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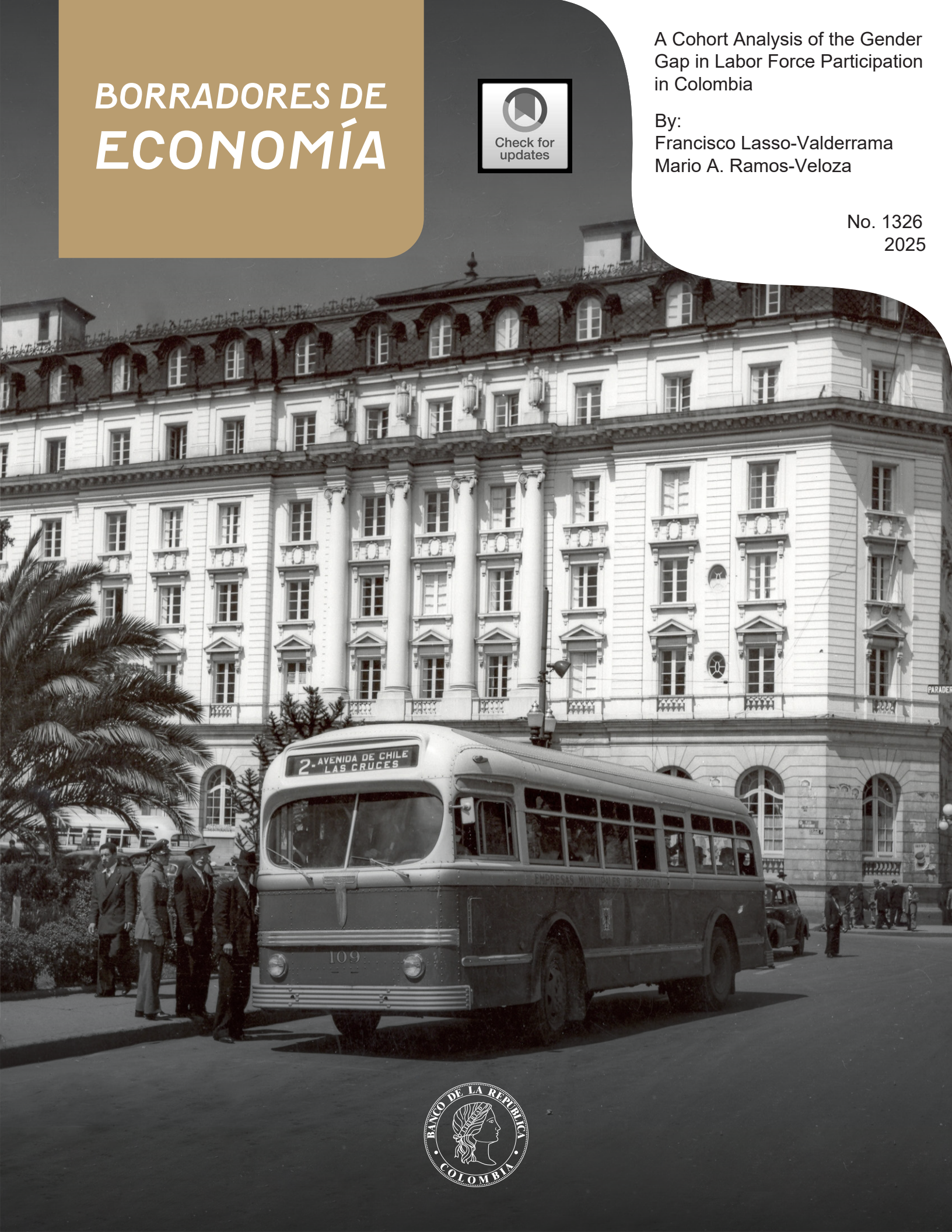

BANCO DE LA REPÚBLICA
COLOMBIA

A Cohort Analysis of the Gender Gap in Labor Force Participation in Colombia*

Francisco Lasso-Valderrama † Mario A. Ramos-Veloza‡

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Abstract

This study examines the cyclical and structural determinants of Labor Force Participation (LFP) in Colombia between 1984 and 2024, focusing on the gender gap and its implications for potential economic growth. We find that higher female participation drove the upward LFP trend until 2014 and that the added worker effect predominates during economic fluctuations, particularly for women. Projecting the LFP to 2035 under various scenarios, we show that halving the gender gap could increase the potential annual GDP growth by up to 0.41 pp. This underscores the significant potential of increased female participation in driving economic growth and the need for supportive policy.

