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ORIGINAL PAPER

The race between the snail and the tortoise: skill premium and early industrialization in Italy (1861–1913)

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Abstract

In this paper, we estimate series of the skill premium for Italy during the early stages of the industrialization with a refined version of the regression approach originally introduced by Clark (J Polit Econ 113(6):1307–1340, 2005). We compute series for the whole country as well as separate series for macro-regions and for construction and manufacturing, and, within manufacturing, we estimate high and low skill premia for blue collars. We interpret the results with an extended version of the classic Katz and Autor (in: Ashenfelter, Card (eds) Handbook of labor economics, Elsevier, Dordrecht, pp 1463–1555, 1999) framework. The overall premium remained stable until the 1890s and then declined for the joint effect of migrations (almost exclusively of unskilled workers) and the rise in literacy, which was not compensated by the modest increase in industrial employment.

Keywords Human capital · Inequality · Labour markets · Skill premium · Technological progress · Wages

JEL Classification N33 · O14 · O15

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1 Introduction

The accumulation of human capital and "productive" skills is one of the salient features of the process of modern economic growth. In most general terms, human capital and skills provide three different contributions to production. First, skilled workers are likely to be more productive than unskilled ones, even when using the same equipment and raw materials. Second, skilled workers can operate more sophisticated technologies than their unskilled counterparts. Third, skilled workers are likely to be more innovative than unskilled ones. The crucial role played by the quality of the labour force has been highlighted by a recent interpretation of the British Industrial Revolution (Kelly et al. 2014). The emphasis on this issue has also rekindled the attention towards the drivers of skill accumulation such as the apprenticeship system (Humphries 2003; Wallis 2008; Zeev et al. 2017). Moreover, in his survey of the global economic history, Allen (2011) considers the creation of an effective system of "mass education" to speed the adoption and further development of modern industrial technologies as one of the four "pillars" of the "standard model" of industrialization adopted by Western countries.[1]

The returns to investment in human capital depend on the interaction between the supply and demand of skills (Katz and Autor 1999). The higher demand for human capital relative to its supply, the higher its returns that can be measured by the ratio of wages of skilled versus unskilled workers, or of workers with different levels of skill. The demand for skilled workers depends on technical progress, the supply on the development of education, at different levels. Thus, the interaction between demand and supply has been famously characterized as a "race" between education and technology in the title of the seminal book by Goldin and Katz (2008) on the USA during the twentieth century. The changes in skill premium measure the outcome of the race and determine the level of inequality. Kuznets (1955) argued that the structural change from low-productivity sectors (such as traditional agriculture) towards high-productivity sectors (manufacturing) first increases and then decreases inequality, displaying an inverted U-shape form, a pattern which was subsequently referred to as "Kuznets' curve". An increase in the skill premium would worsen the rise of inequality in the early phase and slow down, or reverse the decline, in the second phase. A decrease would reduce the initial rise and fasten the decline. Milanovic (2016: 46–56) has recently extended this idea by putting forward the conjecture of the existence of repeated cycles of inequality (Kuznets waves) since the Industrial Revolution.[2]

The literature on skill-biased technical change as a possible determinant of the recent growth in inequality is extensive. On the other hand, there are series of skill

[1] The other pillars of Allen's standard model are the construction of a national transport infrastructure for creating a large national market, an external tariff for protecting "infant" industries, and the establishment of banks to stabilize the currency and provide business with capital.

[2] Milanovic (2016) acknowledges the possible existence of Kuznets waves of inequality also in preindustrial societies, but their nature is fundamentally different from those taking place after the Industrial Revolution.

premium since the early modern period covering different countries and regions, allowing a global perspective over the period 1500–1800 (Van Zanden 2009). In contrast, the literature on the dynamics of the skill premium during the early stages of modern economic growth is surprisingly thin. As far as we know, there are only four comparative studies (Anderson 2001; Betrán and Pons 2004, 2013; Prado 2010) and some country-specific analyses for the USA (Williamson and Lindert 1980; Goldin and Katz 2008; Lindert and Williamson 2016) and the UK (Williamson 1985; Betrán et al. 2010). Almost all these estimates rely on the simplest definition of skill premium as the excess wage for skilled workers, without any systematic distinction among different levels of skill and among different sectors. This neglect for the skill premium contrasts with the recent upsurge of interest in the long-run dynamics of personal income inequality. This has shifted the attention of scholars from functional income distribution to the distribution of personal or household income and correspondingly from data on factor returns to taxation data.[3] Moreover, another dimension of the skill premium is the gender wage gap since it concerns the abilities of the females to be able to use specific technologies. On this issue, there is a growing literature since the seminal work by Goldin (1995).[4]

This paper provides a reappraisal of the dynamics of the skill premium and its determinants during the early phases of the industrialization by estimating and interpreting series of skill premia in Italy during the so-called Liberal age that is from the unification of the country in 1861 to World War One. This was the period of the first phase of the industrialization of the Italian economy. In comparative perspective, Italy was a "latecomer" country, belonging to the "third wave" of industrialization roughly taking place in the second half of the XIX century (Gerschenkron 1962). In our research, we have collected about 14,500 observations of "typical" (rather than individual) wages, with information on sector, year, location, and occupation (and thus level of skill) from a wide range of mostly official sources. Our sample covers fairly well the primary and secondary sectors in most Italian regions, especially the most advanced ones, but it is rather unbalanced in terms of number of observations per year and omits services altogether. In this context, simple averaging could result in biased estimates. Thus, we adopt the regression approach pioneered by Clark (2005) in his work on English wages from 1200 to 1914. We estimate wage series for skilled and unskilled workers, controlling for sector, source, location, and gender, and compute the nation-wide premium as a ratio of the two.[5] Furthermore, we make two additional contributions. First, we weight the observations with the regional population from censuses in order to minimize the possible distortions from unbalanced regional coverage. Second, we estimate separate wage series by sector (construction and manufacturing), macro-region and also, for manufacturing only,

[3] For recent estimates of inequality in Italy during the Liberal age, see Amendola and Vecchi (2017).

[4] For an updated review, see Olivetti and Petrongolo (2016).

[5] There are two recent contributions on the evolution of Italian real wages in the period 1861–1913: Daniele and Malanima (2017) and Federico et al. (2019), but they are both focused on the divergence in living standard and economic performance between the north and the south, rather than on the dynamics of the skill premium in this historical phase.

by level of skill (high and low). In this way, we obtain different series of skill premia and provide a substantially more detailed view of trends and patterns. Finally, we sketch an interpretation of the dynamics of the premium, at both the aggregate and sectoral levels, using the simple supply/demand framework by Katz and Autor (1999), which we adapt to the historical circumstances of the Italian economy of the period.

The paper is organized as follows. Section 2 outlines our theoretical framework, Sect. 3 describes our sources, while Sect. 4 illustrates our methodology to estimate the skill premium. Section 5 presents our estimates of the Italian skill premium and gender wage gap and discusses their determinants also adopting an international comparative perspective. Sections 6 and 7 document sectoral and regional patterns, while Sect. 8 concludes also offering some methodological remarks for future research in the field.

2 The determinants of the skill premium: a simple interpretative framework

Our interpretative framework is based on Katz and Autor (1999). We assume three separate production factors: physical capital, "raw labour" (i.e. labour force before the acquisition of any human capital or skills), and human capital. We assume physical capital to be complementary to human capital and its supply to be elastic, thanks to the combination of foreign investments and import of machinery. Each worker is endowed with raw labour and thus earns the corresponding return—which is equal to the wage for unskilled workers. Some workers are endowed also with human capital and earn its return, the skill premium. Human capital includes basic education, which can be acquired by attending primary schools, and/or complementary sector-specific skills, which can be acquired via sector-specific technical education, learning by doing, or on-the-job training. The supply of formal education is exogenously determined by investments in schooling, while on-the-job training and learning by doing are endogenous: labour demand from skill-biased technical change creates its own supply with a time-lag. Thus, skills are sector-specific, while raw labour (i.e. unskilled workers) is perfectly mobile across sectors. Returns to both factors are determined in nationally integrated markets.

Following Katz and Autor (1999), we represent the market equilibrium using relative supply and demand curves for skilled labour (Fig. 1a). The vertical axis displays the ratio between skilled and unskilled wages (skill premium) and the horizontal axis the ratio between the numbers of skilled and unskilled workers. The demand curve is negatively sloped: the higher the skill premium is, the fewer skilled workers firms hire. The supply curve instead is vertical because in the short run the share of skilled workers is given. In this model, the demand curve can shift because of factor biased technical change within each sector and/or structural change (Kuznets'

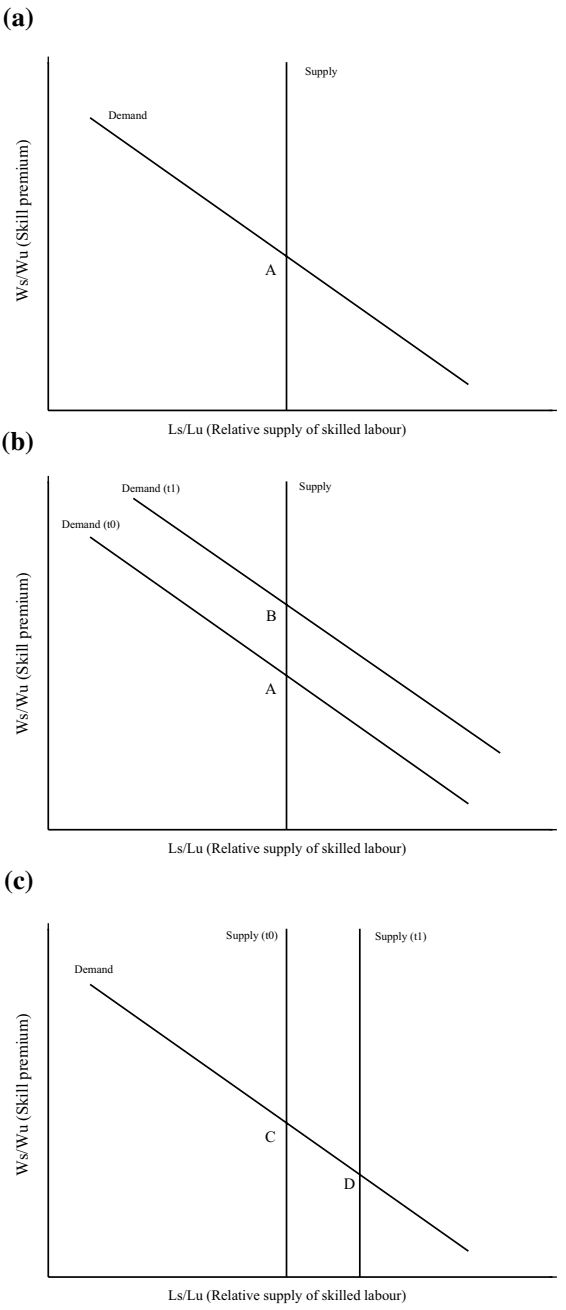

Fig. 1 **a** Simple competitive market equilibrium. **b** Skill-biased technical change. **c** Expansion of education

point).[6] Skill-biased technical change or a shift towards more skill-intensive sectors will shift the demand curve upwards, increasing the premium (Fig. 1b, movement from A to B) and vice versa. An increase in education would shift the supply curve to the right, decreasing the premium (Fig. 1c, movement from C to D) and vice versa. The race between education and technology implies a shift of both demand and supply, and thus, the outcome cannot be determined a priori.

Taking into account the Italian historical context, we develop the model considering: (1) the effects of migrations; (2) the effects of the labour movement, and (3) the delays in the accumulation of human capital via on-the-job training or learning by doing. The effects of migrations depend on the average skill of emigrants relative to the whole population: positive (negative) selection would increase (decrease) the skill premium. A successful collective action of workers could create rents, which would cause the skill premium to diverge from the level prevailing in competitive labour markets. The actual premium is higher (lower) than the competitive one, if the degree of mobilization of skilled workers is greater (smaller) than that of unskilled workers. In our framework, on-the-job training has no long-run effect because it is endogenous—firms give additional skills to their workers when needed. However, an increase in total demand of skilled labour, from some innovation or from a sudden expansion of a sector, can cause a temporary shortage of skilled workers. This would raise the skill premium, until a sufficient number of skilled workers necessary to return to the long-run equilibrium can be trained.

Using a simple linear formulation, the relative demand of skilled workers is given by (Eq. 1):

$$\frac{w_{\mathrm{s}}}{w_{\mathrm{u}}} = A - B \cdot \frac{L_{\mathrm{s}}}{L_{\mathrm{u}}} + C. \tag{1}$$

In the formula, the parameter A is capturing the shifts of the demand curve due to technical change (with $A>0$ we have skilled biased technical change and with $A<0$ we have unskilled biased technical change). The parameter C, instead, is meant to capture the effect of trade unionism. With $C=0$, the trade unions have no effect and the perfectly competitive labour market wage prevails, with $C>0$, trade unions' activity favours skilled workers, and with $C<0$, trade unions' activity favours unskilled workers. Correspondingly, the relative supply of skilled labour is assumed to be perfectly inelastic (Eq. 2a):

$$\frac{L_{\mathrm{s}}}{L_{\mathrm{u}}} = F(\mathrm{NI}, \mathrm{NM}, E) \tag{2a}$$

where NI is the natural increase in population, NM is the net migration, and E is education. This latter is always positive, while the effect of migration is positive if migrants are mostly unskilled (and vice versa). The natural increase affects labour

[6] In this framework, globalization would affect the skill bias via the effects on skill intensity and composition of VA by sector. This may include a change in exports towards more skill-intensive products, but this is not strictly necessary.

force, ceteris paribus, with a lag depending on legislation and family choices about child labour, education, and retirement. More specifically, we assume that the relative supply curve can shift because of the natural movement of population (J), the effects of migrations (K)—with $K>0$ migrants are mostly unskilled, while with $K<0$ migrants are mostly skilled—and education (L). In the model, the expansion of education is represented by $L>0$ (Eq. 2b):

$$\frac{L_s}{L_u} = J + K + L. \tag{2b}$$

In this perspective, the evolution of the skill premium in the long run is clearly the outcome of several interacting forces. With the available data, we can precisely assess only few of them. In particular, the rate and the factor bias of technical change can be inferred only as a residual. However, even without a full-fledged econometric testing, it is possible to put forward some plausible conjectures with the available evidence, starting from the basic distinction between short- and long-run determinants. Technical progress, structural change, and education are likely to exert their impact gradually and over prolonged periods of time, while factors such as emigration and labour mobilization have the potential of determining sharp variations in the skill premium.

