

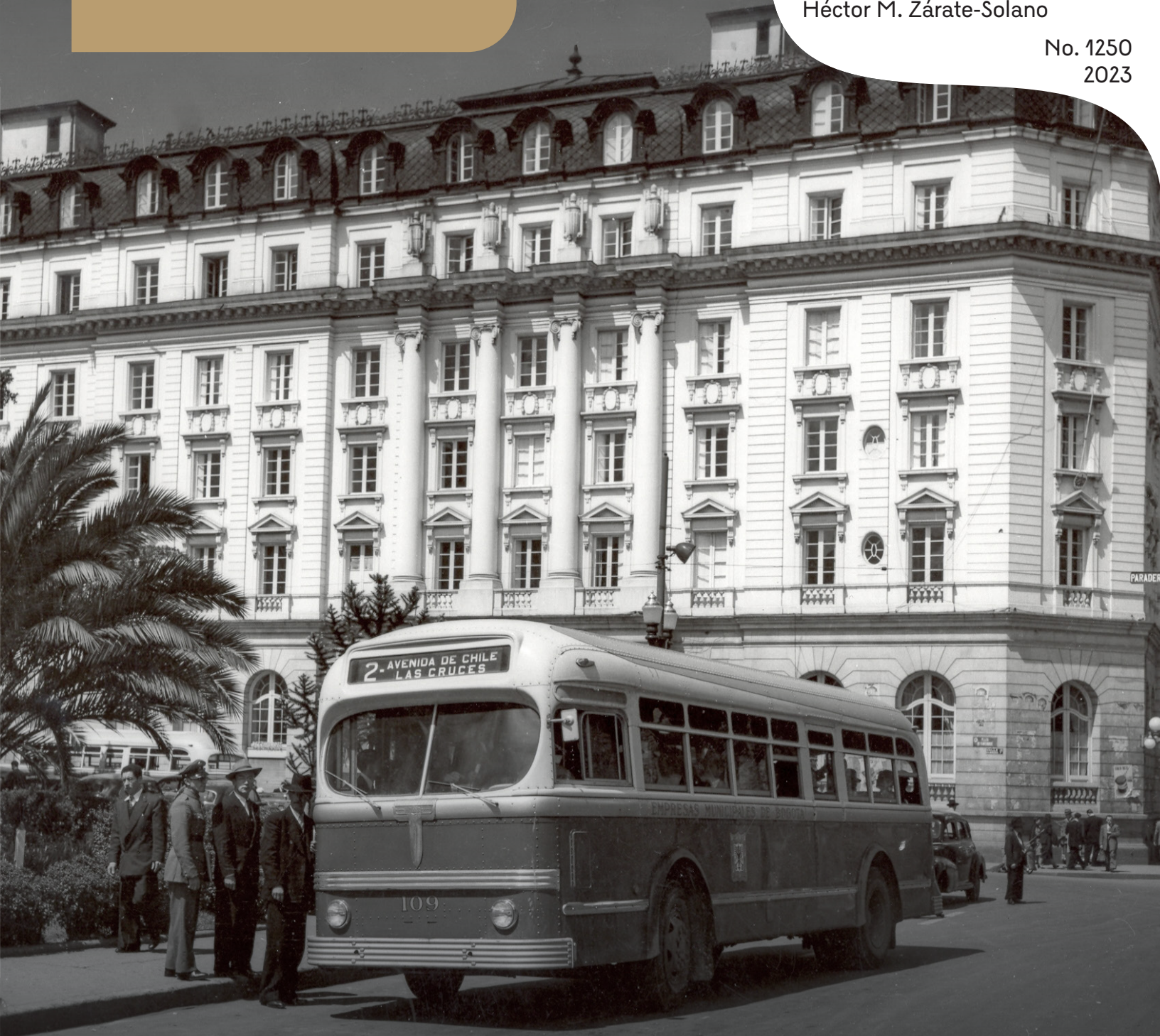
BORRADORES DE ECONOMÍA

Unraveling the Factors Behind
Women's Empowerment in the
Labor Market in Colombia

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Abstract

This paper examines the evolution of women's participation in the labor market from 1960 to 2018, shedding light on the complex factors that influence their labor opportunities. The study emphasizes the significance of the historical context in understanding these factors. This research uncovers nuanced insights using a two-step methodology involving principal component analysis and Time-Varying Effect Modeling (TVEM). The results indicate that the transition from high to low fertility rates significantly influenced female labor participation until the late 1970s. Educational advancements, economic growth, and changing marital dynamics also played a role in shaping evolving patterns. From 1980 to 1995, factors such as diminishing fertility, declining infant mortality, and varying economic conditions influenced women's labor involvement. From 1995 to 2010, higher education emerged as a key driver, accompanied by shifting societal norms, and from 2010 to 2018, the period witnessed positive contributions from fertility rates, minimum wage, and male labor participation. This study underscores the intricate relationship between education, demographics, social norms, and economics in shaping women's labor force participation, providing valuable insights for gender-inclusive policies and promoting women's economic empowerment.

JEL Classification: C29, J16, N36.

Keywords: female labor participation, Time-Varying Effect Modeling, demographic transition, Colombia

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Los factores detrás del empoderamiento de las mujeres en el mercado laboral en Colombia[♦]

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Resumen

Este artículo examina la evolución de la participación laboral de las mujeres desde 1960 hasta 2018, analiza los factores que influyen en sus oportunidades laborales y destaca la importancia del contexto histórico para comprender la relación entre estos factores. El estudio utiliza una metodología de dos etapas, incluyendo el análisis de componentes principales y el modelo de efectos cambiantes en el tiempo (TVEM por su sigla en inglés). Los resultados muestran que la transición demográfica tuvo un impacto significativo en la participación laboral femenina hasta finales de la década de 1970. Además, los avances educativos, el crecimiento económico y los cambios en normas sociales, incluyendo el matrimonio, contribuyeron a explicar la dinámica laboral de las mujeres. Desde 1980 hasta 1995, factores como la disminución de la fecundidad, la reducción de la mortalidad infantil y las condiciones económicas moldearon su participación laboral. A partir de 1995, la educación superior se convirtió en un factor clave, junto con cambios en las normas sociales. Durante el período 2010 - 2018, se observaron contribuciones positivas de las tasas de fecundidad, el salario mínimo y la participación laboral masculina. Este estudio resalta la compleja relación entre la educación, la demografía, las normas sociales y la economía en la configuración de la participación de las mujeres en la fuerza laboral, y proporciona información valiosa para desarrollar políticas inclusivas de género promoviendo el empoderamiento económico de las mujeres.

Clasificación JEL: C29, J16, N36.

Palabras clave: participación laboral femenina, modelo de efectos cambiantes en el tiempo, transición demográfica, Colombia.

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I. Introduction

During the twentieth century, one of the most important achievements for Colombian women was the remarkable increase in their labor force participation, especially during the second half of the century. Women's participation increased from 18% in 1951 to 26% in 1978, 47% in 1992, 55% in 2000, and 60% in 2018.¹ The upward trend in female labor participation can be attributed to the remarkable advancements in education, fertility, sanitation, civil rights, and political engagement that women experienced during this period. The contribution of married women to the growth of labor participation was a key driving force behind this significant improvement. They seemed to be more responsive to economic cycles and to the legislation introduced in the first half of the twentieth century, which allowed married women to enter the workforce.

This paper contributes to identifying the main drivers of women's participation in the labor market since the second half of the 20th century, tracing the transformation of women's roles and opportunities. The changing nature of female labor force participation and its determinants highlights the importance of considering the historical moment and context in which these variables are examined. We present evidence that the effects of these variables have changed over time. To this end, we follow a two-step approach in which, first, we implement a principal component dimension reduction to summarize the whole set of variables (fertility, education, mortality, marriage, labor force participation, violence, female political participation, and some macroeconomic variables) with a few components. Second, we employ the Time-Varying Effect Modelling (TVEM) method to find the dynamic pattern evolution for the coefficients over time under different specifications on the female labor force participation determinants. We use annual aggregate data from 1960 to 2018.

The literature on the determinants of female labor participation using aggregate datasets focuses on cross-country comparisons and individual countries analysis.² Several studies for OECD countries examine the determinants of female labor participation. For example, Cavalcanti and Tavares (2008) find that higher availability and lower prices of domestic appliances increased female labor participation in these countries from 1975-1999. In addition, Mishra and Smyth (2010) find a negative

¹ This trend was interrupted by the Covid-19 pandemic in 2020. Since the beginning of 2022, the participation of women started to recover. For more details, see, for example, García-Rojas, Herrera-Idárraga, Morales, Ramírez-Bustamante, and Tribín-Urbe (2020).

² Another strand of the literature uses individual datasets from population surveys and censuses. See, for example, Blau and Kahn (2007), Fernández (2013), Gangl and Ziefle (2009), Gasparini and Marchionni (2015, 2017), Goldin (1988, 2006), Goldin and Mitchell (2017), Olivetti (2014).

and significant long-run relationship between the female labor force participation rate and the fertility rate for 1985-2005. Furthermore, Gonzales, Chandra, Kochhar, and Newiak (2015) analyze the labor participation gap between men and women in these countries during 1950-2012 and show that education has a positive effect on the participation of women in the labor market, thus reducing the participation gap. Conversely, household size has a negative effect on the participation of women, thus increasing this gap. For the G7 countries, Mishra, Nielsen, and Smyth (2010) find that, in the long run, a reduction in the fertility rate increases female labor participation for the period 1960-2006.

Furthermore, Mammen and Paxson (2000) conducted an analysis on the impact of economic development on female labor participation in 90 developed and developing countries during the 1970s and 1980s. They discovered that, at the initial stages of the development process, female participation follows a U-shaped pattern in relation to income levels. For India, Nepal, Pakistan, Bangladesh, and Sri Lanka, Shami, Islam, and Rayhan (2019) investigate the macroeconomic determinants of female labor participation for the period 1990-2015. Their results suggest that gross national income and the enrollment rate in secondary education positively affect labor participation whereas the fertility rate has a negative effect. Lastly, Doepke, Hannusch, Kindermann, and Tertilt (2022) survey the Economics of fertility and find that the variables explaining the negative relationship between income and fertility and women's labor force participation and fertility have changed recently in high-income countries. According to these authors, these relationships have flattened and even turned positive in some countries. In recent decades, the quantity-quality tradeoff does not hold. Instead, the key determinants of these relationships are factors that allow women to combine career and family (e.g., family policy, cooperative fathers, favorable social norms, and flexible labor markets) (see, Goldin, 2006).

Regarding the literature on the determinants of female participation in the labor market for individual countries, Junaid, Sultana, Jabeen, and Ali (2019) find that increases in output, the number of children, female unemployment, and poverty levels reduce women participation in Pakistan between 1980-2015; on the contrary, higher levels of education encourage women to participate in the labor market. Next, Mehrotra and Parida (2017) indicate that a higher level of education and a higher salary increase female participation, mainly in urban areas of India, from 1983 to 2015. Moreover, Narayan, Nguyen, and Nghiem (2021) investigate the effect of economic integration on Vietnam's female labor force participation from 1986-2014. Their results show that trade, especially with high-income countries, positively affects female labor participation in this country. Also, regarding the traditional determinants of female labor participation, these authors find that health status and government

spending on education are the most important determinant of female participation in Vietnam. This literature also includes developing models to investigate women's increasing labor participation in the United States. For instance, Eckstein and Lifshitz (2011) show that the rise in the participation of married women mainly respond to the increase in education and women's wages, lower child-rearing costs, improvements in home technologies, changes in social norms, a decrease in fertility rate and an increase in the number of divorces during 1962-2004.

