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Women inventors in Italy, 1861–1939

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ABSTRACT

This paper studies women's participation in innovative activities during the deep societal changes of twentieth-century Italy. It does so by tracking female inventors among the 330,000+ patents registered in Italy between 1861 and 1939. The resulting dataset allows us to disaggregate women's inventive activity across industries, provinces, and social backgrounds. Despite accounting for only 0.7% of total patents, the number of women patenting increased steadily from 1861 to 1939. Until 1920, the growth of female-linked patents was comparable to that of male-only patents, but started to slow down during Fascism. The gap between the quality of inventions registered by women and men was gradually reduced. Women also patented in a wide variety of technological sectors. This suggests that entrepreneurial women were able to innovate, but that systemic barriers, particularly during the Fascist period, limited their inventive potential, suggesting an intersection of gender dynamics and political climate in shaping female inventive activities.

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twentieth-century Italy; female entrepreneurship; invention; fascism; gender patenting gap; patents; geography of invention; family structure; marriage; marital authorisation; entrepreneurship

Introduction

In recent decades, a growing number of research efforts have emphasised the importance of women in every sector of economic activity and their central contribution to the economic prosperity of industrialised countries (see Wallach Scott, 1989 and, for a recent literature review, Merouani & Perrin, 2022). Such research has mostly relied on original sources that have been able to find otherwise 'invisible' women and has highlighted the important economic role of women (Boserup, 1970; Goldin, 1990), especially as part of the labour force (Humphries, 2006; Humphries & Sarasúa, 2012; Whittle, 2019), emphasising the role of human capital (Baten & De Pleijt, 2022; Diebolt & Perrin, 2013). Other studies have examined the entrepreneurial activities of women in many sectors of the American and British economies in the 18th and 19th centuries (Aston, 2012; Barker, 2006; Gamber, 1997; Kwolek-Folland, 1994, 1998), although the literature is expanding and has recently adopted a more global perspective (Aston & Bishop, 2020).

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A recent strand of literature has also observed the important heterogeneity of the innovative and entrepreneurial activities of women in France (Chanteux, 2022; Khan, 2016; Merouani & Perrin, 2024a) in the United Kingdom (Khan, 2024) and in the United States (Khan, 2000) during the eighteenth and nineteenth century. Feminist theories of technology have also noted that the very concept of technology is culturally based on mechanical and civil engineering inventions (Wajcman, 2010), with the consequence that it is 'male machines rather than female fabrics' that define what a technology is (Oldenziel, 1999). As a result, less value is placed on the creative contributions of women because they are deemed less fundamental according to a gender stereotype that associates men with machines (McGaw, 2003). Even today, in Europe, only 16% of patents list a woman among the inventors (Perrin & Merouani, 2024b), women are less likely to be credited than men in science (Ross et al., 2022), and gender gaps persist in many other dimensions (Frecheville-Faucon et al., 2024).

Studies that have empirically analysed these issues have mainly focused on countries that were already largely industrialised in the nineteenth century, but little is systematically known about how much and how women contributed to industrialisation in countries that developed later and where gender gaps are even more pronounced today.¹ Italy certainly figures among these countries. Although Italy is now an industrialised country, its industrialisation started only in the 1890s, very slowly and geographically unevenly, and despite limited investment in innovative activities and scientific research (Nuvolari & Vasta, 2015b). Today, female labour force participation in Italy is among the lowest in the Organisation for Economic Co-operation and Development (OECD), even though the gender pay gap is lower than the EU average.² However, few comprehensive studies exist on Italian women's entrepreneurship. Gender stereotypes have long emphasised the low predisposition of women to innovation and entrepreneurship (Castagnoli, 2013; Curli, 2002). An important step forward was taken by Rinaldi and Tagliazucchi (2021), who analysed in detail Italian female entrepreneurs in executive-type jobs, focusing on the second half of the twentieth century, noting the large male dominance on the one hand and barriers in education, experience abroad, and managerial careers on the other.

Quantitative historical studies on this issue must come to terms with the fact that in the sources we have, it is easier to find low-skilled working women, or, in more recent historical eras, those in executive roles, but it is more difficult to find those in mid-level 'entrepreneurial' roles. For Italy, the use of micro-data derived from marriage certificates, family monographs and historical household budgets in the nineteenth and early twentieth centuries has paved the way for important advances in our understanding of female labour force participation (Freschi, 2024; Mancini, 2018), the determinants of gender differences in occupational mobility (Freschi & Martinez, 2024), and evidence of gender discrimination and gender segregation in time use (Mancini, 2023a, 2023b). According to Khan (2005), patents can be particularly useful to shed light on an otherwise invisible segment of women.

Building on these insights, this study examines female entrepreneurship with a focus on female inventors filing patents in Italy. Our definition of an entrepreneur concurs with the definition adopted in this special issue as a woman who 'identifies opportunities for business, takes risks (however small they might seem), assumes responsibility for decisions and seeks to make money' (Aston & Bishop, 2020, p. 5). Women innovators had to make risky business decisions with the expectation of making money, despite the uncertainty associated with the commercial success or failure of the invention. In addition, patents were an important way for women entrepreneurs to participate in the Italian economy (see section 3).

This paper offers a long-term perspective on the innovative activities of women in Italy by constructing a new database that includes all patents registered by women during the period 1861–1939. The particularly broad temporal coverage allows this study to also take into account the social and political upheavals that occurred during the first half of the twentieth century, such as educational reforms, changes in gender and family structure patterns, including those influenced by fascist propaganda, and geographical disparities in industrialisation, in order to understand their influence on the trends and changes observed in women's participation in innovative and entrepreneurial activities.

Institutions and gender norms in early twentieth century Italy

Differences between men and women are often socially constructed and subject to variation throughout history (Rose, 2010). According to the gender theory of Joan Scoot (1986), gender is a means for expressing and legitimising power. In Italy, there were significant legal barriers to individual female activity, including entrepreneurial activity. This was legitimised by a specific social construction of the role of women in a patriarchal society (see Zanolla, 1980 for a case study approach). Under the Pinanelli Code, introduced along with the Civil Code in 1865, women could not own property or engage in business activities, including holding an independent bank account, without the permission of their husband, or, if unmarried, their father. Widows were formally exempt from this authorisation requirement, but deceased husbands could always decide through wills how their property was to be administered in the event of their death. Women were also expected to take the surname and citizenship of their husband and to live where he decided. Inheritance was theoretically to be divided equally between the heirs, but in practice the norm was to give control of business and affairs to one son (Colli et al., 2003). Women were also prohibited from holding public offices, and the right to vote was not extended to women until 1946. The requirement of patriarchal authorisation and the denial on holding public office was only abolished in 1919.

Family structure varied greatly depending on whether one looked at rural or urban areas in the South or North. The extended family prevailed, with nuclear families often relying on the rest of the family for support (Willson, 2009). Agriculture, which remained largely traditional even in the 1930s, led to the maintenance of extended family structures (Federico & Martinelli, 2015). Marriages were primarily economic affairs especially for rural and working-class women (Barbagli, 2013), and divorce was not an option until it was legalised in 1970. Regardless of their marital status, most women had to work to support the family economy, leaving them little time to devote to parenting (Pescarolo, 2019). Khan (2016, 2020) notes that in nineteenth century France, family businesses – also common in Italy – provided women with important opportunities for innovation, despite existing institutional and social barriers. Building on sociological literature (Hajnal, 1982; Todd, 1990), Bertocchi and Bozzano (2015) find a correlation between the prevalent family structures of different parts of Italy and gender equality outcomes, such as regional patterns of gender education gaps. They identify four main family types in early twentieth and late nineteenth century Italy: nuclear families with partible inheritance and late marriage (North-West and Sardinia), authoritarian families with non-partible inheritance (or 'incomplete stem', in the North-East), authoritarian families with partible inheritance (or 'communitarian', in the Centre excl. Latium), and nuclear families with partible inheritance and early marriage (South and Latium). The authors suggest that gender equality is more pronounced in the North-West and Sardinia, where nuclear families with partible inheritance and late

marriage prevail. These characteristics are expected to provide women with a more advantageous and equitable position within the family and society compared to the other family systems.