3 Sources

We have retrieved most of our wages data from three official sources, namely the yearly *Annuario Statistico Italiano* (ASI ad annum), an enquiry on wage paid by the state for public works (MAIC-DGS n.d.), and the monthly *Bollettino dell'Ufficio del Lavoro* (MAIC ad annum). The *Annuario* reports data on manufacturing workers, mostly from specific firms, over the whole period 1859–1913. The enquiry collects data on wages paid for public works in the construction sector in all Italian provinces (but Parma) from 1862 to 1878. The *Bollettino dell'Ufficio del Lavoro* published data on agricultural wages by task for all Italian provinces from 1905 onwards, plus scattered (but rich) information on industrial wages on specific sectors and locations.[7] We have supplemented these main sources with information from other official and semi-official sources and all secondary sources on wages that to the best of our knowledge are available. Among them, the enquiry of the *Società Umanitaria* (1907), a Milanese philanthropic institution founded in 1893, deserves a special mention providing many information on wages and occupations, for all industrial workers in Milan in 1903. Table 5 in "Appendix 1" documents the distribution of observations by sources.[8]

[7] We have estimated provincial series of daily wages in agriculture from these data with information on the number of days for each task in the crop year from technical sources (for details, see Federico et al. 2019).

[8] A complete list of the sources is provided in "Appendix 2".

We have classified each observation according to the occupational title as reported in the source documenting more than 300 different jobs. We define as unskilled any worker performing basic manual labour with very little or no training at all. This is consistent with the *Historical International Standard Classification of Occupation* (HISCO), which defines unskilled occupations as those requiring less than 30 days of training (Van Leeuwen, Maas and Miles 2002). We consider as unskilled all agricultural workers, even if their training did need more than 30 days, because the seasonality of agriculture prevented any specialization (Clark 2005; Federico et al. 2019). There were no specialized ploughers, harvesters, and so on, who could earn a skill premium over unskilled labourers because they would have been unemployed for most of the year. Therefore, the skill premium was zero within the sector, while agricultural skills were useless outside agriculture. In other words, when employed in other sectors, agricultural workers could, at least initially, earn only the unskilled wage. This implies that, in the terms of our model, industrialization, *ceteris paribus*, shifted rightwards the relative demand of skilled labour. We classify as skilled any worker who could perform tasks with a modicum degree of complexity. In the construction sector, we consider navvies as unskilled and masons as skilled. In manufacturing, we consider as skilled all workers using any type of industrial machinery, even of a relatively unsophisticated type.[9] This broad definition is likely to conceal the wide heterogeneity of skills in manufacturing.[10] Thus, for the latter sector, we distinguish two further levels of skill, low and high, again allocating workers according to the description of their jobs and taking into account the definitions of the HISCO classification. Thus, following these criteria, we have defined as low skilled those occupations which did not require formal technical education nor a long period of on-the-job training. In contrast, high-skilled jobs required formal technical education or very long (at least three years) on-the-job training.[11] We consider both male and female workers, with female wages accounting for about 27% of total observations.

Figure 2 shows the distribution of observations over time. About 40% of them refer to the initial period (1859–1878) and approximately 46.5% to the last years (1901–1913), with a peak in 1904 as the first issues of the *Bollettino dell'Ufficio del Lavoro* provide a large number of industrial wages. In contrast, data are fairly scarce for the period 1879–1901, as already pointed out by Federico et al. (2019). In this paper, we have made a further effort to improve the coverage for this period, but the results are not entirely satisfactory. In any case, our estimation procedures (Sect. 4) can deal with some biases of the sample.

[9] We omit workers with some managerial roles, most notably the "capomastri" in construction sector, since their skills are not strictly related to the ability of performing specific production tasks.

[10] A simple measure of this variety is the cross-sectional coefficient of variation of wages by year, which is the more meaningful the larger is the number of observations (we have only eight years with more than 100 observations). The coefficient, for males only, is very high in the early period (0.52 in 1859, 0.47 in 1866, 0.45 in 1874) and then drops to about 0.30 in the 1900s (0.26 in 1903, 0.29 in 1904, 0.30 in 1906 and 1907 and 0.27 in 1911).

[11] In "Appendix 1" (Tables 6, 7, and 8), we present the lists of the most common occupations for each skill category.

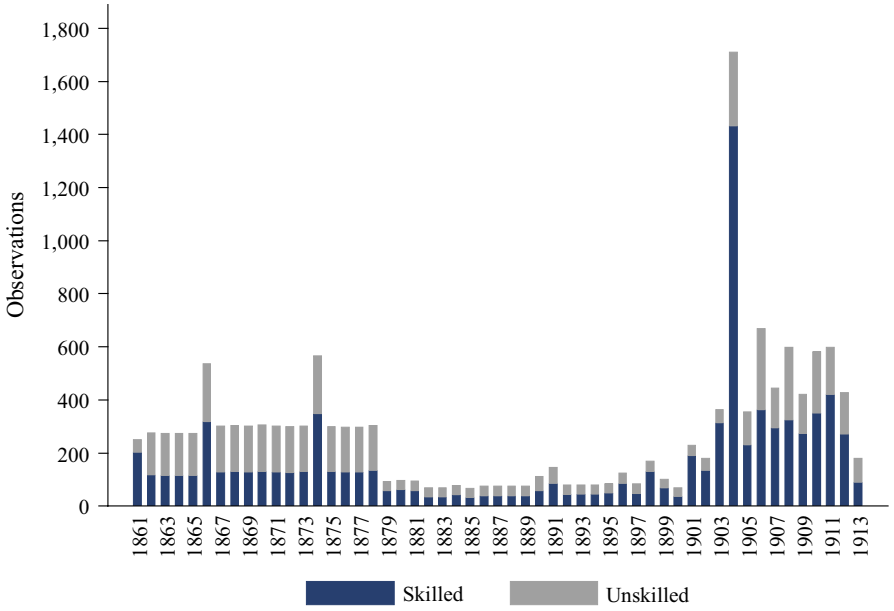

Fig. 2 Observations distribution by years and skill levels

The distribution of observations by skill level is fairly balanced in the initial years, while in the last period the majority refers to skilled workers' wages. This shift is broadly consistent with the slow growth of industrial employment, but the lack of data on the distribution of skills in economy-wide sources such as the censuses makes impossible to speculate to what extent the change in our sample captures shifts in the composition of the Italian workforce. Figures 15 and 16 in "Appendix 1" show the distribution of observations between the two levels of skills in manufacturing and across regions. It is worth noting that there is a major coverage of the northern regions: the north-western area accounts for almost 40% of the observations, the north-east-centre for 37%, while the south provides 23% of the data. Lombardy is the region with most observations in the north (3187), Sicily in the south (980), while the least populated regions, such as Basilicata and Umbria, have relatively fewer observations. Overall, if we consider a disaggregation in three broad macro-areas (north-west, north-east-centre, and south), the sample appears reasonably balanced.

Concerning the sectoral distribution, relative to active population, the sample is characterized by an under-representation of agriculture and an over-representation of the construction sector.[12] Within the industrial sectors, there is a strong coverage of the textile industry (which was the most important sector in terms of the labour employment of the time). However, there is also a good coverage of both the heavy

[12] According to Giordano and Zollino (2015), agriculture accounted for 75.1% of total workforce excluding services in 1881 and 71.5% in 1911. See Sect. 5 for a more detailed analysis of economy-wide structural change.

industries of the First and Second Industrial Revolution which can be useful for the study of the impact of technological change on the demand of skills. Table 9 in "Appendix 1" contains a detailed breakdown of our sample by sector and gender.

4 Methods: estimating the skill premium with a regression approach

Our sample, while quantitatively large, is unbalanced, and thus, using simple averages (Betrán and Pons 2004, 2013) might yield biased results. Likewise, sector-specific series for construction or manufacturing (Anderson 2001) might not be representative of the whole economy. Thus, we adopt the regression approach pioneered by Clark (2005) in his reconstruction of real wages in England from 1200 to 1914. He estimates series of real wages as series of time dummies in a regression controlling for location and occupation. This "unweighted" regression addresses only partially the issue of the general "representativeness" of the sample. Thus, we add a further refinement in our baseline ("weighted") specification. We weight each observation by taking into account simultaneously the number of observations available in our sample at regional level and the population of the region in question in the same year, from the census, interpolating when necessary (MAIC).[13] Accordingly, we run the following weighted regression model (Eq. 3):

$$\ln\left(w_{\mathrm{p}}\right) = \alpha + \sum_{i=0}^{1}\sum_{j=1}^{J}\beta_{ij}SKILL_i PERIOD_j + \gamma GENDER + \sum_{k=1}^{K}\delta_k SECTOR_k + \sum_{l=1}^{L}\theta_l SOURCE_l + \sum_{m=1}^{M}\varphi_m LOC_m + \varepsilon_p \tag{3}$$

where w_{p} is the wage of the p-th observation; *SKILL* is a dummy which is equal to 1 if the worker is skilled and 0 otherwise; *PERIOD* is an indicator for each of three-year fixed intervals between 1861 and 1913 with, for example, 1870 including data between 1869 and 1871[14]; and the estimated coefficient β_{ij} on the interaction term *SKILLPERIOD* gives the time effect by skill conditional on a set of controls. In particular, *GENDER* is a dummy equalling one for female wage; *SECTOR*, *SOURCE*, and *LOC* are indicators for sector (4 sectors as shown in Table 9 in "Appendix 1"), source (5 sources as shown in Table 5 in "Appendix 1"), and location (the three macro-areas level dummies), respectively. The estimates are obtained by setting as baseline the unskilled male construction worker from the macro-area north-west. We obtain wage series of skilled and unskilled workers as the exponential of the sum of coefficient α and β_{ij}, and then, we compute the skill premium as the ratio of

[13] The weight on observation i (w_i) is given by the share of the region r in the national population in year t (sh_{rt}) divided by the number of observations of region r in year t (n_{rt}): $w_i = \frac{sh_{rt}}{n_{rt}}$.

[14] We use three-year periods in order to have enough observations for the regression model estimates with interaction (not for smoothing).

the two series. This model estimates skilled and unskilled workers' wages controlling for the average effect of gender, sector, and location. Therefore, in order to capture year to year variations in the gender wage gap and the sectoral and area-specific skill premia we use different specifications which include interaction terms between gender, sector, and location with time.[15]

Figure 3 compares our baseline model ("weighted") with the "unweighted" specification à la Clark and the simple average of skill premium. Additionally, as a further robustness check, we also include national series obtained as a weighted average of the "area-specific" and "sector-specific" estimates using as weights occupation and population data. The resulting nation-wide "sector-specific" and "area-specific" series are remarkably similar to our baseline even if constructed with different specifications, while the "unweighted" series shows some discrepancies. In contrast, the simple average of the skill premium shows an implausible decline from 1.94 in 1876 to 1.25 in 1882, which reflects the collapse in the number of observations occurring in that period (Fig. 2).

As a final robustness check, in Fig. 4 we compare the series of unskilled wages obtained from our "baseline" weighted specification with the series of unskilled wages constructed by Federico et al. (2019). Reassuringly, the series exhibit a very similar pattern, the correlation coefficient being equal to 0.97.[16] Furthermore, the regression-based series of unskilled wages is 20.8% higher, on average, than the Federico et al. (2019) series. This gap is likely to reflect differences in the underlying samples. The Federico et al. (2019) series mostly relies on wages of navvies (in the earlier period) and agricultural workers since the 1880s, with hardly any manufacturing wages. In contrast, the present series includes a sizeable number of urban workers, who might have received higher nominal wages to compensate the higher prices of food and the disamenities of cities.

[15] We estimate the following equations for the gender wage gap, the sectoral, and area-specific skill premia, respectively:

$$\ln\left(w_{\mathrm{p}}\right) = \alpha + \sum_{i=0}^{1}\sum_{j=1}^{J}\beta_{ij}GENDER_i PERIOD_j + \gamma SKILL + \sum_{k=1}^{K}\delta_k SECTOR_k + \sum_{l=1}^{L}\theta_l SOURCE_l + \sum_{m=1}^{M}\varphi_m LOC_m + \varepsilon_{\mathrm{p}}$$

$$\ln\left(w_{\mathrm{p}}\right) = \alpha + \sum_{i=0}^{1}\sum_{j=1}^{J}\sum_{k=1}^{K}\beta_{ijk}SKILL_i PERIOD_j SECTOR_k + \gamma GENDER + \sum_{l=1}^{L}\theta_l SOURCE_l + \sum_{m=1}^{M}\varphi_m LOC_m + \varepsilon_{\mathrm{p}}$$

$$\ln\left(w_{\mathrm{p}}\right) = \alpha + \sum_{i=0}^{1}\sum_{j=1}^{J}\sum_{m=1}^{M}\beta_{ijm}SKILL_i PERIOD_j LOC_m + \gamma GENDER + \sum_{k=1}^{K}\delta_k SECTOR_k + \sum_{l=1}^{L}\theta_l SOURCE_l + \varepsilon_{\mathrm{p}}$$

We interpret the results of these series in Sects. 5, 6, and 7.

[16] Unskilled wages in agriculture and the building industry followed a similar trend also in France between 1250 and 1860 (Ridolfi 2019).