In Colombia, research on the determinants of female labor force participation has primarily relied on microdata. For instance, Angulo and López de Rodríguez (1975), using the 1971 national household survey, find that the relationship with the head of the household³, marital status, and occupation are the most important variables explaining female labor participation. Similarly, López de Rodríguez and León de Leal (1977) show that marital status and family size affected labor participation the most. Also, Vélez and Winter (1992), using the June 1988 National Household Survey, indicate that the probability of participating increases with the woman's education, the size of the household, and being a household head. In contrast, it decreases with children under the age of 6.

The analysis of Ribero and Meza (1997), using September National Household Surveys (1976-1985), suggests that being the head of the household and being educated increases the probability of participating while being married, the presence of young children and the household size negatively affect this probability. In the same way, the results of Tenjo and Ribero (1998), using household surveys in 1988, 1994, and 1996, indicate that education, family unemployment, and age increase this probability. In contrast, the presence of young children and being the wife of the head of the household reduced this probability. Along the same lines, Sánchez and Núñez (2003) show that higher levels of education and low fertility rates are the main determinants of women's labor participation in urban Colombia between 1978-1998.

The participation of married women and mothers has also been studied in Colombia. For example, Castañeda (1981), in his study of urban mothers, and Magnac (1992), in his analysis of married women in urban areas, find that education increases the probability of participation while having children reduces it. Similarly, the estimations of Arango and Posada (2007) indicate that education, labor income taxes, children aged between 1 and 2 years old, and the presence of other people unemployed at home are the main determinants of the labor participation decision of married women

³ The relationship with the head of the household corresponds to the wife, daughter, sister, sister-in-law, or other.

between 1984 and 2000. Furthermore, Amador, Bernal, and Peña (2013) identify that the increase in female participation is driven by the participation of married women and women with low educational attainment between 1984 and 2006. González and Daza (2015) determine, for the period 2002-2013, that having higher education increases women's labor participation, especially for married women after 2008, while the presence of young children reduces this participation.

Finally, Santamaría and Rojas (2001) conclude that the growth of labor participation between 1983 and 2000 has been driven by the increase in the participation of women in the labor market because of cultural, institutional, and economic changes. These authors find that the main factors affecting women's participation were the decline in fertility, greater access to education, the change in gender roles within families, the greater participation of the service sector in the economy, and the economic cycle.

This paper contributes to further our understanding of the drivers behind the behavior of female labor participation in Colombia for almost seventy years. To our knowledge, this is the first paper that uses historical aggregate data for an emerging economy, considering that the relationship between female labor participation and its determinants has changed over time. Moreover, Colombia could serve as an example for promoting the rapid economic empowerment of women through progressive reforms and advancements. The country could provide a reference point for countries currently struggling with low female labor force participation.

This study underscores the significance of allowing variables to evolve and recognizing the importance of historical context in shaping women's empowerment. It is important to acknowledge that history cannot be condensed into a single average, as it is through historical analysis that we gain insights into the dynamics and transformations of women's empowerment. The analysis reveals the significance of the demographic transition, educational opportunities, economic conditions, social norms, and key events such as the peace process on female labor participation over time. The findings emphasize the need for policies and interventions that address barriers, promote gender equality, and create inclusive labor markets. By understanding and addressing these drivers, society can foster greater gender equity and unlock the full potential of women as contributors to economic growth and development.

The remainder of the paper is organized as follows. Section 2 describes the data and the empirical strategy used in our analysis. Section 3 presents the principal component analysis results and the

individual variables' effect on the female labor force participation rate in Colombia. And, section 4 concludes.

II. Empirical strategy and data

A. Empirical strategy

The empirical strategy used in this paper follows a two-step approach. First, we implement a principal component dimension reduction to summarize the data in fewer than the original number of dimensions without losing essential information. Second, we use the Time-Varying Effect Modeling (TVEM) method to find the pattern evolution for the estimated coefficients over time under different specifications, including the principal components and individual variables, on the female labor force participation in Colombia.

1. Principal component dimension reduction

The exploratory analysis of the dataset relied on a non-supervised dimensional reduction technique known as Principal Components Analysis (PCA), which aims to identify linear combinations of the variables that best explain the data variability. PCA is a statistical technique that explains the matrix of variances and covariances of a set of m variables through a few linear combinations. This transformation converts a set of correlated variables into a set of uncorrelated variables through an orthogonal transformation. The visual inspection of the principal components was done through summary statistics from the covariance matrix via the scree, eigenvalue, and variance plots. These plots provide the distribution of the eigenvalues, which tell us about the decrease in the variance of the scores, and it is useful to determine the optimal number of components representing the data. Additionally, we consider two-dimensional scatterplots of the three principal components to find further patterns in the data.⁴

2. Time-Varying Effect Modeling Method

In the second stage, we employ a time-varying effect modeling (TVEM) method to analyze Colombia's female labor force participation rate. TVEM is a natural extension of linear regression

⁴ For an in-depth overview of high-dimensional data analysis, see, for example, Koch (2013).

models, wherein coefficients of variables vary over time.⁵ This approach allows us to examine the overall shape and inflection points of each variable's impact on female labor force participation directly from observations. We use a variable-selection method incorporating automated model building and the Least Absolute Shrinkage and Selection Operator (LASSO) methods to determine the most relevant variables. Moreover, our specifications consider the impact of the three principal component scores.⁶

Formally, a TVEM is defined as:

$$y_t = \beta_0(t) + \beta_1(t)X_1 + \cdots + \beta_p(t)X_p + \varepsilon_t \quad (1)$$

where $\beta_0(t), \beta_1(t), \dots, \beta_p(t)$ are unknown dynamic coefficient functions that are assumed to be smooth over time t ; X_1, \dots, X_p are the set of selected variables according to the shrinking dimension reduction technique.

The inference of the TVEM follows a two-step procedure. First, approximate the function of each coefficient over a small sub-interval with low-order polynomials. Therefore, within each subinterval, the functions are estimated with combinations of spline basis⁷, and estimation of $\beta(\cdot)$ is made by $K + 2 + 1$ quadratic penalized-spline basis functions, *P-splines*:

$$\begin{aligned} \beta_0(t) &= a_0 + a_1t + a_2t^2 + \sum_{k=1}^K a_{2+k}(t - t_k)^2 \\ \beta_p(t) &= b_0 + b_1t + b_2t^2 + \sum_{k=1}^K b_{2+k}(t - t_k)^2 \end{aligned} \quad (2)$$

Where K are the specified inner knots. The coefficients $a_j, b_j (j = 0, 1, \dots, K + 2)$ of these truncated power functions represent the number of jumps in the estimation of $\beta(\cdot)$, which are relevant for the smoothness of the estimated functions. In other words, estimation of $\beta_i(t) (i = 0, 1, \dots, p)$ is transferred to the estimation of a_j, b_j , respectively. Second, fit a TVEM by approximating the linear combination of these functions.

⁵ For details see, for example, Prüser and Schlösser (2020) and Lanza and Linden-Carmichael (2021).

⁶ Hastie, Tibshirani and Friedman (2001) provide details on this issue.

⁷ A spline is a segmented function consisting of a polynomial function joined together so that the whole curve and its first and second derivatives are continuous.

B. Data

In this paper, we use information from a database previously assembled by Iregui-Bohórquez, Melo-Becerra, Ramírez-Giraldo, and Tribín-Urbe (2021), who examine the long-term transformation of the role of women in areas such as employment, education, fertility, and political participation in Colombia from 1905 to 2018. Since our main interest relies on female labor participation, we had to shorten the period of study, starting in 1960, because the data before that year were scattered and not strictly comparable.⁸

The initial selection of variables is taken from the literature on the determinants of the female labor participation rate. We mainly focus on analyzing the relationship between the female participation and fertility rate, education (primary, secondary, and tertiary, for both men and women), infant mortality (total, male and female), maternal mortality, marriage rate, male labor force participation rate, homicide rates (for both men and women), female political participation in both the senate and the chamber of representatives, and some macroeconomic variables such as the real GDP per capita growth and real minimum wage for a total of twenty-two variables. Tables A1.1 and A1.2 in Appendix 1 present the variables used in this paper, their definitions and sources, and their main descriptive statistics, respectively.

III. Results

In this section, we examine the findings of the principal component analysis and identify the variables that have the most significant impact on the variability of the female labor force participation rate (f_lfp_r). We also evaluate the effect of individual variables on the f_lfp_r in Colombia using the TVEM method.

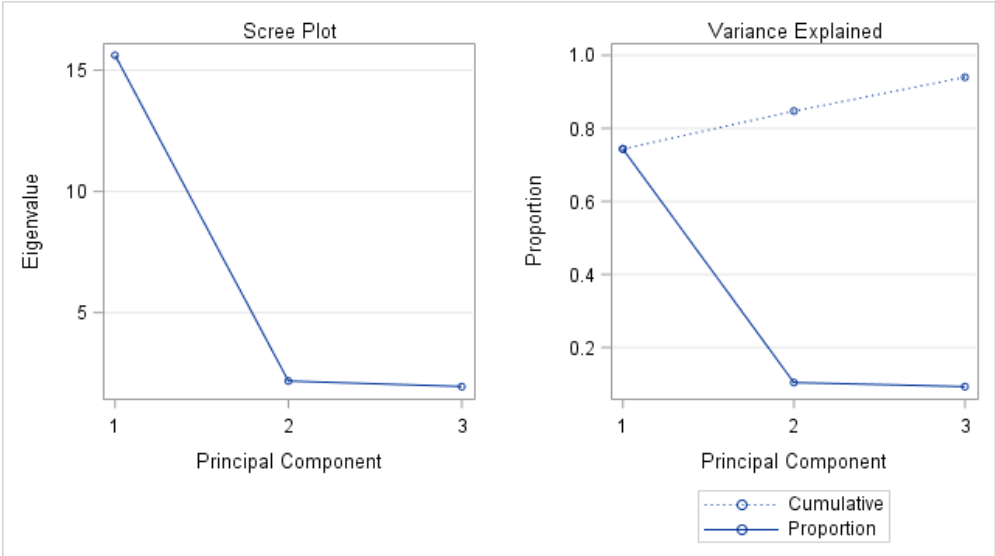
A. Principal Component Analysis

In the PCA we set three main component scores to reduce the original process of dimension twenty-two. The results are shown in Figures 1, 2, and 3. In particular, the left panel of Figure 1 shows the size of the eigenvalues on the y-axis against their index on the x-axis. We note that the first eigenvalue

⁸ Data on the female labor participation rate from 1960 to 1983 was constructed using census data, and the missing observations were fit by a *spline* curve to the observed values.

is large compared with the second and third ones. Thus, the eigenvalue of the first component is approximately 15.5, while the second and third components have eigenvalues under 2.0. Moreover, the lower curve in the right panel, the contribution in percentage to the total variance, and the upper curve shows the cumulative contribution to the total variance. The largest eigenvalue contributes over 70 per cent of the total variance, and the three principal components account for almost 90% of the total variance. Despite that an elbow at the second eigenvalue is visible, the similar value of the third eigenvalue led to decide that three principal components are required to represent the data.

