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Measuring female discrimination through language: a novel indicator and its effect on production efficiency in Italy

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Abstract

Purpose – While the economic literature mostly tackled discrimination looking at labour costs, this work focuses on its relation to labour productivity, arguing that discrimination may worsen the performance of female employees. In this view, it represents a source of allocative inefficiency, which contributes to reducing output.

Design/methodology/approach – Female discrimination is both a social and an economic problem. In social terms, consolidated gender stereotypes impose constraints on women's behaviour, worsening their overall well-being. In economic terms, women face generally worse labour market conditions. Using long-run Italian data spanning from 1861 to 2009, the authors propose a novel measure of female discrimination based on the observed frequency of discriminating epithets. Following social capital theory, the authors distinguish between structural and voluntary discrimination, and use Data Envelopment Analysis for time series data to assess the extent of inefficiency that each component of discrimination induces in the production process.

Findings – The results draw the trajectory of female discrimination in Italy and provide evidence in favour of the idea that female discrimination reduces productive efficiency. In particular, the structural component of female discrimination, although less sizeable than the voluntary component, plays a major role, especially in recent years, where more stringent beauty standards fuel looks-based discrimination.

Originality/value – The contribution of this work is twofold. First, based on contributions from social sciences different from economics, it proposes a novel theoretical framework that explores the effect of discriminatory language on labour productivity. Second, it introduces a novel and direct measure of female discrimination at the country level, based on the bidirectional link between language and culture. The indicator is easily understood by policymakers and may be used to evaluate the effectiveness of anti-discrimination policies.

Keywords Time series analysis, Data envelopment analysis, Labour productivity, Female discrimination

Paper type Research paper

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1. Introduction

Discrimination is a long-standing societal problem (Heath and Di Stasio, 2019). While it represents a concern *per se*, worsening the well-being of segments of the population, it also generates adverse economic consequences for society as a whole (Becker, 1961; Sedgley and Elmslie, 2018). One major category that has been suffering from several forms of discrimination throughout history is constituted by women, which count for about half of the world's population. Using the available metrics, the economic literature reports a large drop in female discrimination over the past century, especially in industrialised countries, where economic growth was paralleled by gradual female empowerment (Kleven *et al.*, 2019). Despite this declining trend, female discrimination remains a major societal challenge, whose extent features wide cross-country heterogeneity. This is especially true for Italy, a country where socially conservative stances and traditional gender roles are reinforced by the historical influence of the Catholic Church (Worthen *et al.*, 2017). This is an example of dominant culture, identified as one of the main causes of female discrimination (Carter *et al.*, 2019).

Several attempts have been made to measure female discrimination (Cea D'Ancona, 2017; Stoet and Geary, 2019). Most applied contributions adopted an indirect approach, aiming to deduce the extent of discrimination from societal outcomes. Some direct (or perception-based) measures of female discrimination have also been devised (see for example Umana-Taylor and Guimond, 2010; Cea D'Ancona, 2017), although they mostly relate to case studies. In general, the empirical literature is characterised by the lack of a direct measure of female discrimination that (1) allows for cross-country comparisons (standardisation) and (2) is not affected by the respondent's subjectivity (perception bias). Contributions from psychology and linguistics establish a bidirectional relationship between culture and language (Moradi and Rahmani, 2017), arguing that language represents an immediate expression of cultural traits, including prejudices and discriminatory stances (Ng, 2007). In particular, frequent usage of discriminatory words may subconsciously (i.e. through the structural component) lead speakers to internalise discriminatory attitudes and eventually induce discrimination. Linguistic discrimination, moreover, represents a source of stress for women in the workplace (Sczesny *et al.*, 2016).

Discriminatory language in this sense imposes a communication barrier between female employees and their co-workers. To overcome this barrier, female workers incur a psychological cost that worsens their productivity. In aggregate terms, lower productivity implies slower economic growth. In other words, discrimination induces an element of inefficiency in the production process. On the one hand, this theoretical framework produces equilibrium outcomes consistent with the predictions of economic theory. On the other hand, it tackles the economic consequences of discrimination by looking at labour productivity rather than labour cost (as originally proposed by the economic literature, see for instance Becker, 1961). This framework allows to identify insulting epithets targeting women as the basis for the measurement of female discrimination. Subsequently, the impact of female discrimination on production may be estimated.

Thus, the present work has two goals. First, it proposes the Historical Female Discrimination Index (HFDI), a novel and direct measure of female discrimination based on linguistic data that exploits the bidirectionality between language and culture. The HFDI is then decomposed into a structural component and a voluntary component. Second, aiming to test the idea that discrimination induces an allocative inefficiency, this work uses Data Envelopment Analysis (DEA) to assess the economic consequences of female discrimination.

From a methodological point of view, Italy is an interesting case study, since the Italian language is spoken almost exclusively in the Peninsula, allowing an almost perfect match between the language and the country. Moreover, Italy features a long history of discriminatory language (Ponterotto, 2014) that reflects an even longer history of cultural conservatism and traditionally established gender roles (Worthen *et al.*, 2017; Ioverno *et al.*, 2019). All these negative conditions are likely to worsen the productivity of female workers. Thus, we treat discrimination of as a driver of labour productivity.

The rest of this article is organised as follows. Section 2 outlines the theoretical framework of this analysis, drawing on contributions from economics, sociology, psychology and linguistics. Section 3 presents our background economic model. Section 4 presents the empirical strategy proposed. Sections 5 describes the dataset employed. Section 6 illustrates and comments the results considering the previous literature. Section 7 concludes.

2. Theoretical framework: language as a measure of discrimination

The economic literature has long tackled the problem of female discrimination. Both the pioneering contribution by Becker (1961) who treated discrimination as a *preference-based* phenomenon, and more recent works that introduced the notion of *statistical discrimination* (Fang and Moro, 2011) argue that discrimination rhymes with inefficiency. Factors such as limited access to education, lack of training on the job, as well as biases in hiring and promotion decisions determine various forms of inefficiencies, including market failures, lower employment and wage-productivity gaps, reduced productivity, slower economic growth and increased income inequality (Cavalcanti and Tavares, 2016; Tronson and Thew, 2019; Boring and Philippe, 2021). Ferrant and Kolev (2016) estimate that the loss in global income associated with female discrimination is about 16%. Similarly, according to the International Labour Organization (ILO), gender-based discrimination costs up to 10% of total GDP in some countries (ILO, 2018). Hunt *et al.* (2016) claim that bridging gender gaps in labour force participation, employment and wages could add $12tn to global GDP by 2025, a figure substantially confirmed by Woetzel *et al.* (2018). Neyer and Stempel (2021) show that, at the macroeconomic level, female discrimination induces more severe recessions in the face of demand shocks, crippling output and boosting the inflation effect of monetary policies. Overall, a clear consensus emerges from the economic literature on the fact that reducing female discrimination may produce significant economic benefits, including increased productivity, improved firm performance and higher economic growth (Shoreibah *et al.*, 2019).

Several metrics have been proposed to measure discrimination empirically, attempting to assess its extent by looking at its economic effects (Lane, 2016). The earliest contributions focused on wages (Becker, 1961; Oaxaca, 1973), but other creative approaches have been proposed (Villemez and Touhey, 1977; Toutkoushian, 1994; Vella and Oliveau, 2005). All these attempts represent indirect measures of the phenomenon. Sociologists break down discrimination into two components: structural and voluntary (Bourdieu, 1979; Re, 2006). The former is deeply rooted in culture and societal attitudes, creating a subconscious set of prejudices that inform individual action. The latter instead originates from a precise and contingent socio-political design aiming to marginalise some social categories. While voluntary discrimination is intentionally enforced by active subjects or by legislative provisions, structural discrimination derives from consolidated social norms that ultimately trace back to cultural categories (Phillips, 2019). The interplay between the voluntary component and the structural component determines overall discrimination, which in turn translates into both actions and words.

In the case of women, straightforward examples of discrimination-related actions/behaviours are observed with respect to several other aspects of social life, including labour market outcomes (Mihăilă, 2016). A vast literature, counting both theoretical and applied works, has already tackled these problems, as well as their economic consequences (see Lane, 2016 for a thorough review). Fewer studies have covered instead the role of discriminatory words (notable exceptions are Cotter, 2007; Agovino *et al.*, 2022), while even fewer have focused on the language of female discrimination. Linguistic research indicates that several language features may enforce and reinforce discrimination (Moscatelli *et al.*, 2008). Grammatical constructions, word order and lexical items are all examples of language characteristics that may contribute to establishing and reinforcing discrimination. According to the theory of Linguistic Relativity, every language contains and conveys views on society, and a certain amount of historical experience accumulated by the community of language speakers over the generations. These intrinsic elements of language guide the perception of reality in speakers (Whorf, 2012).

