ISSN: 1576-0162
DOI: http://dx.doi.org/10.33776/rem.v0i68.8293

Forecasting the Gender Wage Gap in Argentina from a Productivity-Based Approach

Proyecciones sobre la brecha salarial de género en Argentina a partir de un enfoque basado en la productividad

Diana Suárez
dsuarez@campus.ungs.edu.ar
Instituto de industria - Universidad Nacional de General Sarmiento (IDEI/UNGS)

Florencia Fiorentin
ffiorentin@campus.ungs.edu.ar
Instituto de industria - Universidad Nacional de General Sarmiento (IDEI/UNGS) / Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)

Florencia Barletta
fbarlett@ungs.edu.ar
Instituto de industria - Universidad Nacional de General Sarmiento (IDEI/UNGS)

Recibido: mayo 2024; aceptado: noviembre 2024

Abstract

This paper analyzes the association between the gender wage gap (GWG) and productivity at the industry level in Argentina from 2002 to 2022, drawing on gender studies and literature on structural change. Using dynamic OLS regression with random effects across the 1st to 4th quantiles, we examine the relationship between the GWG, female labor participation, and industry productivity. Results indicate that increased female participation is positively associated with reductions in the wage gap in the least productive industries. Additionally, female education rates contribute positively to reducing the GWG. The findings also reveal that productivity gains in the most productive sectors help narrow the gender wage gap, suggesting that structural shifts toward higher productivity levels may play a role in closing this gap.

Keywords: Gender wage gap; productivity; structural change.

Resumen

Este artículo analiza la asociación entre la brecha salarial de género (GWG, por sus siglas en inglés) y la productividad a nivel sectorial para el caso argentino (2002-2022), con base en los estudios de género y la literatura sobre cambio estructural. A partir de una regresión dinámica con efectos aleatorios por cuartiles, se testea la relación entre la GWG, la participación femenina y la productividad sectorial. Los resultados muestran que el aumento de la participación femenina se asocia positivamente con reducciones en la brecha salarial en los sectores menos productivos. La tasa de graduación femenina impacta positivamente en la reducción de la GWG. Estos resultados sugieren que el cambio estructural hacia niveles más altos de productividad podría contribuir a cerrar la brecha salarial.

Palabras clave: Brecha salarial de género; productividad; cambio estructural.

JEL Classification/ Clasificación JEL: O11; J16; O47.

1. Introduction

The gender wage gap (GWG) refers to the disparities in earnings between genders and is a topic of significant and growing concern in both the academic literature and policy discussions (Jayachandran, 2015; UN-Women, 2022; WEF, 2023). In this context, several empirical studies have sought to understand the underlying sources of this gap (Allen and Sanders, 2002; Olivetti and Petrongolo, 2016; Redmond and McGuinness, 2019, among others). These studies are framed within the concepts of endowment effects and discrimination effects.

The endowment effect is grounded in human capital theory and posits that differences in earnings are related to salary determinants such as individual productivity levels, skills, education, and personal predispositions. Consequently, this perspective suggests that the salary gap is likely to decrease as women attain higher levels of education and pursue better-paying jobs (Abegaz and Nene, 2018; Brynin and Perales, 2016; Redmond and McGuinness, 2019; Si et al., 2021).

The discrimination effect, based on feminist economic theory, argues that even when women and men possess equal qualifications, women tend to receive lower wages than their male counterparts due to systemic discrimination within the labor market. Most of these studies conclude that while endowment factors have contributed to the reduction of the GWG, a substantial portion of the gap remains attributable to unobservable factors that account for discrimination against women (Ahmed and McGillivray, 2015; Redmond and McGuinness, 2019; Sin et al., 2022).

To shed some light on the GWG, several studies indicate that the gap varies significantly across different industries (Durán Lima and Galván, 2023; Olivetti and Petrongolo, 2014). In this context, one manifestation of structural heterogeneity that impacts Latin American countries is the presence of wage differentials among industries, which reflect substantial productivity gaps (Cimoli and Porcile, 2016; Fagerberg, 2018; Montobbio, 2002). Consequently, the characteristics and trends of the GWG may be intricately linked to the structure of productivity within these sectors.

We assert that this structural heterogeneity has important implications for the gender wage gap, particularly given the well-documented unequal distribution of female workers across various industries. Moreover, the ways in which structural heterogeneity influences both participation rates and the

GWG remain largely underexplored. Therefore, this paper seeks to contribute to this debate within the context of Latin American countries.

Therefore, policies aimed at diversified economic development in Latin American countries must take the GWG into account, alongside the implementation of measures to address the reduction of this disparity. The GWG continues to affect thousands of female workers, and given that endowment effects are insufficient to eliminate the gap and discrimination persists, its impact is likely to endure in the future. According to various studies, the estimated time required to close the GWG ranges from 169 years (WEF, 2023) to 300 years (UN-Women, 2022) to close the GWG.

The objective of this paper is to examine the gender wage gap within the productive structure of Argentina, a Latin American country that has shown minimal progress in reducing gender disparities (CEP XXI, 2021). We aim to illuminate the characteristics of this wage gap, providing insights that policymakers—particularly those involved in gender policy and structural change—can utilize. Additionally, this study seeks to contribute to the fields of human capital and feminist economics through the lens of structural change. The guiding questions of this research are as follows: To what extent do trends in the GWG vary according to the productivity levels of different industries? How does the relationship between wage gaps and labor force participation vary across sectors? Furthermore, does the enhancement of female capabilities play a role in narrowing the GWG?