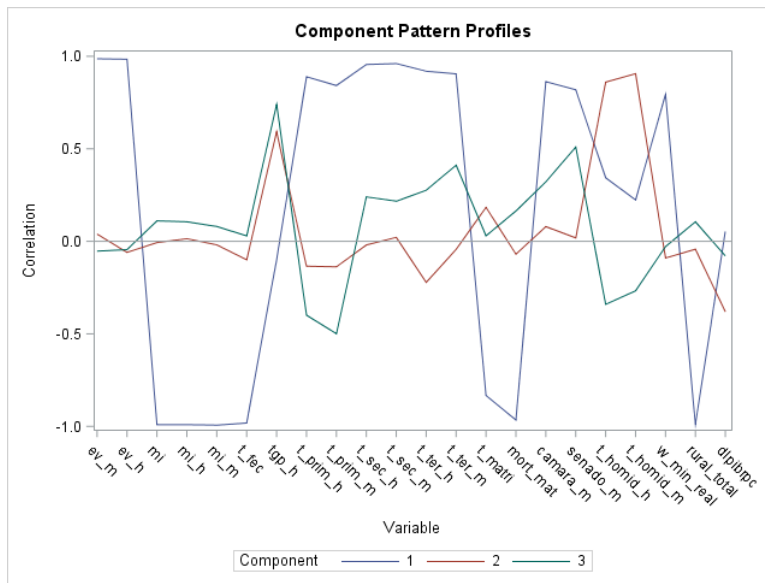
Figure 1: Scree plot: selection of the three principal components



Source: Own calculations.

Next, we present the pattern profile of each component (Figure 2). The first component, which explains approximately 71% of the total variance, is closely related to human capital and demographic change, since education, fertility, life expectancy, and mortality are highly correlated with this component. For example, component one shows a positive correlation with education and a negative correlation with mortality and fertility. The second component, which accounts for 10% of the total variance, is primarily associated with violence, specifically the homicide rate. The third component, explaining 9% of the total variance, is mainly related to male labor force participation and female political participation (see Appendices 2 and 3).

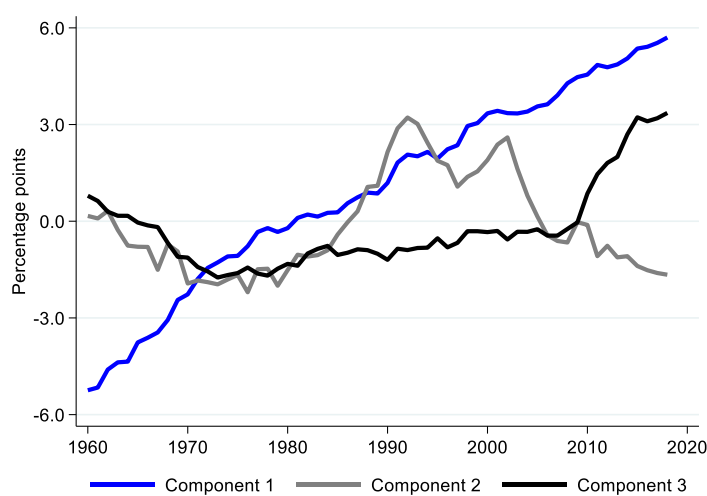
Figure 2: Component pattern profiles



Source: Authors' calculations.

Figure 3 illustrates how the three principal components have evolved between 1960 and 2018. The first component has shown a consistent upward trend throughout the period, mainly due to improvements in education, increased life expectancy, and reduced fertility and mortality. The second component significantly increased from the mid-1980s until the late 1990s, driven by political and drug violence surges. The third component has presented an upward trend reflecting the rise in women's political participation because of the implementation of significant legislative measures to enhance women's political representation in the country, such as the gender quotas for electoral lists.

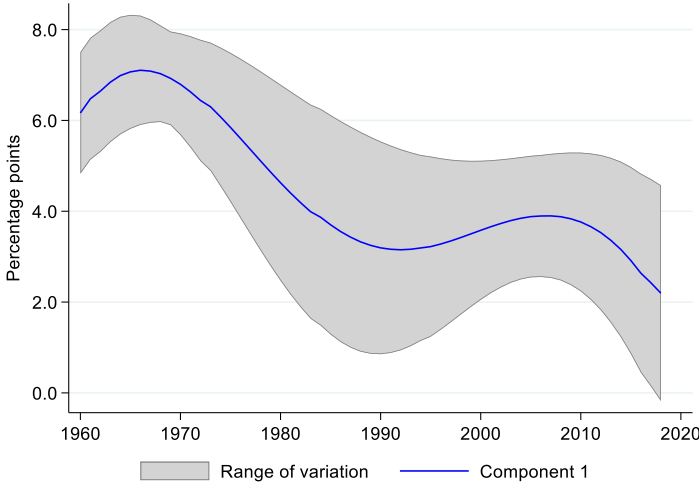
Figure 3: Evolution of the first three components



Source: Own calculations.

In the next stage, we employ the TVEM method to find the dynamic evolution for the estimated coefficients in a specification with the f_lfp_r as the dependent variable and the first principal component as the explanatory variable (Figure 4). Throughout the entire period, the effect of the so-called human capital and demographic component is positive, albeit decreasing. The beginning of the period showed the highest impact, as the female participation was low. Later, the effect is reduced, though remaining positive, as the f_lfp_r increases. Specifically, the human capital effect remained high during the first decade (1960-1969), with a coefficient of 6.8 percentage points (pp), whereas during the decade (2000-2018), the estimated coefficient was 3.1pp, on average. It is worth noticing that during 1960-1990 the behavior of the component is similar to the evolution of the fertility rate.

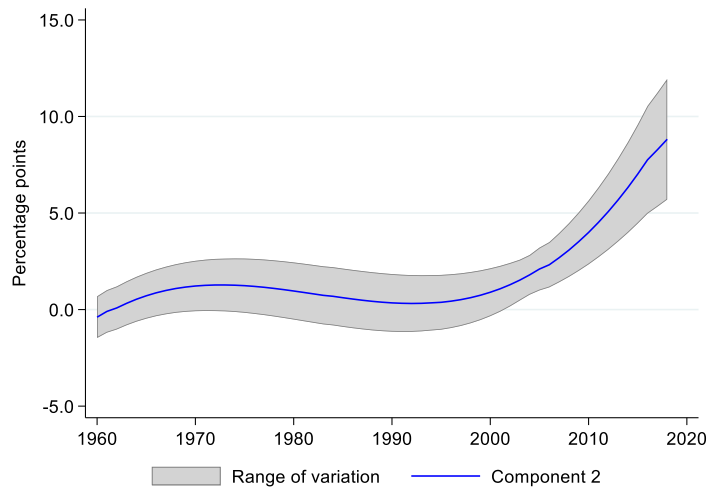
Figure 4: First principal component



Source: Own calculations.

The second component, primarily linked to violence, had a relatively stable impact on the f_lfp_r until the early 1990s, when it began to increase (Figure 5). Between 1960 and 1991, the coefficient averaged 0.7 pp. However, between 1992 and 2018, there was an upward trend with 3.0 pp on average. The results indicate that men were more affected by political and drug-related violence than women, increasing women's participation, as discussed in more detail in the next section.

Figure 5: Second principal component

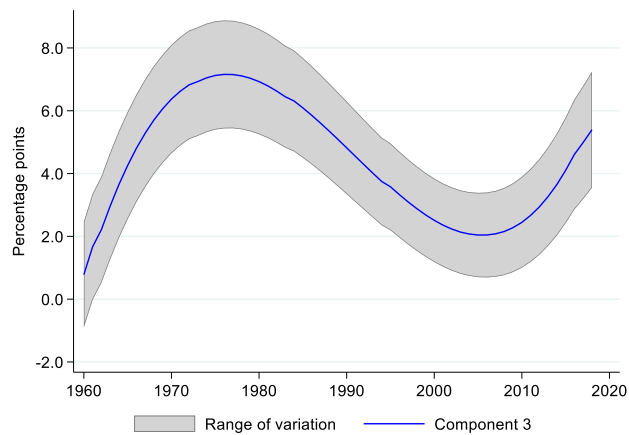


Source: Own calculations.

Regarding the third principal component, mainly associated with the male labor force participation rate (m_lfp_r) and women's political participation, we observe a substantial initial impact on the f_lfp_r , with an average coefficient of 5.1pp between 1960 and 1977, mainly due to the positive relationship between these two variables, as we will discuss later on (Figure 6). From 1978 to 2005, the effect remained positive but decreased to an average of 4.5pp, indicating a weaker positive relation between these two variables. Female participation continued increasing at a lower rate than men's, but towards the 2000s, it stagnated. However, since the beginning of the 21st century, we have seen a change in the trend of this component's effect on the f_lfp_r .

As discussed below, two important laws were enacted to promote women's political participation: Law 581 of 2000 and Law 1475 of 2011. Law 581, also known as the "quota law," stipulated that women must hold 30% of decision-making positions in the public sector. This law has increased employment opportunities for women in the public sector (Pachón and Aroca, 2017; Wills, 2007). Law 1475, on the other hand, mandates that for elections to collegiate bodies, lists with five or more candidates for popularly elected corporations must be composed of at least 30% of one gender. In the case of Parliament, the quota law has risen the number of female candidates and the number of elected women, as highlighted by Iregui-Bohórquez et al. (2021).

Figure 6: Third principal component



Source: Own calculations.

B. Analysis of individual variables on the f_lfp_r

In this section, we examine the effect of some individual variables on the f_lfp_r in Colombia using a TVEM method. Their correlation with the principal components dictated the choice of variables. It is worth mentioning that both long and short-run factors can affect female participation in the labor market. In the long run, better education, reduced fertility and infant mortality, changes in women's marriage decisions, and changes in social norms can affect the evolution of female participation. In the short run, the f_lfp_r responds to changes in economic activity.

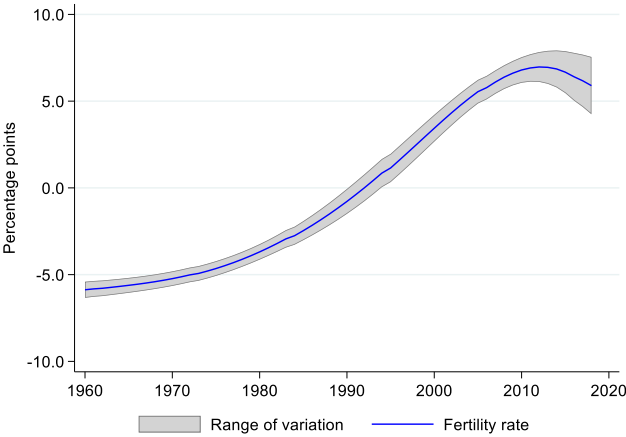
i) Fertility rate

Colombia experienced the demographic transition since the end of the 1960s from high fertility rates (6.2 children in 1967) to low fertility rates (1.8 in 2018). The reduction in the fertility rate was mainly the result of greater education for women, access to contraceptive methods, and the decline in infant mortality (Iregui-Bohórquez et al., 2021).