Lexicon is especially interesting in this view, since it represents the simplest and most straightforward instrument through which cultural categories materialise and are reiterated (Reisigl and Wodak, 2003; Agovino *et al.*, 2022). Insulting and derogatory terms in particular convey in an immediate fashion societal stances against certain social groups. Lexical discrimination has been analysed in empirical studies by looking at the usage of discriminatory epithets against women (see for example Carnaghi *et al.*, 2011). The fact that all modern languages contain a vast repertoire of epithets that characterise women in a negative way, focusing either on their looks or on their behaviours (Cruz, 2019) seems to confirm the global scale of female discrimination. Besides reinforcing negative stereotypes, linguistic discrimination represents a source of stress for women in the workplace (Sczesny *et al.*, 2016). The idea that language affects worker performance is not new (Dustmann and Fabbri, 2003). Most of the previous literature, however, has focused on language proficiency. In this view, communication (Bianchi *et al.*, 2008) – and more importantly *miscommunication* (Lang, 1986) – contributes to the determination of labour productivity. Discriminatory language creates a psychological cost burden that female workers must bear in order to interact with their colleagues. The effort put by women in order to overcome the psychological barrier created by discriminatory language worsens their productivity, thus decreasing economic efficiency at the firm level. In aggregate terms, lower productivity means slower economic growth. This entire theoretical framework is represented graphically in Figure 1.

3. Modelling the impact of discrimination on productive efficiency

Our model aims to explain the effect of female discrimination on labour productivity, assuming that female employment remains unaffected by discrimination. Specifically, we tackle the *downstream stage* of the labour market, focusing on employed women who face a discriminatory environment that reduces their productivity. Thus, we do not consider the *upstream stage* of the labour market, where skills are acquired. According to human capital theory, limited access to education historically worsened women's productivity, which may explain their worse labour market outcomes (see Kao *et al.*, 1994; Colander and Woos, 1997; Wu, 2007). Conversely, we assume, following some theoretical works (see for instance Borjas, 2012) and some empirical contributions (Oaxaca, 1973), that men and women feature the same productivity in the absence of discrimination. This assumption is also dictated by the lack of historical data on human capital endowments. Our framework departs from the Cobb–Douglas production function:

$$Y_t = AK_t^{\alpha}L_t^{\beta} \tag{1}$$

Where Y_t represents output, A is a technological constant, K_t represents capital, and L_t stands for labour. Parameters α and β indicate the elasticities of production with respect to capital and labour. Equation (1) describes a production process taking place in the absence of discrimination. We treat discrimination in the workplace as a phenomenon that reduces labour productivity. In other words, indicating with $0 < d_t < 1$ the degree of discrimination

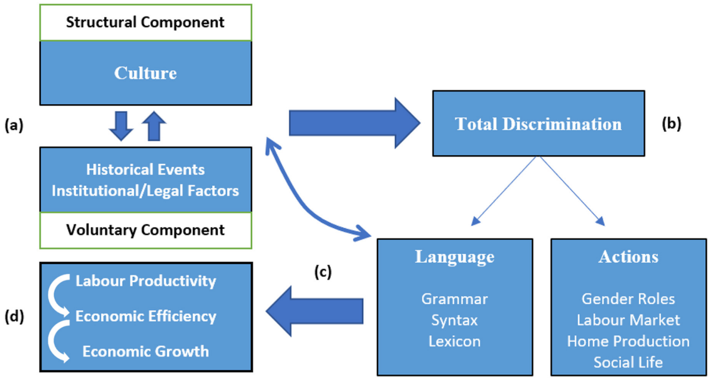


Figure 1.
Theoretical framework: female discrimination and economic outcomes

Source(s): Original Elaborations by the authors

in period t, discrimination impacts the labour factor L_t. Thus, actual labour demand is $L_t^d = L_t(1 - d_t)$. The drop in labour demand induced by discrimination is equivalent in quantitative terms to a drop in employment. For instance, a non-discriminated worker is worth 1 (as she participates at full in the production process), while a discriminated worker is worth less than 1 because her participation in production is undermined by discrimination, which weakens her productivity. In this view, d_t may be seen as the share of workers who would have been employed in the absence of discrimination but remain out of the production process. Alternatively, it can be interpreted as the loss in the amount labour inputs generated by the lower quality of the hours worked by female employees. In our case, discrimination has a qualitative and quantitative effect on the productivity of female workers. Specifically, the effect of discrimination is primarily qualitative because it affects the employee's psyche undermining her will and enthusiasm. This first effect, which cannot be measured, produces a second measurable effect, consisting in a production drop [1]. Some basic consequences are as follows:

$$L_t^d \leq L_t$$

$$if\ d_t \to 0, then\ L_t^d = L_t \qquad (i)$$

$$if\ d_t \to 1, then\ L_t^d = 0 \qquad (ii)$$

In the absence of discrimination, all workers are treated equally, and actual labour demand coincides with the labour force (i). On the other hand, under full discrimination, all workers are discriminated, and labour demand is zero (ii). These two extreme cases represent two ideal scenarios, in the middle of which real-word labour market outcomes are likely to lie. In general, discrimination produces negative effects on firm's performance (Becker, 1961), since it entails an inefficient organisation of inputs. Introducing actual labour demand, the production function becomes

$$Y_t^d = AK_t^\alpha[(1 - d)L_t]^\beta \qquad (2)$$

By looking at the marginal productivity of labour derived from equation (2), a clear problem emerges:

$$\frac{\partial Y_t}{\partial L_t^d} = AK_t^\alpha \beta[(1-d)L_t]^{\beta-1} < \frac{\partial Y_t}{\partial L_t}$$

When discrimination grows, labour productivity drops. The drop in production may be obtained using equation (1) and equation (2)

$$Y_t^d = (1-d_t)^\beta Y_t \tag{3}$$

Taking natural logs on both sides of equation (3):

$$log Y_t^d = log(1-d_t) + log Y_t \tag{4}$$

Under discrimination, actual output Y_t^d is lower than "potential" output Y_t. Discrimination, thus, reduces efficiency and decreases output. d_t behaves as a bad output, which should be eliminated to guarantee efficiency in the production process. Thus, this work uses DEA to evaluate the effect of female discrimination on productive efficiency. Departing from equation (4), we use actual production (i.e. production minus the discrimination component) as output. Moreover, we introduce a *bad output*, proxied by our discrimination indicator.

4. Methods

This section presents the empirical strategy employed to measure female discrimination and evaluate its impact labour productivity and economic performance. Our analysis is organised in three steps. First, we introduce the HFDI as a direct measure of female discrimination. Second, we evaluate its time evolution and break it into the structural component and the voluntary component. Finally, measure the effect the HFDI (and of its components) on labour productivity using DEA for time series.

4.1 The Historical Female Discrimination Index

Cultural categories, including gender beliefs and discriminatory social norms, are deeply entrenched in history (Giavazzi *et al.*, 2019), show a strong degree of persistency and are reiterated on a daily basis through language (Drescher, 2015). Contributions from cultural anthropology, psychology and linguistics point to a bidirectional relation between language and culture (Levinson *et al.*, 2002; Agovino *et al.*, 2021). On the one hand, cultural categories shape the main characteristics of languages, which evolve in response to the speaker's perceptions and needs. On the other hand, language plays a major role in forming, disseminating and maintaining cultural categories and gender stereotypes (Kesebir, 2017). In this view, the usage of language structures contributes to shaping the perception of reality. Based on the above, frequent usage of discriminatory epithets targeting women signals a widespread negative social attitude and reinforces gender stereotypes. In other words, the frequency of usage of discriminatory terms is a proxy for discrimination.

In order to measure discrimination operatively, this work employs a composite indicator first proposed by. A detailed description of the indicator is provided in the Supplementary materials. While language is used to portray reality, it also shapes reality, in the sense that it produces a representation of social objects (Semin, 2000). Since discriminatory epithets reiterate and strengthen traditional cultural models, the more frequent their usage, the stronger their contribution to female discrimination (which in turn reduces female productivity). A key condition in the epithet selection is the availability of observations over the lengthy time span of our analysis, ranging from 1861 (the year of Italian unification) to 2009. Some discriminatory epithets are neologism, while others have grown less popular with time. Only those observed persistently across the period of analysis were considered.

Lexical analysis highlights two types of discriminatory terms, i.e. those related to the aesthetic sphere and those related to female sexuality. The former target female looks in a derogatory way and include various forms of body shaming. The latter pertain to sexual behaviour, in line with a consolidated tradition that associates women with prostitution as a form of ultimate debasement (Rubini *et al.*, 2017). Table 1 lists the terms employed, with their English equivalents in parentheses.

While body shaming is a somewhat recent phenomenon that gained momentum in the digital era (Sobieraj, 2018), "slut-shaming" practices (Hess, 2016) are deeply rooted in history. Negative stereotypes related to female prostitution and promiscuity trace back to early antiquity. In the Roman Republic, prostitutes were associated with she-wolves and brothels were called *lupanaria* (a term deriving from *lupus,* literally "wolf"). Another term used in Latin to denote female prostitutes was *troia* (still in use in modern Italian) that originally indicated female pigs (Dalla, 1987). This terminology reveals a conception of the social category of prostitutes lying at the border between the human and the animal realm. The sub-human nature of prostitutes is related to the supposed immorality of their performances and to their alleged role in spreading diseases (Roncarati and Ravenna, 2006). It is important to highlight that the terms selected constitute a representative sample of local-level jargons and are consistently used across the entire timespan. For each term, based on Google Books Ngram Viewer, occurrences per book page are considered. Aggregating the individual terms into pillars and then the two pillars together, the HFDI is computed. The HFDI obtained in this fashion represents a proxy for the discrimination term *d* in equation (4).