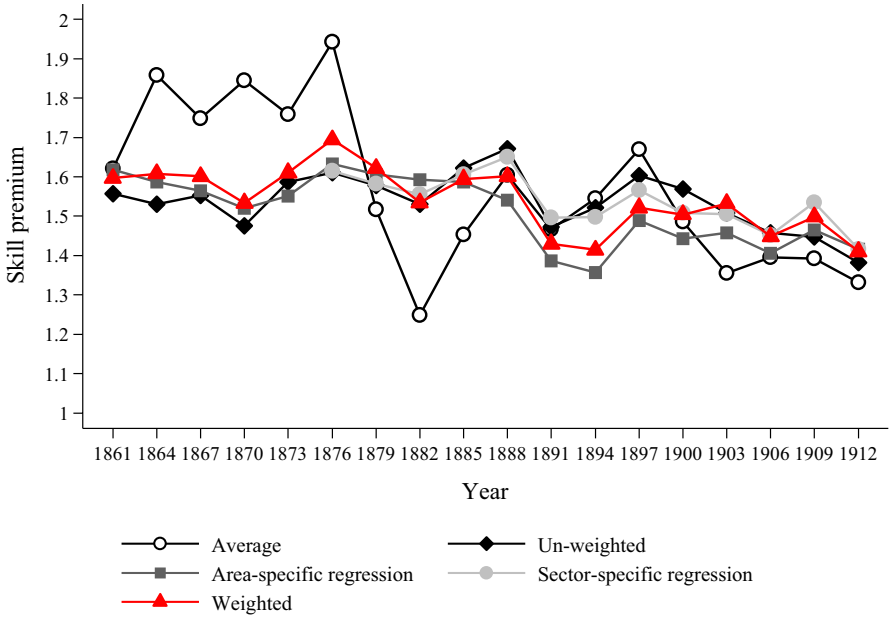

Fig. 3 Different methods of skill premium estimation. *Sources* Wages, this study. Regional shares in total population: our own elaboration on Census data. Occupational shares in agriculture, construction, manufacturing, and mining: Broadberry et al. (2013). Notes: the "sector-specific" estimate of the Italian skill premium starts in 1876 due to the lack of wage data for all sectors before that date

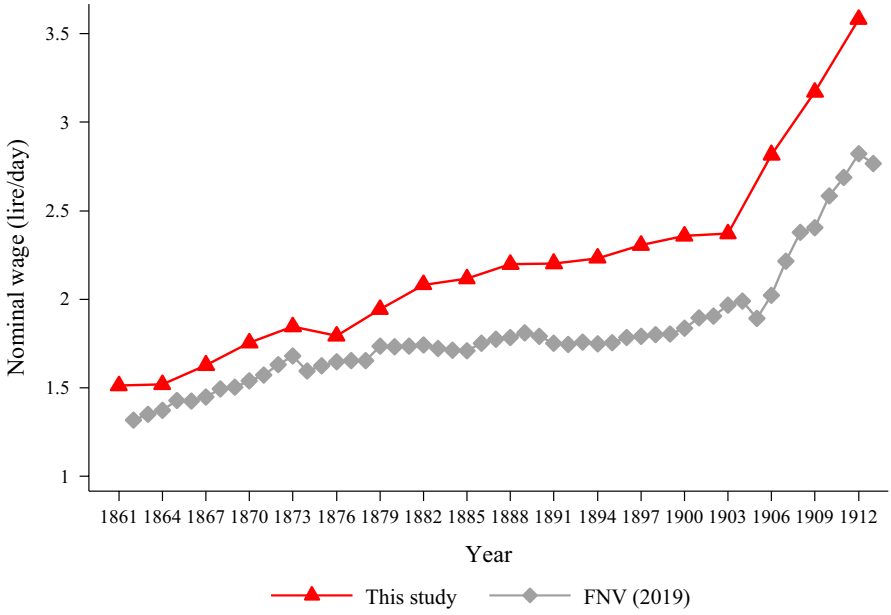

Fig. 4 Nominal wages of unskilled workers in Italy (1861–1913). *Sources* This study and Federico et al. (2019)

5 The dynamics of skill premium: an economy-wide perspective

As a first step, Fig. 5 compares our baseline estimate with the available economy-wide series of five European countries with different levels of industrialization (UK as a first comer, France as a second comer, Denmark, Sweden, and Switzerland as latecomers), and the USA (for a full description of each series, see "Appendix 1", Table 10).[17] It highlights a substantial difference between the USA and Europe.[18] In the USA, the skill premium always exceeded 1.7 throughout the period and grew substantially since the 1890s, up to 2 on the eve of World War One. In contrast, in Europe it ranged from 1.25 to 1.7 and was stable or slowly declining. The Italian skill premium was the second highest in Europe after the UK, and, thanks to the larger number of observations, the series shows a much more complex medium term pattern.

The Italian skill premium remained broadly stable until the late 1880s, declined sharply in the early 1890s, labelled as the "darkest years of the Italian economy" by Luzzatto (1968), rebounded through the mid-1890s and early 1900s and then declined somewhat until World War One. This pattern is the outcome of different trends in skilled and unskilled wages (Fig. 6). In addition, in order to provide a perspective on the progress of different categories of workers in real terms, Table 1 shows the growth rates of nominal wages of skilled and unskilled workers by subperiods and the dynamics of the cost of living index (Baffigi 2015). Until 1888, nominal (and real) wages increased in parallel, but the crisis hit much more skilled than unskilled workers, as real wages declined by 15.6% and 4.3%, respectively, in the three following years. By 1903, real wages of skilled workers were back to their late 1880s level, while unskilled wages were a little higher—so that the skill premium was about 5% lower than at its 1888 peak. The conditions of all workers improved dramatically thereafter, but unskilled ones benefitted slightly more: their real wages in 1912 were one-third higher than ten years earlier, while real wages of skilled workers increased by 25%.

Figures 5 and 6 refer to all workers. We will discuss sector- and area-specific trends in the next two sections, while Fig. 7 plots the gender wage gap. Unfortunately, the series omit services, which were a major source of employment for educated women. The gap in agriculture and industry remained remarkably stable throughout the period oscillating between 0.4 and 0.5 and rose to 0.55 in the pre-war years. This level of the gender wage gap is fully in line with the one emerging from the contributions of social historians.[19] In a longer broader perspective, this level seems to have been typical of Southern Europe during the early modern period (de

[17] For a useful overview of industrialization waves, see von Tunzelmann (1995) and for the industrialization in the periphery, see O'Rourke and Williamson (2017).

[18] According to Frankema and Van Waijenburg (2019), in the nineteenth century, skill premia in Africa and Asia were very high relative to Europe but with the growth in school attainment rates, these rapidly converged to the levels prevailing in Western European countries during the twentieth century.

[19] According to Ortaggi Cammarosano (1991, p. 181): "one of the most constant discrimination against women was their low level of wages. In agricultural as in industrial work, for work done at home as well as in the factory, women received half the wages for men for doing the same job. This ratio remained constant over many decades […]. It testified to the presence of custom and attitudes which went very far back in time".

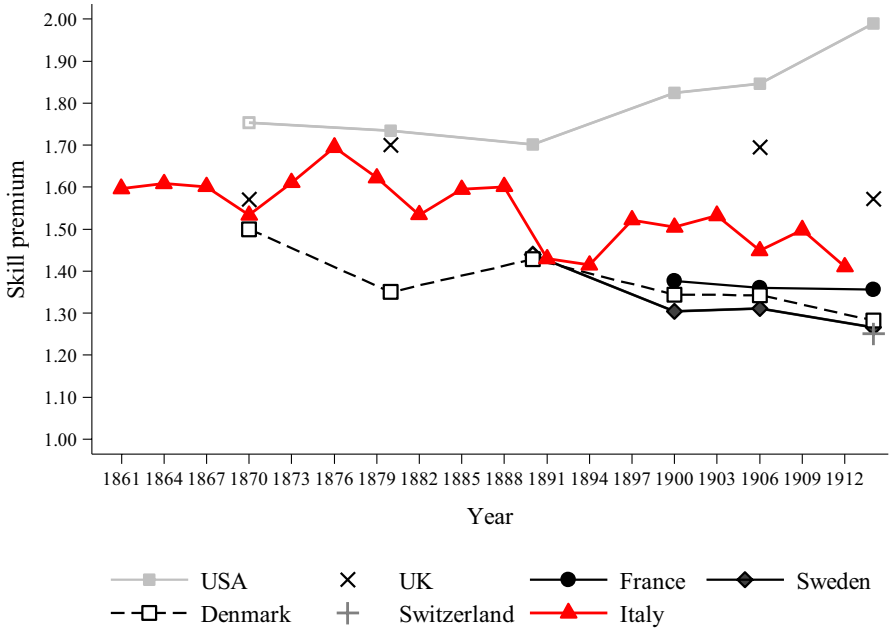

Fig. 5 Skill premium in international comparative perspective. *Sources* Italy, this study. Other countries, Betrán and Pons (2013). *Notes*: the French data are consistent with the benchmark estimates for 1896 and 1911 reported in Bayet (1997, Tab. 5, p. 169)

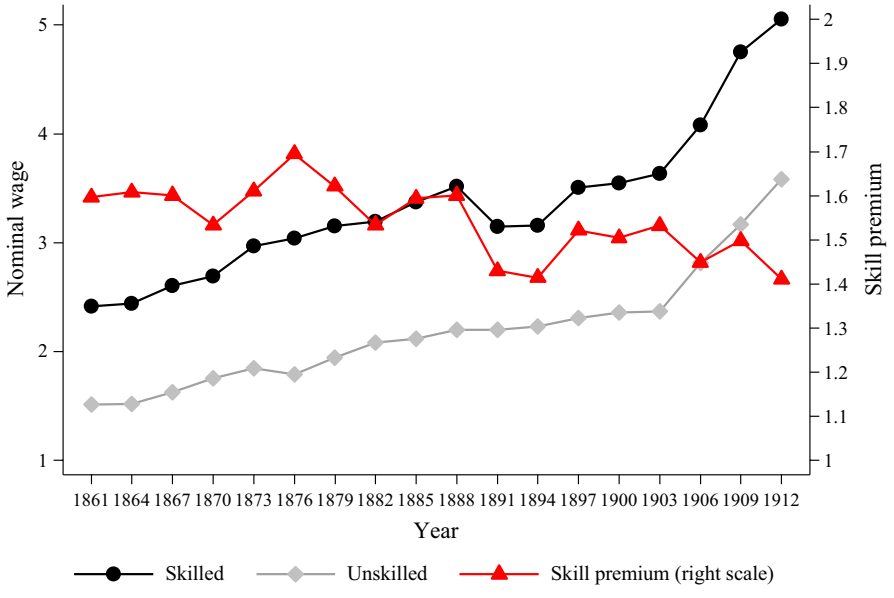

Fig. 6 Skill premium and nominal wages in Italy (1861–1913)

Table 1 Decomposition of the growth (percent) of the skill premium (1861–1913)

Period	Nominal wages skilled	Nominal wages unskilled	Skill premium	Cost of living index
1861–1888	**1.30**	1.29	0.01	0.26
1888–1903	0.21	**0.50**	−0.29	0.08
1903–1913	3.67	**4.59**	−0.92	1.15
1861–1913	1.37	**1.62**	−0.25	0.45

Bold values indicate the main driver of growth (skilled or unskilled wages) of the skill premium for various sub-periods

Sources See text. The cost of living index is retrieved from Baffigi (2015)

Notes The intervals refer to set of observations of three-year windows centred on the indicated years

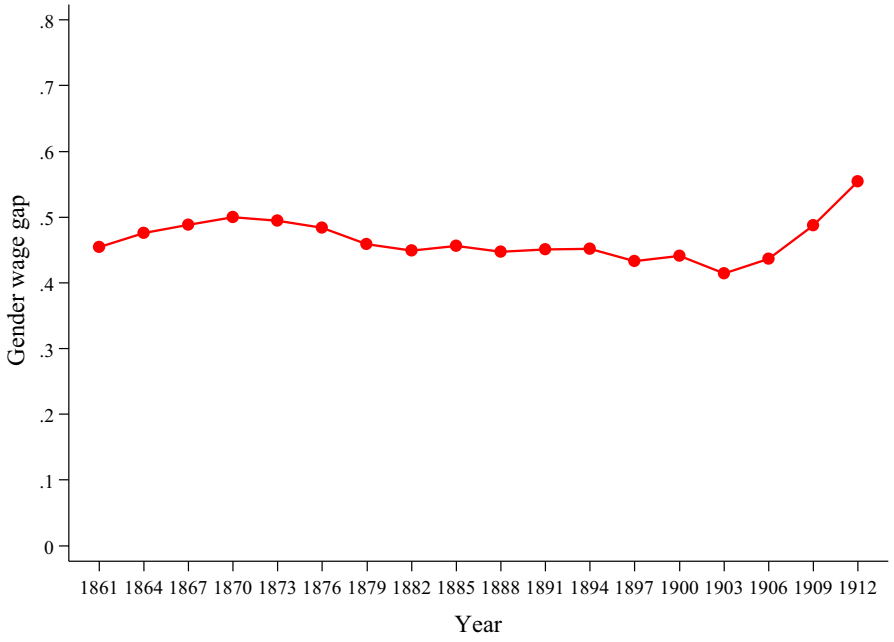

Fig. 7 Gender wage gap in Italy (1861–1913)

Pleijt and Van Zanden 2018), and it is not distant from the gender wage gap prevailing in the USA (Goldin 1990) and France (Bayet 1997) in the nineteenth century.

How can we explain the trends depicted in Figs. 6 and 7? Our estimates of the skill premium comprise only 18 year-points, with limited cross-sectional variations in terms of sectors or regions. This prevents us from exploring the determinants of the skill premium with an econometric analysis. Therefore, in the following, we shall sketch an interpretation of the dynamics of the skill premium by discussing the available evidence on the determinants of the skill premium according to our model. The four panels of Fig. 8 display the evidence concerning the historical evolution of

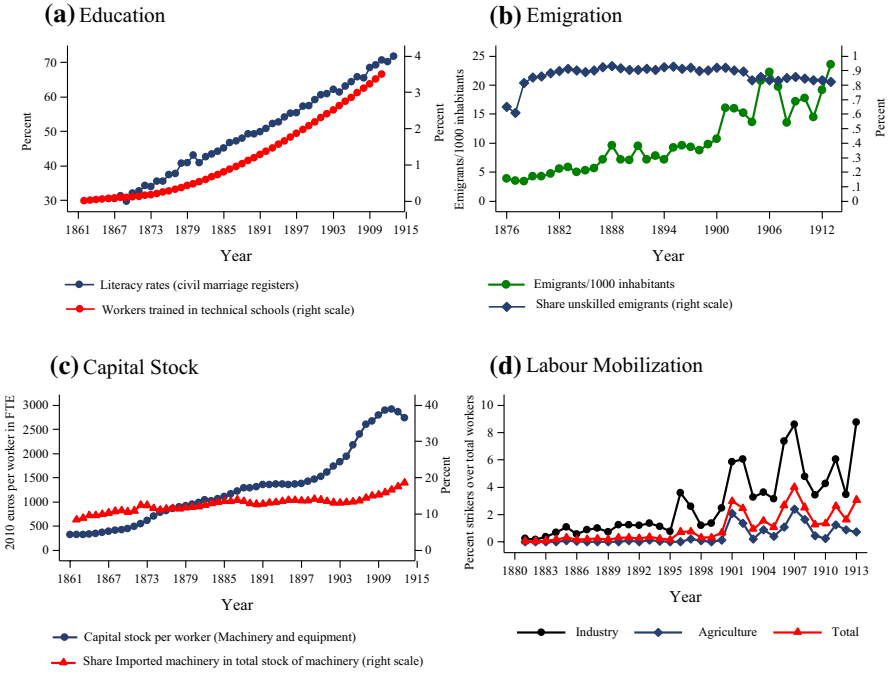

Fig. 8 Determinants of skill premium. *Sources* Education: literacy rates of brides and grooms from *Annuario Statistico Italiano*; Data on technical education from Vasta (1999). Population aged more than 15 years from ISTAT, *Statistiche storiche* online database. Intervening values have been interpolated linearly. The series labelled "workers trained in technical schools" represents the stock of workers trained in technical schools (*Istituti tecnici* and *Scuole di arti e mestieri)* computed on the population aged 15 years or more assuming 40-year work-life after the end of the education. Migration: Migration data from ISTAT, *Annuario statistico dell'emigrazione italiana* (1926) tables I and VII (unskilled includes farmers (agricoltori) and unskilled workers (terraioli, braccianti); Population, current boundaries, from ISTAT, *Statistiche storiche,* online database. Capital stock: Machinery and equipment from Broadberry et al. (2013). Strikes: *Annuario Statistico Italiano* (1905–1907; 1911–1914)

education (a), emigration (b), capital stock (c), and labour mobilization (d) over the period 1861–1913. We shall discuss each of them in turn.