Recent studies have pointed to the perpetuation of educational inequalities between men and women in Italy since 1815 (Ciccarelli & Weisdorf, 2019; Martinez, 2024), although educational reforms have played an important role in closing these gaps, in particular the Daneo-Credaro public school reform of 1911 (Cappelli & Vasta, 2021). The Gentile school reform of 1923 introduced an elitist female high school, much criticised by feminists of the time for the masculinist principles that inspired it (De Grazia, 1993, p. 153). This reform extended the period of compulsory education to five years for both men and women, but drastically reduced the female secondary school and University enrolment (Pescarolo, 2019, p. 398).

The Fascist period is usually seen as particularly male-dominated and openly hostile to gender equality, and not by chance: demographic propaganda was strongly natalist, and Fascist ideology was misogynistic and opposed to women working outside the home (Macciocchi, 1979; Meldini, 1975; Willson, 2009). A limited number of studies have attempted to better understand the actual scope of such propaganda messages within women's life experiences. De Grazia (1993), Dau Novelli (1994) and Curli (2015) have observed some tensions towards modernity, with the emergence of extra-party oppositions, more education, and with new voting rights, albeit limited to local elections (see also De Grand, 1976). Mancini (2023b) studied the gendered division of labour in rural Fascist Italy, observing that in the 1930s women worked much both inside and outside the home, within a still strongly patriarchal society.

Another factor that may have influenced the patterns of female patenting activity in late nineteenth and early twentieth century Italy is industrialisation. The debate over the effects of industrialisation on gender outcomes has been particularly lively. In industrialising Britain, data on statures, nutrition, and expenditures have been used to show that women were disadvantaged in the allocation of household resources (eg Horrell & Oxley, 2013, 2016; for Fascist Italy: Mancini, 2023b). In industrialising Southern Europe, a growing body of literature is measuring the extent of excess female mortality, or 'missing girls', related to pro-boys biases (Beltrán Tapia & Szołtysek, 2022; Szołtysek et al., 2022). For Italy, Beltrán Tapia and Cappelli (2024) found a 2–3% of excess female mortality in the period 1861–1921 due to female neglect in infancy and childhood.

The Italian economy underwent structural changes in the late nineteenth and early twentieth centuries. Figure 1 shows that the industrialisation of Italy really took off in the 1910s (panel a), although signs of progressive industrial development can be traced back to the late nineteenth century (panel b). This economic transformation may have encouraged more women to patent, particularly in regions with a higher concentration of industrial activity. Additionally, it may have affected female patenting activity by shifting the labour force towards more industrially oriented sectors and altering the sectoral composition of female patents as a result.

Patenting in liberal age and fascist Italy

Patents provide a very useful index of inventive activities because they are comparable over time and space.³ Nevertheless, each national innovation system has different institutional characteristics which may explain the differences in use between different countries. The

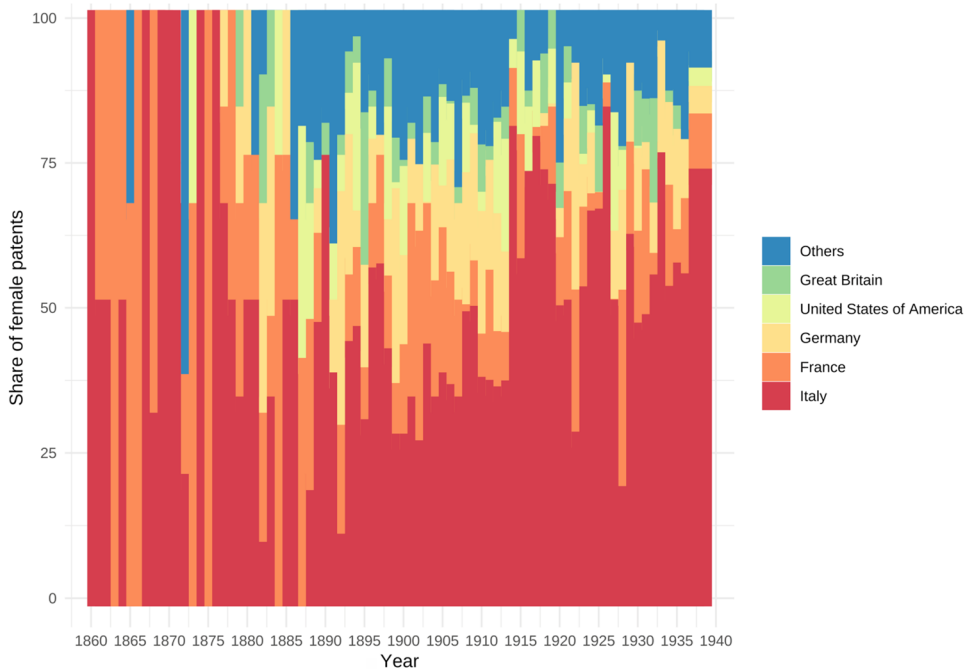


Figure 1. Contribution of each country to the share of Italian female patents, 1861–1939.
Note: Own elaboration of Italian patent data.

Italian patent system was established by Law No. 1657 of January 31, 1864 (No. 24), which extended the Piedmontese patent law to the whole country without major changes. The Italian patent law then remained essentially unchanged between 1864 and 1939, with the sole exception of the new Law of 1923 (R.D. 23 July 1923 no. 1970). According to this law, patentees could no longer decide the patent duration, which was set at 15 years, and made the annual renewal fee fixed. Apart from these formal differences, even this reform left the system essentially unchanged. The duration of patents is often used as a measure of the quality of the invention as perceived by the inventor: patents with longer duration are more expensive for the patentee, so they should be of higher quality. Duration lends itself particularly well as an indicator of quality in Italy because, until 1922, inventors were required to specify the exact number of years for which they wished to protect their invention, rather than choosing a discrete value between 5, 10, and 15 years as in France. We can use the duration as a measure of quality only until 1922, when all patents were granted for 15 years from the start under the new Law.

Three main factors made the Italian patent law particularly 'democratic' (Khan, 2005) and, in principle, open also to female inventors with few financial resources and who faced particularly high transaction costs, such as the need of marital authorisation. First, an inventor was free to choose the duration of the patent, which ranged from one to 15 years. Second, the monetary cost required was lower than in other European patent systems, although higher than in the United States (Nuvolari & Vasta, 2015a, p. 863). The patent law also specified a clear fee for each patent typology, with costs increasing proportionally with the patent duration. For example, a one-year patent costed 50 lira (about 400–500 euros in 2024 prices). A ten-year patent costed 800 lira (100 lira in initial fees plus 700 lira in annual escalating

renewal fees). Third, as in France and Sweden, the system was registration-based, so it did not select inventions based on the novelty of the ideas or who the actual inventor was. As a result, inventions imported from abroad could be registered by Italian ‘inventors’. The first patent registered by a woman (no. 1064, year 1861) Rosa Predavalle of Genoa, was indeed an import patent. The title of the patent was ‘armonitone, that is, a piano with sordino’. Finally, the system was ‘democratic’ towards foreign inventors, as it did not discriminate against patents registered by inventors residing abroad. The first of these foreign patents was registered in Italy by two women from Paris, Josephine Sisco, and Marie Sisco, who imported a ‘system of pipes for cleaning guns and cannons’ (patent no. 1364, year 1862).

These characteristics are important in explaining trends in Italian patents. For example, most inventions registered in Italy are registered by foreign inventors (see Martinez et al., 2025) and this is true also for female patentees (see Figure 2). Although Italian female inventors accounted for an increasing share of patenting and the low number of female-linked patents in the 1860s and 1870s made the shares volatile, a significant share, ranging from about 25 to 60 per cent of patents, was filed by foreign residents.⁴ There were no substantial differences in the industry composition of Italian and foreign patents, although Italian inventors patented more in the domestic sector and less in the engineering-oriented industrial and transportation sectors (see Appendix Figure A4). The Italian patent system also had other notable peculiarities: it allowed firms to register their patents directly; it unfortunately did not contain systematic information on the occupations of patentees, and it did not contemplate a description of the prior art through citations, unlike in the United States of America (Berkes, 2018).