4.2 Structural component and voluntary component

Once the indicator is computed, the structural component and the voluntary component may be extracted. In this regard, we use a dummy variable, associated with Law 242 of 1902 (which remained in force until 1945) [2], to capture the voluntary component of discrimination.

$$y_t = \alpha + \beta D_t + \varepsilon_t \tag{5}$$

Where y_t represents alternatively the HFDI or its pillars, D_t is the dummy variable that controls for the negative institutional changes that occurred, proxying of voluntary discrimination, and ε_t is a well-behaved stochastic term. Although ε_t is unobservable, its sample equivalent e_t, labelled *residual term*, proxies the structural component of discrimination, as it is obtained as the difference between total discrimination and the voluntary component. In this view, e_t may be seen as the part of discrimination that remains once the series has been purified of its voluntary component. Variable purification is on the other hand a common approach in economic applications (Fazio and Lavecchia, 2013). Equation (6), using time series data, characterises the relationship between the dependent variable and its past. For this reason, the most appropriate method in this case is ARIMAX (see Supplementary materials).

Table 1.
Discriminatory terms included in the HFDI

Aesthetics pillar	Sexuality pillar
Grassona (fatty woman)	*Puttana* (bitch)
Culona (fat-ass woman)	*Troia* (whore)
Cessa (literally "toilet", i.e. dog)	*Bagascia* (slut)
Zitella (spinster)	*Baldracca* (skank)
	Donnaccia (hooker)

Source(s): Original Elaborations by the authors

4.3 DEA for time series data

In order to estimate the impact of discrimination on the Italian economy between 1861 and 2009, we implement an efficiency analysis using the HFDI and its pillars, so as to verify which component of discrimination plays the larger role and which pillar influences the performance of the Italian economy more substantially. Consider output vector $y_t = (y_t^G, y_t^B)$, given by good output, i.e. GDP or y_t^G, and bad output, i.e. discrimination or y_t^B. $x_t = (x_{1t}, x_{2t})$ is the input vector (labour and capital). Following Lynde and Richmond (1999), we assume the existence of a monotonically increasing concave production function $f(.)$ and parameters $\theta_t \in R$, $A_t \in R$, and $s_t = (s_{1t}, s_{2t}) \in R^2$, whereby:

$$y_t = f(\theta_t A_t (x_{1t} - h_{1t}, x_{2t} - h_{2t})), t = 1861, \ldots, 2009 \tag{6}$$

$$0 \leq \theta_t \leq 1$$

$$0 < A_1 \leq A_2 \leq \ldots \leq A_n = 1$$

$$y_t \geq 0, x_{1t} \geq 0, x_{2t} \geq 0, s_{1t} \geq 0, s_{2t} \geq 0$$

θ_t measures overall technical efficiency in input use. A_t is an index technological progress, normalised to 1 in 2009. s_t is a vector of slacks in input use. Integrating a frontier production function facilitates the computation of a DEA efficiency measure, using time periods as decision-making units (DMUs). To estimate efficiency, we use model (2), allowing for decreasing or constant returns to scale and input orientation (da Silva *et al.*, 2022). Bad output may be handled in several ways. Ignoring it would induce a bias. It may be treated as an input, which would however not mirror the production process. Alternatively, nonlinear DEA models treat it as a different output (Färe *et al.*, 1989). Finally, a monotonically decreasing transformation (e.g. $1/y_t^B$) may be applied, thus treating bad output as a source of output reduction. We use the latter solution and we define the linear programming problem:

$$\min_{\theta_t, \lambda_t} \theta_t \tag{7}$$

$$s.t\, e'\lambda_t \leq 1$$

$$y^{G'}\lambda_t \geq y_t^G$$

$$y^{B'}\lambda_t \leq y_t^B$$

$$X'\lambda_t \leq \theta_t x_t$$

$$\lambda_t \geq 0, \theta_t \, free$$

Where $y_t = (y_t^G, y_t^B), y^G = (y_1^G, \ldots, y_n^G)', y^B = (y_1^B, \ldots, y_n^B)', x_t = (x_{1t}, \ldots, y_{mt})', X = (x_1, \ldots, x_n)'$. e is an $N \times 1$ vector of ones, and θ_t is a scalar. This approach seeks a linear combination of observed activities, with weights given by the elements λ_{jt} of the vector λ_t, yielding at least the output level y_t, and it uses as inputs a vector not greater than $\theta_t x_t$, where θ_t is as low as possible, and the sum of the coefficients of the linear combination is no larger than unity (Lynde and Richmond, 1999). The solutions to the problem are denoted by θ_t^*, λ_t^*. Then, from the third set of constraints in Equation (8)

$$X'\lambda t_t^* = \theta_t^* x_t - s_t^* \tag{8}$$

where $s_t^* \geq 0$ is a vector of slack variables. We implement an output-oriented Banker, Charnes and Cooper (BCC) formulation of the DEA method (Banker *et al.*, 1984). Using equation (9), it is possible to estimate period-specific effective (or optimal) input vector at time t (da Silva *et al.*, 2022):

$$\widehat{z}_t = X'\lambda t_t^* = \theta_t^* x_t - s_t^* \tag{9}$$

Following Lynde and Richmond (1999), we define the indices of efficiency in the use of individual inputs. In particular, the relative intensity index γ_{jt} of use of the j th input at time t is:

$$\gamma_{jt} = 1 - \frac{s_{jt}}{x_{jt}} \tag{10}$$

Once this analysis is completed for the HFDI, the same procedure is repeated for its two components. The structural component is approximated by the residuals of equation (5). Residuals may take on both positive and negative values. Since the DEA method cannot be applied to negative values, we follow Pastor's approach (1996) and we use the translation invariance property of DEA to handle negative values, preserving their ranking (Rapposelli, 2012).

5. Data

Our dataset includes yearly observations spanning from 1861 to 2009 and referring to Italy. More recent observations are not available. While the HFDI and its two pillars represent original contributions proposed by the present work, data on GDP is drawn from ISTAT and is expressed in 2010 prices. The series of Net Capital Stock and Labour are based on earlier estimations by Giordano and Zollino (2015). The main features of the dataset are shown in Table 2.

6. Results

This section illustrates the results of the empirical analysis and provides some comments on the historical trajectory of female discrimination in Italy, contextualising our results in light of the previous literature.

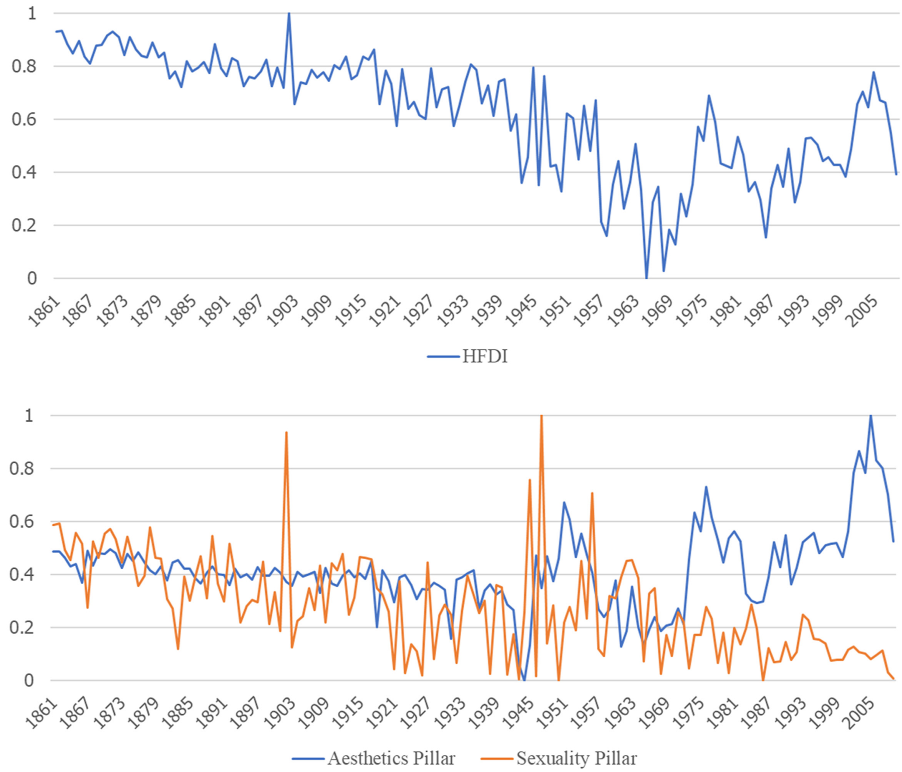
6.1 Female discrimination in Italian history

Figure 2 shows the time series of the HFDI, highlighting a steady downward trend between 1861 and the 1960s. Subsequently, discrimination bounces back from the early 1970s to end of the series. The decline observed in the first period is consistent with the literature. Casalena (2016) for instance claims that the slow but steady overcoming of traditional bourgeois values, which used to picture women as the angles of the hearth, induced a drop in female discrimination that followed the economic modernisation of 19th century Italy. The starting point of "liberal" Italy was, however, all but flattering. From the time of unification, Italian women were excluded from political participation, despite several measures that gradually