5.1 Education

The Italian education system provided blue collar workers with two different levels of skills. Primary schooling taught them basic skills, such as the capacity to read and perform simple computations, while technical education provided more advanced skills required for the use of tools or machinery. However, a formal apprenticeship system was virtually non-existent in this period. We will deal with technical education in the next section, while here we focus on primary education. Before Italian unification, primary education had been mainly supplied by the Church or private schools and literacy was correspondingly low (Ciccarelli and Weisdorf 2018). In 1859, the Kingdom of Sardinia (i.e. Piedmont) approved a law (no. 3725/1859,

known as Casati Law) establishing a compulsory two-year education, which was then extended to all other areas that became part of the new Kingdom of Italy (De Fort 1996). The law stipulated that schools had to be funded by municipalities and thus enrolment increased only very slowly, especially in the south (Cappelli and Vasta 2020). In 1860, only 48% of males and 29% of females of the relevant cohort were enrolled in primary school (Lee and Lee 2016). By 1910, the enrolment rates were 81% for males and 77% for females. In contrast, almost all children in the USA, the UK, and France were enrolled over the same years. Thus, despite growing literacy rates, Italy was still clearly lagging behind advanced countries by the end of the period. Table 11 in "Appendix 1" provides an overview of the evolution of literacy rates in a sample of Western countries for the period in question.

Typically, literacy rates are retrieved from Italian population censuses, which were taken every ten years with the exception of the 1891 census which was cancelled for state budget problems. In order to have a more fine-grained perspective, in panel (a) of Fig. 8 we proxy the yearly change in literacy with the series of the share of brides and grooms who signed the marriage register, instead of using the "traditional" censuses data. The series proxies literacy of workers in their prime age and shows a steady increase, with a remarkable convergence between genders.[20] The ratio between literacy of females and males, or gender parity index (GPI), passed from 0.54 in 1870 to 0.85 in 1913, while the GPI for the population more than 6 years old increased from 0.45 in 1871 to 0.78 in 1911, still remaining lower than in other advanced European countries (Cappelli and Vasta 2018). The relative increase in the supply of literate females was bound to narrow down the gender wage gap, ceteris paribus. There are several possible reasons for the prolonged stability in the gender wage gap (Fig. 7), such as the omission of service sector, which employed a large number of literate women, and perhaps the persistence of gender discrimination in labour markets (Ortaggi Cammarosano 1991).

5.2 Migration

Italians had always migrated abroad, but the number rose significantly over time passing from about 4 per thousands in the 1870s to about 10 in the 1890s and then jumping to almost 20 in the early twentieth century, with peaks slightly lower than 25 in 1906 and 1913 (Fig. 8, panel (b)). Over 80% of emigrants were males, and the share of the category "*condizioni non professionali*" (not in the workforce) was negligible until the mid-1900s rising to about 5% of the total on the eve of World War One.[21]

The effect of this outflow of workforce on the skill premium depended on the skill level of emigrants relative to the total population. The Italian migration statistics

[20] The average age at marriage (1865–1913) was 29 years and 6 months for men and 25 years and 4 months for women (*seriestoriche.istat.it*, Table 3.6).

[21] This increase suggests a change in the nature of Italian emigration. Until the end of the twentieth century, Italian emigrants were almost exclusively males looking for jobs. Subsequently, some of these emigrants started to settle abroad and they were reached by their families. Thus, the "not in workforce" category includes chiefly housewives and small children. The share is indeed lower than emigrants younger than 15 years.

(ISTAT 1926) are quite detailed, but do not report any information about the skill level of migrants. We proxy the share of unskilled emigrants with the sum of "*agricoltori*" (farmers—i.e. sharecroppers, tenants and so on) and "*terraioli e braccianti*" (i.e. agricultural workers and unskilled construction workers) in the total of migrant workers. They accounted for about nine-tenths of the total until the early 1900s, for about four-fifths afterwards, and for 87% of all migrated workers over the whole period.[22] These figures are likely to underestimate the actual share, as we assume that all migrants from manufacturing and services were skilled.

We estimate the effect of migration on wages for skilled and unskilled workers (and thus on the skill premium) in 1912 following the partial equilibrium approach by Taylor and Williamson (1997). We compute the counterfactual wages, assuming no emigration as (Eq. 4):

$$w^* = \eta^{-1} L^* \tag{4}$$

where L^* is the increase in labour supply without emigration and η is the elasticity of labour demand to wages, which Taylor and Williamson (1997) show to be (Eq. 5):

$$\eta^{-1} = -\sigma^{-1}(1-\theta) \tag{5}$$

where σ is the elasticity of substitution of the production function and θ is the labour share in total income. We estimate the percentage increase in labour supply L^* and the labour shares in 1911 separately for skilled and unskilled workers. The increase in supply is the ratio of the number of emigrants since 1876 (long-run effect), or since 1903 (short run effect), to an estimate of the workforce from the 1911 population census (see "Appendix 3" for details). Without migration since 1876, in 1912 wages would have been 13.4% lower for skilled and 43.9% for unskilled workers than our estimate, and the skill premium in 1912 would have been 39% higher—i.e. higher than the American one. This finding contradicts the interpretation proposed by Sori in his work on Italian emigration (1979, pp. 169–173), arguing that migration did not have any substantial and long-lasting equalizing effect on wages. Furthermore, the mostly male migration should have narrowed the gender wage gap if female workers were substitute for male unskilled workers. This effect might explain the modest reduction of the gender wage gap since 1903 (Fig. 7).

5.3 Technical change

Unfortunately, we do not have a direct measure of the skill bias of technical change. However, the available evidence suggests that Italy was not particularly innovative in this period. A possible indicator of national innovative capabilities is the number of patents granted to Italian residents in the USA.[23] These increased from 0.1 per

[22] Using height data, Spitzer and Zimran (2018) have shown that Italian migration in the USA was negatively selected at the national level, but positively selected at the provincial level.

[23] See also Nuvolari and Vasta (2017) for an analysis of the spatial patterns of inventive activity in Italy in the period 1861–1913 using patent data.

million inhabitants in the 1880s to 1.6 on the eve of World War One. However, by the end of the period they were still a small fraction of the British (21.7) and German (20.7) ones (Nuvolari and Vasta 2015, Fig. 4). Italy was really at the frontier only in a niche market as the production of silk-reeling machinery (Federico 2009). The conventional wisdom also suggests that Italy imported technology from abroad and/or imitated foreign technologies (machinery and equipment) choosing those that were not too demanding in terms of skill requirements and coal intensity, adapting in this way to the country factor endowment (Giannetti 1998; Bardini 1997; Cohen and Federico 2001; Nuvolari and Vasta 2015). In real terms, the imports of machinery increased 24 times between 1870 and the peak of 1908 (Federico et al. 2011).[24] This measures a flow, but the demand for skilled labour should be positively related to the stock of machinery. The available series measures the capital stock in machinery and equipment, excluding means of transportation, for the whole Italian economy, including agriculture and services (Giordano and Zollino 2015). Thus, we compute capital stock per worker (Fig. 8, panel c) dividing the stock of machinery by the number of workers in full time equivalent from the same source. The capital stock per worker increased steadily but slowly in the decades after unification, grew rather fast in the 1880s, stagnated in the 1890s and then boomed until the early pre-War years. The pre-War rise coincided with an increase in the share of imported machinery in the total stock, which can be considered as a crude measure of the deployment of more advanced technology.[25] This movement suggests a substantial acceleration of the growth in demand for skilled workers in this final period.

5.4 Structural change

The early stages of Italian industrialization caused a limited shift of the labour force from agriculture to industry since the mid-1890s. According to Broadberry, Giordano and Zollino (2013), the share of employment in industry in full time equivalent (FTE) over the total economy was fluctuating around 17% until the mid-1890s and grew up to 22.3% in 1913. These figures are likely to underestimate the number of skilled workers in the whole economy, as they assume that services employed no skilled workers (which is impossible), or that their omission is compensated by the misclassification of an equal number of unskilled workers in industry (which is highly implausible). The share of employment in industry plus services in the total economy, which surely overestimates the number of skilled workers, increased somewhat less, from 36.8% in 1861 to 39% in 1891 and 44.6% in 1913. We estimate the impact of structural change by computing the level of the skill premium in 1912, under the assumption of constant shares of employment in agriculture, industry, and construction on their aggregate. As expected, structural change increased the skill premium, *ceteris paribus*, but the effect is rather small. The premium in 1912 would

[24] For a description of Italian trade database, see Federico and Vasta (2015).

[25] We compute cumulating imports under the assumption of 17-year life-cycle (from Giordano and Zollino 2015). Accordingly, the initial imported capital stock in 1862 is assumed 85 million lire—equivalent to 17 times the import value of that year.

have been 5.9% lower if the shares had remained constant since 1861, 6.4% lower if they had remained constant since 1888, and 3.5% lower if they had remained constant since 1903. This exercise, by definition, neglects the effects of changes within manufacturing, which would increase further the skill premium, if, as likely, it was higher in "modern" sectors such as engineering or chemical industry, than in more traditional ones, such as food processing or textiles. However, the effect is likely to be small because the "modern sectors" increased slowly from 10% of industrial employment in 1871 to about 13% in 1881, 16.8% in 1901, and 21.2% in 1912.[26]

5.5 Labour mobilization

Betrán and Pons (2013) argue that labour mobilization has been a major determinant of the skill premium. In their cross-country regression exercise, strikes turn out as negatively correlated with the skill premium and tend to favour unskilled workers. Their work is not strictly comparable to ours, as they consider a longer time period and several countries. However, the labour movement was progressively increasing its strength also in Italy.[27] The share of strikers in the workforce increased dramatically since the turn of the century, with major peaks in 1901, 1907, and, especially 1913 (Fig. 8, panel (d)), when mobilisation involved about one-tenth of industrial workers (384,000 out of 4.2 million, including construction).[28]

Not all strikes affected the level of wages and thus the skill premium. Some strikes were motivated by reasons other than salary such as better working conditions and the reduction of work-time. Furthermore, strikes for pay rises often failed.[29] According to the Italian statistics, only two-fifths of all strikes in the period 1901–1913 was wage-related, and only a third of them (i.e. 15% of all strikes) was completely or partially successful. (A detailed breakdown of the type of strikes and their outcomes is provided in Table 12 in "Appendix 1".)

The strike evidence also points to an asymmetry between sectors. Successful salary-motivated strikes in agriculture increased wages of unskilled workers throughout

[26] Advanced industry includes metal-making, engineering, chemicals, printing and publishing, rubber and plastics, and utilities. The denominator is the sum of manufacturing and utilities. Data for 1871 come from Ciccarelli and Missiaia (2013, Table C.1), who reproduce the census figures without correction. Data for 1881, 1901, and 1911 are taken from Vitali (1970, Table 3), who adjusts for different minimum ages but not for the inconsistent treatment of women employment. The 1881 census classified as workers all females who were employed part time at home, while the other censuses included only full-time workers (Mancini 2018). The effect was particularly large in textile industries in the south. Thus, we correct by extrapolating backwards the number of females in 1901 with the rate of change of male employment from 1881 to 1901.

[27] Strikes were formally illegal until 1889 and, around 1900, government declared itself neutral in capital/labour conflicts. The first major general strike took place only in 1904 (Lay et al. 1973; Berra and Revelli 1978).

[28] The number of strikers in agriculture peaked in 1907 (254,000).

[29] Note that, potentially, strikes on hours might increase wages, if they achieved a cut in hours worked with the same salary. We neglect this issue as all our data refer to days of work rather than hours. The following discussion refers to the number of strikes, which is the only information about motivation and outcome available in the source. We have to implicitly assume that the average number of strikers was equal.

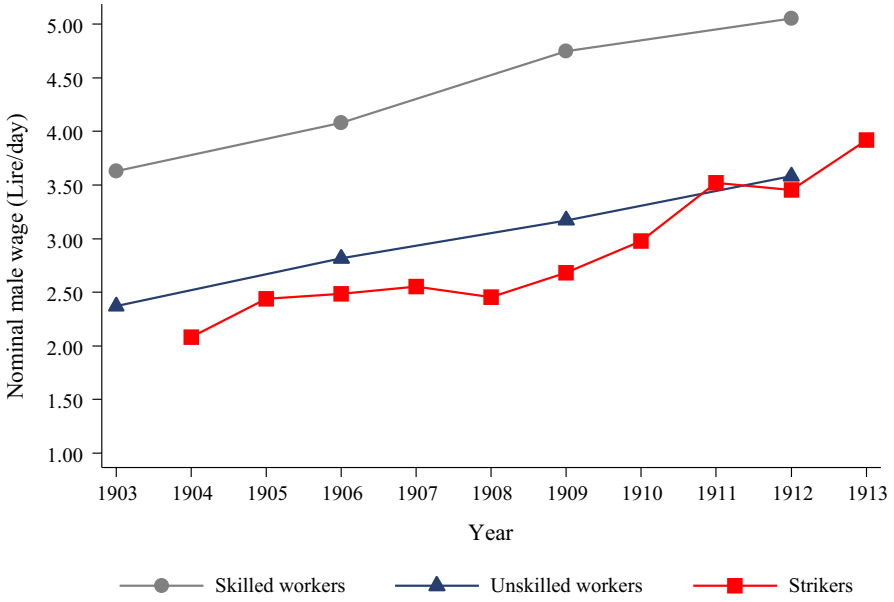

Fig. 9 Wages of strikers in industry in Italy (1903–1913). *Sources* MAIC—*Statistica degli Scioperi* (1907, 1908, 1911, 1912a, 1912b, 1913, 1914, 1915, 1916). *Notes:* The source reports the total wage bill lost by strikers and the total days of strike. Wages of different type of male workers have been computed using the share of male strikers reported in the *Statistica degli Scioperi* of 1913 (MAIC—*Statistica degli Scioperi* 1916) and the gender wage gap estimated in Fig. 7

the whole economy and thus decreased the skill premium, *ceteris paribus*. Strikes in agriculture accounted for about one-quarter of the total. The effect of successful salary-motivated strikes in construction and industry depends on the skill of strikers: they would decrease (increase) the skill premium if strikers were predominantly unskilled (skilled) workers. The statistics do not provide systematic information on the skill level of strikers, but they do report their average wage, unfortunately without distinguishing strikes by motivations and outcomes. The average wage of male strikers in industry and construction was close to our wage estimate for unskilled workers (Fig. 9).[30] This implies that, as argued by Berra and Revelli (1978), labour mobilization was dominated by the claims of unskilled workers.