Sources and data

The main data source of this study is the complete series of about 330,000 patents registered in Italy from 1861 to 1939 (see Martinez et al., 2025). The historical sources for this dataset

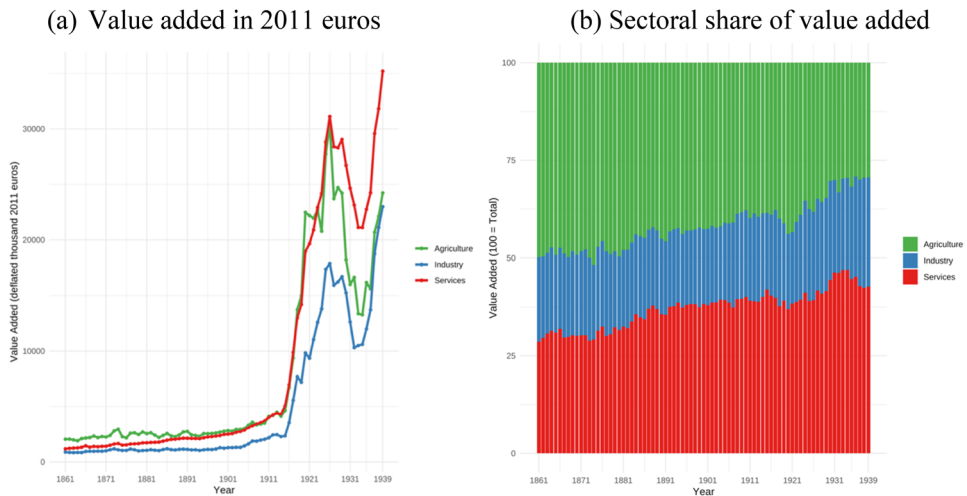


Figure 2. Italian value added in agriculture, industry and services, 1861–1939. (a) Value added in 2011 euros. (b) Sectoral share of value added.

Note: Own elaborations of Baffigi (2013b) data.

are the official serial publications of the Ministero di Agricoltura, Industria e Commercio (MAIC). This data-set is not a sample (Nuvolari & Vasta, 2017), but it contains the full set of patents issued in Italy from Unification until WWII.

Each patent entry contains the following information: the place of residence of each patentee, the date on which the patent was applied for (*data di deposito*); the date on which the patent was granted (*data di rilascio*); the official patent number in the register; the name(s) of the patentee(s); the province of residence of the Italian patentee(s); the country of residence of the patentee(s); the initial duration of the patent; the number and duration of the extensions (*prolungamento*) of the patent; the patent typology (*ordinaria, rivendicazione, prolungamento, importazione, riduzione, and completo*); a short description of the invention; and one of the 25 technological categories (ie electronical, chemical, etc.) in which the patent was classified by the Ufficio brevettuale.

To identify female inventors, I assembled a database of 258,000 Italian and foreign female first names based on name dictionaries and linked them to the names of patent holders. The resulting linkages were then manually cross-checked to ensure the correct selection of female patents.⁵ The manual checking of the linkages was crucial to ensure a correct selection of patents filed by women, as some historically used names have now disappeared or are very rare, such as Ersilia (patent no. 312017, 1933), Melvenia (patent no. 306634, 1933), Eufrazia (patent no. 3081, 1869), or Marcantonina (patent no. 4511, 1873). Patents registered exclusively by men only are included in this paper for comparison. The patents were further classified according to other variables derived from the patent database: the marital status of the women (coded as married if the patents contain both the maiden and the husband surname, eg 'Fisher Emy *nata* Langemann'), the type and number of collaborations, the number of inventions registered by each individual female inventor, the technological class to which the patent belongs according to the scheme of Khan (2024), and the duration of the invention, starting from which a patent is considered to be of high quality if the duration is of 10 or more years and of low quality otherwise, following a well-established literature (for Italy, Martinez et al., 2025; Nuvolari & Vasta, 2015a, 2017).

The sources have two main limitations concerning their ability to measure female entrepreneurship as defined in the introduction. The first relates to the categorisation of married women. 53 patents (2.8% of the total female-linked patents) were filed by women together with men who shared their surname. From the source it is not possible to say with certainty whether they were married or not to the men with whom they shared the surname. Rather than assume that such women were married, such patents are categorised as filed by a woman together with a male relative. This choice may underestimate the share of married patentees, but only marginally so: only about 3% of female-linked patents have male co-inventors with the same surname. The second methodological limitation concerns the gender categorisation of unisex names. The Italian names all had a clear gender identity at the time, but unisex names were used instead to some extent by foreign patentees (eg Camille, Dominique, Clarence). In order to avoid misclassifying the gender of patentees, such cases are excluded from the female patent database. Including them would have resulted in a total of 1,920 female patents, of which 42 (2.1%) are likely to be misclassified due to ambiguous first names. After correcting for the measurement error due to linkage (estimated at around 2.1%), the resulting database contains 1,878 (=1,920–1,942) female patents.

Inventions and female innovation

This section presents the main patterns of Italian female patenting activity and compares them with the results available in the literature for other countries. Women have always registered far fewer patents than men over the period 1861–1939 (Figure 3). Nevertheless, the number of female inventions grew following a very similar trend to that of men. Similar growth rates between men and women were also observed in France between 1791 and 1900 (Merouani & Perrin, 2024b) and in the United Kingdom for much of the period between 1800 and 1900 (Khan, 2024). In Italy, the net increase in the rate of innovation remained constant in the 1880s, although it increased in France and the United Kingdom, arguably because the innovative transformations associated with the Second Industrial Revolution occurred later and more gradually in Italy.

Figure 4 offers gives us a glimpse of the long-term trends of female inventive activities in Italy during the second half of the nineteenth century and during the first half of the twentieth century by showing the gender patenting gap, defined as the ratio between the number of female-linked patents and the total number of patents registered in Italy (in percentage terms). The Italian gender patenting gap over the period 1861–1939 is 0.72% – 0.80% for patentees resident in Italy and 0.70% for patentees resident abroad. This is lower than for the United Kingdom over the period 1800–1930 (around 2.5%: Khan, 2024, pp. 7–8), France in the second half of the nineteenth century (1.6%: Merouani & Perrin, 2024b), and ongoing work for Nazi Germany (1.5% in 1933: Donges et al., 2025, p. 34), and for the United States (rising from 1 to 5% in the period 1845–1924: Andrews, Berkes & Nur Gozen, 2025, p. 16).

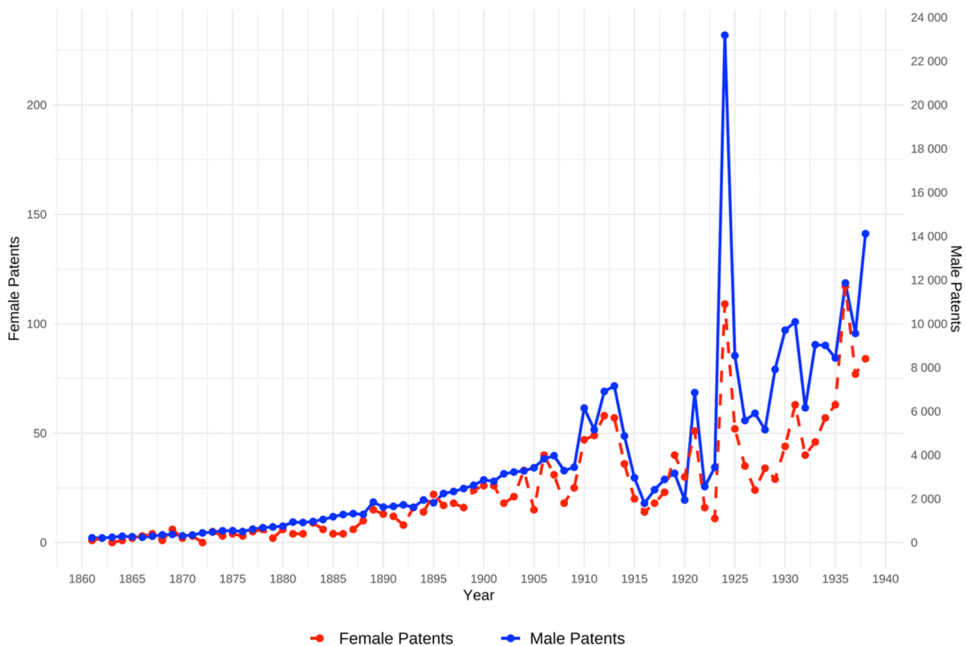


Figure 3. Number of patents filed by women and men, 1861–1938.
Note: Own elaboration of Italian patent data.