These questions are relevant in the context of Latin American countries, and particularly in the case of Argentina, where a heterogenous sectoral structure prevails in terms of productivity, among many other dimensions (Cao and Vaca, 2006; Katz, 2018; Niembro and Starobinsky, 2021). Unlike the existing literature on sectoral differences in the gender wage gap (GWG), our approach is grounded in the examination of varying levels of productivity that affect wages across industries, rather than relying on a sector-based definition of technological intensity. This methodological choice is informed by the critical importance of enhancing productivity in all sectors, particularly in developing countries like Argentina, where many industries remain significantly below the international frontier (Saviotti and Frenken, 2008). The central question we explore is whether advancements to higher productivity levels exert any influence on the gender wage gap. Ultimately, our aim is to provide evidence that contributes to a deeper understanding of the characteristics of gender disparities within economies marked by structural heterogeneity.

The remainder of the paper is structured as follows. After this introduction, the second section presents the conceptual framework, which combines studies on the gender gap with the economic view related to structural change, from where the research questions are derived. The third section presents the empirical strategy, in terms of the construction of the database and econometric tests. Section four is centered on the results and the answer to the research question. The fifth and last section is devoted to the conclusions.

2. Conceptual framework

Studies on the wage and participation gap have proliferated in recent years (Abegaz and Nene, 2018; Allen and Sanders, 2002; Angelov et al., 2016; Azmat and Ferrer, 2017; Brynin and Perales, 2016; Redmond and McGuinness, 2019; Si et al., 2021; Sin et al., 2022). This body of literature primarily seeks to clarify the factors contributing to labour gaps and to analyze potential solutions for narrowing these disparities. In this paper, we focus specifically on the gender wage gap (GWG) and its relationship with the labor force participation gap (PG) among women.

The GWG refers to the lower salaries women receive compared to men, even when they are in the same position, in the same industry (Blau and Kahn, 2017). At the macro level, the GWG is estimated as the difference in average salaries between men and women in the whole economic structure. Studies focusing on understanding the causes and determinants of the gender gaps wonder how much of the gap is due to differences between female and male workers, and how much is due to unobservable factors (Abegaz and Nene, 2018; Allen and Sanders, 2002; Angelov et al., 2016; Azmat and Ferrer, 2017; Brynin and Perales, 2016; Redmond and McGuinness, 2019; Si et al., 2021; Sin et al., 2022). Studies focusing on observable differences in the gender wage gap (GWG) are primarily grounded in human capital theory. These studies argue that the GWG tends to diminish as female workers acquire increasingly valued skills in the labor market, particularly through higher levels of education. This phenomenon is referred to as the "endowment effect" (Ahmed and McGillivray, 2015; Anker, 1997; Redmond and McGuinness, 2019). Research that explores additional unexplained factors influencing the GWG is situated within the framework of feminist economics. These studies assert that such factors are primarily linked to discrimination against women, a concept termed the "discrimination effect." Overall, both effects have been shown to significantly impact the GWG (Ahmed and McGillivray, 2015; Sin et al., 2022).

The human capital literature converges on several key factors that contribute to the endowment effect.

Firstly, one critical aspect is the recognition that women's education and skill acquisition play a significant role in reducing wage disparities (Abegaz and Nene, 2018; Brynin and Perales, 2016; Redmond and McGuinness, 2019; Si et al., 2021). In addition, there are female and male characteristics that cause the GWG. Different explanations were found. Women tend to prioritize employment that is geographically convenient, offers job security, and provides flexible hours, among other non-wage-related factors (Redmond and McGuinness, 2019; Sin et al., 2022). In contrast, men often select jobs primarily based on salary rather than additional benefits (Redmond and McGuinness, 2019). Moreover, it has been demonstrated that women possess less bargaining power when it comes to wages, which accounts for a portion of the overall gender wage gap (GWP) observed in New Zealand (Sin et al., 2022). Additionally, evidence indicates that men typically receive higher wages due, in part, to

greater productivity, suggesting that the wage gap is also linked to disparities in productivity (Abegaz and Nene, 2018; Brynin and Perales, 2016; Sin et al., 2022). For instance, Abegaz and Nene (2018) study the relationship between gender wage and productivity gaps in the Ethiopian manufacturing sector from 1996 to 2010. Their findings indicate that when average productivity is controlled for, the gender wage gap is diminished but remains significant. They further identify an aspect of occupational segregation, noting that a higher proportion of women are employed in lower-paying firms (Abegaz and Nene, 2018).

Secondly, despite the robust evidence regarding the determinants of the GWG, existing studies consistently indicate that a portion of this gap remains unexplained and is thus unrelated to observable worker characteristics. The factors identified in previous research do not fully account for the disparity. For instance, Sin et al. (2022) report that the gender wage gap ranges from 13% to 17%. Of this gap, the productivity differential accounts for 4.5 percentage points (p.p.), while women's attitudes toward salary negotiation contribute an additional 5 p.p. Consequently, between 3.5 and 7.5 p.p. remain unexplained. Furthermore, Redmond and McGuinness (2019) reveal that only 13% of the gender wage gap can be attributed to identifiable factors. Ahmed and McGillivray (2015) demonstrate that in Bangladesh, the reduction in the GWG is primarily attributable to discrimination effect –less discrimination against women in the labour market-, rather than endowment effect.

To shed light on the unexplained aspects of the wage gap, a limited number of studies have incorporated the industry affiliation of workers. This approach aims to identify the industry-specific sources of both the wage and participation gaps through decomposition and/or multilevel analyses (Olivetti and Petrongolo, 2014, 2016; Sin et al., 2022). This literature finds that regardless of workers' attributes, the characteristics of the industry also play a crucial role in explaining the gap. As previously noted, women are often employed in sectors that offer lower salaries, a phenomenon that may be associated with reduced levels of productivity within those industries (Abegaz and Nene, 2018). Durán Lima and Galván (2023) demonstrate that the gap is higher in exporting compared to those that do not engage in export activities. Similarly, Sin et al. (2022) identify that a portion of the wage gap is attributable to industrial characteristics, noting that women are often employed in less productive firms. Ahmed and McGillivray (2015) reveal that the GWG varies across the wage distribution, suggesting that this variability may be influenced by industry-specific factors, as the gap is not uniform across different sectors. Nevertheless, the impact of productive structures and industry-specific characteristics on the wage gap is less addressed by the literature.