JEL Classification: J16, J21, J24

Keywords: *Labor force participation, Gender gap, Demographics, Economic growth.*

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Un Análisis de Cohortes de la Brecha de Género en la Participación Laboral en Colombia

Resumen

Este estudio analiza los factores cíclicos y estructurales que determinan la participación laboral en Colombia entre 1984 y 2024, centrándose en la brecha de género y sus implicaciones para el crecimiento económico potencial. Se encuentra que la mayor participación femenina impulsó la tendencia alcista hasta 2014, y que el efecto trabajador adicional predomina durante las fluctuaciones económicas, particularmente en las mujeres. Al proyectar la participación laboral hacia 2035 bajo distintos escenarios, se observa que reducir la brecha de género a la mitad podría incrementar el PIB potencial hasta en 0,41 puntos porcentuales anuales, lo que subraya el significativo potencial del aumento de la participación femenina para impulsar el crecimiento económico y la necesidad de políticas de apoyo.

Clasificación JEL: J16, J21, J24

Palabras Clave: *Participación Laboral, Brecha de género, Demografía, Crecimiento económico.*

1 Introduction

Globally, during the second half of the 20th century, significant reductions in gender gaps were observed, particularly in the labor market, driven by increased female educational attainment and declining fertility rates (Flórez, 2010; Iregui-Bohórquez et al., 2021). This substantial improvement in women's human capital has positively affected both society and the economy. These trends are important for the economy as they affect the working population and its productivity. Moreover, achieving greater gender equality strongly affects national income (Cavalcanti and Tavares, 2016; Cuberes and Teignier, 2016). Consequently, analyzing the evolution of LFP is of great interest because of its strong link with the labor supply. Increases in LFP translate into a larger workforce and higher potential output, thereby stimulating long-term economic growth. In advanced economies, Labor Force Participation contributed significantly to growth between 1985 and 2000 IMF (2018).

The evolution of the LFP also influences other variables in both the short- and long-run, such as contributions to healthcare and pension regimes. In the short run, a larger proportion of formal workers will reduce stress on the government budget to finance healthcare and increase direct contributions to pensions.[1] Additionally, a higher attachment to the labor force could increase workers' formality, which is an essential topic in countries such as Colombia, where informality accounts for approximately 50% of total employment. Therefore, higher female participation can mitigate the adverse effects of population aging on economic growth and healthcare. This is an issue for economies worldwide. For instance, in industrialized countries, the increasing trend of LFP stopped at the beginning of the millennium. Since then, governments have designed policies to include a larger population in the labor market and reduce the negative effects of lower population growth on Labor Force Participation rates and economic growth Clements et al. (2015).

When designing policies, it is important to determine whether the dynamics are determined by structural or cyclical factors Aaronson et al. (2006). If the decline in LFP is cyclical, the unemployment rate may underestimate labor market slack, suggesting a favorable long-term growth outlook. Conversely, if the decline is structural, the unemployment rate accurately reflects the momentum, implying a less optimistic long-term growth scenario than the previous one. This study focuses on characterizing the structural and cyclical factors of gender-disaggregated LFP in Colombia by addressing the following questions: First, is the reduction in the participation gap driven by observable or unobservable factors? Second, what will be the LFP trajectory in the next decade, and what are its implications for the potential output? To answer these questions, following Aaronson et al. (2014, 2006), we estimate a synthetic cohort panel that allows us to characterize the evolution of urban participation by gender, cohort, and age.

This study analyzes the structural and cyclical determinants of Colombian LFP for both genders, projects these indicators under various scenarios, and examines their impact on potential GDP growth by 2035. Our key findings are that the increased labor market attachment of women explains the upward trend in aggregate participation between 1984 and 2014, with an increase in human capital as the main driver of this increase and

[1] In pay-as-you-go pension systems, higher participation and employment can increase revenue and reduce strain on the government budget and the working-age population in the coming decades. On the other hand, in funded pension systems, higher LFP can stimulate national savings and boost economic growth.

the consequent reduction in the gender gap. Furthermore, we find that halving the gender gap in LFP could boost annual potential GDP growth by 0.41 pp, leading to a cumulative increase in the level of potential GDP growth of 4.50 pp relative to our baseline scenario, which incorporates the expected trends in the structural determinants of LFP. Although population aging presents challenges, increased female participation offers substantial opportunities for stronger economic growth.

This study contributes to the literature in several ways. First, it provides detailed projections of the Colombian LFP under various scenarios, explicitly accounting for demographic changes, cohort effects, and the gender gap. Second, it quantifies the impact of increased female LFP on potential GDP growth within a production function framework, highlighting the substantial macroeconomic benefits of closing this gender gap. Third, it emphasizes the importance of considering the broader societal implications of female labor market participation, particularly its impact on social security contributions and public finances, which is especially relevant in Colombia. Finally, our findings offer valuable insights for policymakers in Colombia and other developing economies facing similar demographic and labor market challenges, suggesting that policies promoting female Labor Force Participation can be powerful engines for economic growth and social progress.