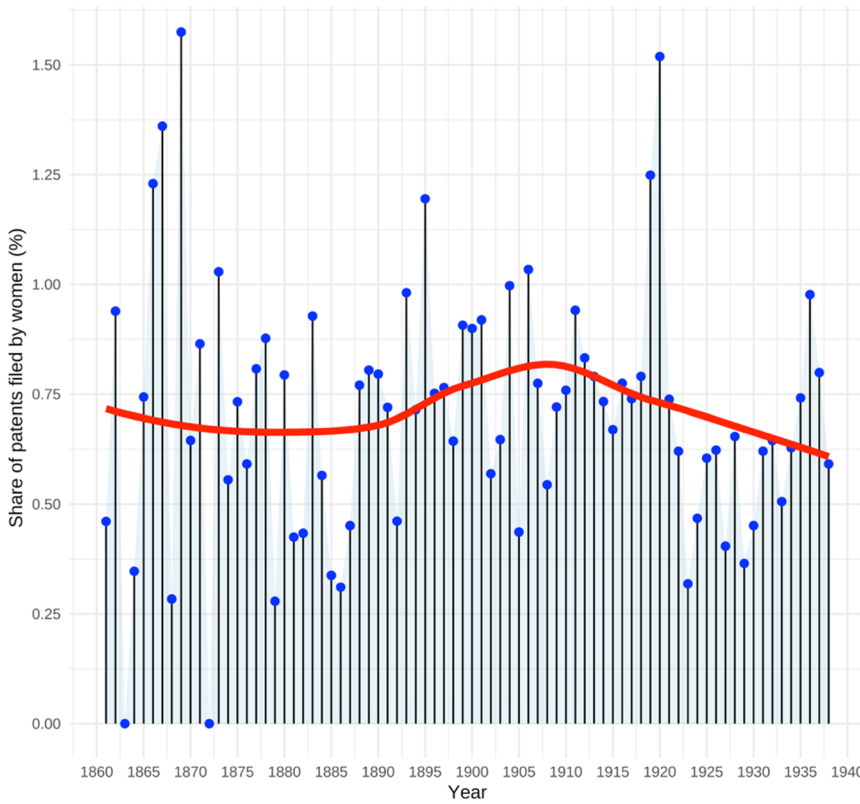


Figure 4. Gender patenting gap in Italy, 1861–1938.

Note: The gender patenting gap is calculated as the ratio between the number of female-linked patents and the total number of patents (in %).

Unlike for France, where this patenting gap remains very stable in the second half of the nineteenth century (Merouani & Perrin, 2024b, p. 9), in Italy it appears to be variable over time. During the first signs of industrialisation in the 1890s and 1900s we can observe a slight increase in the share of women patenting. From 1920 to 1939, the share of female inventors decreases again, and the growth rate of female innovation becomes lower than that of men (see Figure 5). This divergence between male and female innovation rates was already partly present in the Giolitti era (1903–1914), but much less pronounced. The divergence was reduced during World War I, probably due to the ability of women to develop inventions suitable for the wartime economy, such as the ‘campaign tent’ patented by Francesca Giuseppa Sillani, the ‘fuel economizer’ patented by Lina Holzer, or the ‘apparecchio lancia-bombe’ (bomb-throwing apparatus) by Demetrio Maggiora and Marie Anne Clarke.⁶ Finally, the gender patenting gap backfired during the Fascist period, with a steady downward trend in the share of female inventors, reaching its minimum for the entire 1861–1939 period in 1939. This decline in female patenting activity in the Fascist period is also statistically significant (see Table A1 in the Appendix). Although it could be attributed to the reform of the patent system in 1923, this is unlikely, as the reform left the system essentially unchanged. For this reason, in the following section I will try to go into more detail and explain more plausible reasons for the observed patterns in the gender patenting gap. In particular, I will

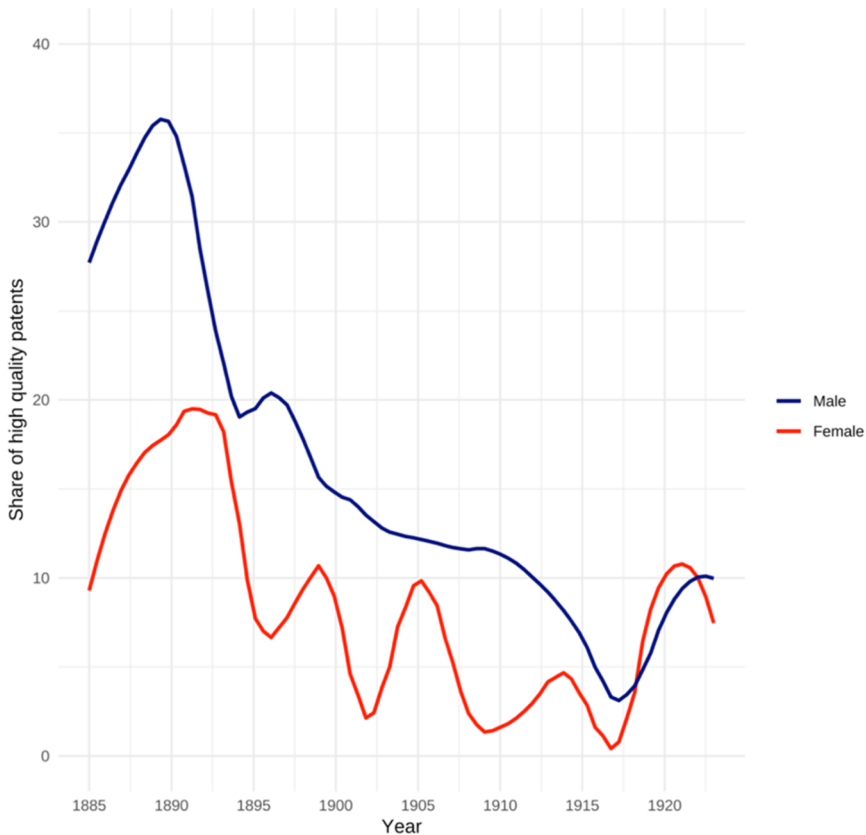


Figure 5. Share of high-quality patents (duration of 10 years or more).
Note: Elaboration of the patent data using a lowess (span = 0.25) smooth interpolation.

focus on the main factors discussed in the previous sections and related literature: supply-side social and institutional characteristics such as marriage bars and family structure, and demand-side explanations related industrialisation and the sectorial composition of inventive activity.

Explaining the patterns of the Italian gender patenting gap

A first step in explaining the patterns of female representation in inventive activities can be to try to understand as much as possible who Italian female inventors were, and whether their demographic and social characteristics have changed over time. [Table 1](#) summarises some of these characteristics. The share of female inventors who have registered only one invention has remained stable at around 80%. There are more single patent holders in Italy than in the United Kingdom, France and the United States (Khan, 2024, p. 9), where these percentages ranged from 69% in the United Kingdom to 36.8% in France (see [Table 1](#), panel A). Multiple patenting required a greater investment in innovative capital and presupposed a greater interest in commercialising one's inventions (Khan, 2005, 2017). The fact that Italian women often invented only once may suggest that they were less confident that their inventions could have a commercial outcome. However, as we shall see, the quality of women's inventions was

Table 1. Characteristics of female inventors and inventions in Italy, 1861–1939.

<i>Panel A: number of inventions filed by each female patentee</i>								
N inventions	1861–1896		1897–1914		1915–1939		All periods	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
1	180	80.7	429	76.9	874	79.7	1,483	79.0
[2.3]	37	16.6	81	14.5	173	15.8	291	15.5
[4.9]	6	2.7	48	8.6	50	4.6	104	5.5
10+	0	0.0	0	0.0	0	0.0	0	0.0
Total	223		558		1,097		1,878	
<i>Panel B: marital status of the female inventor</i>								
Marital status	1861–1896		1897–1914		1915–1939		All periods	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Widow	28	12.6	41	7.3	68	6.2	137	7.3
Married	22	9.9	99	17.7	240	21.9	361	19.2
Unmarried	173	77.6	418	74.9	789	71.9	1,380	73.5
Total	223		558		1,097		1,878	
<i>Panel C: co-inventors</i>								
Co-inventors	1861–1896		1897–1914		1915–1939		All periods	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Female relative	4	1.8	7	1.3	14	1.3	25	1.3
Female other	9	4.0	14	2.5	24	2.2	47	2.5
Male husband	0	0.0	5	0.9	8	0.7	13	0.7
Male relative	1	0.4	17	3.0	26	2.4	44	2.3
Male other	27	12.1	70	12.5	129	11.8	226	12.0
No co-inventors	182	81.6	445	79.7	896	81.7	1,523	81.1
Total	223		558		1,097		1,878	
<i>Panel D: domestic and foreign inventors</i>								
Country	1861–1896		1897–1914		1915–1939		All periods	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Domestic	83	37.2	213	38.2	643	58.6	939	50.0
Foreign	140	62.8	345	61.8	454	41.4	939	50.0
Total	223		558		1,097		1,878	
<i>Panel E: high quality and low quality inventions</i>								
Invention quality	1861–1896		1897–1914		1915–1939		All periods	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
High	36	16.1	25	4.5	17	7.7	78	7.8
Low	187	83.9	532	95.5	204	92.3	923	92.2
Total	223		557		221		1,001	
<i>Panel F: independent and firm inventors</i>								
Invention quality	1861–1896		1897–1914		1915–1939		All periods	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Firm	9	4.0	15	2.7	17	7.7	41	4.1
Independent	214	96.0	543	97.5	1,080	92.3	1,837	95.9
Total	223		558		1,097		1,878	

Note: The total number of patents in panel E is lower than the total of the remaining panels because precise duration information is only available up to 1923.

similar to that of men. An alternative explanation could therefore be that the effort required both inside and outside of the household hindered intensive female patenting activity.