In the framework of human capital literature, Olivetti and Petrongolo (2016) investigate the extent to which the closure of the participation gap can be attributed to shifts in industry composition and/or changes in female participation within each sector. Their analysis utilizes a database encompassing nine high-income countries. Starting from a binary classification

of the economy into goods and services, they propose that the increasing participation of women in the labour market is, in part, a consequence of the expansion of the service sector. This sector has generated employment opportunities that align more closely with the preferences and household roles of female workers. Consistent with human capital theory, this phenomenon is particularly evident in the production of services that are less reliant on physical skills and more dependent on "soft" skills. Consequently, this evidence has resurged the longstanding debate regarding the division of the workforce between "hard" and "soft" capabilities.

In this context, economic literature on structural change has largely proved that industry structure is not neutral in the explanation of economic growth and incomes (Cimoli and Porcile, 2016; Fagerberg, 2018; Montobbio, 2002). In turn, innovation theory has historically recognized the existence of sectoral patterns of technological intensity, which impact both productivity and wage levels (Malerba et al., 1997; Pavitt, 1984). If industry impacts on incomes and wages, derived from technological intensity; and if there are patterns of female participation in employment, which tends to be higher in low-tech industries such as social services, hotels, and business services industries (Allen and Sanders, 2002); then there are good reasons to expect some association between productivity and the gender wage gap.

In this context, evidence suggests that structural change processes, characterized by an increasing emphasis on knowledge-intensive sectors, facilitate job creation that prioritizes intellectual attributes over physical capabilities. Consequently, following the main hypothesis of human capital literature, it can be expected that structural change will contribute to a reduction in gender wage gaps. Thus, countries that exhibit specialization patterns biased toward natural resources and less knowledge-intensive sectors are likely to experience larger gender wage disparities, while those where high-tech industries have gained prominence should exhibit narrower gaps[1]. For instance, Baum and Benshaul-Tolonen (2021) empirically examine the impact of natural resource dependence on gender equality. They found that countries in which natural resources rents -from oil, gas, coal, minerals, and forests- account for a greater share of GDP have higher levels of gender inequality. Some specificities of those sectors in terms of activities, type of work, geographical location and organizational culture and their impact on the gender gap have been also addressed by literature (Aragón et al., 2018; Argoitia et al., 2023; Kotsadam and Tolonen, 2016). In turn, Rendall (2013) shows evidence about the importance of structural change towards "brain-intensive" sectors in reducing gender disparities, by decreasing the labour demand for physical attributes. His results suggest a positive impact of this type of transformation on reducing gender inequality in wages and employment shares in five countries – USA, Brazil, Mexico, Thailand and India-.

1 This does not mean that the wage gap disappears with the level of education. On the contrary, it generally persists, although on a smaller scale.

Based on the literature reviewed, three hypotheses lead our empirical exercise in the following section. Firstly, since literature has found evidence that positively associate female participation with low-productivity firms and industries, we expect increases in female participation in the labour force to be positively associated with increases in the GWG. This way, *H1 states that a reduction in the gender participation gap (female to male participation) leads to an increase in the gender wage gap.* Following the literature, the idea behind the hypothesis is that women incorporate (or are accepted) in the labour market in less productive activities and worse paid jobs

The second and third hypothesis are based on human capital theory. The second one is derived from the impact of productivity on the gender wage gap. According to the literature reviewed, movements to higher levels of productivity are associated with more brain-intensive jobs, as opposite to brawn-intensive, given the implementation of technological innovation. Literature has also shown the relative advantages of women in the first case, and the negative effect in the second one. Hence, *H2 states that productivity gains positively impact the reduction in the gender wage gap.*

The third hypothesis is derived from the human capital theory statement about the relative advantage of women in industries with a higher demand of skills, or brain-intensive. If true, higher levels of capabilities among women would put them into similar levels of employability, then a shorter gap should be expected. Accordingly, *H3 states that higher levels of female capabilities positively impact on the reduction of the gender gap.*

3. Dataset and estimation strategy

3.1. Dataset and descriptive statistics

The empirical analysis relies on a dataset that aggregates data from the Observatory of Employment and Entrepreneurial Dynamics (OEDE, by its acronym in Spanish), from the Argentinean Human Capital Ministry, along with data from national accounts sourced from the National Institute of Census and Statistics (INDEC, by its acronym in Spanish) –hereinafter OEDE/INDEC database. This database encompasses information about employment, salaries, economically active population (EAP), tertiary graduates, and productivity, all viewed through a gender lens. Encompassing the period from 2004 to 2022, it covers all economic activities at the two- and three-digit levels of the International Standard Industrial Classification (ISIC), resulting in a balanced panel comprising 810 observations across 45 industries[2].

The selection of Argentina for our empirical analysis is twofold. On the one hand, evidence of the gender gaps in its labour market shows that they are decreasing very slow, and that in some industries the gap has even increased (CEP XXI, 2021). On the second hand, Argentina has been largely studied in

2 Description of the variables and sources is presented in Appendix 1.

terms of its productive structure, and a lot has been written related to the need to increase the level of productivity among all the sectors (Niembro and Starobinsky, 2021).