This paper is organized into six sections as follows. This introduction is followed by a discussion of the key structural and cyclical factors influencing Colombia's Labor Force Participation, such as the demographic bonus, women's labor market integration, population aging, and the cyclical nature of labor supply. The third section details the cohort panel data model employed, the fourth discusses the variables used to explain the evolution of LFP, and the fifth presents our results. The projections of GDP for the next ten years, based on the evolution of structural variables, are provided in the sixth section. Section seven concludes.

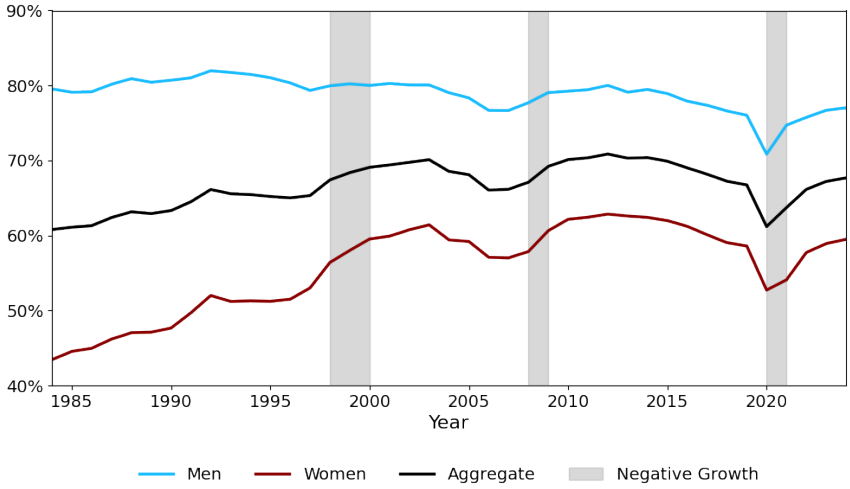
2 Dynamic of Labor Force Participation in Colombia.

Labor Force Participation in Colombia is presented in Figure 1, which focuses on urban participation, as it is the longest time series available and closely reproduces the dynamics of indicators with greater geographic coverage. [2] Roughly speaking, we can see that the increased participation between 1984 and 2004 is mainly explained by the higher attachment of women to the labor market, a trend shared with advanced countries but with differences in timing. This trend reduced the gender gap in participation from 40% to 20%. After 2004, the aggregate participation rate remained stable. This behavior is true for both men and women. The gender gap decreased slightly from 20% to 18%. Another interesting result is that after periods of negative economic growth in gray-shaded areas, participation increases.

We also observed some gender differences in the patterns of LFP throughout the life cycle. The left panel of Figure 2 presents the dynamics of the LFP over the life cycle for the three cohorts of men. The darkest brown line represents the participation of men born between 1966 and 1968, the orange line represents the participation of men born between 1976 and 1978, and the light orange line represents the participation of men

[2]The main seven cities and their metropolitan areas represent about 40% of total population. They include Bogotá, Medellín (Caldas, La Estrella, Sabaneta, Itagüi, Envigado, Bello, Girardota, Copacabana y Barbosa), Cali (Yumbo), Barranquilla (Soledad), Bucaramanga (Girón, Piedecuesta y Floridablanca), Manizales (Villa María) y Pasto.

Figure 1: Dynamics of Labor Force Participation



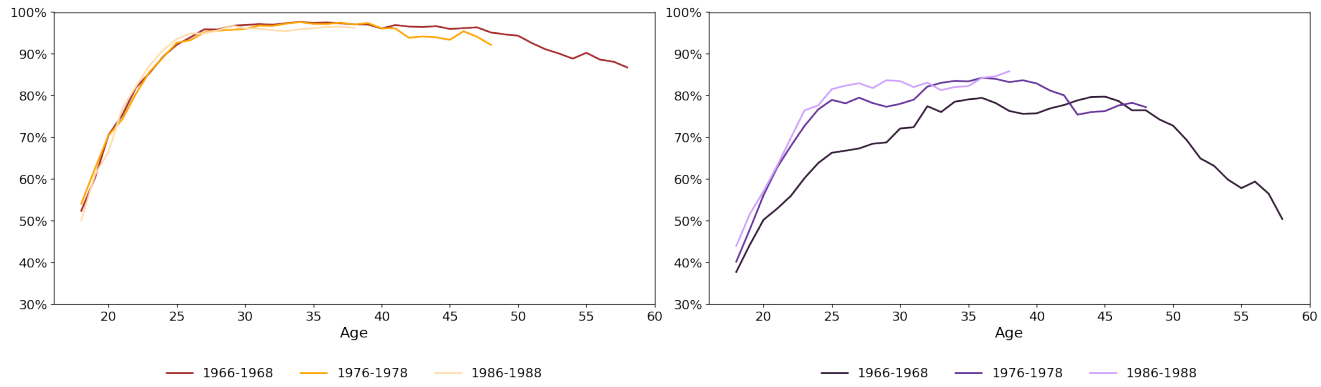
Source: Household Surveys, DANE

born between 1986 and 1988. There were no significant differences in participation throughout the men's life cycle. At 18 years, participation is about 53%, and it increases slowly up to 25 years when superior education is completed, up to approximately 98% for men in their 30, and participation remains stable up to their 50s. Subsequently, we observe a small decline in participation, which could be related to the inability to reach the pension.