The proportion of married female inventors increased from 9% during the Liberal age (1861–1896) to 20% during the interwar years (1915–1939) (Table 1, panel B), but remained lower than in France (45%: Merouani & Perrin, 2024b, p. 13). Combined with the fact that

very few women patented jointly with their husbands (about 1%: [Table 1](#), panel C), this seems to suggest that marriage made it particularly difficult to engage in innovative activities, if only because of the legal difficulties associated with the denial of independence in business affairs that persisted until 1919, and later because of Fascist policies that were particularly hostile to women's participation in the skilled workforce. This interpretation finds support in the fact that in France, where the proportion of married female inventors was higher than in Italy, most institutional constraints against the independent economic activity of married women instead were already lifted in the late nineteenth century.⁷ In her pioneering study of Italian single women, 'Donne sole', Palazzi (1997) notes that single women living in cities were quite independent in their own choices. In rural areas, in contrast, the ability of women to exercise authority depended on their seniority and the centrality of their position within the extended family.

Regarding collaborations with other inventors, about 3% of female inventors have registered patents with other female inventors, more than half of whom share the same surname ([Table 1](#), Panel C). This percentage rises to about 15% for collaborations with men, of whom only 2.3% share the surname with female inventors. About 82% of female inventions are registered by individual female inventors, in line with the UK share (76.5%) and slightly lower than the US share (92.4%) (Khan, 2024). The number of collaborative patents remains very stable over time. The number of patents registered by foreign women is around 60% between 1861 and 1914, in line with the strong presence of foreign inventors in Italy. In contrast to total patents, however, it can be observed that the number of inventions registered by foreign women in Italy during the inter-war period falls sharply to 38% (see also [Figure 1](#)). This decline does not occur for patents registered by men (Martinez et al., 2025), and, given the magnitude, may partly explain the decrease in the representation of women inventing observed during the Fascist period.

As introduced in the section 2, Khan (2016) noted that family businesses loosened the constraints that made it particularly difficult for a woman to patent. Italian women did not however file many patents through firms and female inventors are mostly independent, in line with the general patterns of Italian invention (Nuvolari & Vasta, 2015a). Only a percentage ranging from 3 to 9% of women registered patents in the name of a firm ([Table 1](#), Panel D). In the Italian case, therefore, family businesses seem to play a less important role than in France in enabling women to invent more. However, it is possible that additional female entrepreneurs have contributed to family businesses patents (as well as to patents registered by their husbands) without being acknowledged through patent ownership and thus remain 'invisible' in patent records.

To understand the decline in the share of female inventors that occurred during the twentieth century, it is necessary to look not only at changes in the quantity but also at changes in the quality of inventions. According to the quality indicator represented by the duration of patents, there are no substantial differences between inventions registered by men and women in Italy. The share of women's patents with a duration of 10 or more years is about 8% ([Table 1](#), Panel D), thus slightly lower than the average of male-only patents, which is about 12% ([Figure 5](#)). Although the difference between in patent duration between men and women is statistically significant (coefficient = -0.014: see [Table A1](#), column 4 in the Appendix), such small quality differences gradually decrease until they disappear (see [Figure 5](#)). The fact that the differences in duration decrease from the 1920s onwards lends support to the intuition that legal discriminatory practices hindered female patenting

activity, as it may be explained by the fact that until 1919, women had to seek permission from their husbands to do their own business. The abolition of marital authorisation removed an important resource constraint, which may explain why the difference in duration that existed until then also disappeared.

Demand-related factors related to industrialisation seem to best explain where and why we see female innovators in Italy. In terms of sectoral composition of the patenting activity, patents are very diverse by industrial sector (Figure 6). The sectors with the highest number of patents granted to women industrial and related to machinery and transportation, followed closely by patents related to textile and clothing improvements and related to the household. The large share of female patenting in industrial sectors supports the hypothesis that the composition of female patenting activity closely reflected the demand of an industrialising country. The proportion of patents in each sector remains fairly constant over time, except for a slight increase in the share of patents related to transportation and machinery between 1915 and 1939, which can be explained by the greater involvement of women in war-related patents during World War I (see Figures 6 and 7). The capacity of women to invent largely in sectors outside of the domestic sphere is not new (Gage, 1888; McGaw, 1997; Stanley, 1995), but it is important to emphasise that also ‘feminine technologies’ also have their own importance, and feminist theories of technology have conceived technology both as a source and a consequence of gender relations (Wajcman, 2010).

The positive trend of Italian industrialisation seems to coincide with the increase in female patenting output and in its quality, supporting the idea that industrialisation may have affected not just the sectoral composition, but also the quantity of female patenting output (compare Figure 1(a) with Figure 3 and Figure 4). However, this association between

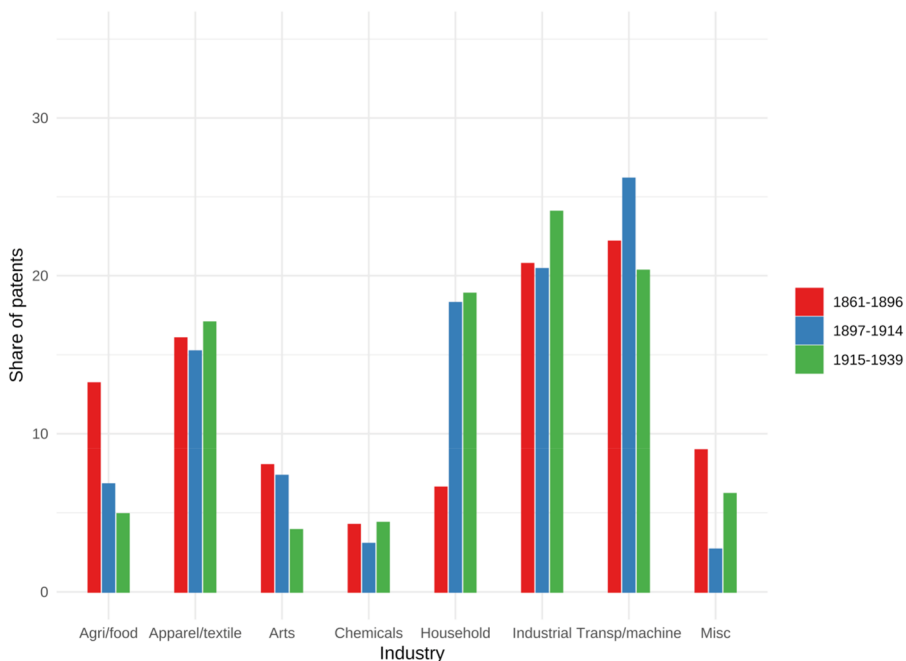


Figure 6. Female patents in by industrial sector (in %), 1861–1939.

Note: The Industry classification follows Khan (2024).