Based on the coefficients obtained through the TVEM, our analysis suggests that the relationship between fertility and women's labor participation varied over time from 1960 to 2018 (Figure 7). The results show a strong negative marginal effect from the fertility rate to the female labor participation. During 1960-1969, we observed a strong negative relation between fertility and women's labor participation, signaling that a reduction of one child per woman during this period was associated with an increase of 5.63pp in the f_lfp_r , on average. Therefore, any reduction in fertility rates during this period was crucial for empowering women economically by enabling them to participate more

fully in the labor force. Between 1970 and 1979, we observed a weaker negative impact of the labor participation rate, with an estimated coefficient of -4.66pp, suggesting that the negative impact of fertility on labor participation was still present but to a lesser degree than in the previous decade. Between 1980 and 1989, this impact further weakened, with an estimated coefficient of -2.52pp. That way, the impact of fertility on labor participation continued to diminish over time. In Colombia, the negative association between fertility and female labor force participation follows the same pattern found in high-income countries during the 1960s-1980s. This relationship has been explained by the quantity-quality trade-off and the time cost of raising children. It has historically resulted in a strong negative association between female labor force participation and fertility (De la Croix and Doepke, 2003, Galor and Weil, 1996).

Figure7: Effect of the fertility rate on the female labor force participation rate



Source: Own calculations.

During the first few decades studied, married women and women with children faced significant obstacles to joining the labor market. As a result, any reduction in fertility rates during this period was associated with a larger increase in labor force participation rates for women. From 1960 to 1985, Colombia underwent one of the most rapid declines in fertility worldwide, with the number of children per woman decreasing from 7 to 3 (Jaramillo-Echeverri, 2023; Iregui-Bohórquez, et al., 2021). However, since the 1990s, there has been a marked increase in the labor force participation rates of married women and women with children, reaching between 40% and 50% for this population segment. Therefore, from 1990 to 1999, the coefficient of 1.04pp suggests a positive effect of fertility on labor force participation, within the range of fertility rates observed during this period, as fertility rates were relatively low (with an average of approximately three children per woman).

During the 2000-2009 period, a coefficient of 5.20pp suggests a strong positive influence from fertility to the women labor force participation, even as fertility rates continued to decline. Similarly, the robust positive estimated coefficient of 6.63pp during the 2010-2018 period suggests the positive impact has continued to strengthen, despite a recent stagnation and fluctuation in the f_lfp_r and a continued decline in fertility rates (although to a lesser extent than in previous decades). Within the range of fertility rates observed during this period, women with higher fertility rates were even more likely to participate in the labor force than in the previous decade. Our findings are consistent with recent trends in labor force participation rates for women of fertile age. In 1985, these women had a labor force participation rate of 55%, which had increased to approximately 60% by 2018 (Iregui-Bohórquez et al., 2021). This finding suggests that changes in social norms and policies may have contributed to the observed positive association between fertility and labor participation in more recent decades, allowing women with higher fertility rates to participate more fully in the labor market. These changes are important for promoting gender equality, work-life balance, and economic empowerment. As studied by Goldin (2020, 2021), career-family compatibility has recently become a major focus on women who aspire to have a family and a career at the same time. Similar changes in the relationship between fertility and female labor force participation have been observed in high-income countries (Doepke et al., 2022). New theories in the economics of fertility highlight the importance of family policy, cooperative fathers, favorable social norms, and flexible labor markets in enabling women to balance career and family goals and even reversing the female participation-fertility relationship.

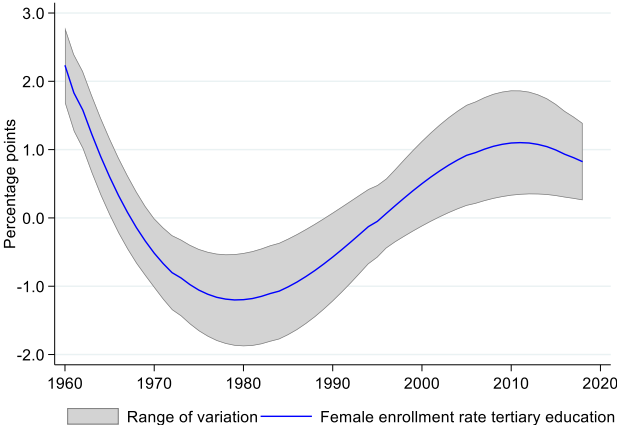
ii) Female enrollment rate in higher education

During the study period, education enrollment increased for both men and women, the gaps in primary and secondary education closed, and there was a rapid increase in female participation in higher education. The country's economic transformation increased the demand for human capital, as did investment in human capital. Concerning higher education, despite the increase in enrollment rates, they continued to be very low for both men and women.

The results from the TVEM method indicate that the relationship between female enrollment rate in higher education (f_enrol_h) and f_lfp_r from 1960-2018 has varied over time (Figure 8). The changing nature of this relationship highlights the importance of considering the historical moment and context in which these variables are examined. In the 1960s, when women's participation in university enrollment started to increase, there was a positive relation between these two variables,

with an average coefficient of 0.83pp, indicating that as more women pursued higher education during this decade, their participation in the labor force also increased.

Figure 8: Effect of the female enrollment rate in tertiary education on the female labor force participation rate



Source: Own calculations.

In the following years, while female participation continued to increase, women's enrollment in higher education also grew but at a slower pace; thus, the increase in female participation could be attributed to increases in secondary education rather than in higher education, given that there was still room for improvements in the enrollment rate in secondary education. The relationship between higher education and female labor participation could be associated with the low enrollment rates for both men and women, despite the increase in women's enrollment. In fact, in 1985, Colombia's higher education coverage rate (10%) was still much lower than that of other countries, such as Argentina (38%), Chile (14%), Spain (29%), and the United States (64%). Furthermore, the careers that women studied, which according to Vélez and Winter (1992), were oriented towards educational fields that led to low-paying careers, may have harmed their labor force participation. Also, cultural and social norms regarding gender roles and expectations may have affected the relationship between female enrollment in higher education and female labor force participation.

Since the mid-1990s, the country started experiencing changes in social norms and economic conditions and increased access to education and employment opportunities for women. From 1995 to 2010, the female enrollment rate in higher education increased from 13.4% to 23.9%, mainly due to the measures established in the 1991 Constitution and Law 30 of 1992, which recognized education as a right and increased the contributions from the national government budget for higher education.

The relationship between female enrollment in higher education and female labor force participation was positive, with average coefficients of 0.84pp and 1.01pp, in the 2000s and 2010s, respectively. During the last two decades, women's enrollment rates in higher education increased significantly, from 9% in 1986 to 37% in 2018. It is worth highlighting that since 1990, the women's enrollment rate in higher education exceeded that of men.

With respect to women's labor force participation, Colombia experienced a sharp increase, rising from nearly 40% in 1985 to 60% in 2018. The country has the steepest increase in female participation within the region, going from having the lowest female labor participation to having the highest rates in the last three decades (Elías and Ñopo, 2010). This increase in labor force participation during this period was observed for women between 41 to 65 years old, followed by the group of 31 to 41 years old, whose rates passed from 55% and 33%, respectively, in 1985 to 65% and 85% in 2018. These two groups used to have low participation rates, which reflects changes in social norms over time (Iregui-Bohórquez et. al., 2021). Thus, the increase in female labor force participation over the analyzed period follows from a long-term process in which women's education plays a significant role.

iii) **Infant mortality rate**

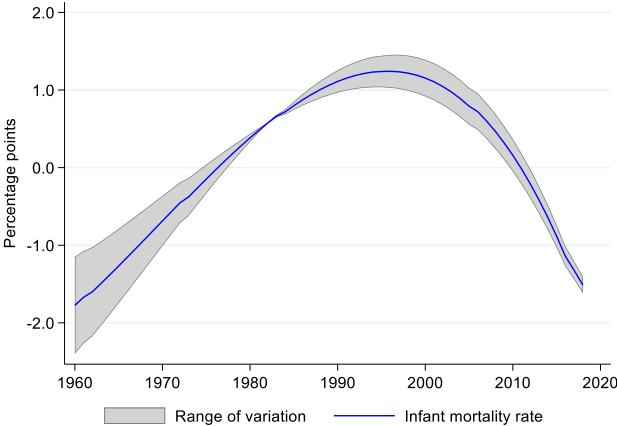
Regarding the relationship between infant mortality and female labor participation, we observe a U-inverted pattern where the regression results change significantly over time (Figure 9). The behavior of the infant mortality rate and the demographic and epidemiological transitions that took place in Colombia are important in explaining the changes in the estimated coefficients. During the 1960s and 1970s, the average coefficient indicated that a 1% decrease in infant mortality led to a 0.75pp increase in female labor force participation.

In the following decades, the coefficients suggest a weaker effect of the infant mortality rate on the f_lfp_r . This finding could be attributed to the reduction in infant mortality and improvements in health infrastructure and medical technology, which reduced the time women spent caring for sick children and created better conditions for women to participate in the labor market.⁹ By 1985, infant and maternal mortality rates reached their lowest levels, and the decrease in neonatal mortality rates during 1990-2015 contributed to the overall reduction in infant mortality rates. It is worth noting that

⁹ See Bhalotra, Venkataramani and Walther (2022) for a study about the labor market responses to reductions in infant mortality.

improvements in women's education also contributed to reducing child mortality rates and improving their children's education (Iregui-Bohórquez, et al., 2021). Since the late 1990s, the estimated coefficients have decreased, suggesting that the effect of infant mortality on female labor participation is losing importance over time as the infant mortality rate is reduced.