5.6 Our interpretation

We sum up our interpretation of the determinants of the skill premium in Table 2. An upward (downward) arrow indicates that the factor was determining an increase

[30] We have estimated the wage of male strikers using the following formula: $w_s = a \cdot w_{sm} + (1-a) \cdot b \cdot w_{sf}$, where w_s is the average wage of strikers, a is the share of male strikers, b is the gender wage gap, and w_{sm} and w_{sf} are the wages of male and female strikers, respectively. This formula yields: $w_{sm} = w_s/[a + (1-a) \cdot b]$. The share a is taken from MAIC—*Statistica degli scioperi* (1916); this share is obtained by interpolating the values between 1903 and 1913. The gender wage gap is taken from Fig. 7.

Table 2 Determinants of the skill premium, Italy (1861–1913): a tentative interpretation

	1861–1888	1888–1903	1903–1912
Annual growth rate of skill premium (percent)	0.01	− 0.29	− 0.92
Supply factors			
Education	↓	↓	↓
Emigration	=	↓	↓ ↓
Demand factors			
Structural change	=	↑	↑
Technical change	↑	=	↑
Labour mobilization	=	?	↓

(decrease) in the skill premium, while a "=" indicates that the factor changed too little to affect the skill premium. In the first phase (1861–1888), when the skill premium was stable (0.01% increase per year), there was very little emigration, no labour mobilization, and structural change had a negligible negative effect on the skill premium (an annual decrease of 0.04%). The slow diffusion of primary education reduced the skill premium, and thus, its impact must have been compensated by the increase in demand from the growth of capital stock (technical change), especially in the 1880s. In Table 2, for consistency with the two other periods, we interpret the decline (−0.29% per year) in the skill premium from 1888 to 1903 as the result of long-term trends. The capital stock remained constant and structural change increased the premium (by 0.2% per year), which, however, declined for the joint effect of growth in literacy and the start of emigration. However, a look at the movements of the premium (Fig. 6) suggests an alternative interpretation. Indeed, the change from 1888 to 1903 could be the outcome of a downward shock to employment in advanced sectors, followed by a partial return to the equilibrium in the late 1890s. After 1903, the decline of the skill premium (−0.92% per year) can be interpreted as the outcome of a very strong downward effect of migration, supplemented by labour mobilization and the further increase in literacy. In this phase, structural change accelerated (to 0.4% yearly), but its cumulated effect was only one-tenth of the total effect of emigration (−3.5% vs. 38.2%). The skill premium declined by 8.3%, and this would leave an unexplained difference of 26.4 percentage points even in the implausible hypothesis that the effects of education and labour movements were negligible. This substantial gap must have been filled by skill-biased technical change.

6 The dynamics of skill premium: a sectoral perspective

We estimate separate series of skilled wages for construction and manufacturing. Since there are not enough observations of unskilled wages in these sectors to estimate separate series, consistently with our assumption of fully mobile unskilled workers across sectors, we compute the denominator using the national series of

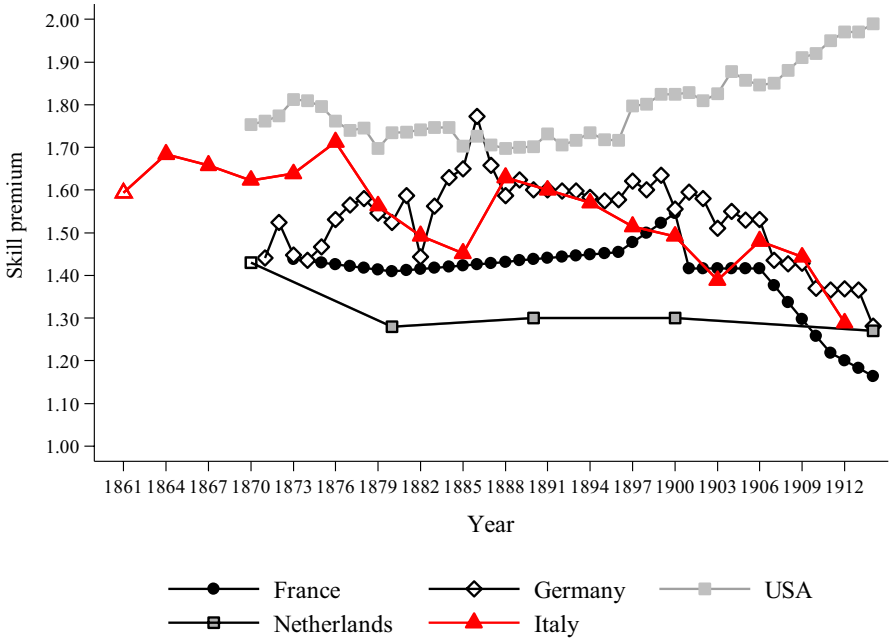

Fig. 10 Skill premium in international comparative perspective (construction). *Sources* Italy, this study. Netherlands, Betrán and Pons (2013). Other countries, Anderson (2001)

unskilled wages estimated with Eq. (3), namely a specification including an interaction between skill and period without a specific sectoral dummy.

We plot the resulting series of skill premium in construction in Fig. 10, alongside the available series for the same sector in some European countries and the USA. The skill premium increased in these latter, as for the whole economy, and probably for the same reasons. In all other cases, including Italy, the skill premium for construction workers was definitely lower on the eve of World War One than fifty years before. In all cases but the Netherlands, the skill premium declined mostly or exclusively in the twentieth century. The pattern for France differs quite substantially from the economy-wide one (Fig. 5).

Figure 11a suggests that in Italy as well as France sectoral trends in skill premia differed considerably. The skill premium in manufacturing was low and stable, ranging between 1.1 and 1.34, with an average of 1.24. In contrast, the skill premium in construction was always higher than in manufacturing, but in the final phase rapidly converged with the skill premium in manufacturing.

Figure 11b suggests that the difference between construction and manufacturing (Fig. 11a) mostly reflects differences within manufacturing sector between high- and low-skilled workers, as defined in Sect. 3. On the one hand, the skill premium for high-skilled workers, relative to unskilled ones, and its movements in time are similar to levels and patterns in construction. The all period average

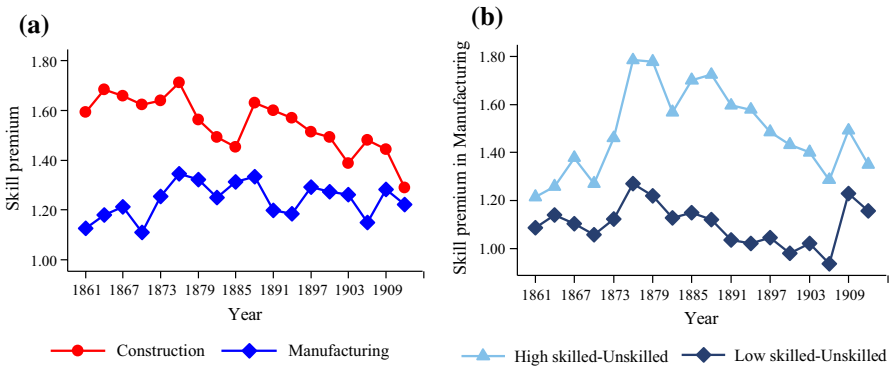

Fig. 11 Skill premium in Italy in the construction sector and manufacturing (1861–1913)

is 1.49 (1.55 for construction), and the premium peaked in 1876, remained at a similar level until the mid-1890s, and then declined more or less steadily to 1912. On the other hand, the skill premium for low-skilled workers, in manufacturing relative to the unskilled ones, was low (average 1.10), stable and closer to the skill premium of the sector-wide average. This simple comparison suggests that competences of low-skilled workers were not very advanced. Indeed, the large bulk of low-skilled manufacturing workers belong, in our sample, to low-technology industries such as textiles and leather.

The combination of a low and stable skill premium for low-skilled workers and a rising and then declining premium for high-skilled ones yields an inverted U-shaped pattern for the ratio of high to low-skilled workers (henceforth "high-skill" premium). The series (Fig. 12) rises by 38% from 1861 to 1894 and then plunges by one-quarter, a whisker above its initial level. This Kuznets' curve dynamics was driven by high-skilled wages in the first period and by low-skilled ones after 1894 (Table 3).

The interpretation of movements in the "high-skill" premium needs some adjustments to the analysis of overall changes in Sect. 5. Indeed, some recent researches have pointed to the crucial role played by intermediate skills for industrialization (Diebolt et al. 2019). First, we distinguish only two periods, with a peak in 1894. Second, we can rule out any major effect of emigration, which, as said, featured almost exclusively unskilled workers. Third, the relevant education is the technical one, which included three different types of institutions, often not clearly distinguishable (Soldani 1981). The lowest one, the *scuole tecniche* (technical schools) could be attended after the two years of compulsory primary school. The highest one was the *istituti tecnici*, which, in spite of the (confusing) similar name, provided more advanced competencies. The third set of institutions were the *Scuole d'arti e mestieri,* established, since the 1870s, to provide specific skills (Morcaldi 2004). Table 13 in "Appendix 1" documents the expansion of technical education in the period considered: the total number of students enrolled in technical schools was negligible at the beginning and grew throughout the period, but the share of students in total population was still very low in 1911.

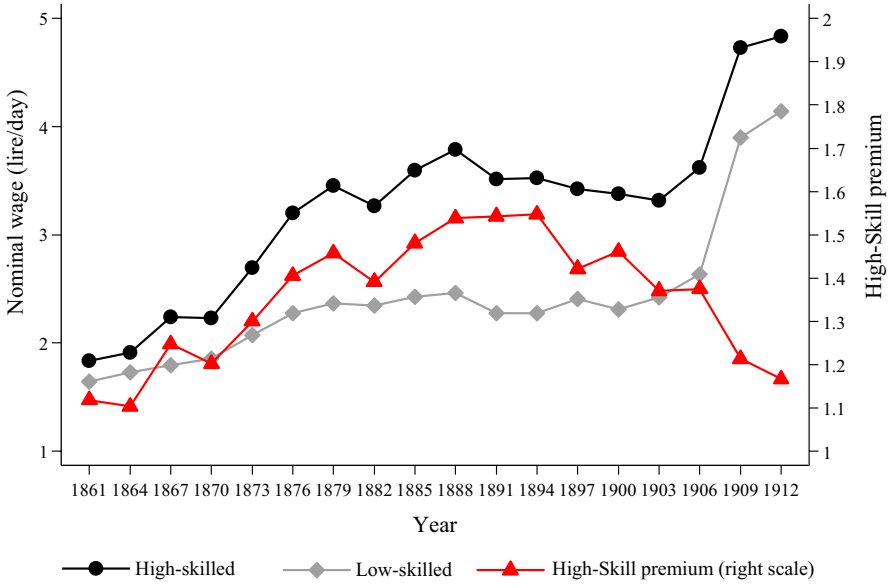

Fig. 12 High-skill premium in manufacturing (high- and low-skilled) in Italy (1861–1913)

The impact of technical education on the high-skill premium, however, depends on the stock of trained workers rather than on the yearly flow. We estimate it as the sum of yearly enrolment for *istituti tecnici* and *scuole di arti e mestieri,* assuming a working life of 40 years. There is no doubt that the *istituti tecnici* trained high-skilled workers, while the *Scuole d'arti e mestieri* were more heterogeneous. Nevertheless, we include their students in our estimate hypothesizing that the poor quality of some of their graduates was compensated by the omission of all students of *scuole tecniche* and other local vocational schools. The total stock (Fig. 8a) accounted for 3.7% of the employment in manufacturing (in its lower bound) in 1881, 16.4% in 1901, and 23.3% in 1911. Thus, (technical) education contributed to the downward slide in the high-skill premium. The effect of the early twentieth century labour mobilization on the skill premium depends

Table 3 Decomposition of the growth (percent) of the high-skill premium in manufacturing, Italy (1861–1913)

Period	Nominal wage high-skilled	Nominal wage low-skilled	High-skill premium	Cost of living index
1861–1894	**1.92**	0.96	0.96	0.26
1894–1912	1.58	**2.99**	− 1.41	0.52
1861–1912	**1.83**	1.75	0.08	0.36

Bold values indicate the main driver of growth (high-skilled or low-skilled wages) of the high-skill premium in manufacturing for various sub-periods

Sources See text. Cost of Living retrieved from Baffigi (2015)

Table 4 Determinants of the high-skill premium, Italy (1861–1913): a tentative interpretation

	1861–1894	1894–1912
Annual growth rate of skill premium (percent)	0.96	− 1.41
Supply factors		
Technical education	=	⬇
Emigration	=	=
Demand factors		
Structural change	=	=
Technical change	⬆	⬇
Labour mobilization	=	⬇

on the relative involvement in striking activity of low- and high-skill workers. The available evidence suggests that the wages of strikers in manufacturing were closer to those of low-skilled workers, especially on the eve of the World War One (see Fig. 17 in "Appendix 1"). Thus, the only positive impact on the skill premium could be that of structural change. This is not the case: as anticipated in Sect. 5, the share of "modern" sectors almost doubled from 1881 to 1911—but if it had remained constant, the high-skill premium would have been less than 1% lower.