Therefore, Table 1 presents the descriptive statistics of the database. For the total sample, female labour force participation increased from 30.2% in 2004 to 33.2% in 2022, reflecting only a 3 percentage points (p.p.) rise over nearly 20 years. Conversely, female employment-to-EAP ratio remained relatively stable, ranging from 43.5% to 44.2% over the same period. Notably, the disparity in monthly average salaries[3] between genders persists, although it reduced between 2004 and 2022 in 5 p.p.: while women earned 24.5 p.p. less than men in 2004, this gap narrowed to 19.4 p.p. by 2022. In addition, women's representation among tertiary graduates increased from 59.3% to 64.2% of the total graduates during this period. In summary, there has been progress in female labour market participation, wage equality, and educational attainment, albeit at a gradual pace over the past two decades.

Table 1. Descriptive statistics

	Total	Female (% to total)		
	2004	2022	2004	2022
Labour force *(1000 persons)*	4105	6487	30.2	33.2
Average wage *(US$)*	930	2827	75.50	80.64
Economically active population *(1000 persons)*	485400	622397	43.5	44.2
Tertiary graduates *(1000 persons)*	75	140	59.3	64.2

Source: Own elaboration based on OEDE/INDEC database. Obs. 810.

Following Badel and Goyal (2023), the gender participation gap (GPG) was defined as the difference between the ratio female to male employment $\left(\frac{FEAP_i}{FEAP_M}\right)$ and female to male participation $\left(\frac{FL_i}{ML_i}\right)$ in the economically active population, at the industrial level. Formally:

$$GPG_i = \left(\frac{FEAP_i}{FEAP_M}\right) - \left(\frac{FL_i}{ML_i}\right) \quad (1)$$

The GWG was estimated analogously although in absolute terms. That is, the ratio of the difference between male average wages (and female average wages (to male wages (, at the industry level. Formally:

$$GWG_i = \left(\frac{MW_i - FW_i}{MW_i}\right) \quad (2)$$

This way, both gaps account for percentage point differences between men and women, where higher numbers mean higher gaps for women.

3 It is important to note that the database provides data about salary per worker, not about salary per worker hours.

Given the definition of gender gaps, various methodologies in the literature have been employed to forecast their evolution using deterministic trend methods, which provide time-to-gender-equality estimations. Based on Badel and Goyal (2023), we will estimate the time-to-gender-equality based on two methods: the logarithm and the raw one. The logarithmic method consists of regressing the logarithm of the gender gap against the time variable, specifically the year in this case. In contrast, the raw method entails regressing the raw gender gap against the same time-variable. Results yield insights into the temporal trends of the gap and allow for extrapolation until the gap approaches zero. In the logarithmic method, a negative resulting coefficient indicates the annual percentage rate of reduction in the gender gap, whereas in the raw method, it represents the average yearly reduction in percentage points (p.p.). Both methods are utilized by international organizations such as the IMF (Badel and Goyal, 2024), WEF (2023) and UN-Women (2022), particularly for monitoring progress toward the 5th Sustainable Development Goal of United Nations.

The third dimension under analysis is productivity levels. Table 2 illustrates the GPG and GWP at the end of the period (2022), alongside productivity levels categorized by quantile distribution. The relationship exhibits an inverted U-shape, where a negative coefficient in the first quantile indicates that female participation exceeds that of males. This is followed by an increase in the second and third quantiles, culminating in a decrease in the final quantile, although the positive coefficient persists. In the case of GPG the relationship shows a U-shaped curve; the gap starts at a level of 0.3008 in the first quantile, declines between the second and third quantiles, and subsequently rises again in the fourth. Consistent with the findings presented in Section 2, the descriptive statistics indicate that female participation is higher at lower productivity levels, which is accompanied by a larger wage gap. However, this relationship becomes less clear across the remaining productivity levels. These heterogeneous results account for the relevance of a more complex estimation.

Table 2. GPG, GWG and productivity (2022)

Quantiles	Productivity	GPG	GWG
1	0.3836	-0.0085	0.3008
2	0.6603	0.3231	0.2807
3	1.0669	0.2476	0.0024
4	3.7455	0.2098	0.2426

Source: Own elaboration based on OEDE/INDEC database. Obs. 810.

3.2. Estimation strategy

In order to test the hypotheses presented in section 2, a dynamic OLS regression with random effects was estimated. The model tests the association between the GPG, GWG and variations in productivity growth, at the industry level. Formally:

$$WG_{it} = \beta_0 + \beta_1 Year + \beta_2 GPG_{it} + \beta_3 \Delta Prod_{it} + \beta_4 F\_Grad_{it} + u_{it} + \epsilon_t \quad (3)$$

Where the wage gap of industry *i* at time *t* depends on a yearly trend (*Year*), the GPG, the productivity growth and the female graduation rate), to account for the impact of the accumulation of skills. and are the usual random effects and error terms, respectively. Hausman (1978) tests for efficiency between random and fixed effects, RE and FE; Wooldridge (2010) Serial Correlation Test and Wald Test for heteroscedasticity were estimated afterwards, in order to assess the specification of the model. P-values are reported after the estimation results. Robust standard errors were set in the estimation.