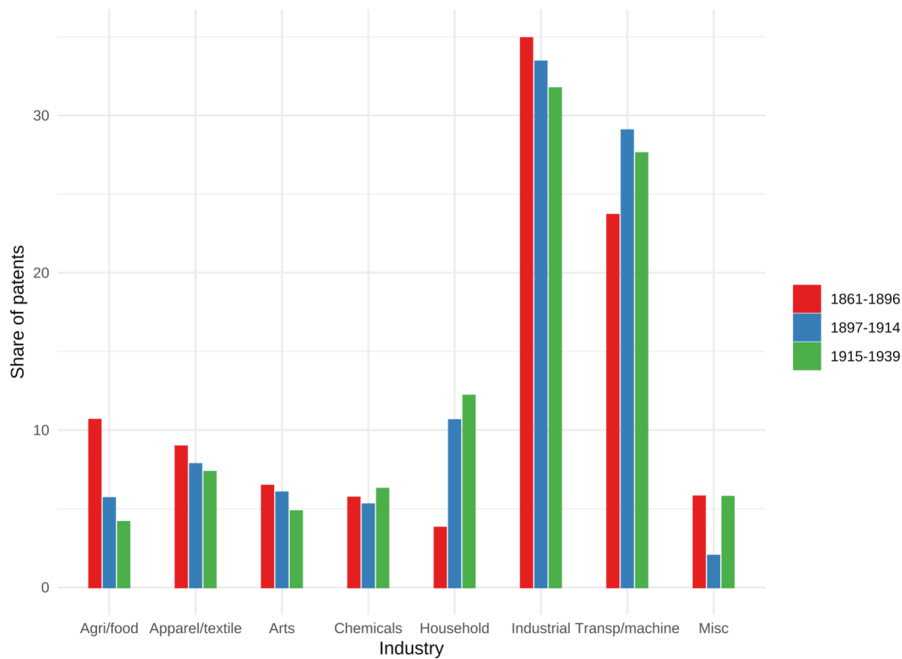
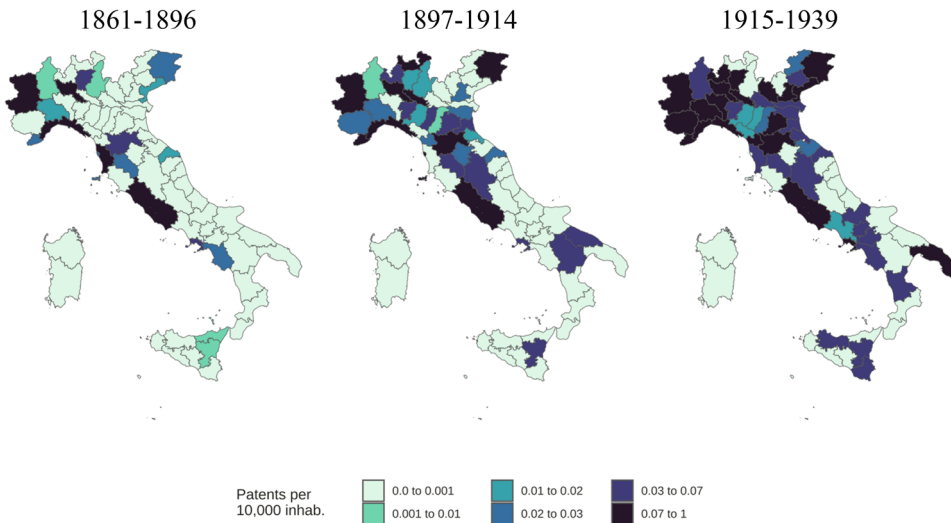


Figure 7. Male patents in by industrial sector (in %), 1861–1939.
Note: The Industry classification follows Khan (2024).

industrialisation and patenting activity should be also assessed from a geographical perspective, as Italian innovation patterns are highly heterogeneous in spatial terms. Although we know that differences in innovative activity closely follow regional disparities in the level of industrialisation (Martinez et al., 2025; Nuvolari & Vasta, 2017), it is not known such disparities are also reflected in provincial differences in the level of female entrepreneurship. Figure 8 shows the intensity of female innovation in the Italian provinces and supports the role of industrialisation in explaining women’s patenting activity, showing that it is quite widespread across the country. This evidence challenges the family systems thesis, as patenting is more concentrated in industrialised provinces rather than in specific macro-areas like the North-West and Sardinia, which Bertocchi and Bozzano (2015) argued to be characterised by family structures particularly favourable to women.

Figure 8 further highlights that female innovation is much more geographically dispersed than total innovation: Apart from the provinces of the ‘industrial triangle’ (Milan, Genoa, and Turin) and large cities such as Rome and Naples, other particularly innovative provinces can initially be observed, both in terms of female patents per capita (panel A) and the share of female patents in total patents (panel B): Udine and Bergamo in the North, Pisa and Florence in the Centre, and Salerno in the South. All these provinces had a strong vocation for textile and silk processing (Florence, Pisa, and Udine) or cotton processing (Bergamo and Salerno) (Ciccarelli & Fenoaltea, 2013; Freschi & Martinez, 2024; MAIC, 1890). The large percentage of female patents registered in the textile and apparel sector may explain this heterogeneous geography of early Italian female innovation. In later periods female innovation diffuses and intensifies in provinces indexed by Ciccarelli and Fenoaltea (2013) as ‘gainers’ of Italian industrialisation: Capitanata and Lecce in Apulia, Catania and Siracusa in Sicily, and many provinces

Panel A. Per capita patenting activity



Panel B. Female patents over total patents of each province

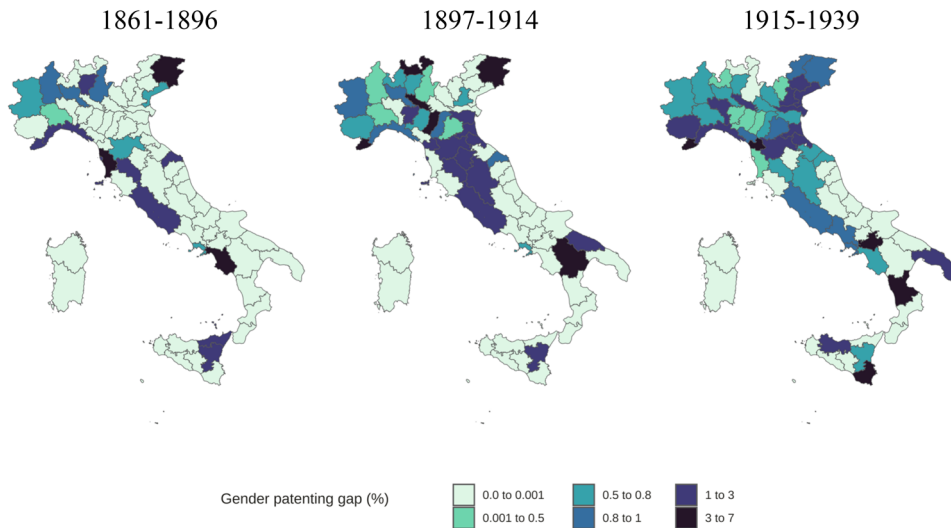


Figure 8. Geographical distribution of female inventive activity. Panel A. Per capita patenting activity. Panel B. Female patents over total patents of each province.
Note: Population data are taken from national population censuses.

of Emilia Romagna and Veneto. ‘Losers’ of Italian industrialisation, such as Salerno and Pisa, lose their primacy in female invention.

To summarise the key findings and compare the role of supply and demand factors, I adopt a probit regression analysis. The analysis explains the propensity of women to patent with the following explanatory factors: Fascism (Year \geq 1922), marital status, place of residence (Italian vs. foreign), patent quality (patent duration), and industrial sectors (see [Table A1 in the Appendix](#)). The regression results suggest that the propensity of women to patent is statistically lower in the Fascist period. Supply-side factors proxied by marital status do not seem to explain patenting activity once quality differences between male and female patents are considered.

Instead, the probit analysis supports the fact that demand-side factors related to industrialisation can explain female patenting activity. Although women are statistically more likely than men to patent in sectors related to textile, clothing and the household (see [Table A1 in the Appendix](#)), there are many patents from industrial ‘male’ (Lerman et al., 2003) sectors such as those related to engineering, especially mechanical and civil (see [Figure 6](#)). This suggests that, although there were few female inventions, the composition of women patenting followed the demands of an industrialising country. This fact cannot be explained by the influence of marriage on patenting in ‘male’ sectors: although in the industrial sector more patents are registered by married women than by unmarried women, similar differences between married and unmarried inventors also exist in sectors such as textiles and household (see [Appendix Figure A2](#)).