Variable	Obs	Mean	Std. Dev	Min	Max	Source
HFDI	149	0.624	0.216	0	1	Ngram viewer
Aesthetics pillar	149	0.716	0.346	0	1	Ngram viewer
Sexuality pillar	149	0.38	0.185	0	1	Ngram viewer
Labour	149	229,672	275,274	21,415	872,532	Giordano and Zollino, 2015
Capital	149	169,613	249,301	2,688	892,134	Giordano and Zollino, 2015
GDP	149	460,339	523,477	55,721.31	1,687,143	ISTAT

Source(s): Original elaborations by the authors

Table 2.
Descriptive statistics



Source(s): Original Elaborations by the authors

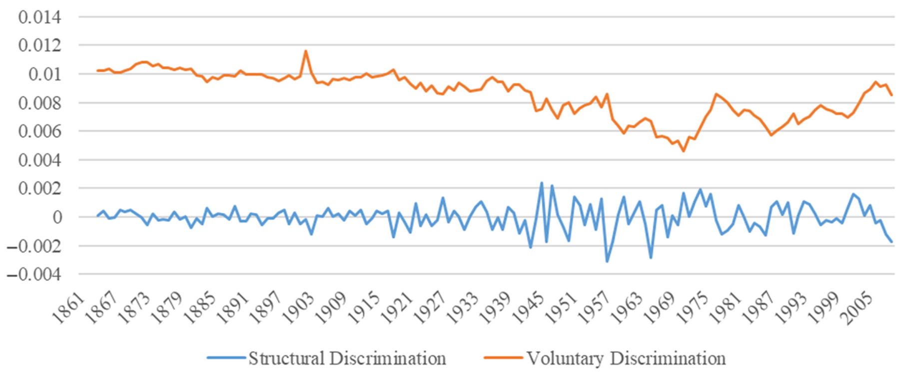
Figure 2.
HFDI and its pillars (1861–2009)

broadened voting rights for men. In the late 19th century, the slow but steady process of industrialisation and urbanisation was accompanied by social advances, prompting changes in women's roles that translated into pressures from the civil society (Gibson, 1990). Women's movements consolidated into organisations promoting equal rights in education, work and politics and questioned some constraints imposed on women's rights. The political response to these instances was mostly repressive. Although from 1877 women were allowed to testify in courts, Law 242 of 1902 imposed restrictions on female labour, setting maximum wages equal to those of underage boys. Some attempts to grant women voting rights in 1912 were put off *sine die*. In the face of the establishment of female organisations, the scientific community reacted with a series of studies that aimed to prove the psycho-physical inferiority of women with respect to men (Gibson, 1990). Pseudo-scientific evidence was used as the justification for female discrimination in this period. Positivist criminologists in particular produced data in support of the stereotypes about the nature of women, depicted as insensitive, unintelligent, childish, weak, vain and deceitful. Vote was as a weapon they had no need of (Lombroso and Ferrero, 1915).

Fascist-era laws and regulations incorporated and replicated the idea 19th century idea that women's main role in society consisted in reproduction and family care (De Grand, 1976). The fascist regime (1922–1943) was characterised by an ambivalent position towards women, as it promised modernity but denied female emancipation (De Grazia, 1992). Eventually, Italian fascism acted on a conservatory vision of gender roles, granting substantial incentives and awards to women that bore several children, in an attempt to crystallise a societal standard where woman rhymed with motherhood (Corner, 1993; Willson, 2007). The dismantling the legal and cultural heritage of fascism was slow and gradual, although universal suffrage was established *ex abrupto* in 1945. Under democracy, women's rights received wider attention, while several obstacles to formal equality were gradually removed, starting from the 1948 Constitution. Female emancipation and education spread gradually across the country in the 1950 and 1960s. This period saw the emergence of a distinctly feminist literature and of a public debate on women's rights (De Giorgio, 1996). Within the mass mobilisation of 1968, feminist protesters reported that women still lacked freedom within the family. Thus, family and sexuality became first entered political debate, shifting the focus towards the reappropriation of the female body. This cultural and political climate sprung the introduction of abortion.

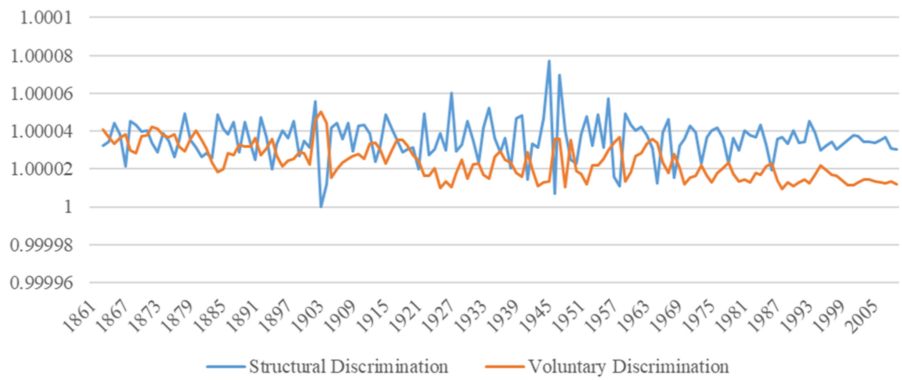
The Seventies saw the Italian feminist movement score several significant victories that extended women's rights in many fields (Malagreca, 2006). Bottom-up reactionary responses were strong and improvements in the legal status of women were seen with suspicion by many (Bracke, 2017). As shown by the literature indeed, the dissolution of cultural stereotypes is hardly a smooth and linear process (Courouve, 1986; Agovino *et al.*, 2021). Overall, opposition to the extension of women's rights in the Seventies took on the subtle form of cultural rather than legal discrimination, which explains the narrow gap between structural and voluntary discrimination displayed in Figure 3. The last (unsuccessful) political Crusade invoked by late president Amintore Fanfani against abortion represents a shining example of how politics did no longer constitute the main battleground for the fight between conservativism and female rights. Gender stereotypes were reiterated in newspapers and television shows rather than in legal prescriptions (Furnham and Voli, 1989). This phenomenon explains the upward slope observed for the HFDI from 1970 to 2000.

Decomposing the index into its two pillars, more information may be obtained. The aesthetics pillar dominates the sexuality pillar over most of the timespan considered. The latter is mainly driven by the structural component (Figure 4). Both pillars tend to decrease until the end of Second World War, when democratisation and freedom of press granted voice and editorial location to a variety of prose texts. The sudden removal of censorship after the fascist-era resulted into tumultuous movements for both pillars, after which the sexuality pillar decreased steadily, while the aesthetics pillar peaked in the mid-1950s before exploding in the early 1970s. Colour TV broadcasts (from 1977 onwards), increasing international trade and intensive advertising contributed in this period to the establishment of strict aesthetic



Source(s): Original Elaborations by the authors

Figure 3. Voluntary and structural components of the HFDI (1861–2009)



Source(s): Original Elaborations by the authors

Figure 4. Voluntary and structural components of the sexuality pillars (1861–2009)

standards on female looks (Silverstein *et al.*, 1986), paving the way for the growth of the aesthetics pillar. The focus on looks, sprung by the *male gaze* started to penalise in several societal contexts women that deviated from the "fit, young and beautiful norm", even in fields that had nothing to do with aesthetics (Ponterotto, 2014, 2016; Giuliani, 2018). The rise of social media in more recent years seems to be exacerbating this problem (Sobieraj, 2018; Dragotto *et al.*, 2020).

6.2 Efficiency analysis on total discrimination

This section presents the results of the efficiency analysis, conducted on four models:

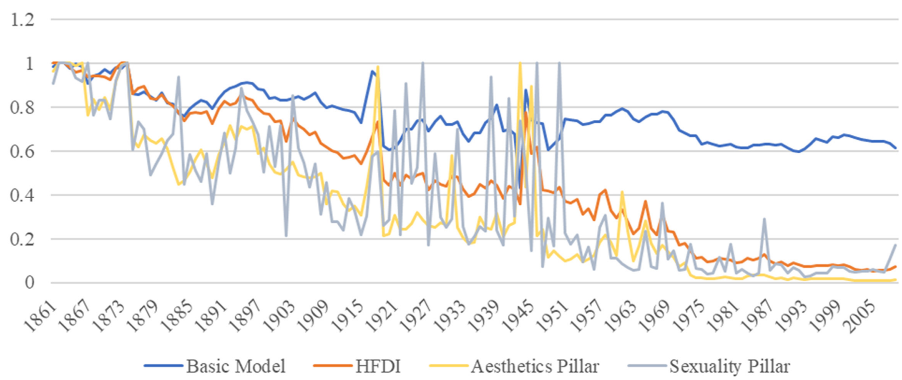
(1) **Model I** assuming no discrimination