Following Badel and Goyal (2024), regressing the year against the gap accounts for institutional, regulatory, and other political measures aimed at closing the gender gap at the national level. Given the national average and the overall trend of the gap in Argentina, we expect a negative and significant association, suggesting that an additional year positively contributes to the reduction of the gap. Additionally, we incorporate the effect of the GPG, which accounts for the relative increase in the number of women in the total labour force of the industry, compared to male participation. As discussed in Section 2, it is important to note that women tend to be overrepresented in low-productivity industries. In alignment with H1, we expect a positive and significant relationship, indicating that reductions in the GPG lead to increases in the GWG. The association between productivity growth and the GWG is addressed by H2. Based on the literature reviewed in Section 2, we expect that increases in average wages, which are typically associated with higher levels of productivity and skill, will have a positive and significant impact on the reduction of the gap, resulting in a negative coefficient. Table 4 outlines the primary variables and their respective characteristics. Finally, in accordance with H3, we expect to observe a negative association between graduation rates and the gender gap

To address the presence of heterogeneity, the aforementioned hypotheses will be tested across different levels of productivity. The distribution of productivity levels is established through a quantile classification, ranging from low to high labor productivity. The sample is classified according to the interannual variation in productivity, thereby allowing shifts between quantiles over time.

It is important to note that this estimation does not encompass the determinants of the gender wage gap. Our primary objective is to test and measure the association between the GWG and three key factors that differentiate men and women in the labour market: female participation in the workforce, labour productivity, and graduation rates, as well as the relationship between varying productivity levels and the gap. Nonetheless, we aim to contribute to gender studies that examine the determinants of the wage gap, recognizing that certain aspects of the explanation is still a puzzle. We consider that this puzzle can be partially addressed considering differences in productivity gains at the industry level.

Table 3. Definition of variables

Variable	Definition	Values
WG	Gender wage gap.	-1 to 1
GPG	Gender participation gap. Interannual variation.	-1 to 1
Prod	Gross productive value to total workforce. US$ dollars. Interannual variation.	0 to ∞
F_Grad	Female tertiary graduation rate, relative to female labour force participation.	0 to 1
Case identifiers		
i	Industry. Industry on two- and three-level ISIC Rev. 3.	45 industries
T	Time.	2004 to 2022

Source: Own elaboration based on OEDE/INDEC database.

4. Results

4.1. Forecasting of the gender gap

Table 4 presents the results of the time-to-gender-equality estimations, based on national averages for the period 2004-2022. The GPG decreased from 0.128 p.p. in 2004 to 0.109 p.p. in 2022. This means that female labour participation was 0.109 p.p. lower than female participation within the total EAP in 2022. Therefore, while women constituted approximately 44% of the EAP, they accounted for around 33.2% of the total labour force. Regarding the evolution of the gap, this represents a yearly reduction rate of -1.04% and an average reduction rate of -0.0013 p.p. per year. At this pace, and assuming all else remains constant, the GPG would close within 90 to 230 years.

The evolution of the GWG shows fewer promising results, given the slower rhythm of reduction. Between 2004 and 2022, it dropped from 0.331 to 0.271, that is a -0.0013 p.p. of average annual reduction and a -0.45% average interannual variation. This means that it will be closed sometime between the years 2225 and 2752, *ceteris paribus*. In other words, it shows a stable tendency which can be marginally reduced only over the centuries.

Table 4. Participation and wage gap – National estimates and forecasting

	Gap		Forecast (ln)		Forecast (raw)	
	2004	2022	Coeff ln	Years	Coeff raw	Years
GPG	0.128	0.109	0.0104	230	-0.0013	90
GWG	0.331	0.271	0.0045	730	-0.0013	203

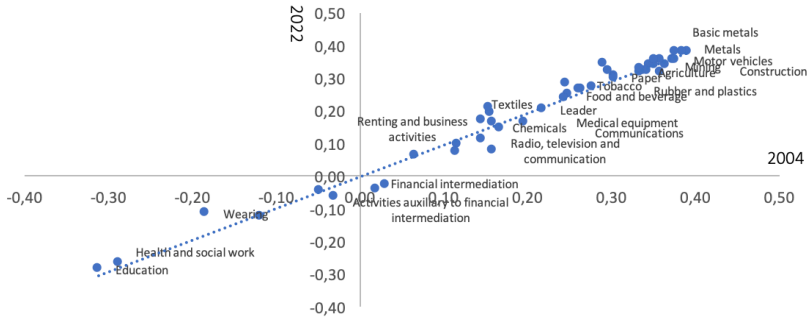
Source: Own elaboration based on OEDE/INDEC database. Obs. 810.

As we shall see, average national values hide high levels of heterogeneity at the industrial level and show a convergence pattern towards the disappearance of the gender gap where in fact there are industries where female participation is higher than men's one and industries where the gap is still on the rise. Graphs 1.a. and 1.b. depict the relationship between the GPG in 2004 (abscissas) versus 2022 (ordinates) at the industrial level. Out of 45 industries, 29 reduced the

GPG (those below the 45° line), in 10 industries it widened (the ones over), and the gap is non-existent in 5 industries (below 0). In the case of the GWG, similar heterogeneity is observed: 35 out of 45 industries reduced the gap, in 7 industries is widened, and 3 industries do not exhibit a WG.

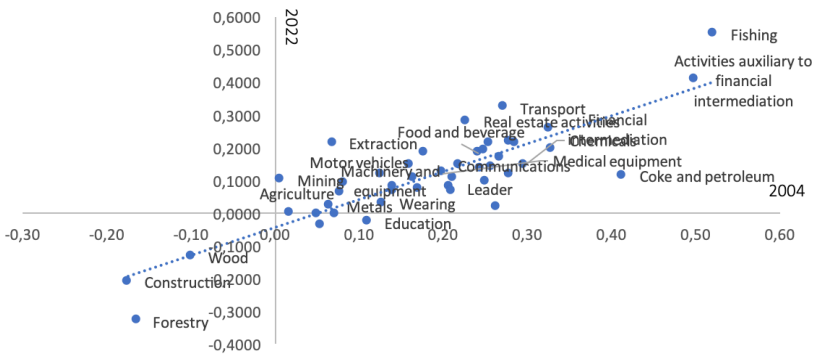
The combined analysis of the gaps shows that except for fishing, all industries closed at least one of the gaps and 24 industries closed both. Among the industries that closed both gaps it is worth mention those usually classified as knowledge intensive, such us medical equipment and business activities. Among the ones that increased the GPG although with a reduction in the GWG there are chemicals and communications.