Conclusion

This paper provided a reconstruction of female innovation, as measured by patents, in twentieth century Italy as it underwent major changes due to factors such as industrialisation, World War I, and Fascism. In the period 1861–1939, there were strong family, legal, educational, and gender barriers that resulted in less than one female inventor for every 100 male inventors obtaining a patent. The low proportion of patents registered through family enterprises suggests that family businesses were less of a means for Italian women to innovate than in other contexts such as France (Khan, 2016). This paper also shows that during the 1920s and 1930s, the share of female inventors fell significantly. This is even though in 1919, the need for male authorisation for women to conduct business was abolished. The analysis presented in this paper also suggests a technically advanced character of Italian female invention. In fact, the average patent quality of patents registered by women patents increased over time and matches that of men in the 1920s. Moreover, female innovations often belonged to high-tech industries such as the industrial and machinery sectors.

In attempting to understand what the driving factors behind women innovation were and why we see fewer women innovators in the Italian twentieth century than in more industrialised countries such as France, the United Kingdom and the United States, a fundamental role can arguably be attributed to country-specific demand-side factors related to industrialisation and Fascism. Despite the sizeable growth in aggregate output of Fascist Italy (Baffigi, 2013a, 2013b), the reality of women’s work experiences often clashed with the ideological and policy objectives of motherhood and household management. The women’s labour force participation was either stable or increasing, particularly in agriculture (Mancini, 2018, 2023b). And yet, in line with the findings of this paper, Gabbuti and Gómez León (2024) find that working conditions for women became more difficult under Fascism: the gender wage gap began to increase, marking a sharp reversal of the long trend of decreasing gender wage gaps of the Liberal Age. Moreover, the corporatist legislation of the Fascist regime made employers particularly capable of exploiting their employee’s inventions and to claim the authorship of such inventions, as documented by Gabbuti et al. (2024, p. 23). Supply-side considerations, such as marriage bars and educational reforms, do not seem to have played a significant role: although Fascist reforms extended the years of mandatory primary education, they also hindered the access of women to higher education.

This paper seeks to contribute to the literature explaining changes in women's involvement in business, but also agrees with Mancini (2022) that much research remains to be done in this regard for Italy. First, the explanations offered for the decline in the share of female inventors could be enriched with case studies that examine whether female patents were more targeted at female users, and the role of more specific factors, such as changes in gender norms during Fascism and demographic changes related to the number of married women in the twentieth century. There is also a need for comparative studies comparing trends in female entrepreneurship in Italy with those in countries that have had different trajectories of industrialisation and gender inequality, such as France. This would also help to understand, for example, whether the observed decline in the female patenting activity in the first half of the twentieth century is specific to Italy or to authoritarian regimes, or whether it is part of a wider trend.

Notes

1. An important exception are the studies by Bernardita Escobar Andrae (2015, 2017) on the contribution of female entrepreneurship in nineteenth-century Chile. The share of female inventors in Italy was of just of 4.4% in 1985 and reached an average level of 14% in the years 2010–2019 (Di Addario et al., 2024).
2. OECD (2017) for labor force participation and Eurostat (2022) for gender pay gaps. See also Del Boca and Giraldo (2013) and Mancini (2018). The gender pay gap indicator is calculated by pairing male and female workers with similar employment conditions and characteristics but on the basis of hourly wages, so it does not take into account the different number of hours worked between men and women: in 2020, men worked an average of 38 h per week compared to 32 h per week for women (Istat, 2020). Mancini (2022) offers a review of the state of the art on gender inequality in Italy, and Dilli et al. (2019, 2021) offer a global historical perspective on the patterns of gender inequality since 1900.
3. As Griliches (1990) observed, because the number of patents is often large compared to macro-inventions, 'patent statistics loom up as a mirage of wonderful plentitude and objectivity' (id., 1661). Additionally, many important innovations were not patented: Moser (2005) found that of the 1851 Crystal Palace world's fair innovations, only a small share were patented. Using data from the Turin international exhibition of 1911, Domini (2020) finds that most exhibits were commercialized products without an innovative content.
4. The main analysis of this paper considers both Italian and foreign inventors while focusing on the gender gap within Liberal and Fascist Italy for three main reasons. First, foreign patentees who resided abroad but patented in Italy can still be considered relevant contributors to the Italian economy. Second, not all inventors living abroad can be classified as foreign, since residence is recorded only at the time of each patent application and between 1876 and 1914, 14 million Italians emigrated (Gomellini & O'Grada, 2011, p. 271). Third, previous studies on female inventors have included both domestic and foreign inventors, making it important to adopt a similar approach for comparability of gender gaps. Nevertheless, the paper also presents the key findings specifically for Italian residents. Figure A1 in the Appendix illustrates the share of female patents among this group, showing that the Liberal period is marked by stronger growth in female patenting activity, whereas the Fascist period reflects a remarkable stagnation. Additionally, the analysis examines Italian residents in terms of socio-demographic characteristics (Table 1, panel D), industrial sectors (Figure A4 in the annex), and geographical dimensions of innovation (Figure 8).
5. The main name dictionaries used in this study have been Rossebastiano and Papa (2005) for Italian first names and the U.S. name census for foreign first names. The linkage has also been cross-checked with the about 730,000 first names spanning 106 countries obtained from Facebook users.

6. Demetrio Maggiora and Marie Anne Clarke, patent no. 151345 of 1916; Francesca Giuseppa Sillani, patent no. 158245 of 1918; Lina Holzer, patent no. 165995 of 1918.
7. In 1881, French women obtained the right to open a bank savings account without the assistance of their husbands; a law of 1886 extended this right to make the husband's consent unnecessary; a law of 1907 allowed women to dispose freely of their own earnings; finally, divorce was reintroduced in 1884 and the divorce law was further liberalised in 1904. McMillan (2000, pp. 152–153).

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Appendix. Further results

Table A1. Determinants of female patenting in Italy, 1861–1939.

	<i>Dependent variable:</i>			
	Female-linked patent (0/1)			
	<i>Probit regression</i>			
	(1)	(2)	(3)	(4)
Year ≥ 1922	−0.108*** (0.016)	−0.156*** (0.018)	−0.165*** (0.018)	−0.284*** (0.080)
Married		5.388*** (0.321)	5.391*** (0.326)	7.770 (29.574)
Patentee residing abroad		−0.233*** (0.018)	−0.223*** (0.018)	−0.104*** (0.027)
Duration (years)				−0.014*** (0.004)
Sectors				
Apparel/textile			0.237*** (0.044)	0.199*** (0.056)
Arts			−0.006 (0.052)	−0.033 (0.066)
Chemicals			−0.115** (0.056)	−0.182** (0.078)
Household			0.131*** (0.042)	0.146*** (0.054)
Industrial			−0.169*** (0.040)	−0.226*** (0.051)
Misc			0.001 (0.053)	0.040 (0.079)
Transp/machine			−0.107*** (0.040)	−0.132*** (0.050)
Num. Obs.	282,439	282,439	281,322	129,806
Pseudo-R ²	0.002	0.173	0.184	0.088

Note: Probit regressions. Standard errors are in parentheses. The omitted category for the sectors is Agri-food.

* $p < .1$; ** $p < .05$; *** $p < .01$.

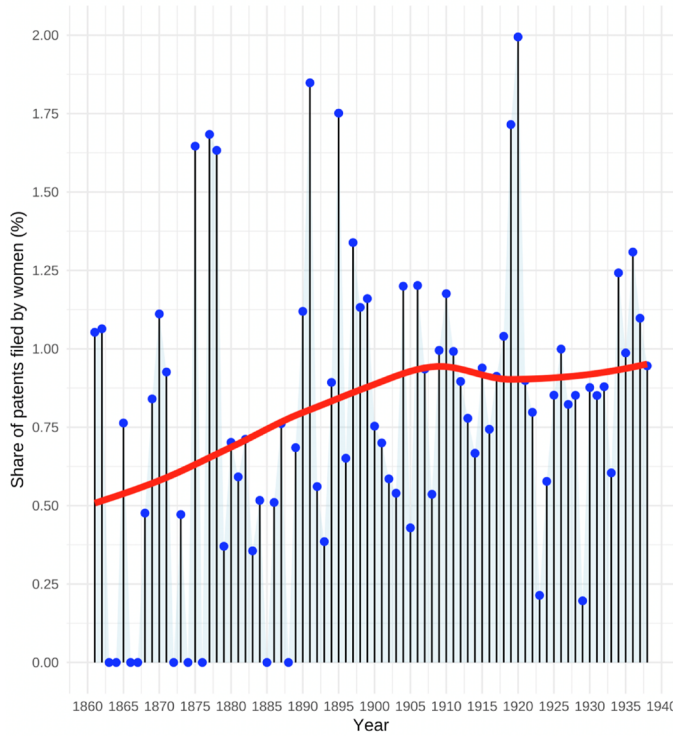


Figure A1. Gender patenting gap for inventors residing in Italy, 1861–1939.
Notes: The gender patenting gap is calculated as the ratio between the number of female-linked patents and the total number of patents (in %). Inventors residing in Italy are defined as inventors whose place of residence is located in Italy at the time of registering a patent.