We present our interpretation of changes in the high-skill premium in Table 4. The rise (0.96% per year) in the first period can only be explained by technical change. The total capital stock and the share of imported machinery (Fig. 8c) did rise, especially in the 1880s, but there was no counterbalancing force—technical education was still very underdeveloped. Thus, one can claim that the increase in the capital stock caused the steep rise in the high-skill premium, because it took place in a very thin market for skilled workers. The trend changes after 1894 with a pronounced decline (−1.41% per year) of the high-skilled premium.[31] This decline can be mainly accounted for by the growth in technical education, with some possible effect of labour mobilization. This tentative interpretation is consistent with our hypothesis of a positive effect of technical progress on the aggregate skill premium (Sect. 5.3), provided that technical change, during the Gerschenkronian spurt, favoured simple technologies that could be tended by low-skilled workers. For instance, Italian cotton spinning factories used the low-skilled intensive ring spinning machineries rather than the relatively skilled intensive British mules (Saxonhouse and Wright 2010). It is important to stress that this conjecture is still consistent with the characterization of technical change as skill biased in Table 2: mechanization was biased against unskilled workers, while, at the same time, resulting in an intensive use of low-skilled workers. This interpretation resonates with a number of contributions of the Italian economic historiography arguing that Italian entrepreneurs systematically

[31] This discontinuity is broadly consistent with the results of the econometric analysis by Felice and Carreras (2012) on the pattern of Italian industrialization.

adopted technologies characterized by the prevalent use of low-skilled workers in this historical phase (Nuvolari and Vasta 2015).

7 The dynamics of skill premium: a regional perspective

An enduring tradition in the Italian economic historiography has pointed to the divergent development trajectories followed by the different areas of the country (for a recent survey, see Federico et al. 2019). Figure 13 plots the estimates of the skill premium by macro-areas. In this case, the series are obtained by estimating a regression featuring an interaction term between macro-area, period, and skill, still controlling for sector, gender, and source as in Eq. (3). The north-west is characterized by a low and stable level of the skill premium during the entire period. The skill premium is higher in the north-east-centre until the late-1880s and then declines until the end of the period converging with the north-west. Unfortunately, the series of the south has a significant gap between 1879 and 1897, since the limited number of observations prevents us from estimating a reliable regression-based series for this time interval. The available estimates of the south show a very high skill premium up to 1879 and a significantly lower level between 1879 and 1897 which is still higher than in the other two macro-areas.

The initial gap in the skill premium between the north-west and the north-east-centre and south can be plausibly accounted for by the initial endowments of human capital. The maps of the literacy levels in 1861, 1881, and 1911 of Fig. 14 point indeed to a persistent regional divide throughout the period.

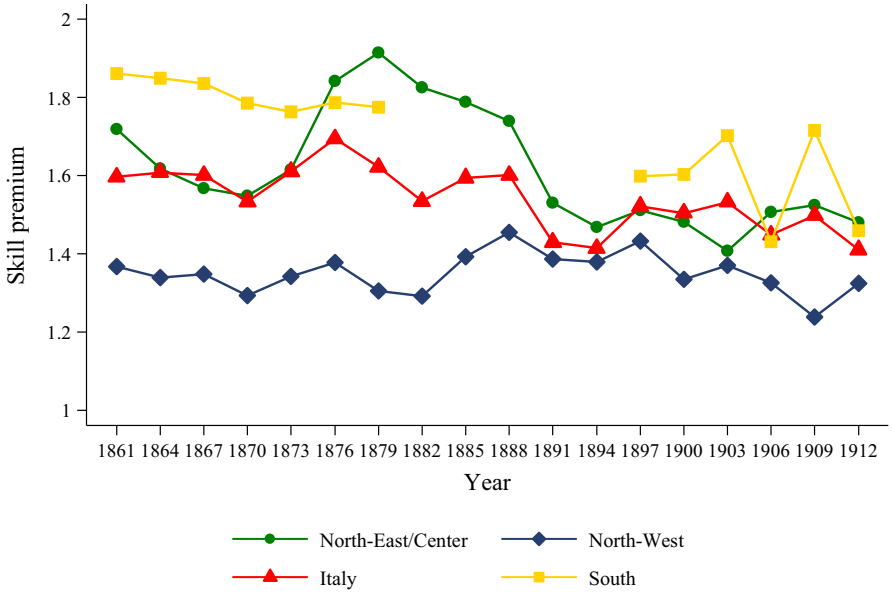

Fig. 13 Skill premium in Italy by macro-areas (1861–1913)

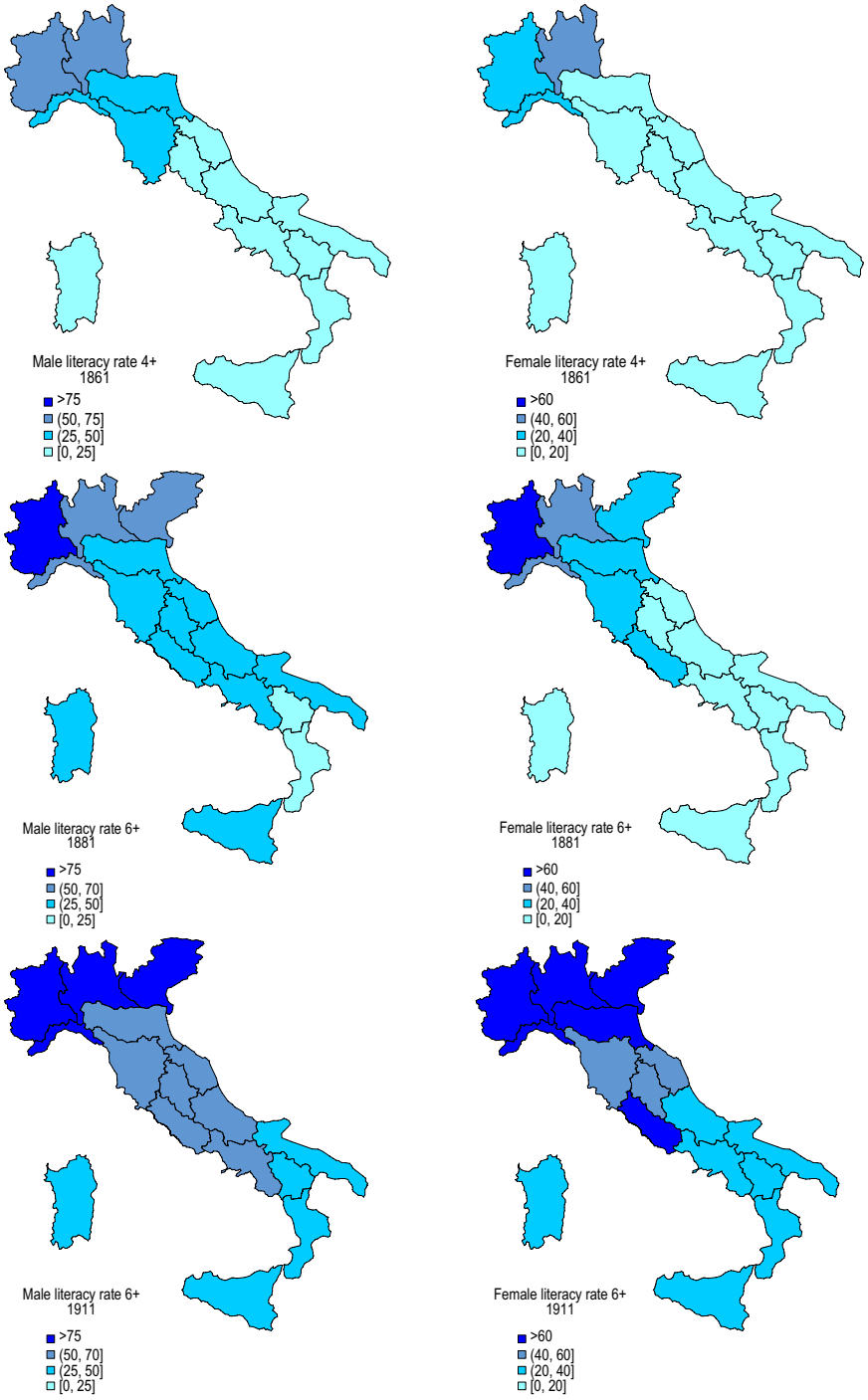

Fig. 14 Literacy rate in Italy by gender and region (1861–1911). *Source* our own elaboration on Census data. For 1861, data by age are not available for 5 and 6 years

The convergence of the skill premium in the south and the north-east-centre towards the levels of the north-west, starting from the 1890s, can be explained by the dynamics of migration flows. Our data on migration suggest that migrants abroad were mostly unskilled agricultural workers (Fig. 8b). Unfortunately, there are no similar data on the skill composition of internal migration. However, Federico et al. (2019, pp. 90–91) have documented that there were substantial internal migration flows from the north-east-centre towards the north-west (between 6.5 and 8% of people living in the north-west were born in the north). The higher skill premium in the north-east-centre plausibly suggests that the migrants from this macro-area were mainly unskilled workers, which might explain this decline. In any case, the immigration of unskilled workers should have caused an increase of the skill premium in the north-west. On the contrary, Fig. 13 shows a broad stability in the north-west prevailing in this period. This suggests that this upward pressure on the skill premium coming from internal migration, in combination with structural change and technical change, was more than compensated by other factors favouring unskilled workers, such as labour mobilization.

8 Conclusions

This paper provides the first comprehensive estimates of the Italian skill premium and gender wage gap during the Liberal age and, at the same time, interprets its evolution. The historical literature suggests two main possible determinants—structural change à la Kuznets (1955) and the race between education and technology à la Goldin and Katz (2008), plus possibly the labour movement, if it succeeds to shift the market out of its competitive equilibrium. We extend this framework to take into account also migrations, and, even without a formal econometric testing, we reach some preliminary conclusions on the variation of the skill premium in the Italian context.

First, emigration had a major impact, since the late-1880s, by increasing the wages of unskilled workers versus all skilled (low and high) workers. Second, structural change had a limited impact because before 1913 industrialization had just begun. The massive shift from agriculture to industry happened in Italy only after World War Two. Third, the accumulation of both human capital and technological capabilities was limited, and thus, the overall race between education and technology might be characterized as slow-motion competition between a snail and a tortoise. However, this general conclusion must be qualified by considering both the markets for high-skilled workers and for low-skilled ones. The premium for manufacturing low-skilled workers relatively to unskilled workers remained broadly constant, in spite of the powerful downward push of emigration, the improvements in literacy rates and also, to some extent, the growing labour mobilization. In contrast, the discontinuity in the skill premium for high-skilled workers in the mid-1890s suggests a shift in the market conditions. Before 1894, the demand for high-skilled workers outstripped the supply, while afterwards the development of technical education, possibly supplemented by

on-the-job training, more than met the needs. These were years of relatively fast industrial growth in Italy: our findings imply that the technology needed mostly low-skilled workers—people who would respect factory discipline and could operate simple machinery, but lacking more sophisticated technical competences. This trend appeared as de-skilling when compared with traditional artisans, and also with some advanced countries. Women benefitted only marginally, in spite of their growing education. Indeed, the gender wage gap remained broadly stable, and we cannot rule out some discrimination in the labour market.

Our results have also more general methodological implications. The movements of skill premium must be interpreted with a suitably general model and, above all, must be measured at the economy-wide level. No sector can be used as providing a synthetic indicator of the overall skill premium during the first industrialization, as it has been done frequently with the construction sector for the preindustrial period (Allen 2001; van Zanden 2009). In contrast, in the industrial period, technical progress and skills were highly sector-specific and this significantly limited the sectoral mobility of skilled workers. In this area of research, therefore, there are no shortcuts: the premium should be computed with a broad range of wages across all sectors. The regression approach introduced by Clark (2005) is a useful tool to extract consistent series also from very scattered and unbalanced samples.

Acknowledgements We would like to thank Maria Angeles Pons and Mauro Rota for sharing their data with us and Gabriele Cappelli, Giulia Mancini, Luca Mocarelli, and Tiziano Razzolini for very useful comments and suggestions. We thank Alberto Montesi and Sara Pecchioli for excellent research assistance. The paper has benefited from the comments of all participants at the 8th edition of EH/tune Economic History Workshop (Siena, 2018), the FRESH meeting (Groningen, 2018), the Economic History Society Annual Conference (Belfast, 2019), the BETA Workshop (Strasbourg, 2019), the 16th Annual STOREP Conference (Siena, 2019), the European Historical Economics Society Conference (Paris, 2019), and the Université Paris 1 Panthéon-Sorbonne's International economics and labor markets seminar (Paris, 2019).

Appendix 1

See Figs. 15, 16, and 17 and Tables 5, 6, 7, 8, 9, 10, 11, 12, and 13.