Figure 9: Effect of the infant mortality rate on the female labor force participation rate



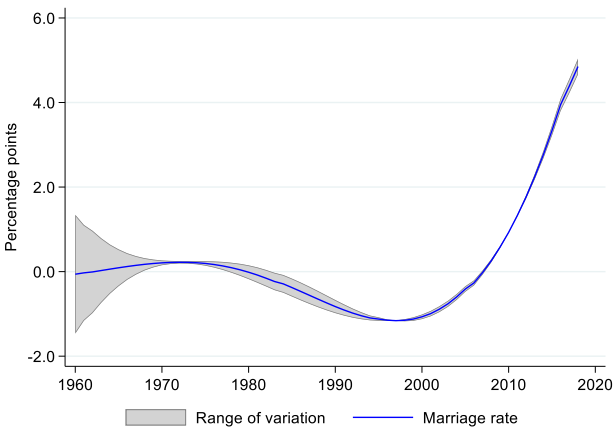
Source: Own calculations.

iv) Marriage rate

We also consider the changing relationship between the marriage rate (per 100,000 inhabitants) and women's labor participation in Colombia (Figure 10). From 1960-1979, a mild positive correlation was observed between these two variables, suggesting a moderate positive effect of higher marriage rates on labor force involvement from women during this period when marriage was more prevalent. However, a significant shift in this relationship occurred from 1980 to 2009. The coefficient dropped to -0.36pp in the 1980s, deepened to -1.06pp in the 1990s, and settled at -0.42pp in the early 2000s. This negative partial correlation indicates that as the marriage rate decreased, there was a corresponding increase in women's labor participation. According to Valdés and Gomáriz (1993), the proportion of cohabitating couples increased from 8% in 1970 to 13% in 1985. Moreover, Esteve, Saavedra, López-Colás, López-Gay and Lesthaeghe (2016) found that Colombia was a notable example of the surge in unmarried couples choosing to live together. In fact, over the period of 1973 to 2005, the percentage of women aged 25 to 29 who opted for cohabitation rose dramatically from 20% to 66%. This trend towards cohabitation could have contributed to the marginal decrease in marriage rates while enabling women to participate more fully in the labor force. However, the increase in marriage rates since 1990 coincided with the approval of divorce by Law 25 of 1992. As explained by Iregui Bohórquez et al. (2021), before the enactment of this law, many couples chose to

establish de facto marital relationships. After its promulgation, some of them decided to formalize their unions. According to Sun and Zhao (2016), in societies where divorce is permitted, couples exhibit distinct behavior, with women having greater power in negotiations, leading to increased autonomy and empowerment, which could lead to greater labor participation for women.

Figure 10: Effect of the marriage rate on the female labor force participation rate



Source: Own calculations.

In contrast with the previous decades, the period from 2010-2018 saw a dramatic shift, with the coefficient surging to 2.84pp. This marked change suggests a significant transformation in the dynamics between marriage rates and women's labor participation. Amador, Bernal, and Peña (2013) noted that this surge in female labor participation was largely driven by the increasing participation rates of married or cohabiting women.

v) **Male homicide rate**

During the late 1960s, Colombia experienced a period of social unrest marked by various factors. According to Luna and Villarreal (1994), the political structure of the National Front¹⁰ started showing signs of exhaustion during this time, leading to the emergence of peasant self-defense groups and radicalized urban sectors that eventually transformed into guerrilla organizations. In addition, drug-related violence, starting with the marijuana wars and later evolving into the cocaine wars, became more prominent in the mid-1970s. Furthermore, the 1980s witnessed the emergence of paramilitary groups. Throughout this period, the homicide rate per 100,000 inhabitants fluctuated

¹⁰ The National Front was a political coalition between the conservative and liberal parties between 1958 and 1974 to face a period of violence and partisan retaliation that affected the country.

around 61. During these years, violence was constantly present and fluctuating, while women experienced increasing economic empowerment and consequently increased their participation in the labor market.

It is worth noting that Colombia, one of the longest-standing democracies in Latin America, has a history marked by widespread violence and human rights abuses. Colombia has consistently ranked among the most violent countries in the world.¹¹ In this context, it is observed that men are generally more prone to acts of violence compared to women. Numerous studies have consistently shown that men commit a higher number of offenses and, as a result, are more likely to experience casualties in situations of internal conflict (Knight, Ponce de Leon, and Tribin, 2021; Smith, 2014; Steffensmeier and Allan, 2005; Buzawa, Buzawa and Stark, 2017). Warfare has been known to impact women's participation in the labor market. For instance, research conducted by Doepke, Hazan, and Maoz (2015) suggests that World War II had a lasting influence on women's employment, leading to a significant increase in women entering the workforce.

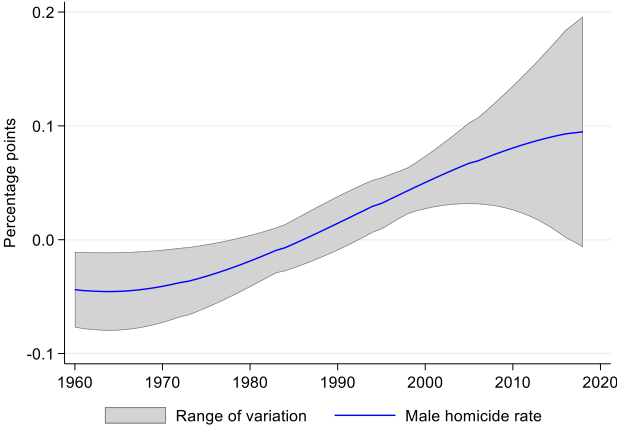
From 1960 to 1989, the relationship between the male homicide rate and women's labor participation can be negative, small, and sometimes negligible (Figure 11). Between 1960 and 1969, the coefficient of -0.04pp suggests that as the male homicide rate decreased, women's labor participation exhibited a slight tendency to increase. Similarly, in 1970-1979, the coefficient of -0.03pp indicates a continued negative relationship. Moving forward to 1980-1989, the coefficient of 0.00pp suggests no significant relationship between the male homicide rate and women's labor participation. These coefficients highlight the limited impact of changes in the male homicide rate on women's labor participation from 1960 to 1989.

During the 1990s and the early 2000s, a positive relationship existed between these two variables. As the violence related to drug trafficking escalated in Colombia, resulting in the murder of many men, women began to enter the labor market at a higher pace (Iregui-Bohórquez et al., 2021). This increase in women's labor participation can be attributed to the need to offset income losses and the demand for women's skills in urban labor markets (Calderón, Gáfaró, and Ibáñez, 2011); hence, their participation showed a slight improvement compared to men. The employment rate also displayed a positive trend, reaching approximately 50% by the end of the period, indicating a modest

¹¹ Data from Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2021. <https://ourworldindata.org/homicides>.

advancement in women's employment opportunities relative to men (Iregui-Bohórquez et al., 2021). In this challenging environment, women played a crucial role in the labor force by reaching new heights of participation and filling the gaps left by men affected by the war. Their increased participation demonstrated their resilience and underscored their contribution to sustaining the workforce during the cycles of violence.

Figure 11: Effect of the male homicide rate on the female labor force participation rate



Source: Own calculations.

It is worth mentioning that at the beginning of the 2000s, the government, in response to the prevailing violence, deployed a strong military presence, although the impact of this militarization was complex and had mixed effects (Castro Torres and Urdinola, 2018). Since 2005, with the “Justice and Peace Program”¹² and later with the initiation of the peace agreement process in 2012, the male homicide rate decreased. There was a significant de-escalation compared to the violence experienced during the 1990s and 2000s. During this period the relationship between the male homicide rate and female labor participation continued to be positive although the confidence intervals widen, indicating increased uncertainty in this relationship.

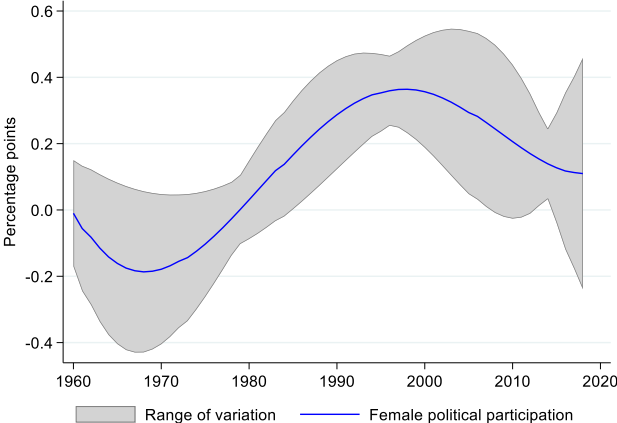
vi) **Female political participation**

Regarding the relationship between women's labor participation and their political participation, the overall findings suggest a complex and nuanced relationship. There are periods of positive and

¹² The Justice and Peace Program was established by Law 975 of 2005. This program aimed to incentivize paramilitaries to demobilize and reintegrate into society. This law offered various incentives, including reduced sentences for individuals involved in human rights violations (Tribin, 2015).

negative associations, but the influence of political participation on labor participation is relatively small with wide confidence intervals (Figure 12).

Figure 12: Effect of female political participation (chamber of representatives) on the female labor force participation rate



Source: Own calculations.

In the 1960s and 1970s, the average coefficient was -0.12pp indicating a negative relationship between women's labor and political participation. Women's political involvement during this time primarily consisted of voluntary and community work, lacking meaningful representation and power. Their participation rates remained lower than men's, and their voting rates consistently lagged, possibly influenced by their traditional homemaker roles (Luna and Villarreal, 1994; Pinzón de Lewin and Rothlisberger, 1977). The unstable and fluctuating growth of women's political participation during these years may have contributed to the observed small or negative correlation, as their labor participation was gradually increasing but still relatively low.

From 1980-1989, the coefficient of 0.15pp suggests that women's labor participation also exhibited an upward trend as political participation increased. This positive association gains further strength with the coefficient of 0.34pp from 1990-1999, indicating a stronger relationship between the two variables, which coincides with significant developments in legislation and policies promoting gender equality and women's participation in politics. For instance, the Political Constitution of 1991 recognized the equality of men and women and guaranteed the participation of women in politics (Iregui-Bohórquez et al., 2021).¹³ Notably, the participation of women in the chamber of representatives saw a significant jump from 4% to 10% between 1989 and 1991. The positive trend

¹³ For a more detailed explanation of the effects of the Colombian constitution of 1991 on female labor participation, see Galindo-Silva and Herrera-Idárraga (2023).

continues from 2000-2009, signifying that higher political participation is accompanied by a notable increase in women's labor participation.

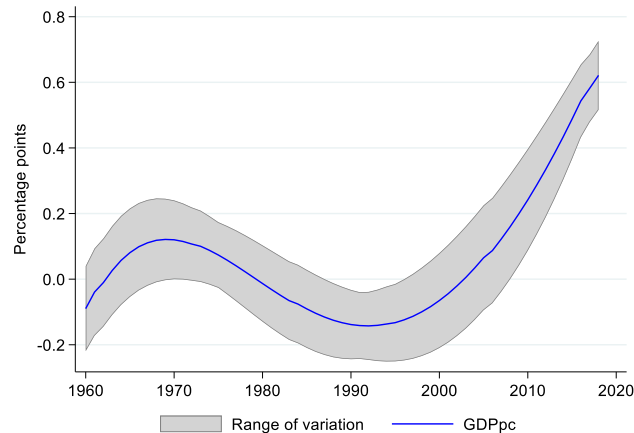
The positive correlation between political participation and women's labor participation continued from 2010-2018. This period saw the implementation of significant legislative measures to enhance women's political representation in Colombia. In particular, the introduction of Law 1475 in 2011 established gender quotas for electoral lists, ensuring a minimum level of female representation. This initiative increased the percentage of female candidates and a higher overall presence of women in political bodies. However, it is important to acknowledge that despite these advancements, Colombia still lags behind many other Latin American countries regarding women's representation in parliament (Iregui-Bohórquez et al., 2021). Additionally, although the participation of women in the chambers reached its historical peak during this period, their labor force participation experienced only a modest and relatively stable growth. As a result, the impact of political participation on women's labor participation may not have been as significant during this time.