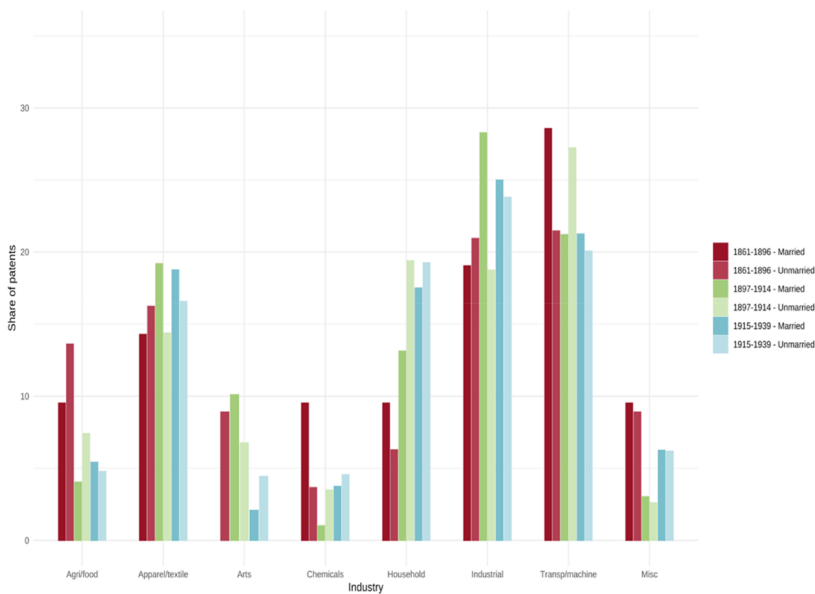


Figure A2. Female patents in by industrial sector and marriage status (in %), 1861–1939.
Note: The Industry classification follows Khan (2020).

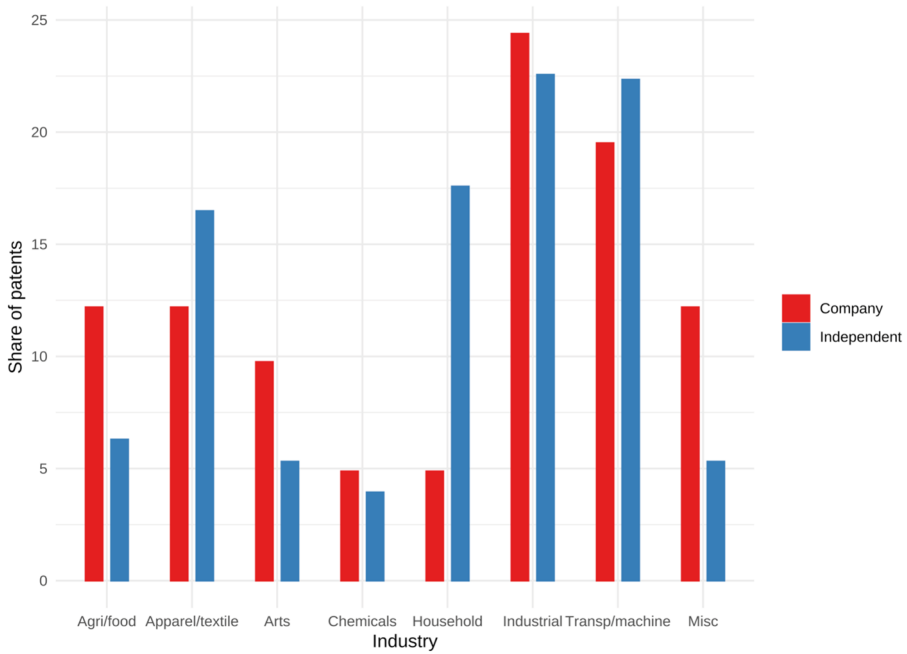


Figure A3. Female patents by industrial sector, for firms and independent inventors. Note: The Industry classification follows Khan (2020).

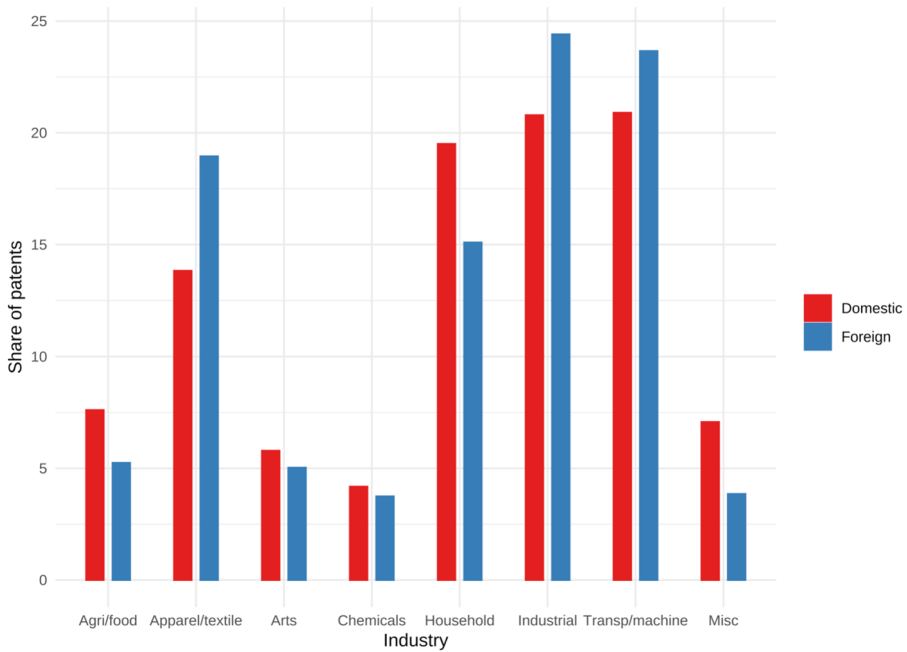


Figure A4. Female patents by industrial sector, for foreign and domestic patentees. Note: The Industry classification follows Khan (2020).

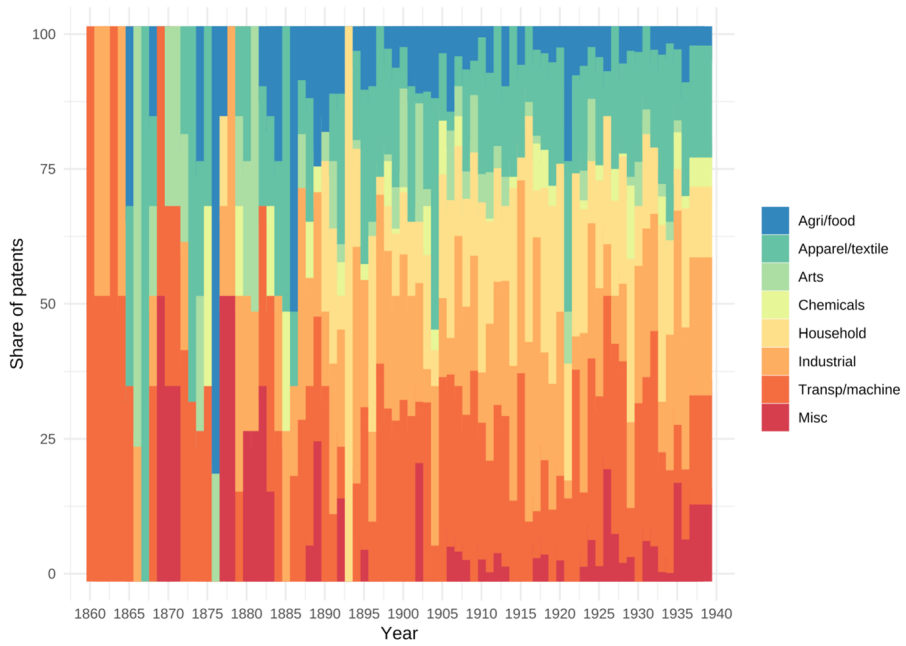


Figure A5. Share of patents in each industrial sector (female).

Note: Own elaboration of Italian patent data.