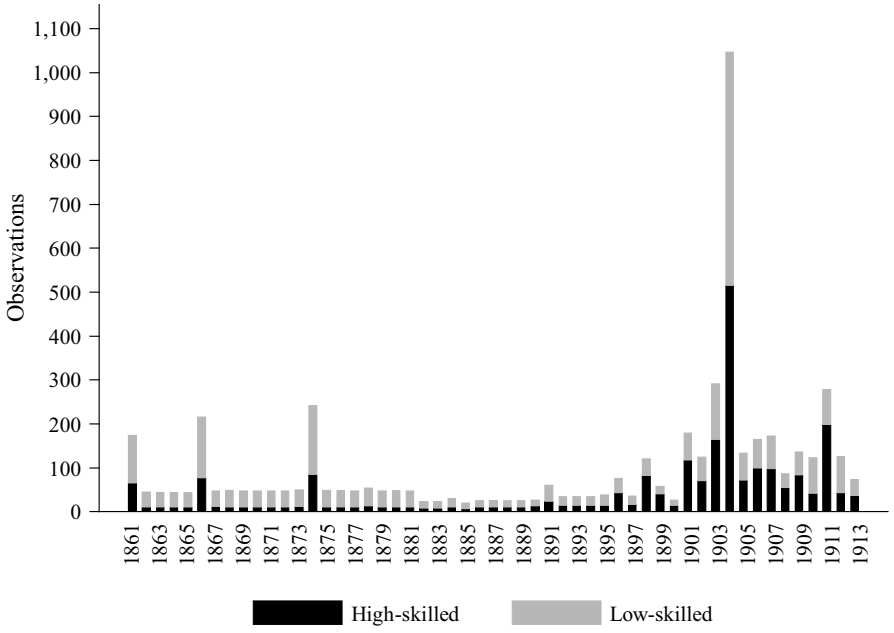

Fig. 15 Wage observations by year and skill level in manufacturing

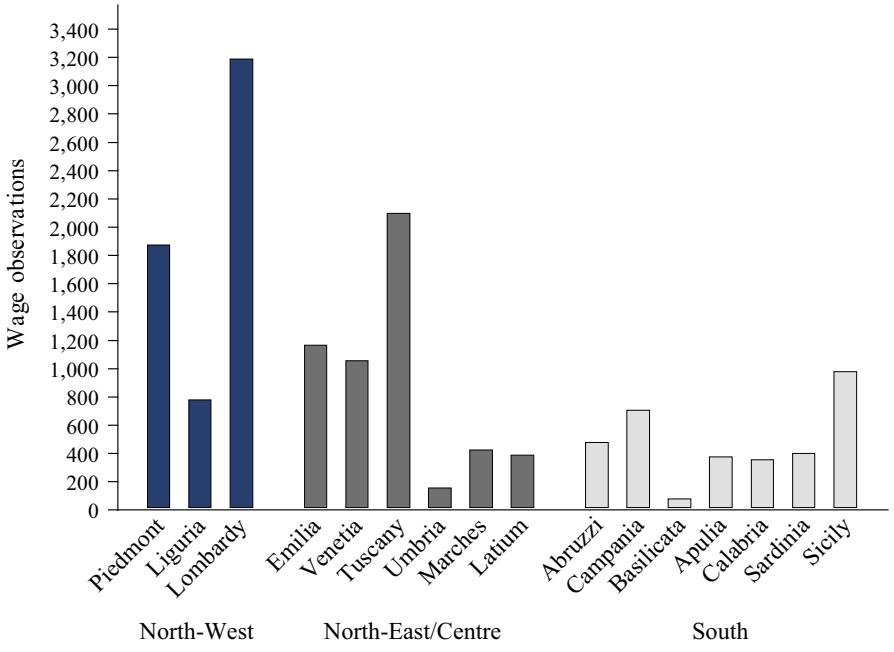

Fig. 16 Wage observations by region and macro-area

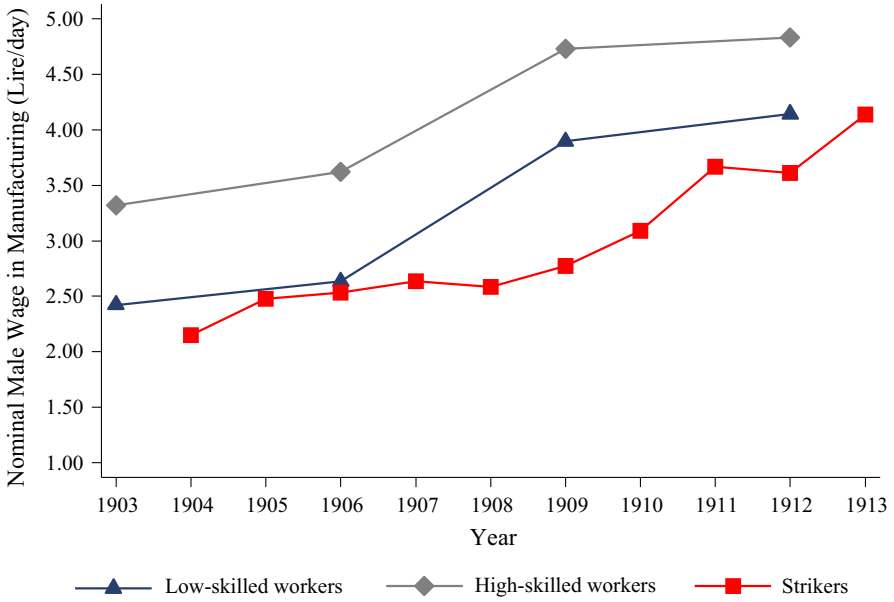

Fig. 17 Wages of strikers in manufacturing in Italy (1903–1913). *Sources and Notes* as in Fig. 9

Table 5 Wage observations by source

Source	Number of observations	Share in sample (%)
Dipartimento Generale della Statistica (1862–1878)	3850	26.5
Bollettino dell'Ufficio del Lavoro	3422	23.6
Annuario Statistico Italiano	3314	22.8
Other official sources	2737	18.9
Secondary literature	1190	8.2
Total	14,513	100.0

Sources See text

Table 6 Unskilled occupations

Unskilled occupations	Number of observations	Share in sample (%)	Cum.
Manovale edilizia (building labourer)	3066	51.29	51.29
Terraiolo (navvy)	1309	21.90	73.19
Manovale (labourer)	961	16.08	89.26
Operaio a giornata (day labourer)	136	2.28	91.54
Bracciante (agricultural day labourer)	103	1.72	93.26
Giornaliero (day labourer)	85	1.42	94.68
Carriolante (wagoner)	74	1.24	95.92
Facchino (porter)	55	0.92	96.84

Table 7 Low-skilled occupations

Low-skilled occupations	Number of observations	Share in sample (%)	Cum.
Muratore (mason)	1981	35.91	35.91
Filatore (spinner)	586	10.62	46.53
Operaio comune (factory worker)	372	6.74	53.27
Falegname (carpenter)	180	3.26	56.53
Tessitore (weaver)	138	2.50	59.04
Mezzante (silk worker)	123	2.23	61.27
Operaio addetto alla fabbricazione della carta (papermill worker)	121	2.19	63.46
Orlatrice e rammendatrice (tailor)	105	1.90	65.36
Scopinatore (brusher)	103	1.87	67.23
Cavatore (quarryman)	97	1.76	68.99

Table 8 High-skilled occupations

High-skilled occupations	Number of observations	Share in sample (%)	Cum.
Tornitore (lathe turner)	276	9.68	9.68
Minatore (miner)	211	7.40	17.08
Aggiustatore (joiner)	210	7.37	24.45
Filatore seta (silk spinner)	209	7.33	31.78
Macchinista (engineer)	166	5.82	37.60
Fabbro fucinatore, forgiatore (blacksmith)	148	5.19	42.79
Armatore (weapon maker)	101	3.54	46.33
Impressore, tipografo (typesetter)	98	3.44	49.77
Calzolaio (shoe maker)	96	3.37	53.14
Artiere (artisan)	90	3.16	56.30

Sources See text

Table 9 Wage observations by sector

Industrial sector	Females	Males	Total	Share in sample (%)
Agriculture	27	1317	1344	9.3
Construction	1627	4300	5927	40.8
Mining	65	1533	1598	11.01
Industry	2294	3350	5644	38.9
Textiles	1696	714	2410	42.7
Basic metals	12	560	572	10.1
Leather	82	367	449	8.0
Repair and installation of machinery		375	375	6.6
Chemicals	105	258	363	6.4
Tobacco	177	178	355	6.3
Wood	16	234	250	4.4
Paper	86	147	233	4.1
Printing	37	175	212	3.8
Food	39	107	146	2.6
Other transport equipment		75	75	1.3
Other non-metallic mineral products	8	64	72	1.3
Wearing apparel	18	37	55	1.0
Motor vehicles		38	38	0.7
Electrical equipment	9	9	18	0.3
Other manufacturing	9	8	17	0.3
Beverages		2	2	0.0
Coke and refined petroleum		2	2	0.0
Total	4013	10,500	14,513	100

Sources See text

Table 10 Sources for international comparisons

Country	Betrán and Pons (2013)	Anderson (2001)
Australia	Building sector (Melbourne and Sidney)	Building sector (daily wage from Melbourne and Sidney) plus weekly data for several sectors
Brazil	Building sector (Rio de Janeiro)	
Canada	Railway industry	Railway industry
Denmark	Crafts and industries	Crafts and industries
France	Nine sectors	Building sector, Paris
Germany	Building sector, wide sample	Building sector, wide sample
Japan	Manufacturing and Construction	
Netherlands	Building sector (Amsterdam)	
Spain	Twelve sectors for 1884, thirteen sectors for 1914	
Sweden	Several sectors	Municipal workers (between 1870 and 94 extrapolated with Stockholm)
Switzerland	Thirteen sectors (from 1913)	
Turkey	Building sector	
UK	Ten sectors	
USA	Manufacturing	Building sector (extrapolated back to 1870 with manufacturing)

Sources Anderson (2001), Betrán and Pons (2013)

Table 11 Literacy rate by countries (1860–1913)

Country	1860	1880	1900	1913
France	62.7	72.8	83.5	88.1
Germany	86.0	92.0	96.3	97.0
Italy	25.3	38.4	50.1	60.7
Netherlands	73.5	80.0	87.5	92.5
Sweden	91.2	93.6	96.0	97.6
UK	69.4	82.7	94.1	96.4
US	80.3	83.0	88.4	91.8

Sources see the dataset reporting the Historical Index of Human Development (https://espacioinvestiga.org/home-hihd/?lang=en) and Prados de la Escosura (2015)

Table 12 Strikes' motivation and outcomes, Italy (1901–1913)

Year	Number of strikes	Related to wage	*C*	*P*	*T*	*M*	*S*	?
Industry								
1901	1514	782	244	46	176	68	246	2
1902	1183	604	142	40	139	70	211	2
1903	722	352	85	12	88	20	145	2
1904	931	420	116	29	56	61	151	7
1905	1196	506	122	47	64	63	200	10
1906	1770	1156	295	135	160	200	333	33
1907	3797	1525	387	263	241	226	373	35
1908	2535	1150	252	177	160	163	365	33
1909	1784	688	169	72	109	80	250	8
1910	1654	729	153	92	130	123	226	5
1911	2037	751	144	114	110	124	254	5
1912	1611	650	122	79	86	121	232	10
1913	1460	549	100	51	81	101	203	13
Agriculture								
1901	1310	629	273	100	69	62	120	5
1902	409	200	44	13	49	16	77	1
1903	73	29	5	3	7	4	9	1
1904	396	162	60	20	7	32	38	5
1905	245	108	23	11	18	15	39	2
1906								
1907	1407	409	79	66	82	68	104	10
1908	977	283	85	35	45	43	53	22
1909	260	100	24	17	9	15	32	3
1910	198	76	23	15	13	15	7	3
1911	325	112	19	19	27	16	25	6
1912	433	152	39	26	30	27	29	1
1913	188	63	13	8	10	8	23	1

Sources MAIC—*Statistica degli scioperi avvenuti nell'industria e nell'agricoltura* (various years before 1904) *and* MAIC—*Statistica degli scioperi* (various years after 1904). *Notes:* strikes related to wage are classified according to the outcome: completely favourable to workers (*C*), partially favourable (*P*), tie (*T*), minimally favourable (*M*), unfavourable (*S*), and uncertain (?)

Table 13 Technical and vocational education in Italy (1862–1911)

Year	*Scuola tecnica*		*Istituti tecnici*		*Scuole di arti e mestieri*	
	Total students	Students per 000 pop	Total students	Students per 000 pop	Total students	Students per 000 pop
1862	13,000	0.49	4923	0.19	500	0.02
1871	18,931	0.67	6609	0.24	1444	0.05
1881	24,833	0.84	11,880	0.40	16,180	0.55
1891	34,244	1.07	16,409	0.51	26,692	0.84
1901	47,000	1.39	17,420	0.51	40,979	1.21
1911	94,738	2.57	28,832	0.78	59,463	1.61

Sources Number of students from Vasta (1999: 1062); Population from the Maddison Project (Bolt et al. 2018)

Appendix 2: List of sources for wages

Primary sources

ISTAT-DGS-MAIC (1885) Annali di statistica, Serie III, vol. 14. Tipografia eredi Botta, Roma.

ISTAT-DGS (1887) Annuario Statistico ltaliano 1886. Tipografia eredi Botta, Roma.

ISTAT-DGS (1888) Annuario Statistico ltaliano 1887–1888. Tipografia eredi Botta, Roma.

ISTAT-DGS (1893) Annuario Statistico ltaliano 1892. Tipografia nazionale G. Bertero, Roma.

ISTAT-DGS (1904) Annuario Statistico ltaliano 1904. Tipografia nazionale G. Bertero, Roma.

ISTAT-DGS (1908) Annuario Statistico ltaliano 1905–1907. Tipografia nazionale G. Bertero, Roma.

ISTAT-DGS (1912) Annuario Statistico ltaliano 1911. Tipografia nazionale G. Bertero, Roma.

ISTAT-DGS (1913) Annuario Statistico ltaliano 1912. Tipografia nazionale G. Bertero, Roma.

ISTAT-DGS (1914) Annuario Statistico ltaliano 1913. Tipografia nazionale G. Bertero, Roma.

ISTAT-DGS (1915) Annuario Statistico ltaliano 1914. Tipografia nazionale G. Bertero, Roma.

MAIC (1904–1922) Bollettino dell'Ufficio del lavoro. Tipografia nazionale G. Bertero, Roma (ad annum).

MAIC—Ministero di Agricoltura, Industria e Commercio (1905) Materiali per lo studio delle condizioni dei lavoratori della terra nel Mezzogiorno, vol 1 Capitanata e Puglie. Pubblicazioni dell'Ufficio del Lavoro, Roma.

MAIC—Ministero di Agricoltura, Industria e Commercio, Ufficio del lavoro (1908) Notizie sulle variazioni dei Salari e degli orari nell'industria serica italiana dal 1901 al 1907. Officina poligrafica italiana, Roma.

MAIC—Ministero di Agricoltura, Industria e Commercio, Ufficio del lavoro (1910) Le condizioni di lavoro nell'industria laterizia in Italia. Officina poligrafica italiana, Roma.

MAIC—Ministero di Agricoltura, Industria e Commercio, Ufficio del lavoro (1911) Salari ed orari nell'industria edilizia in Italia negli anni 1906–1910. Officina poligrafica italiana, Roma.

MAIC—Ministero di Agricoltura, Industria e Commercio, Ufficio del lavoro (1911) Salari ed orari nell'industria serica italiana nell'anno 1909. Officina poligrafica italiana, Roma.

MAIC—Ministero di Agricoltura, Industria e Commercio (1913) Tariffe di salario e di orario nell'arte muraria (1911 e 1912). Officina poligrafica italiana, Roma.

MAIC-DGA—Ministero di Agricoltura, Industria e Commercio—Direzione Generale dell'Agricoltura (1876–1879) Relazione intorno alle condizioni dell'agricoltura in Italia nel quinquennio 1870–74. Tipografia Barbera, Roma.

MAIC-DGS—Ministero di Agricoltura, Industria e Commercio—Direzione Generale di Statistica (1862–1878) Salari. Prezzi medi di un'ora di lavoro degli operai addetti alle opere di muratura ed ai trasporti di terra e mercedi medie giornaliere degli operai addetti alle miniere. n. d., Roma.

Secondary sources

Aleati G (1961) Le retribuzioni dei lavoratori edili in Milano, Pavia e nei rispettivi territori dal 1819 al 1890. ILTE, Torino.

De Maddalena A (1974) Prezzi e mercedi a Milano dal 1701 al 1860. Banca Commerciale Italiana, Milano.

Di Rollo F (1965) Le retribuzioni dei lavoratori edili a Roma dal 1826 al 1880. ILTE, Torino.

Felloni G (1963) Le retribuzioni dei lavoratori edili a Genova dal 1815 al 1890. ILTE, Torino.

Felloni G (1998) Un secolo di salari edilizi a Genova 1815–1913, pp. 1217–1230, «Atti della Società Ligure di Storia Patria, nuova serie», XXXVIII/2.