(2) **Model II** considering female discrimination by incorporating the HFDI

(3) **Model III** controlling for aesthetics-based discrimination only

(4) **Model IV** controlling for sexuality-based discrimination only

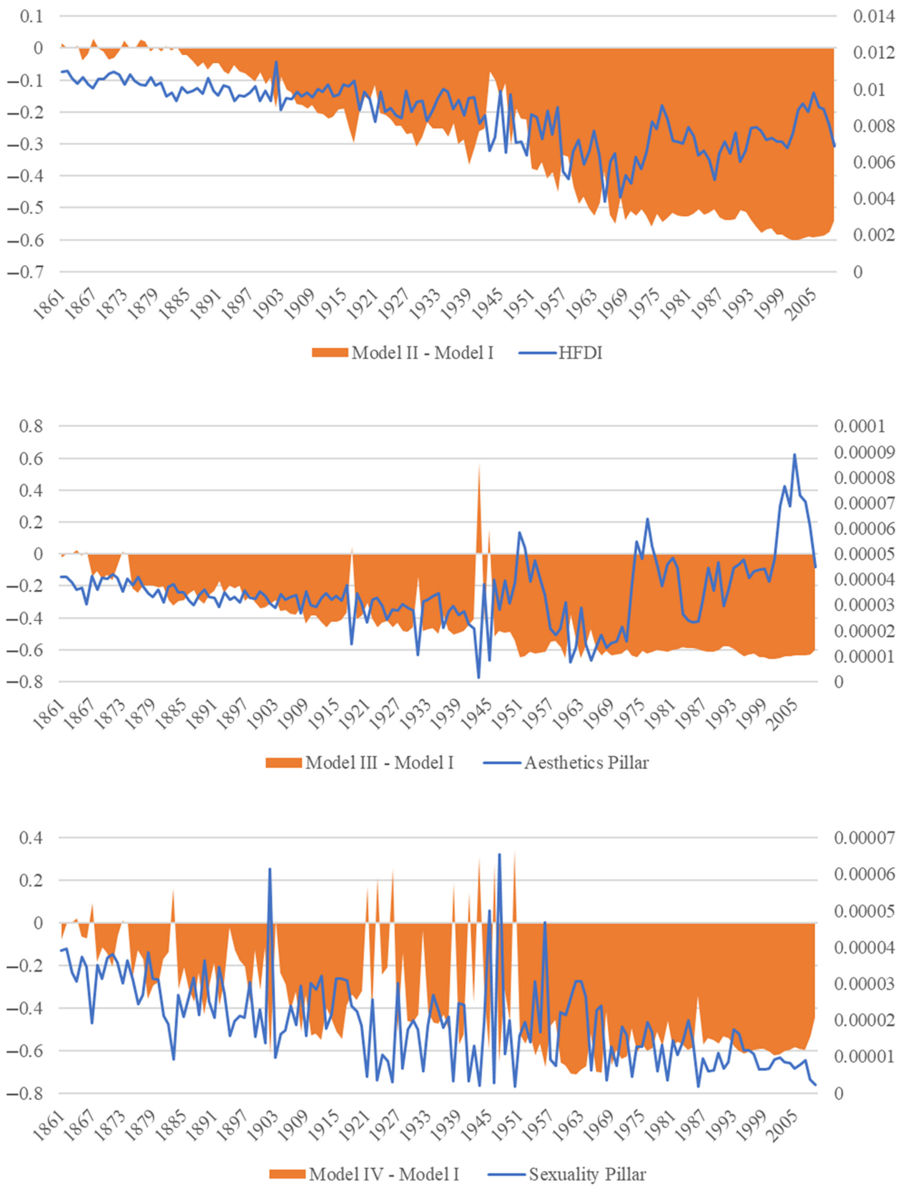
Figure 5 indicates a decreasing trend in efficiency for all the models estimated. The production process in the absence of discrimination shows high efficiency scores. When



Source(s): Original Elaborations by the authors

Figure 5. Efficiency scores (1861–2009)

discrimination is introduced, efficiency drops significantly. Deviations from the benchmark values of Model I, especially evident in Model III and Model IV, grow larger after 1948. Although the scores of Model III and Model IV tend to overlap for most of the period analysed, after the 1970s Model IV's scores decrease more markedly, implying that in recent decades, looks-based female discrimination has been driving the efficiency drop. Figure 6 further



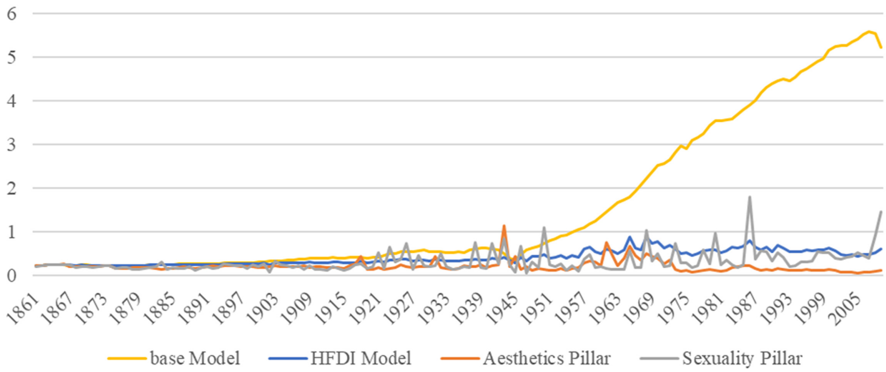
Source(s): Original Elaborations by the authors

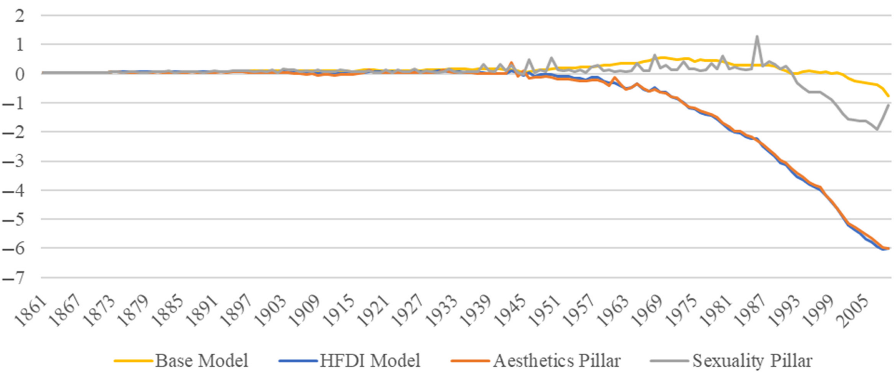
Figure 6.
Efficiency gaps with respect to Model I (1861–2009)

proves that production efficiency depends on female discrimination. A decline in efficiency, measured as the difference between the scores of Model I and Model II, is observed, especially after Second World War, mainly due to an increase in aesthetics-based discrimination. The optimal amount of labour absent discrimination indeed features a markedly increasing trend from 1945 onwards, as shown in the upper part of Figure 7. Introducing discrimination, the optimal labour falls substantially after 1945. The optimal amount of capital instead drops significantly under discrimination, as shown in the lower part of Figure 7. These results highlight the role of discrimination in the production process. Discrimination induces a distortionary effect, altering the combination of inputs. Specifically, input usage is reduced, with negative effects on economic growth. Figure 8 shows that absent discrimination, labour is always used intensively, with few exceptions. Introducing discrimination, the intensity of use of labour features wider downward peaks. The effect of discrimination is less marked on the intensity of use of capital. This result indicates that discrimination affects more severely workers (through their productivity) than capital.

6.3 Voluntary and structural discrimination

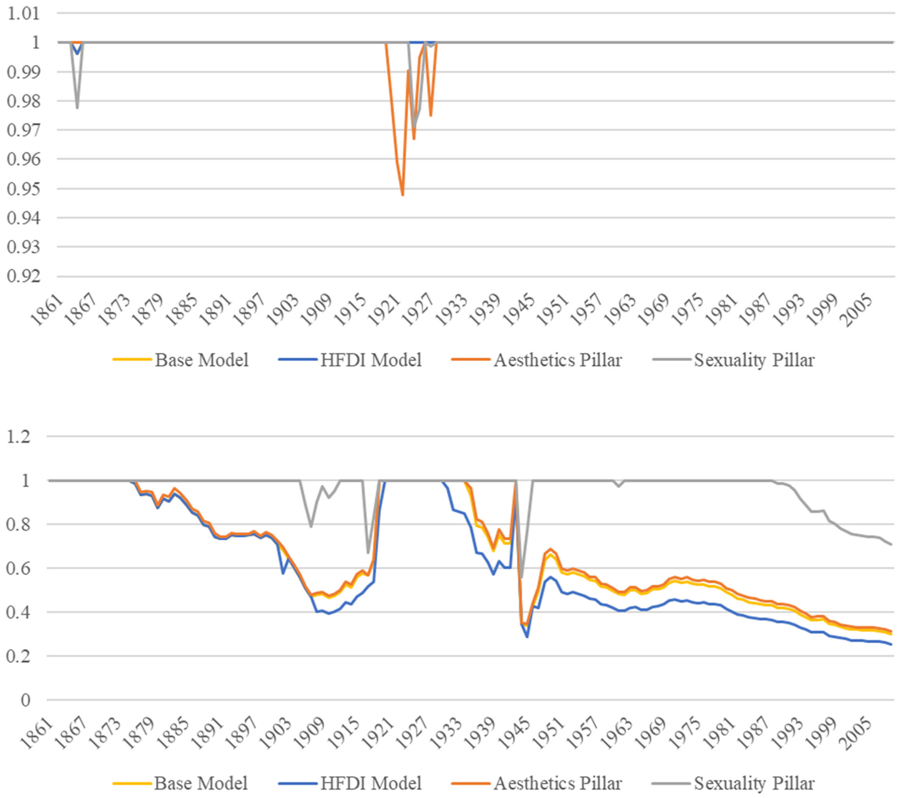
ARIMAX results (see the Supplementary materials) show that the aesthetics pillar is driven only by the structural component, while the sexuality pillar depends on both components. Figure 9 shows the until 1880 the efficiency scores associated with the two components