Graph 1.a Gender participation gap 2004-2022 – Industry level



Source: Own elaboration based on OEDE/INDEC database. Obs. 810.

Graph 1.b Gender wage gap 2004-2022 – Industry level



Source: Own elaboration based on OEDE/INDEC database. Obs. 810.

4.2. Dynamic OLS regression with random effects

Table 5 depicts estimation results for the total sample (column 1) and the selected productivity levels (column 2 to 6). Results show a negative association between year and the gender wage gap, confirming the average trend observed in section 3: it decreases 0.00496 p.p. per year, on average for all industries. This prospective result coincides with other studies that have focused on the tendency of the wage gap both at the national and international level (Badel and Goyal, 2024; UN-Women, 2022).

Regarding the association between productivity levels and the GWG, results show that the gap is being closed faster at the extreme values of the productivity variation, meaning a higher coefficient at the 1st and 4th quantile, and even a larger one in the latest (0.00502 and 0.00629, respectively). Based on the average gender wage gap presented in table 3, and once that gap has been controlled by the gender participation gap, the productivity levels and the rate of female graduation, these coefficients mean that the gap will be closed in 66 years, instead of the 203 observed in raw values.

The other way around, the positive coefficient of the gender participation gap means that the impact is direct: reductions in the GPG leads to reductions in the GWG. However, this impact is significant only for the 1st and 2nd quantiles, with a decreasing impact (0.0339 and 0.0055, respectively). In the case of the 3rd and 4th the association is not significant. Therefore, H1 is rejected, as no inverse relationship exists between the two gaps. On the contrary, the relationship is reversed at the lowest levels of productivity.

Regarding H2, results show that an interannual increase in the productivity levels leads to a shorter wage gap at the 4th quantile (0.01860). For the rest of the quantiles the impact is not significant. Therefore, the hypothesis is only true for the most productive industries, while it is not for the whole industry.

Finally, regarding H3, it is verified at all productivity levels except for the middle-low one (2nd). The impact of an increase in the relative participation of graduated women leads to reductions in the wage gap in the case of the 1st, 3rd and 4th quantiles (0,01233, 0.01491 and 0.02460, respectively).

Table 5. Estimation results – Dep Var.: Wage gap

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total	0.25	0.50	.75	.1
Year	-0.00496**	-0.00502**	-0.00359**	-0.00486**	-0.00629**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GPG	0.00367**	0.03390*	0.00557**	0.00069	-0.00432
	(0.001)	(0.017)	(0.002)	(0.001)	(0.007)
Prod	-0.00288	0.08440	-0.38653	0.03500	-0.01860*
	(0.010)	(0.079)	(0.290)	(0.308)	(0.009)
F_grad	-0.01207	-0.01233**	-0.00867	-0.01491*	-0.02460*
	(0.009)	(0.004)	(0.009)	(0.007)	(0.011)
Constant	10.17884**	10.19211**	7.79720**	9.97299**	12.94819**

(Continue)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total	0.25	0.50	.75	.1
	(1.878)	(1.710)	(2.104)	(2.008)	(2.924)
Observations	810	203	202	203	202
# of industries	45	40	43	45	42
Hausman Test p-value (H0 adequately modeled by RE)	0.4323	0.3317	0.0655	0.2666	0.7134
Wald Test p-value (H0: heteroscedasticity)	0.0000	0.0003	0.0000	0.0000	0.0000
Wooldridge Serial Correlation Test p-value (H0: no serial correlation)	0.6048	0.3611	0.5131	0.7804	0.3133

Robust standard errors in parentheses. ** p<0.01, * p<0.05, + p<0.1. Source: Own estimations based on OEDE/INDEC database.

When examining the quantiles, the annual coefficients reveal that the 66 years required to close the GWG at average levels conceal significant heterogeneity in the productive dynamics of various industries. In the first quantile, the trend suggests that the wage gap will close in 60 years (from 0.3008 to 0.00502). In the second quantile, this duration increases to 78 years, while it is less than one year for the third quantile. The estimation for the fourth quantile is 38 years. These heterogeneous trends underscore the importance of adopting an industry-specific perspective when implementing policies aimed at closing the GWG. Furthermore, contrary to existing literature, we did not identify a direct relationship between productivity levels and the GWG. Consistent with the observations made in the descriptive statistics, we found a U-shaped relationship between productivity and the rate of closure of the GWG.

When analyzing the industries within each quantile, significant heterogeneity becomes evident. While the industries represented in the first quantile predominantly belong to low-tech sectors (such as textiles, construction, and wholesale and retail trade), the third and fourth quantiles encompass both traditional high-tech industries (including chemicals, vehicles, rental and business activities, and communications) and sectors typically classified as low-tech. Notably, in the context of Argentina, these low-tech industries play a substantial role in both domestic and international activities, as exemplified by agriculture. Furthermore, consistent with findings in the literature (Durán Lima and Galván, 2023), the dynamics of high-profile exports and proximity to international markets appear to be positively correlated with the enhanced impact of productivity gains on the closure of the GWG.

Another finding that aligns with previous studies is the relationship between the two gaps: the participation gap (PG) and the wage gap (WG). The association between these gaps is significant only at the lowest levels of productivity—specifically in the 1st and 2nd quantiles—where the gender participation gap is notably low. This observation is consistent with the industries represented in these quantiles, which tend to have high female participation due to historical patterns of labor distribution (e.g., education, health, and social work).