Hansen B (1985) Wage Differentials in Italy and Egypt. The Incentive to Migrate before World War I. J Eur Econ Hist 14(2):347.

Levi G (1966) I salari edilizi a Torino dal 1815 al 1874. In: Maturi W (ed) Miscellanea. Giappichelli, Torino pp 366, 372, 378.

Societa Umanitaria (1907) Le condizioni generali della classe operaia in Milano: Salari, Giornate di lavoro, Reddito, ecc. Editore l'Ufficio del lavoro, Milano.

Appendix 3: Estimate of the effects of emigration

We follow the partial equilibrium approach by Taylor and Williamson (1997). By definition, the effect of a change in labour supply L^* on wages is equal to the labour supply change times the elasticity of labour demand η:

$$w^* = \eta^{-1} L^*.$$

Taylor and Williamson (1997) show that η^{-1} is equal to:

$$\eta^{-1} = -\sigma^{-1}(1-\theta)$$

where σ is the elasticity of substitution in the production function and θ is the share of labour. We compute separately the effects on skilled and unskilled wages, assuming the elasticity to be the same. We estimate w^* with two different no-emigration counterfactual hypotheses. We compute total migration since 1876 ('long run') or 1903 ('short run'), and we compare it with (an estimate of) the number of skilled and unskilled workers in 1911.

We retrieve the total number of emigrants, gross and (since 1902) net, the division by gender, and the share of 'condizioni professionali' (working) from Statistiche ISTAT (Tables 2.9.1 and 2.9.2) and the number of emigrated farming emigrants (labourers, farmers, and tenants) from Annuario Statistico dell'emigrazione (Commissariato generale dell'emigrazione, various years). We compute the total number of working male emigrants as net migrants times the share of males in total migrants (assuming the same percentage of returns for males and females) times the share of working people for both genders.[32] This latter assumption clearly understates the number of working males, as the share of workers was substantially higher for males than for females. We assume that all farmers and 15% of other (non-farming) emigrants were unskilled. This yields a total of 6.1 million unskilled and 0.7 million skilled migrants in the long run (and, respectively, 2.6 and 0.4 since 1903). We get the number of male workers by sector in 1911 from Vitali (1970, tab. 1). We count as unskilled all males working in agriculture, 42% of workers in construction (MAIC-DGS, Population census of 1911, vol. V, tab. 7, p. 345) and 25% of workers in manufacturing and services for a total of 7.6 million out of 11.2 million males in gainful occupation. This implies that skilled workers (3.7 million) accounted for 32.7% of the total. The long-run no-emigration counterfactual amounts to an increase in the workforce of 80% for unskilled and 19.5% for unskilled workers (35% and 10.5% for the short run). According to Giordano and Zollino (2015), labourers got 66% of GDP in 1911. We disaggregate this share between raw labour (of all workers) and human capital (of skilled ones only) as:

$$\theta_u = L_u / \left(L_u + L_s \cdot s\right) \cdot \theta$$

[32] We consider only males as they accounted for four-fifths of migrants.

where L_u and L_s are total unskilled and skilled workers, respectively, and s, the skill premium, is assumed to have been 1.5. The formula yields a share of 41.7% for raw labour and 24.2% for human capital. Thus, with a unitary elasticity $\sigma = 1$ (i.e. a Cobb-Douglass), demand elasticities are equal to -0.58 and -0.76.[33] Without emigration, wages of unskilled and skilled workers would have been 43% and 17.4% lower, respectively, while the skill premium would have been 39% higher.

References

Allen RC (2001) The great divergence in European wages and prices from the Middle Ages to the First World War. Explor Econ Hist 38(4):411–447
Allen RC (2011) Global economic history. Oxford University Press, Oxford
Amendola N, Vecchi G (2017) Inequality. In: Vecchi G (ed) Measuring wellbeing. A history of Italian living standards. Oxford University Press, Oxford, pp 293–332
Anderson E (2001) Globalisation and wage inequalities 1870–1970. Eur Rev Econ Hist 5(1):91–118
Baffigi A (2015) Il PIL per la storia d'Italia: istruzioni per l'uso. Marsilio, Padova
Bardini C (1997) Without coal in the age of steam: a factor-endowment explanation of the italian industrial lag before World War I. J Econ Hist 57(3):633–653
Bayet A (1997) L'accroissement spectaculaire des salaires et de leur pouvoir d'achat. In: Marchand O, Thélot C (eds) Le travail en France, 1800–2000. Nathan, Paris, pp 155–172
Berra M, Revelli M (1978) Salari. In: Tranfaglia N (ed) Storia d'Italia. Il mondo contemporaneo. La Nuova Italia, Firenze, pp 1167–1194
Betrán C, Pons MA (2004) Skilled and unskilled wage differentials and economic integration 1870–1930. Eur Rev Econ Hist 8(1):29–60
Betrán C, Pons MA (2013) Comparing past and present wage inequality in two globalisation periods. Scand Econ Hist Rev 61(2):140–166
Betrán C, Ferri J, Pons MA (2010) Explaining UK wage inequality in the past globalisation period 1880–1913. Cliometrica 4(1):19–50
Bolt J, Inklaar R, de Jong H, van Zanden JL (2018) Rebasing 'Maddison': new income comparisons and the shape of long-run economic development. Working paper of Maddison Project, 10
Broadberry SN, Giordano C, Zollino F (2013) Productivity. In: Toniolo G (ed) The Oxford handbook of the Italian economy since unification. Oxford University Press, Oxford, pp 187–226
Cappelli G, Vasta M (2018) The human capital gender gap and educational reforms in Italy (1861–1921), Mimeo
Cappelli G, Vasta M (2020) Can school centralisation foster human capital accumulation? A quasi-experiment from early XX century Italy. Econ Hist Rev (**forthcoming**)
Ciccarelli C, Missiaia A (2013) The industrial labor force of Italy's provinces: estimates from the population censuses 1871–1911. Riv Stor Econ 29(2):141–191
Ciccarelli C, Weisdorf JL (2018) Pioneering into the past: regional literacy developments in Italy before Italy. Eur Rev Econ Hist. https://doi.org/10.1093/ereh/hey014
Clark G (2005) The condition of the working class in England 1209–2004. J Polit Econ 113(6):1307–1340
Cohen J, Federico G (2001) The development of the Italian economy 1820–1960. Cambridge University Press, Cambridge
Daniele V, Malanima P (2017) Regional wages and the North-South disparity in Italy after the unification. Riv Stor Econ 33(2):117–158
De Fort E (1996) La Scuola elementare dall'unità alla caduta del Fascismo. Il Mulino, Bologna
de Pleijt A, van Zanden JL (2018) Two Worlds of Female Labour: Gender Wage Inequality in Western Europe 1300–1800. Working Papers in Economic History of EHES, 138
dell'Emigrazione Generale (1926) Annuario statistico dell'emigrazione italiana dal 1876 al 1925. Commissariato Generale dell'Emigrazione, Roma

[33] The exact value of the elasticity is irrelevant, as it cancels itself out in the final formula.

Diebolt C, Le Chapelain C, Menard A-R (2019) Neither the elite, nor the mass. The rise of intermediate human capital during the French industrialization process. Cliometrica (**forthcoming**)
Federico G (2009) An economic history of the silk industry. Cambridge University Press, Cambridge
Federico G, Vasta M (2015) What do we really know about protection before the Great Depression: evidence from Italy. J Econ Hist 75(4):993–1029
Federico G, Natoli S, Tattara G, Vasta M (2011) Il commercio estero italiano 1862–1950. Editori Laterza, Roma-Bari
Federico G, Nuvolari A, Vasta M (2019) The origins of the Italian regional divide: evidence from real wages 1861–1913. J Econ Hist 79(1):63–98
Felice E, Carreras A (2012) When did modernization begin? Italy's industrial growth reconsidered in light of new value-added series 1911–1951. Explor Econ Hist 49(4):443–460
Frankema E, Van Waijenburg M (2019) The great convergence. Skill accumulation and mass education in Africa and Asia, 1870–2010. CEPR Working paper, DP14150
Gerschenkron A (1962) Economic backwardness in historical perspective. Harvard University Press, Cambridge
Giannetti R (1998) Tecnologia e Sviluppo Economico Italiano (1870–1990). Il Mulino, Bologna
Giordano C, Zollino F (2015) A historical reconstruction of capital and labour in Italy 1861–2013. Riv Stor Econ 31(2):155–224
Goldin C (1990) Understanding the gender gap: an economic history of American women. Oxford University Press, Oxford
Goldin C (1995) The U-shaped female labor force function in economic development and economic history. In: Schultz TP (ed) Investment in Women's human capital and economic development. University of Chicago Press, Chicago, pp 61–90
Goldin C, Katz LF (2008) The race between education and technology. The Belknap Press of Harvard University Press, Cambridge
Humphries J (2003) English apprenticeship: a neglected factor in the first industrial revolution. In: David PA, Thomas M (eds) The economic future in historical perspective. Oxford University Press, Oxford, pp 73–102
Katz LF, Autor D (1999) Changes in the wage structure and earnings inequality. In: Ashenfelter O, Card D (eds) Handbook of labor economics. Elsevier, Dordrecht, pp 1463–1555
Kelly M, Mokyr J, O'Grada C (2014) Precocious Albion: a new interpretation of the british industrial revolution. Annu Rev Econ 6(1):363–389
Kuznets S (1955) Economic growth and income inequality. Am Econ Rev 45(1):1–28
Lay A, Marucco D, Pesante ML (1973) Classe operaia e scioperi: ipotesi per il periodo 1880–1923. Quaderni Storici 22:87–147
Lee JW, Lee H (2016) Human capital in the long run. J Dev Econ 122:147–169
Lindert P, Williamson J (2016) Unequal gains: American growth and inequality since 1700. Juncture 22(4):276–283
Luzzato G (1968) L'economia italiana dal 1861 al 1894. Einaudi, Torino
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1907) Statistica degli scioperi avvenuti in Italia nell'anno 1904. Tipografia nazionale G, Bertero, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1908) Statistica degli scioperi avvenuti in Italia nell'anno 1905. Officina poligrafica italiana, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1911) Statistica degli scioperi avvenuti in Italia nell'anno 1906. Officina poligrafica italiana, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1912a) Statistica degli scioperi avvenuti in Italia nell'anno 1910. Officina poligrafica italiana, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1912b) Statistica degli scioperi avvenuti in Italia nell'anno 1911. Tipografia nazionale G, Bertero, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1913) Statistica degli scioperi avvenuti in Italia nell'anno 1907. Tipografia nazionale G, Bertero, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1914) Statistica degli scioperi avvenuti in Italia nell'anno 1912. Tipografia nazionale G, Bertero, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1915) Statistica degli scioperi avvenuti in Italia nell'anno 1908 e 1909. Tipografia nazionale G, Bertero, Roma
MAIC—Ministero di Agricoltura Industria e Commercio Ufficio del lavoro (1916) Statistica degli scioperi avvenuti in Italia nell'anno 1913. Tipografia ditta L, Cecchini, Roma
Mancini G (2018) Women's labour force participation in Italy 1861–2011. Riv Stor Econ 34(1):3–68

Milanovic B (2016) Global inequality: a new approach for the age of globalization. Harvard University Press, Cambridge
Morcaldi M (2004) Le scuole industriali (1880–1930). Formazione e capitale umano, Milano
Nuvolari A, Vasta M (2015) The ghost in the attic? The Italian national innovation system in historical perspective. Enterp & Soc 16(2):270–290
Nuvolari A, Vasta M (2017) The geography of innovation in Italy 1861–1913: evidence from patent data. Eur Rev Econ Hist 21(3):326–356
O'Rourke K, Williamson J (2017) The spread of modern industry to the periphery since 1871. Oxford University Press, Oxford
Olivetti C, Petrongolo B (2016) The evolution of gender gaps in industrialized countries. Ann Rev Econ 8(2):403–434
Ortaggi Cammarosano S (1991) Labouring women in northern and central Italy in the nineteenth century. In: Davis JA, Ginsborg P (eds) Society and politics in the age of the risorgimento. Essays in honour of Denis Mack Smith. Cambridge University Press, Cambridge, pp 152–183
Prado S (2010) Fallacious convergence? Williamson's real wage comparisons under scrutiny. Cliometrica 4(2):171–205
Prados de la Escosura L (2015) World human development: 1870–2007. Rev Income Wealth 61(2):220–247
Ridolfi L (2019) Six centuries of real wages in France from Louis IX to Napoleon III: 1250–1860. J Econ Hist 79(3):589–627
Saxonhouse GR, Wright G (2010) National leadership and competing technological paradigms: the globalization of cotton spinning 1878–1933. J Econ Hist 70(3):535–566
Società Umanitaria (1907) Le condizioni generali della classe operaia in Milano: Salari Giornate di lavoro Reddito ecc. Ufficio del lavoro, Milano
Soldani S (1981) L'istruzione tecnica nell'Italia liberale (1861–1900). Studi Storici 22(1):79–117
Sori E (1979) L'emigrazione italiana dall'Unità alla seconda guerra mondiale. Il Mulino, Bologna
Spitzer Y, Zimran A (2018) Migrant self-selection: anthropometric evidence from the mass migration of Italians to the United States 1907–1925. J Dev Econ 134:226–247
Taylor AM, Williamson J (1997) Convergence in the age of mass migration. Eur Rev Econ Hist 1(1):27–63
Van Leeuwen M, Ineke M et al (2002) Hisco-historical standard classification of occupations. University Press Leiden, Leiden
Van Zanden JL (2009) The skill premium and the 'great divergence'. Eur Rev Econ Hist 13(1):121–153
Vasta M (1999) Capitale umano e Ricerca scientifica e tecnologica. In: Amatori F, Bigazzi D, Giannetti R, Segreto L (eds) Storia d'Italia Annali 15—L'industria. Einaudi, Torino, pp 1041–1124
Vitali O (1970) Aspetti dello sviluppo economico italiano alla luce della ricostruzione della popolazione attiva italiana attraverso i censimenti. Istituto di Demografia Università di Roma, Roma
Von Tunzelmann GN (1995) Technology and industrial progress. Edward Elgar, Aldershot
Wallis P (2008) Apprenticeship and training in Premodern England. J Econ Hist 68(3):832–881
Williamson J (1985) Did British capitalism breed inequality?. Unwin Hyman, London
Williamson J, Lindert P (1980) American inequality. A macroeconomic history. Academic Press, New York
Zeev BN, Mokyr J, Van Der Beek K (2017) Flexible supply of apprenticeship in the British industrial revolution. J Econ Hist 77(1):208–250