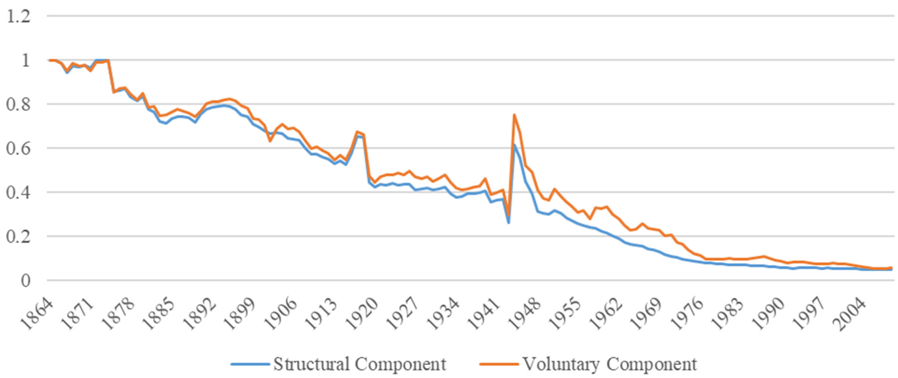
Source(s): Original Elaborations by the authors

Figure 7.
Optimal amounts of labour and capital (hundreds of thousands, 1861–2009)



Source(s): Original Elaborations by the authors

Figure 8.
Intensity of use of labour and capital (1861–2009)



Source(s): Original Elaborations by the authors

Figure 9.
Efficiency scores: structural and voluntary components (1861–2009)

overlap. Subsequently, the two series diverge, showing a dominance of the series controlling for the voluntary component. The gap increases between 1944 and 1976, when the voluntary component displays a decreasing trend, while the structural component features larger fluctuations, driven by shocks that are not immediately reabsorbed.

This period is characterised by generalised improvements in the juridical, political and socio-economic conditions of women, with progressive extensions of civil rights, including active participation to courts, police bodies and the Parliament, permanent shut down of brothels and expansion of labour protection (Fondazione Nilde Iotti, 2018). A further step forward is constituted by the implementation of Article 51 of the Constitution, prescribing the right on part of women to access all public offices without distinctions in careers and limitations in ranks. In the Sixties female, adultery was removed from the list of felonies and divorce was regulated. Cultural attitudes,, however, clashed with the legal advancements obtained.

The structural component in this view represents a background noise that constantly reiterates well-established behaviours. It reacts to external destabilising stimuli, such as legal changes, societal struggles and shifts in the political spectrum. Our results show that the structural component is the fundamental driver of female discrimination. It represents a baseline component, with a constant trend, which, although contained, has the potential to feed voluntary discrimination, which is in turn affected by historical, cultural, institutional and legal changes.

7. Conclusions

Women face across the globe worse work conditions. The economic literature holds that female discrimination is harmful for the economy. Despite a large body of literature and several pieces of evidence gathered on this problem, a direct measure of female discrimination at the national level aiming to capture the phenomenon rather than its economic consequences is to our knowledge missing.

This work proposes a novel approach to measuring female discrimination, exploiting the bidirectional link between language and culture. Based on the frequency of insulting epithets against women, we compute the HFDI for Italy. Plus, we detect a relation between female discrimination and economic growth using a lengthy time series of Italian data, spanning from 1861 to 2009. Our findings may be summed up as follows. First, the trajectory of female discrimination in Italy is characterised by two phases: (1) an early decreasing phase (1861–1969), during which traditional bourgeois models were gradually dismantled by legal reforms and (2) a subsequent increasing phase, during which reactionary societal responses fuelled a rise in discrimination, in spite of the formal extension of women's rights. The first phase saw women make significant strides towards equality, obtaining political rights and access to education and employment. During the second phase, with the spread of the media and with the establishment of more and more stringent beauty standards, looks-based discrimination became preeminent.

Second, female discrimination may be split into two components, of which the structural component represents a background phenomenon of somewhat limited size, which however feeds the voluntary component and emerges more blatantly in the presence of particular historical events. In the first half of the 20th century indeed, with the establishment of discriminatory laws before and during the fascist regime, the structural component reached its peaks. Finally, we find evidence in favour of the idea that discrimination leads to economic inefficiency. This problem is more relevant in recent years, when increases in female labour market participation were not paralleled by proportional increases in production.

The HFDI features some beneficial characteristics. First, it is direct measure of discrimination that looks at the phenomenon *per se* rather than at its consequences.

Second, as it varies between zero and one, its interpretation is straightforward and it may be easily understood by policymakers. In particular, the HFDI is suitable for comparisons, allowing to evaluate the effectiveness of policy actions aimed at reducing discrimination. In this view, it may represent a valid tool in support to policymaking. The long time series employed in our analysis, however, comes with some drawbacks. First, we were constrained not to consider the epithets that existed only in some subperiods. Second, the data pertaining to the earlier decades of our analysis are problematic for a number of reasons, including source representativity, low literacy rates across the population and censorship. Observations outdating Second World War, however, are certainly more reliable. Moreover, some potentially interesting covariates, such as socio-economic, demographic, institutional and political factors, were not available all-over the timespan considered, which may induce omitted variable bias in our estimates. Despite these problems, this work proposes a novel perspective that may prove beneficial for economic research in the next years. Future works may refine the analysis proposed here in several ways. Besides addressing the empirical concerns related to the lack of data using larger, more detailed and more complete datasets, future contributions may consider distinguishing among different economic sectors, based on the intuition that some industries, such as mining and manufacturing, may constitute more hostile environments form women. Moreover, when the data are made available, this analysis may be replicated for other countries, potentially allowing for international comparisons. Finally, the availability of higher-frequency data may allow future contributions to focus on subperiods, improving the internal consistency of the analysis and granting the possibility of choosing a wider set of controls (especially if the period of analysis is more recent).

Overall, this work paves the way for a strand of literature aiming to measure discrimination against a number of social groups, including ethnic and religious minorities, members of the LGBT+ community, people with disabilities and elderly people. The methodology proposed may be used to assess not only the extent of discrimination, but also and assess its negative economic consequences. In summary, the key message conveyed by this work is that choosing words accurately is important, not only as a form of compliance to social norms, but also and especially as a source of (in)efficiency in the production process of an economy.

Notes

1. The interpretation of the labour factor here is broad. By L, we do not denote the number of workers, but more extensively, the amount of labour, intended as a combination of quality and quantity. Discrimination may reduce L along the extensive margin, driving female workers out of the labour force, or along the intensive margin, i.e. pushing them to supply fewer hours of work, or – more subtly – worsening the “quality” of their hours. In our case, given the unavailability of historical series data on working hours offered by women and on women’s participation in the labour market, the hypothesis of a deterioration in the quality of work of women workers due to discrimination holds.
2. We tried to include several other dummy variables to capture institutional shifts. In particular, used dummy identifying (1) the 19th century, (2) the interwar period (1918–1939), (3) the fascist regime (1922–1943), (4) the economic boom of the 1950s, and (5) the societal mobilisation of the late 1960s. Multicollinearity did not allow us to include these variables. The only dummy that exhibited a significant coefficient in all model specifications was the one associated with Law 242 of 1902.

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Supplementary materials (author's own work)

Measuring cultural distance

Kogut and Singh (1988) aimed to measure cross-country cultural distance. The main intuition behind this approach relates to the existence of an ideal unit (also known as reference unit), departing from which actual distance is computed. The structure of the indicator is the following:

$$X = \frac{1}{M}\sum_{j=1}^{M}\frac{\left(I_j - I_j^*\right)^2}{V_j} \tag{A1}$$

Where M represents the number of components aggregated by the index, I_j represents the intensity of characteristic $j = 1, 2, \ldots, M$, I_j^* is the intensity of the reference unit for characteristic j and V_j represents the variance of characteristic j. In our case, the characteristics of interest are the relative frequencies of discriminatory terms, and the ideal level of discrimination is zero, implying that absent discrimination, discriminatory epithets are completely absent. In other words, equation (A1) has $I_j^* = 0 \forall j$. We apply a monotonic transformation, to rescale the indicator between zero and one:

$$HFDI = \frac{X - X_{min}}{X_{Max} - X_{mi}} \tag{A2}$$

where X_{Max} indicates the maximum value observed in the X series and X_{min} indicates the minimum value. This method represents the most widely used strategy to measure cultural distance in the economic literature (Konara and Mohr, 2019). Despite criticism over some aspects of the aggregation method (e.g. the quadratic form and the full degree of substitutability amongst components), the Kogut–Singh index remains by far the most popular methodological construct in the field of culture measurement (Maseland *et al.*, 2018). In light of the bidirectional relationship between language and culture discussed in our work, it is straightforward to decline this approach in the field of linguistic analysis.