Moreover, these sectors exhibit wage gaps that substantially exceed the national average, coupled with average salaries that are also significantly higher than the national average.

This aligns with evidence from human capital literature suggesting that women are more likely to be employed in firms that offer lower wages (Abegaz and Nene, 2018), particularly as many of these industries in Argentina are predominantly public. Furthermore, this prompts the need for future research examining the differences in gender gaps between the public and private sectors. Consequently, the sector-specific characteristics and historical patterns contribute to the gender gap in these fields, indicating that targeted policies are necessary to achieve equity.

It is worthy of a final mention on the relationship between productivity and the gender wage gap. The literature indicates a negative correlation between these two variables (Abegaz and Nene, 2018; Brynin and Perales, 2016; Sin et al., 2022), which aligns with our initial expectations regarding the results. However, this study's industry-level focus is predicated on the assumption that this relationship may vary across different sectors, albeit without specific hypotheses regarding the nature of these differences. Our findings reveal that women employed in industries with the lowest levels of productivity are not impacted by this negative relationship. Contrary to the expectations set forth by human capital literature, productivity gains do not result in improvements in women's relative wages. In contrast, within the industries situated in the highest quantiles, the closure of the gender wage gap is positively associated with productivity gains and skill development, while it does not correlate with the participation gap.

This observation does not diminish the importance of addressing the participation gap; rather, it underscores the necessity for policies aimed at increasing women's participation to also encompass wage equity. Increased participation alone does not automatically translate into equitable income distribution. Therefore, both types of policies—those focused on enhancing participation and those addressing wage disparities—are essential for achieving gender equity.

5. Conclusions

This paper analyzes the gender wage gap through the lens of industrial heterogeneity. A significant body of theoretical and empirical research seeks to explain the existence, persistence, and reduction of these gaps. Most studies on the wage gap derive their explanations from human capital theory, taking into account individual worker characteristics such as education, productivity, age, experience, and bargaining power. From this perspective, researchers aim to identify how these factors contribute to the reduction of the gap. Typically, education is identified as an "equalizing" factor that helps diminish the gender wage gap.

Research examining the gender wage gap in relation to different industries is scarce but consistent in its findings: industrial characteristics significantly impact the gender wage gap. Such analysis is particularly crucial for Latin American countries, which exhibit heterogeneous productive structures. Therefore, any

investigation into gender gaps must consider the economic structure, as it plays a pivotal role in wage determination. Additionally, analyses of economic structure that yield recommendations for development must account for gender gaps, given that these gaps reflect broader structural imbalances. Consequently, closing the gender wage gap is intricately linked to the evolution of the productive structure, particularly in terms of the distribution of economic industries concerning value-added output and employment.

In light of this context, we analyzed the trends and characteristics of the gender wage gap in Argentina for the period 2004-2022 at the industry level. Our results indicate the presence of industry-specific factors that influence the gender wage gap. First, we demonstrate that varying timeframes are required for different industries to close the gender gap, depending on their productivity levels. Furthermore, the relationship between wage gaps and participation gaps varies across industries, with a non-significant association observed in the most productive sectors. Finally, female university graduates play a crucial role in narrowing the gender gap across nearly all industries, aligning with expectations derived from human capital theory. This evidence enriches the literature on the gender wage gap, particularly from an industrial perspective, by illustrating how the characteristics of the gap differ across types of activities. Notably, this paper also provides new insights into the positive relationship between female university graduates and the wage gap while highlighting its limitations when industrial characteristics are overlooked. Further research is warranted to explore the intensity and determinants of this association, such as fields of study and educational attainment levels.

Several limitations affect our research and warrant acknowledgment. Our analysis is conducted at the meso-level, lacking detailed information regarding workers' positions and working hours. Consequently, we cannot definitively ascertain whether the wage gap stems from differences in hourly wages or pay-per-job, or whether it is related to variations in working hours. This challenge remains unresolved due to the absence of hourly-level databases or position-specific data in Argentina. Nevertheless, the consistency of our findings with prior studies indicates that our dataset is adequate for analyzing the gender wage gap. We anticipate that future research will address these issues by integrating more granular data, potentially through the merging of various administrative records.

Despite these limitations, this research elucidates the characteristics of the gender wage gap and the implications of structural heterogeneity. We aim to contribute to the discourse on how structural change can adversely affect female workers if gender inequalities are not addressed. Moreover, we emphasize the significance of public policy in this context, as our primary conclusion highlights the necessity for a policy mix that combines objectives of structural change and gender equity. Any industrial policy, or initiative aimed at promoting female labor force participation, must carefully consider its potential effects on the gender wage gap.

References

Abegaz, M., and Nene, G. (2018). Gender wage and productivity gaps in the manufacturing industry. The case of Ghana. *Economic Papers: A Journal of Applied Economics and Policy*, *37*(3), 313–326.

Ahmed, S., and McGillivray, M. (2015). Human capital, discrimination, and the gender wage gap in Bangladesh. *World Development*, *67*, 506–524.

Allen, J., and Sanders, K. (2002). Gender gap in earnings at the industry level. *European Journal of Women's Studies*, *9*(2), 163–180.

Angelov, N., Johansson, P., and Lindahl, E. (2016). Parenthood and the gender gap in pay. *Journal of Labor Economics*, *34*(3), 545–579.

Anker, R. (1997). La segregación profesional entre hombres y mujeres. *Revista Internacional Del Trabajo*, *16*(3), 343–370.

Aragón, F. M., Rud, J. P., and Toews, G. (2018). Resource shocks, employment, and gender: evidence from the collapse of the UK coal industry. *Labour Economics*, *52*, 54–67.