It is commonly anticipated that women's political and labor force participation would mutually reinforce each other. This phenomenon is observed globally, with increased female representation in legislatures paralleling women's rise in the labor force (Iversen and Rosenbluth, 2008). However, in the context of Colombia, this relationship seems to be less pronounced, potentially attributed to the considerable challenges and barriers that women encounter in achieving substantial growth in political participation (Iregui-Bohórquez et al., 2021).

vii) Real GDP per capita growth

The effect of real GDP per capita growth on the f_lfp_r can be divided into four periods (Figure 13). The first period, from the 1960s to the late 1970s, shows a positive coefficient. A fast and sustained economic growth characterized this period because of rising coffee prices and exports and a shift away from activities in primary sectors such as agriculture and mining towards manufacturing industries, commerce, finance, and services which fostered female participation (Iregui-Bohórquez, et al., 2021). The involvement of women in the labor market began to increase with a lag compared to that of men; female labor participation increased considerably, from 17.3% in 1964 to 30.6% in 1980. During this period, the demographic transition, better access to higher education for women, and changes in social norms also contributed to female labor participation.

Figure 13: Effect of real GDP per capita growth on the female labor force participation rate



Source: Own calculations.

In contrast, the second period, from 1980 to 1995, displays a negative trend. This period includes the economic crises of the early 1980s. According to Magnac (1992), during this crisis, young women withdrew from the labor force but re-entered the market as soon as the crisis was over. It is worth mentioning that according to Tenjo, Álvarez, and Jiménez (2016), the gap between unemployment rates among men and women widens during economic recessions.

The third period, between 1996 and 2002, exhibits a change in the trend, compared to the previous period, from negative to positive in the effect of the real GDP per capita growth on the female labor participation, starting in 1996 (Figure 13). This period was characterized by an increase in unemployment and by a dramatic deterioration in economic activity, which worsened in 1998 and 1999 due to the international crisis that deteriorated the country's terms of trade and reversed capital flows, in a context of economic instability.¹⁴ This economic crisis reduced family income, which led to an increase in the labor supply of some household members to compensate for this loss of income; in particular, the wives who, until then, did not participate in the labor market. This effect is known as the “added worker” effect.¹⁵

The fourth period, from 2003 to 2018, was characterized by continuous economic growth, except for 2008-2009 and 2016-2017 when there was a slowdown in economic activity. The growth during this period was mainly driven by the boom in raw material prices. The impact on the f_lfp_r was positive and increasing, with an average coefficient of 0.29pp. During the first years of this period, 2003-

¹⁴ For more details about the crisis of 1999, see Pérez-Reyna (2017).

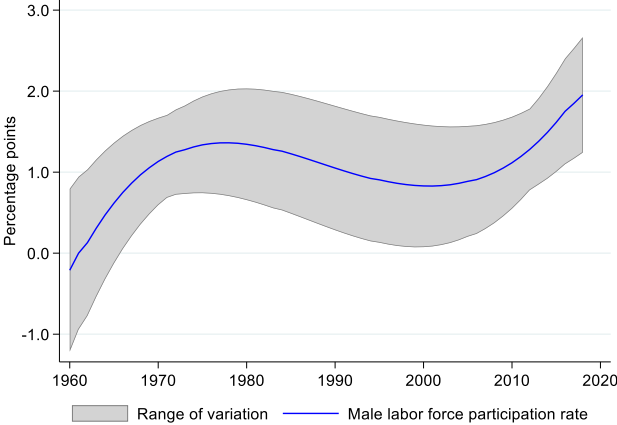
¹⁵ See, for example, López Castaño (2001) and Santamaría and Rojas (2001) for an analysis of the added worker effect during the 1999 economic crisis in Colombia.

2009, the effect was positive but small, whereas between 2010 and 2018 the effect was larger. For example, in 2018, a 1% increase in real GDP per capita growth led to a 0.62pp increase in the f_lfp_r (Figure 13).¹⁶

viii) Male labor force participation

Men's and women's labor force participation rates have a positive relationship that reflects complementarity in their work (Figure 14). Men have maintained consistently high participation rates of around 73% for decades with minor fluctuations. In comparison, women began with a low participation rate of 18% in the 1960s but increased to 61% in the 2010s (Figure 15), which implies that male participation rates remained high and were not impacted as women began to participate more (Tenjo and Ribero, 1998).

Figure 14: Effect of the m_lfp_r on the f_lfp_r



Source: Own calculations.

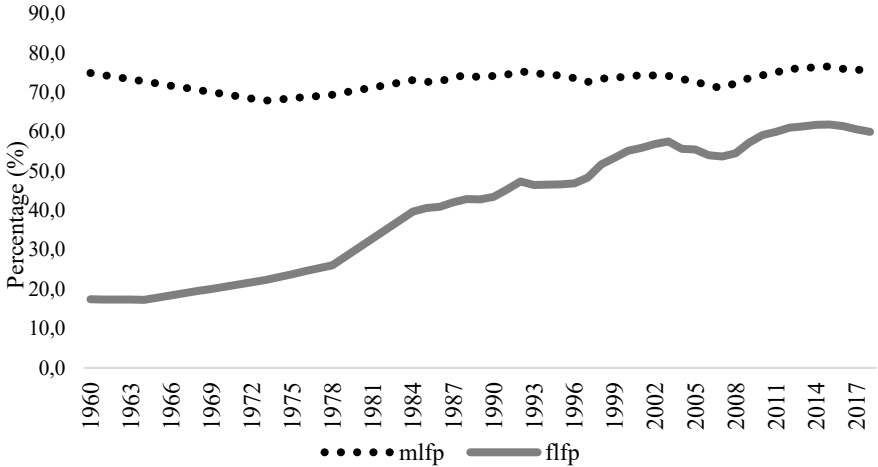
The coefficient of 0.50pp in the 1960s suggests a weak positive relationship between men's and women's labor force participation rates. As men's participation rates increased by one percent, women's participation rates increased by only half a percentage point. The scarce participation of women during this period, around 18%, may have contributed to this result. In contrast, the coefficients of 1.29pp and 1.23pp during the 1970s and 1980s suggest a much stronger positive

¹⁶ Although our estimations do not cover the period of the Covid-19 pandemic, it is important to mention that the participation of women in the labor market was the most affected by the economic downturn, which is in sharp contrast with previous economic crises where men's employment was more affected. According to García-Rojas et al. (2020), the pandemic expelled women from formal to informal occupations, occupied to unemployed, and unemployed to inactivity; consequently, more women were pushed into domestic work.

relationship between the labor force participation rates of men and women. These coefficients imply that women's participation rates increased at a faster rate than men's participation rates. During this period, the participation of women increased sharply, reaching a rate of 39%, while the participation rates of men also recovered from a slowdown the decade before. This trend was especially pronounced among married women, as Iregui-Bohórquez, et al. (2021) noted. In contrast to other countries, an increase in f_lfp_r in Colombia did not reduce m_lfp_r , as male participation had also increased.¹⁷

During the 1990s and 2000s, the coefficients of 0.93pp and 0.90pp, respectively, indicate a weaker positive relationship between men's and women's labor force participation rates. Women's participation rates slowly increased during the 1990s but stagnated towards the 2000s, while men maintained high participation rates.

Figure 15: Male and female labor force participation rates 1960-2018 (Average seven cities)



Source: Own calculations based on Iregui-Bohórquez et al. (2021).

The coefficient of 1.51pp for 2010-2018 indicates a strong positive relationship between men's and women's labor participation rates in recent years. During this period, women's participation reached its highest point of 61%, resulting in a decrease in the gap (15pp), the lowest ever experienced. This positive association between labor force participation for men and women is not only due to having more workers but also because women bring new skills to the workplace. These skills reflect social norms, upbringing, social interactions, risk preferences, and response to incentives. Therefore,

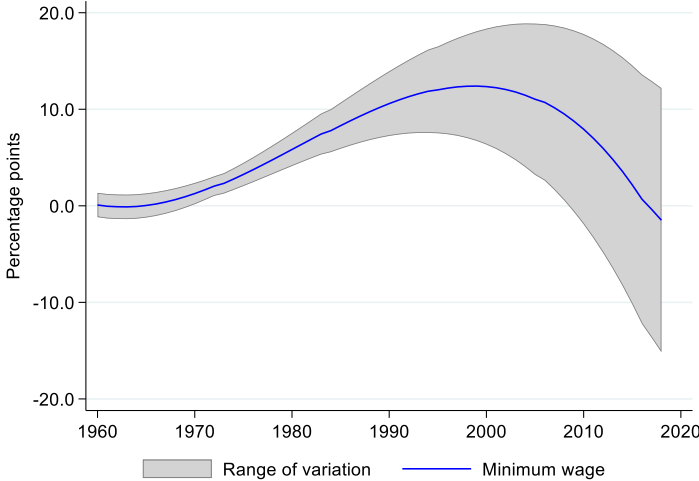
¹⁷ See Tenjo and Ribero (1998).

bringing women into the labor force adds an economic benefit from the diversity over and above the benefit of simply having more workers (Ostry, Alvarez, Espinoza, and Papageorgiou, 2018).

ix) Real minimum wage

Overall, results indicate a positive relationship between the real minimum wage (*rminw*) and female labor force participation in Colombia from 1960 to 2018, although the effect varies over time with a quadratic trend (Figure 16). In the 1960s, a 1% increase in the real minimum wage led to a 0.20pp increase in female labor force participation. In the 1970s, 1980s, and 1990s, the coefficient increased to 3.13pp, 8.06pp, and 11.76pp, respectively, indicating a much stronger effect of the *rminw* on female labor force participation. These findings may be attributed to increased women's education access during this period, improved economic growth, and expanded opportunities for women in the labor market. Policy changes to reduce income inequality and promote gender equality have also contributed to this higher effect. In the 2000s, the coefficient remained high, although with wide confidence intervals, at 11.01pp, but decreased to 3.36pp in the 2010s, which could be linked to changes in economic policies and labor market conditions. Another factor to consider is the role of women in balancing work and family responsibilities, which could have affected their labor force participation in recent years.

Figure 16: Effect of the real minimum wage on the female labor force participation rate



Source: Own calculations.

The relationship between the minimum wage and female labor force participation can be influenced by the difference in reservation wages between women and men and by the presence of children and

dependents in the family. Some studies have shown that the opportunity cost of accepting a job is higher for women with children and that women's reservation wage tends to be higher than men's (Brown, Roberts and Taylor, 2011; Gronau, 1973). However, in middle-income countries like Colombia, nowadays the presence of children may incentivize women to work, reducing their reservation wage for finding a job. According to a recent study by Flórez, Melo-Becerra and Posada (2021), the reservation wage in Colombia is generally higher for men than women. Individuals with children reported a lower reservation wage than those without children. This study also suggests that other factors, such as job flexibility and the accessibility and affordability of public childcare services, may reduce the gender reservation wage gap in Colombia compared to developed countries where such services are less available and more expensive. Flórez et al. (2021) also raise awareness of the impact that the earlier retirement age of women (age 57) compared to men (age 62) can have on their lower reservation wages. As a result, women may be willing to lower their reservation wage to secure a job and receive a future retirement pension.