Methodological Aspects of Autoregressive Moving Average (ARMA) Estimation

The method proposed by Box and Jenkins (1970) departs from the assumption that the data generating process underlying the time series observed may be approximated using an ARMA model if it is stationary or an ARIMA model if it is non-stationary. The method is structured in three steps:

Identification. The model that best summarises the data is selected.

Estimation. The parameters of the model (i.e. the coefficients) are calculated, implementing the model selected.

Diagnostic Checks. The model implemented is evaluated and its assumptions are tested.

The *steps* are repeated iteratively, so that as new information is gained during the diagnostics phase and then incorporated into the identification phase. In the identification steps, the first issue to address concerns stationarity, which evaluated based on the Dickey–Fuller test. In its simplest form, the test assumes an AR(1) model, looking like

$$y_t = \rho y_{t-1} + \varepsilon_t, \varepsilon_t \sim N\left(0, \sigma_\varepsilon^2\right) \tag{A3}$$

Subtracting y_{t-1} from both sides of the equation, the model becomes

$$\Delta y_t = (\rho - 1)y_{t-1} + \varepsilon_t \tag{A4}$$

Labelling $\rho - 1$ as δ,the test is structured as follows:

$$H_0 : \delta = 0, vs\, H_1 : \delta < 0$$

$$DF = \frac{\delta}{SE(\delta)} \sim DF(N-1)$$

Under the null hypothesis, the series is non-stationary. The distribution of the *DF* statistic is peculiar, given the non-stationary nature of the series under the null and the fact that the left-hand side of equation (A3) contains the residuals of equation (A4). If the Dickey–Fuller test fails to reject the null hypothesis, the series is non-stationary, and it must be first differenced. Should the first difference be non-stationary, the second difference must be used and so forth. More sophisticated versions of the test may be devised, adding a constant and/or a time trend.

Two diagnostic plots can be used to help choose the p and q parameters of the ARMA or Autoregressive Integrated Moving Average (ARIMA), i.e. the Autocorrelation Function (ACF), that summarises the correlation of an observation with its lagged values and the Partial Autocorrelation Function (PACF), that summarises the correlation of an observation with its lag values, not accounted for by prior lags. Based on ACF and PACF, the nature of the time series may be inferred.

Estimation is carried out using several alternative methods that converge to the same result as long the time series is long enough. Finally, diagnostic tests are performed, in order to avoid overfitting and ensure that the model specification selected is correct. Information criteria (i.e. Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC)) are often used in order to compare alternative specifications.

2.1 ARMA Results

Before proceeding to estimate the most appropriate ARIMA model for our time series, we verify that they are stationary. Table S1 shows that all the series are non-stationary both in levels and in first differences, as the augmented Dickey–Fuller test fails to reject the null hypothesis of unit root. Nn the contrary, the second differences are stationary (we reject the null hypothesis of unit root of the augmented Dickey–Fuller test).

Table S1. Augmented Dickey–Fuller test for unit roots

Series	Levels	First differences	Second differences
Discrimination index	−1.564 (0.501)	−1.343 (0.324)	−6.963*** (0.000)
Aesthetics pillar	−2.980 (0.184)	−1.455 (0.223)	−18.663*** (0.000)
Sexuality pillar	−1,536 (0.515)	−2.008 (0.488)	−7.668*** (0.000)

Note(s): *** significant at 1%, 5% and 10%, respectively; (): *p*-value

After obtaining the stationarity of the series, we use the ACF and the PACF plot in order to identify the potential ARIMA models. Figure S1 shows that, in the case of HFDI, the alternation of the bars between positive and negative values in both the ACF and PACF charts may suggest an ARIMA model. Similar results also emerge for the ACF and PACF plots of the stationary series of Aesthetics and Sexuality Pillars (see Figures S2 and S3). Unfortunately, the ACF and PACF graphs are not sufficient for the choice of the ideal ARIMA model, and for this reason, we proceed with the estimation of different ARIMA models until we obtain the one that minimises the AIC and BIC criteria; this respects the criterion of parsimony (only parameters statistically significant) and ensures the lowest prediction errors.