Argoitia, J. M., Warszawski, T. F., de las Nieves Puglia, M., and Erlauer, M. F. (2023). *Ser y parecer minera: inserción sostenible de las trabajadoras mineras*.

Azmat, G., and Ferrer, R. (2017). Gender gaps in performance: Evidence from young lawyers. *Journal of Political Economy*, *125*(5), 1306–1355.

Badel, A., and Goyal, R. (2024). When will global gender gaps close? *Economics Letters*, *237*, 111544. https://doi.org/10.1016/J.ECONLET.2024.111544

Baum, S., and Benshaul-Tolonen, A. (2021). Extractive industries and gender equality. *Review of Environmental Economics and Policy*, *15*(2), 195–215.

Blau, F. D., and Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. *Journal of Economic Literature*, *55*(3), 789–865.

Brynin, M., and Perales, F. (2016). Gender wage inequality: The de-gendering of the occupational structure. *European Sociological Review*, *32*(1), 162–174.

Cao, H., and Vaca, J. (2006). Desarrollo regional en la Argentina: la centenaria vigencia de un patrón de asimetría territorial. *EURE (Santiago)*, *32*(95), 95–111.

CEP XXI. (2021). Empleo femenino y composición sectorial en Argentina 2007-2021. *Ministerio de Desarrollo Productivo*.

Cimoli, M., and Porcile, G. (2016). Latin American structuralism: the co-evolution of technology, structural change and economic growth. *Handbook of Alternative Theories of Economic Development*, 228–239.

Durán Lima, J. E., and Galván, M. (2023). América Latina: Brechas salariales en sectores exportadores y no exportadores según regresiones por cuantiles, 2011-2018. *Brechas de Género En Las Cadenas Globales de Valor de América Latina y El Caribe: Nuevos y Viejos Desafíos En Un Contexto de Incertidumbre. Santiago: CEPAL, 2023. LC/TS. 2023/17. p. 75-121*.

Fagerberg, J. (2018). Technological progress, structural change and productivity growth: a comparative study. In *Innovation, Economic Development and Policy* (pp. 214–232). Edward Elgar Publishing.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*, 1251–1271.

Jayachandran, S. (2015). The roots of gender inequality in developing countries. *Economics*, *7*(1), 63–88.

Katz, J. (2018). Las cuatro argentinas que conviven... pero no conversan. Una historia de éxitos, fracasos y desencuentros. *Boletin Informativo Techint*, *356*.

Kotsadam, A., and Tolonen, A. (2016). African Mining, Gender, and Local Employment. *World Development*, *83*, 325–339. https://doi.org/10.1016/J.WORLDDEV.2016.01.007

Malerba, F., Orsenigo, L., and Peretto, P. (1997). Persistence of innovative activities, sectoral patterns of innovation and international technological specialization. *International Journal of Industrial Organization*, *15*(6), 801–826. https://doi.org/10.1016/S0167-7187(97)00012-X

Montobbio, F. (2002). An evolutionary model of industrial growth and structural change. *Structural Change and Economic Dynamics*, *13*(4), 387–414.

Niembro, A. A., and Starobinsky, G. (2021). *Sistemas regionales de ciencia, tecnología e innovación en la periferia de la periferia: un análisis de las provincias argentinas (2010-2017)*.

Olivetti, C., and Petrongolo, B. (2014). Gender gaps across countries and skills: Demand, supply and the industry structure. *Review of Economic Dynamics*, *17*(4), 842–859. https://doi.org/10.1016/J.RED.2014.03.001

Olivetti, C., and Petrongolo, B. (2016). The evolution of gender gaps in industrialized countries. *Annual Review of Economics*, *8*, 405–434.

Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*. https://doi.org/10.1016/0048-7333(84)90018-0

Redmond, P., and McGuinness, S. (2019). The gender wage gap in Europe: Job preferences, gender convergence and distributional effects. *Oxford Bulletin of Economics and Statistics*, *81*(3), 564–587.

Rendall, M. (2013). Structural change in developing countries: has it decreased gender inequality? *World Development*, *45*, 1–16.

Saviotti, P., and Frenken, K. (2008). Export variety and the economic performance of countries. *Journal of Evolutionary Economics*, *18*(2), 201–218. https://doi.org/10.1007/s00191-007-0081-5

Si, C., Nadolnyak, D., and Hartarska, V. (2021). The gender wage gap in developing countries. *Applied Economics and Finance*, *8*(1), 1–12.

Sin, I., Stillman, S., and Fabling, R. (2022). What drives the gender wage gap? examining the roles of sorting, productivity differences, bargaining, and discrimination. *Review of Economics and Statistics*, *104*(4), 636–651.

UN-Women. (2022). *Progress on the sustainable development goals. The gender snapshot. 2022*.

WEF. (2023). *Global Gender Gap Report 2023*.

Wooldridge, J. (2010). *Econometric Analysis of Cross Section and Panel Data* (2nd ed.). MIT Press.

Appendix 1

Table A. Definition of variables

Variable	Definition	Values	Source
L	Total registered employment (except public employment). Number of persons. 1996-2022.	0 to ∞	OEDE
W	Average salary per employee. US$ dollars. 1996-2022.	0 to ∞	OEDE
EAP	Economically active population. People who have an occupation or who, without having one, are actively looking for one. Number of persons. 2003-2022.	0 to ∞	OEDE
GPV	Gross productive value. US$ dollars. 2004-2022.	0 to ∞	INDEC
Grad	Graduation. Total number of graduated persons. 1999-2022.	0 to 1	Min. Educ.
F	Female. Based on national ID.	1 if yes; 0 otherwise.	OEDE
S	Industry on two- and three-level ISIC Rev. 3.	45 industries	OEDE