IV. Conclusions

This research paper adds to the understanding of the key factors influencing women's engagement in the labor market from 1960 to 2018, shedding light on the evolution of women's roles and opportunities. By examining the shifting dynamics of female labor force participation and the factors driving it, we emphasize the significance of considering the historical period and context in which these variables are analyzed. Our findings show that the impacts of these variables have changed over time. One of the most important transformations affecting female labor force participation since the end of the 1960s was the demographic transition. This transition mainly resulted from decreasing infant mortality, access to contraceptive methods, and greater education access for women. Between 1960 and the end of the 1970s, our results indicate a strong negative association between fertility, infant mortality rate, and female labor participation, suggesting that a reduction in fertility and infant mortality rates during these years was necessary for empowering women economically by allowing them to participate more in the Colombian labor market.

Moreover, female labor force participation increased as more women pursued higher education during this period. The results show a mild positive correlation between marriage rates and increased labor participation since married women started to participate more in the labor market. The effect of economic growth on female labor participation during these years was also significant. This period's fast and sustained economic growth fostered female participation in the country. Similarly, an

increase in the real minimum wage led to increases in female labor force participation during the 1960s and 1970s.

From 1980 to 1995, the impact of fertility on labor participation started to diminish over time, which follows the same pattern evidenced in high-income countries during the 1960s-1980s. Also, there is a reduced impact of the infant mortality rate on female labor participation, which can be attributed to improvements in health infrastructure and medical technology. There was also a negative relationship between the real GDP per capita growth and female labor participation. This period includes the economic crisis of the early 1980s, in which young women temporarily withdrew from the labor market but swiftly re-entered once the crisis subsided. For most of this period, there was a limited impact of the male homicide rate, the marriage rate, and female political participation on women's labor force. However, at the beginning of the 1990s, drug-related violence escalated in the country, resulting in the loss of many men's lives, and women started entering the labor market at a higher rate. Also, significant progress in legislation and policies aimed at promoting gender equality and enhancing women's involvement in politics coincided with an increase in the representation of women in the Chamber of Representatives.

In contrast, in the 1980s, there was a stronger positive correlation between the labor force participation rates of men and women, with women's participation growing faster. However, in the early 1990s, this relationship weakened since women's participation increased slower, whereas men's remained high. Also, we observe a substantial impact of the real minimum wage on female labor participation.

Next, for the period 1995-2010, results highlight the impact of higher education in driving women's increased participation in the labor market. The expansion of educational opportunities was accompanied by a notable rise in the participation rate. In addition, the increase in women's enrollment in fields traditionally dominated by men, alongside the decline in enrollment in historically feminized professions, played a significant role in shaping female labor force participation. This shift reflects changing societal norms and attitudes and contributes to a more gender-balanced labor force.

Marriage rates and the impact of male homicides also influenced women's decision to enter the labor market. Moreover, as the violence related to drug trafficking escalated in Colombia, women began to enter the labor market faster due to the need to offset income losses. The real GDP per capita growth

also played an important role in explaining the increase in labor force participation, especially since 2003, when the country experienced positive economic growth rates due to the boom in raw material prices. These findings highlight the complex interplay between social dynamics, economic conditions, and individual choices in shaping female labor force participation.

For the final decade of 2010-2018, several factors contributed positively to women's labor force participation. The main drivers were fertility rates, the real minimum wage, and male labor force participation. During this period, women's participation in the labor force reached its highest point. The positive relationship between fertility rates and labor force participation reflects a shift in social gender norms, where married women and women with children are no longer excluded from the paid workforce. Moreover, with low fertility rates, one additional child does not lead to a reduction in female labor force participation. The real minimum wage has contributed to reducing gender wage gaps and promoting salary equality. Furthermore, male labor force participation, which remained stable during this period, shows a positive correlation with women's labor force participation, which suggests that male and female labor forces are complementary rather than substitutes.

Overall, this study underscores the significance of educational opportunities, demographic transition, changes in social norms, and economic factors in understanding the determinants of female labor force participation during the examined period. Policymakers and stakeholders should consider these findings to develop strategies that promote gender equality, create inclusive labor markets, and empower women to participate fully in the workforce. By recognizing and addressing the factors that influence women's labor force participation, society can foster greater gender equity and harness the untapped potential of women as contributors to economic growth and development.

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Appendix 1

Table A1.1

Definitions, abbreviations, and sources of the variables

Variables	Abbreviations	Definition	Source
Labor force participation rate (Males)	<i>m_lfp_r</i>	It is the percentage relationship between the economically active population (PEA) and the working-age population (PET), %	Censuses and Household surveys (DANE), average seven cities
Labor force participation rate (Females)	<i>f_lfp_r</i>	It is the percentage relationship between the economically active population (PEA) and the working-age population (PET), %	Censuses and Household surveys (DANE), average seven cities
Life expectancy at birth (Females)	<i>f_life_exp</i>	Life expectancy at birth indicates the number of years a newborn would live if the mortality patterns at birth remained the same throughout their lives	Flórez, CE. (2000), DANE vital statistics, United Nations World Population Prospects, and the World Bank (2016 - 2018)
Life expectancy at birth (Males)	<i>m_life_exp</i>	Life expectancy at birth indicates the number of years a newborn would live if the mortality patterns at birth remained the same throughout their lives	Flórez, CE. (2000), DANE vital statistics, United Nations World Population Prospects, and the World Bank (2016 - 2018)
Infant mortality rate	<i>inf_mort_r</i>	Infant mortality is the number of children who die before their first birthday per 1,000 live births per year	Flórez, CE. (2000), DANE vital statistics, the UN Inter-agency group for child mortality estimation (UNICEF, WHO, World Bank, UN DESA Population Division) at childmortality.org
Infant mortality rate (Males)	<i>m_inf_mort_r</i>	Infant mortality is the number of children who die before their first birthday per 1,000 live births per year	Flórez, CE. (2000), DANE vital statistics, the UN Inter-agency group for child mortality estimation (UNICEF, WHO, World Bank, UN DESA Population Division) at childmortality.org

Table A1.1 (Cont.)

Definitions, abbreviations, and sources of the variables

Variables	Abbreviations	Definition	Source
Infant mortality rate (Females)	<i>f_inf_mort_r</i>	Infant mortality is the number of children who die before their first birthday per 1,000 live births per year	Flórez, CE. (2000), DANE vital statistics, the UN Inter-agency group for child mortality estimation (UNICEF, WHO, World Bank, UN DESA Population Division) at childmortality.org
Maternal mortality rate	<i>mat_mort_r</i>	Number of maternal deaths per 100,000 live births	Iregui-Bohórquez et al. (2021)
Fertility rate	<i>fert_r</i>	The total fertility rate represents the number of children a woman would have if she lived to the end of her childbearing years and had children according to age-specific fertility rates for the specified year	Flórez, CE. (2000), page 17, Table 2,1
Marriage rate	<i>mar_r</i>	Demographic indicator that indicates the number of marriages per 1,000 (thousand) inhabitants.	DANE, Anuario General de Estadística, and United Nations Demographic Yearbook; authors' calculations
Gross enrollment rate primary education (Males)	<i>m_enrol_p</i>	The gross coverage rate in primary education is the ratio between students (men) enrolled and the projected population between 7 and 11 years of age, %	Jaramillo-Echeverri, Meisel-Roca y Ramírez-Giraldo (2019), and Ministerio de Educación Nacional (MEN)

Table A1.1 (Cont.)

Definitions, abbreviations, and sources of the variables

Variables	Abbreviations	Definition	Source
Gross enrollment rate primary education (Females)	<i>f_enrol_p</i>	The gross coverage rate in primary education is the ratio between students (women) enrolled and the projected population between 7 and 11 years of age, %	Jaramillo-Echeverri, Meisel-Roca y Ramírez-Giraldo (2019), and Ministerio de Educación Nacional (MEN)
Gross enrollment rate secondary education (Males)	<i>m_enrol_s</i>	The gross coverage rate in secondary education is the ratio between students (men) enrolled and the projected population between 12 and 17 years of age, %	Jaramillo-Echeverri, Meisel-Roca y Ramírez-Giraldo (2019, database)
Gross enrollment rate secondary education (Females)	<i>f_enrol_s</i>	The gross coverage rate in secondary education is the ratio between students (women) enrolled and the projected population between 12 and 17 years of age, %	Jaramillo-Echeverri, Meisel-Roca y Ramírez-Giraldo (2019, database)
Gross enrollment rate higher education (Males)	<i>m_enrol_h</i>	The gross coverage rate in higher education is the relationship between students (men) enrolled at the undergraduate level (university) and the projected population between 17 and 21, % The enrollment data corresponds to that reported by higher education institutions for the first semester of the reference year	Jaramillo-Echeverri, Meisel-Roca y Ramírez-Giraldo (2019), and Ministerio de Educación Nacional (MEN)
Gross enrollment rate higher education (Females)	<i>f_enrol_h</i>	The gross coverage rate in higher education is the relationship between students (women) enrolled at the undergraduate level (university) and the projected population between 17 and 21, % The enrollment data corresponds to that reported by higher education institutions for the first semester of the reference year	Jaramillo-Echeverri, Meisel-Roca y Ramírez-Giraldo (2019), and Ministerio de Educación Nacional (MEN)

Table A1.1 (Cont.)
Definitions, abbreviations, and sources of the variables

Variables	Abbreviations	Definition	Source
Homicide rate (Males)	<i>m_hom_r</i>	Number of homicides (men) per 100,000 individuals	Revista Criminalidad (Policía Nacional, https://www.policia.gov.co/revista-criminalidad/editorial?page=2), Romero-Prieto and Meisel-Roca (2019), and Forensis (Medicina Legal, https://www.medicinalegal.gov.co/cifras-estadisticas/forensis)
Homicide rate (Females)	<i>f_hom_r</i>	Number of homicides (women) per 100,000 individuals	Revista Criminalidad (Policía Nacional, https://www.policia.gov.co/revista-criminalidad/editorial?page=2), Romero-Prieto and Meisel-Roca (2019), and Forensis (Medicina Legal, https://www.medicinalegal.gov.co/cifras-estadisticas/forensis)
Chamber of representatives (Females)	<i>f_chamber</i>	Women in the Colombian House of Representatives is calculated by dividing the current number of women by the total current number of members, %	Parline database on national parliaments (https://data.ipu.org)
Senate (Females)	<i>f_senate</i>	Women in the Colombian Senate is calculated by dividing the current number of women by the current total number of members in the Senate, %	Parline database on national parliaments (https://data.ipu.org)
Real minimum wage	<i>Rminw</i>	The minimum wage in Colombia corresponds to the current legal monthly minimum wage (SMMLV), which is set for periods of one year, and its payment periodicity is monthly. expressed in Colombian pesos of 2018	The real minimum wage was assembled using National Government decrees, information from the Ministry of Labor, and Banco de la República.
Real GDP pc growth	<i>rgdppc_g</i>	GDP per capita is the gross domestic product divided by the population at mid-year, expressed in Colombian pesos of 2015. Then we take logs and the first difference.	Banco de la República (Greco) and DANE