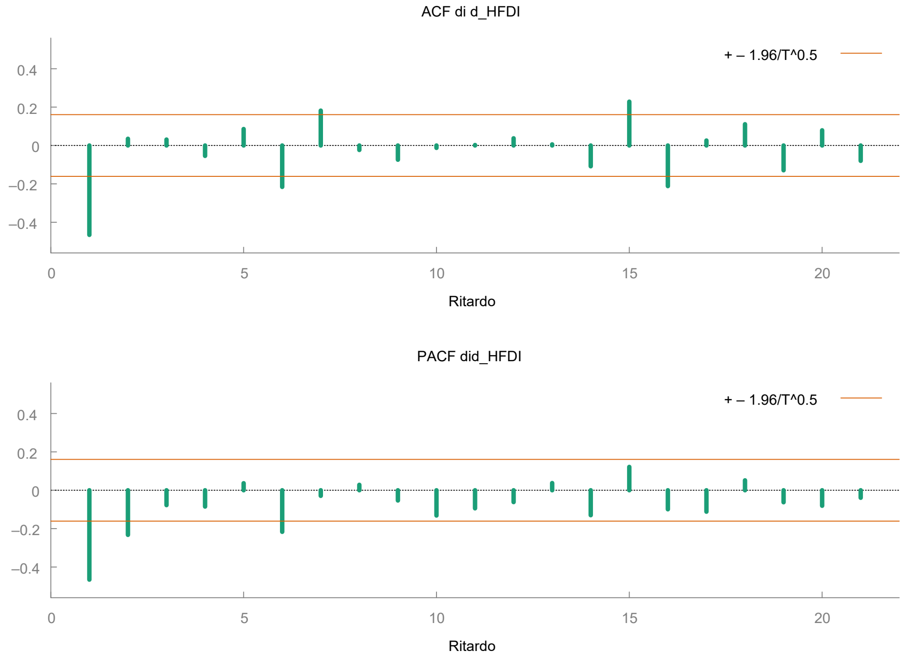

Figure S1.
ACF and PACF for the HFDI series

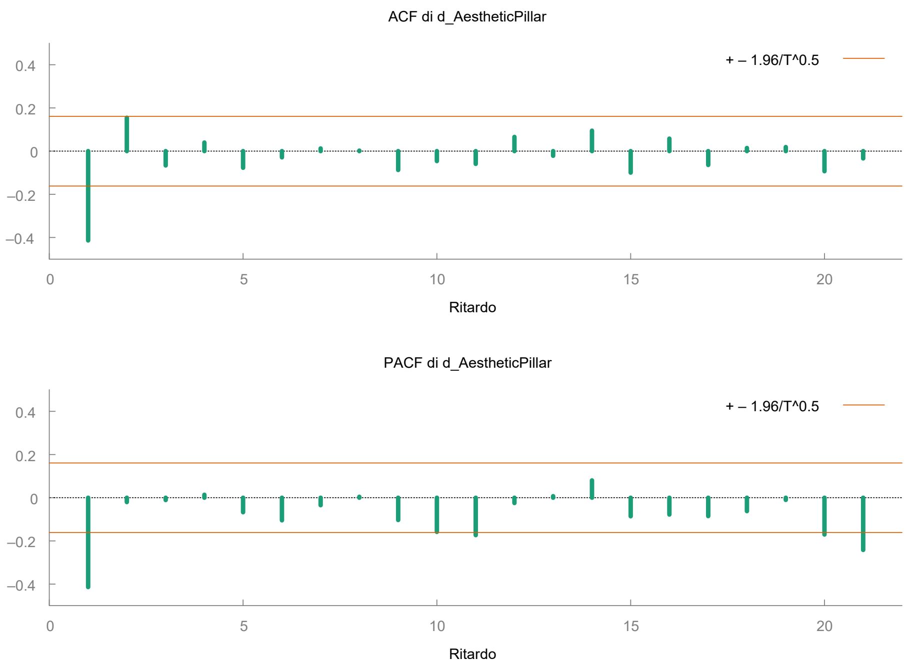

Figure S2.
ACF and PACF for the aesthetics pillar

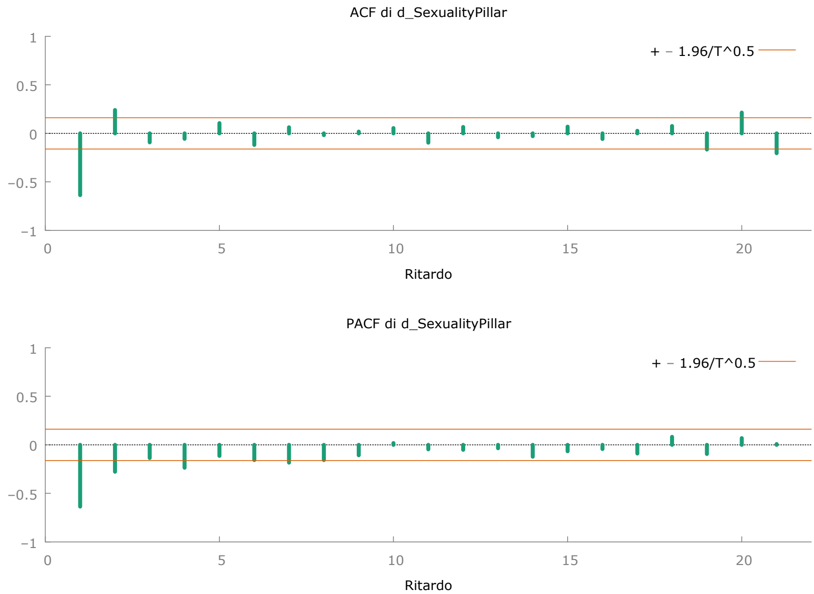

Figure S3.
ACF and PACF for the sexuality pillar

Table S2 shows the ARIMA best model results estimated for each variable. This result is supported by the fact that the models chosen are those with the lowest AIC and BIC criteria and with the lowest prediction errors (Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Mean Absolute Percent Error (MAPE)) (see Table S3)[1]. To examine the adequacy of the estimated ARIMA models, we first checked the assumptions of the white noise term ε_t. The diagnostic tests in Table S3 support the assumption of a normality distributed homoscedastic random noise term. In particular, the Ljung–Box Q test confirms that the residual series are white noise (we do not reject the null hypothesis of normality of residues), and the Breusch–Pagan test not rejecting the null hypothesis allows us to conclude that the residuals are homoscedastic. Furthermore, the ACF graphs on the residuals allow us to exclude the presence of correlation among residues (the bars are contained in the confidence interval), confirming the goodness of our estimates (see the graphs on the left of Figures S4–S6).

Table A2. Parameter estimates of the ARIMA models

Variable	Lags	ϕ_{t-1}	ϕ_{t-2}	θ_{t-1}	Institutional dummy	Lagged institutional dummy
HFDI	(2,1)	-0.529^{***} (0.080)	-0.319^{***} (0.083)	-0.887^{***} (0.018)	0.002^{***} (0.0006)	0.001^{**} (0.0007)
Aesthetics pillar	(1,1)	-0.414^{***} (0.075)		-0.899^{***} (0.017)	-3.9e-06 (5.7e-06)	
sexuality pillar	(1,1)	-0.604^{***} (0.066)		-0.708^{***} (0.012)	2.2e-05*** (6.5e-06)	

Note(s): *** and **; significant at 1%, 5% and 10%, respectively; () : standard errors

Table A3. Diagnostic and selection criteria

Variable	*Criteria* AIC	*BIC*	*MAE*	*RMSE*	*MAPE*	*Tests* LBQ test Q	*B-P test*
HFDI	−1623.118	−1602.233	0.006	0.005	4%	7.377	7.678
Aesthetics pillar	−2993.683	−2978.731	0.016	0.033	9%	8.676	5.655
Sexuality pillar	−2934.180	−2919.228	0.008	0.032	10%	13.300	4.237

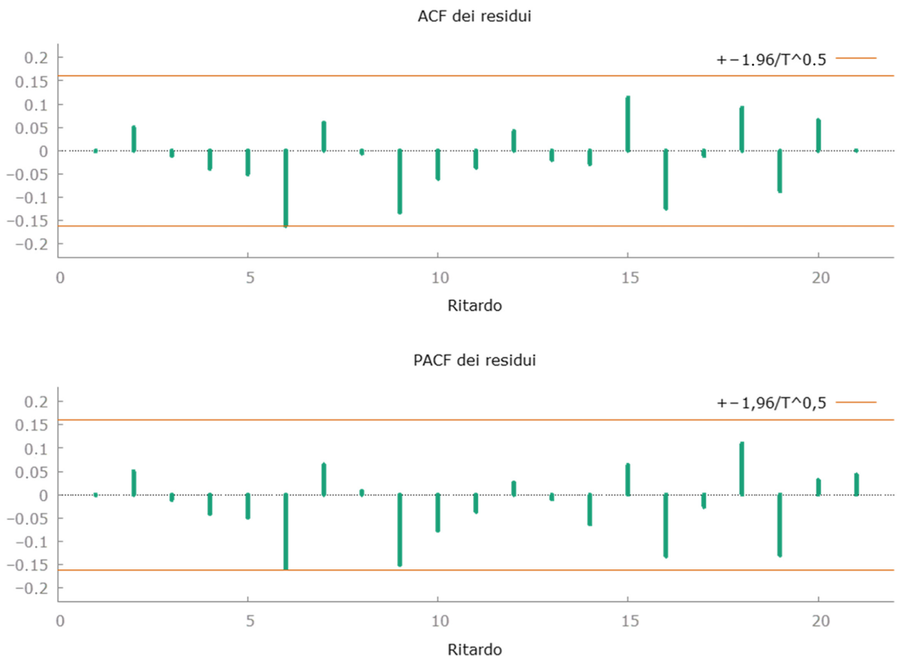

Figure S4. ACF of the residuals of HFDI

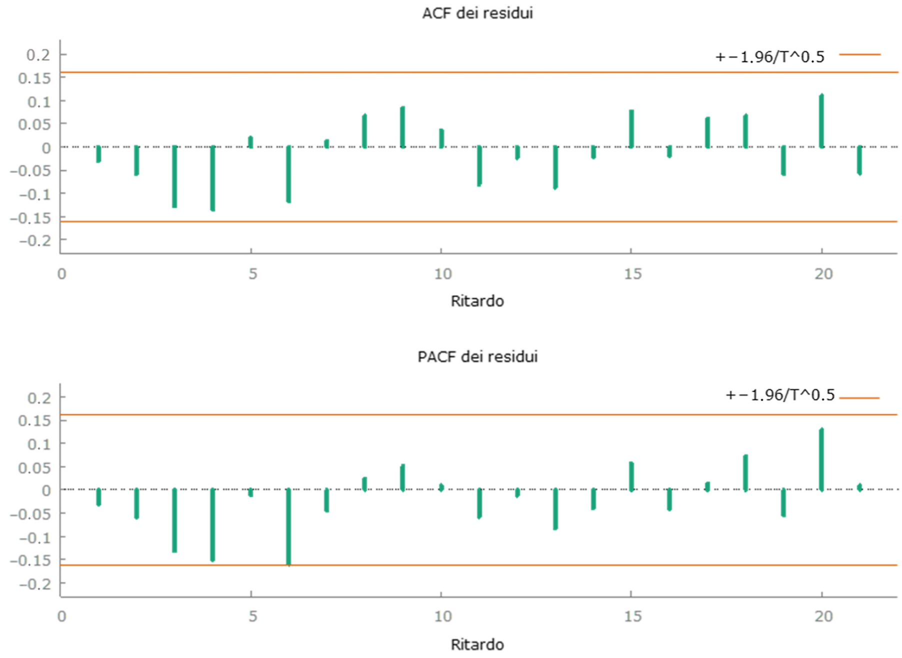

Figure S5.
ACF of the residuals of aesthetics pillar

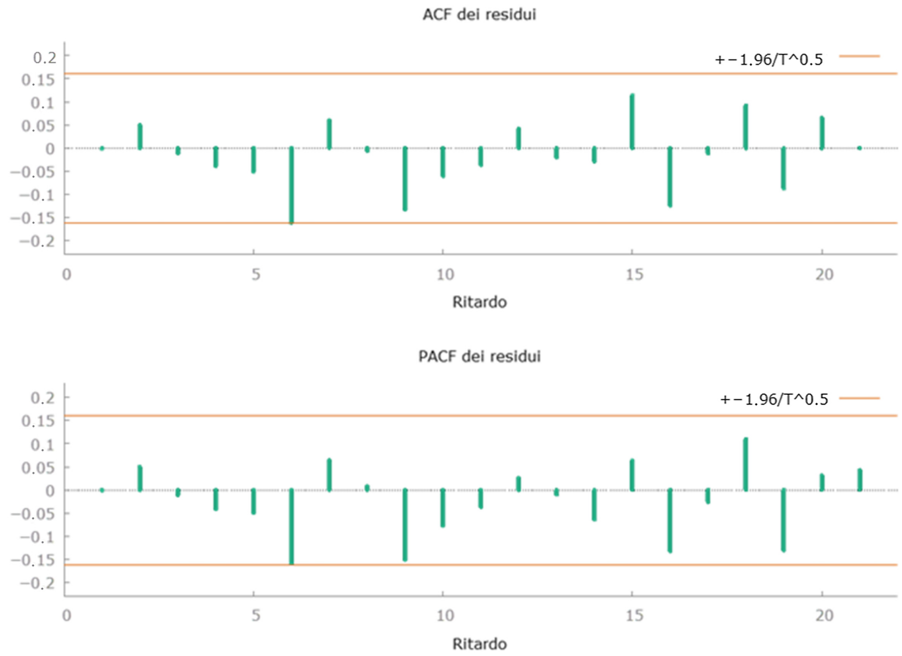

Figure S6.
ACF of the residuals of sexuality pillar