a within fixed effect estimators that control for time invariant firms unobserved heterogeneity. These results need to be considered in light of two important peculiarities of the Italian labour market: the poor recent performance of italian productivity, stagnant since the early 200s and below the EU average, associated with the presence of mainly low skilled immigrants.

Appendix

Table A1. Summary results for first-stage regressions: 1th IV strategy

Endogenous Variables			Under-id		Weak id
	F(2,1381)	P-val	SW Chi-sq(1)	P-val	SW F(1,1381)
Immigr share	169.01	0.000	261.33	0.000	257.34
Ln (physical capital per employee)	14.15	0.000	27.16	0.000	26.75
Weak identification test					
Cragg-Donald Wald F statistic	32.06				
Kleibergen-Paap Wald rk F statistic	13.33				

Table A2. Summary results for first-stage regressions: 2th IV strategy

Endogenous Variables			Under-id		Weak id
	F(3,1329)	P-val	SW Chi-sq(2)	P-val	SW F(2,1329)
Immigr share	107.45	0.000	236.72	0.000	116.45
Ln (physical capital per employee)	9.11	0.000	26.32	0.000	12.95
Weak identification test					
Cragg-Donald Wald F statistic	20.54				
Kleibergen-Paap Wald rk F statistic	8.63				

Table A3. Summary results for first-stage regressions: 3th IV strategy

Endogenous Variables			Under-id		Weak id
	F(2,1381)	P-val	SW Chi-sq(2)	P-val	SW F(2,835)
Immigr share	82.07	0.000	252.22	0.000	122.91
Ln (physical capital per employee)	23.14	0.000	64.24	0.000	31.31
Weak identification test					
Cragg-Donald Wald F statistic	238.27				
Kleibergen-Paap Wald rk F statistic	21.25				

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