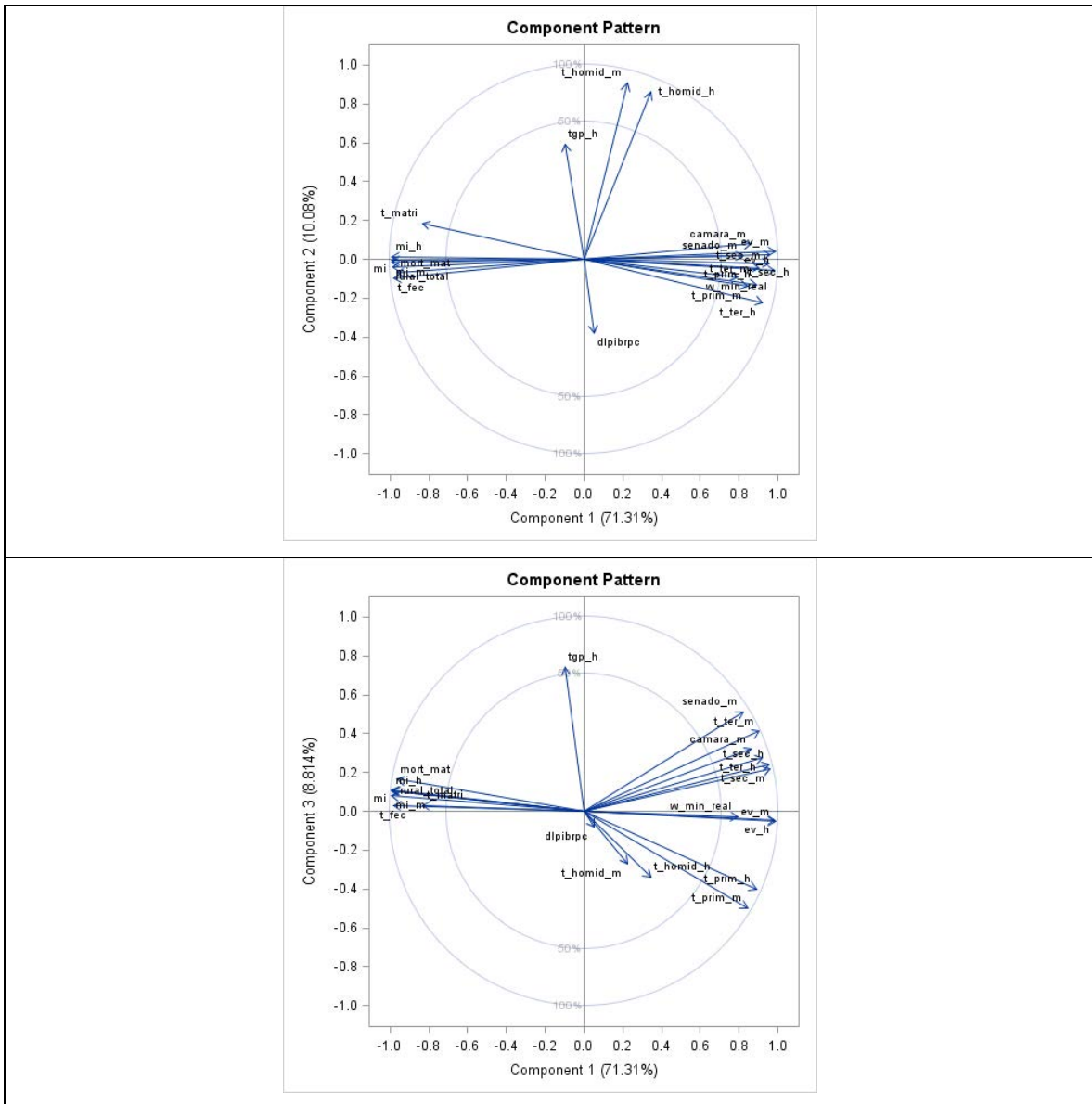
Table A1.2
Descriptive statistics 1960-2018

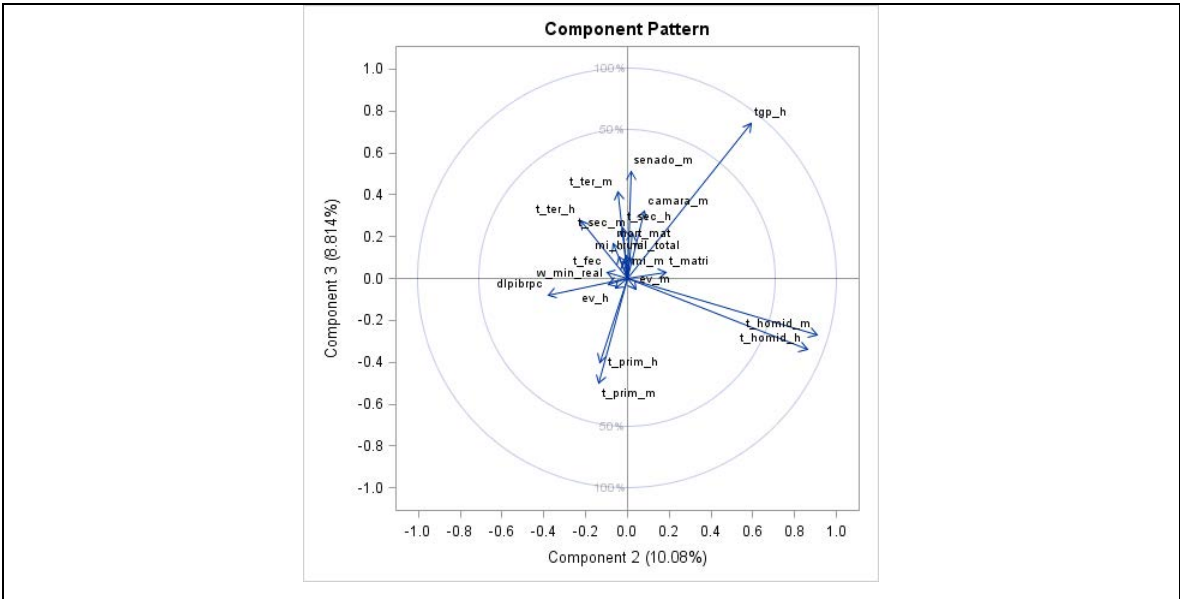
Variables	Abbreviations	Average	Standard deviation	Minimum	Maximum
Labor force participation rate (Males)	<i>m_lfp_r</i>	73,97	2,00	67,90	79,70
Labor force participation rate (Females)	<i>f_lfp_r</i>	49,02	11,89	17,30	61,83
Life expectancy at birth (Females)	<i>f_life_exp</i>	67,22	10,11	46,00	79,86
Life expectancy at birth (Males)	<i>m_life_exp</i>	61,26	9,28	41,90	74,33
Infant mortality rate	<i>inf_mort_r</i>	54,40	34,95	12,20	126,43
Infant mortality rate (Males)	<i>m_inf_mort_r</i>	60,44	39,76	11,84	143,51
Infant mortality rate (Females)	<i>f_inf_mort_r</i>	47,79	30,82	9,53	109,34
Maternal mortality rate	<i>mat_mort_r</i>	135,80	112,97	25,96	412,57
Fertility rate	<i>fert_r</i>	4,05	1,86	1,81	6,78
Marriage rate	<i>mar_r</i>	3,60	1,35	1,07	5,82
Gross enrollment rate primary education (Males)	<i>m_enrol_p</i>	101,01	19,83	53,31	125,29
Gross enrollment rate primary education (Females)	<i>f_enrol_p</i>	95,72	18,52	50,57	117,39
Gross enrollment rate secondary education (Males)	<i>m_enrol_s</i>	46,40	30,22	5,49	99,49
Gross enrollment rate secondary education (Females)	<i>f_enrol_s</i>	50,02	34,17	4,19	108,44
Gross enrollment rate higher education (Males)	<i>m_enrol_h</i>	11,63	7,37	1,68	30,02
Gross enrollment rate higher education (Females)	<i>f_enrol_h</i>	11,10	10,31	0,22	37,24
Homicide rate (Males,)	<i>m_hom_r</i>	79,64	36,02	37,45	169,11
Homicide rate (Females)	<i>f_hom_r</i>	6,98	2,75	3,53	14,05
Chamber of representatives (Females)	<i>f_chamber</i>	8,30	4,65	2,74	19,88
Senate (Females)	<i>f_senate</i>	7,15	6,53	0,88	25,38
Real minimum wage	<i>rminw</i>	530.563	144.249	200.000	781.242
Real GDP pc growth	<i>rgdppc_g</i>	9.182.336	3.669.089	4.363.586	17.188.519

Source: Authors' calculations.

Appendix 2

Figure 2.1: Component pattern





Source: Own calculations

Appendix 3

Table A3.1 Correlation between each variable and its component

Variable	Abbreviation	PC1	PC2	PC3
Life expectancy at birth (Females)	<i>f_life_exp</i>	0.25	0.03	-0.04
Life expectancy at birth (Males)	<i>m_life_exp</i>	0.25	-0.04	-0.03
Infant mortality rate	<i>inf_mort_r</i>	-0.25	0.00	0.08
Infant mortality rate (Males)	<i>m_inf_mort_r</i>	-0.25	0.01	0.08
Infant mortality rate (Females)	<i>f_inf_mort_r</i>	-0.25	-0.01	0.06
Fertility rate	<i>fert_r</i>	-0.25	-0.07	0.02
Labor force participation rate (Males)	<i>m_lfp_r</i>	-0.03	0.40	0.53
Gross enrollment rate primary education (Males)	<i>m_enrol_p</i>	0.22	-0.09	-0.29
Gross enrollment rate primary education (Females)	<i>f_enrol_p</i>	0.21	-0.09	-0.36
Gross enrollment rate secondary education (Males)	<i>m_enrol_s</i>	0.24	-0.01	0.17
Gross enrollment rate secondary education (Females)	<i>f_enrol_s</i>	0.24	0.01	0.16
Gross enrollment rate higher education (Males)	<i>m_enrol_h</i>	0.23	-0.15	0.20
Gross enrollment rate higher education (Females)	<i>f_enrol_h</i>	0.23	-0.03	0.30
Marriage rate	<i>mar_r</i>	-0.21	0.12	0.02
Maternal mortality rate	<i>mat_mort_r</i>	-0.24	-0.05	0.12
Chamber of representatives (Females)	<i>f_chamber</i>	0.22	0.05	0.23
Senate (Females)	<i>f_senate</i>	0.21	0.01	0.37
Homicide rate (Males,)	<i>m_hom_r</i>	0.09	0.58	-0.24
Homicide rate (Females)	<i>f_hom_r</i>	0.06	0.61	-0.19
Real minimum wage	<i>rminw</i>	0.20	-0.06	-0.02
Real GDP pc growth	<i>rgdppc_g</i>	0.01	-0.26	-0.06

Source: Own calculations.

Note: PC corresponds to principal component.