When we analyze the evolution of participation for these three cohorts for women, there are more discernible differences, higher participation of women born in younger cohorts, and the right panel of the figure shows this. The darkest purple line represents the participation of women born between 1966 and 1968, the purple line represents the participation of women born between 1976 and 1978, and the light purple line represents the participation of women born between 1986 and 1988. First, female participation at age 18 was approximately 40% for both cohorts of women born earlier. Participation increases considerably when women finish their education, reaching up to 80% around the age of 26 years, reaching its maximum at 32 years, and 85% for women born in more recent cohorts. By contrast, women in the first cohort took longer to enter the labor market, as their participation increased more gradually and reached a peak of 80% at 32 years. Thus, we see how women born in more recent cohorts have higher participation rates until the age of 40. We observe that, despite the increase in female attachment to the labor market among younger cohorts, there is still a gap at all ages.

Another important factor that contributes to explaining the dynamics of GDP is the demographic bonus, which corresponds to the period in which the population aged 15-64 years grows faster. Therefore, is relatively larger than that of the dependent population and those who do not work (children and the older population). This period represents the potential for economic growth and general well-being of the population resulting from changes in the age structure of the population. Figure 3 presents the evolution of the ratio between the population aged 1– 64 years and the total population using population projections by age range for the

Figure 2: Labor Force Participation through the life cycle.



(a) Men

(b) Women

Source: Household Surveys, DANE

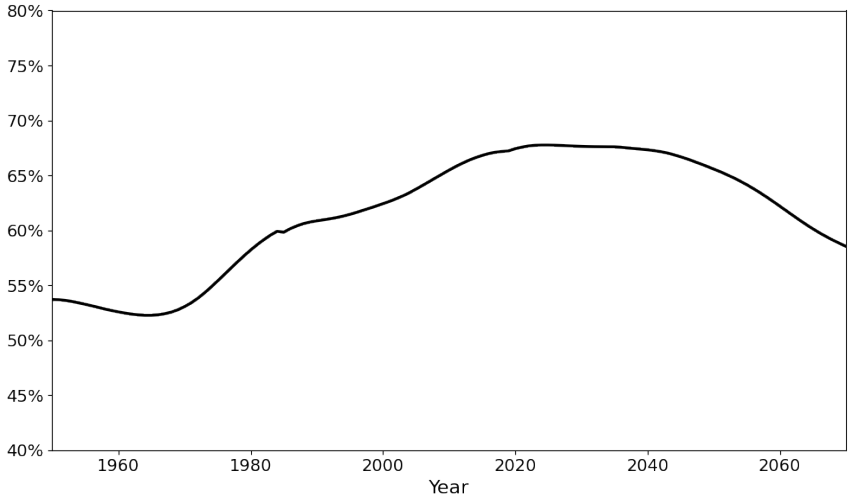
Colombian population from DANE. The minimum ratio (49.8%) was achieved in 1964. From this year onward, the demographic transition has been characterized by a decrease in the dependent population relative to the total population, implying a net increase in the number of people available to work, which must be taken advantage of through public policies. According to demographic projections, the bonus ended in 2021.

Additionally, as behavior after 2004 suggests, the participation rate seems to fluctuate around a long-term value for both genders, which may be associated with cyclical factors of economic activity. Fluctuations in economic growth affect firms' productivity and, consequently, labor demand. Additionally, households review their decisions given changes in the costs and benefits of participating in the labor market. The literature discusses two effects on LFP during the business cycle: the added and discouraged workers. The first effect was described by Humphrey (1940), Woytinsky (1940), and Mincer (1962), who analyzed how married women who were not part of the labor force during recessions, upon perceiving a situation of unemployment of the head of household, decide to enter the labor market to compensate for the reduction in income. On the other hand, the second effect dates back to Long (1953), who describes how unemployed individuals, faced with a costly job search, conduct a cost-benefit analysis and decide to leave the labor supply until better opportunities are perceived.[3] These two effects work in opposite directions, and the aggregate participation response depends on each country's characteristics.

For instance, Lee and Parasnis (2014) find that the evolution of participation during the business cycle is dominated by the discouraged worker effect in developed countries and the added worker effect in developing countries. The authors attribute their findings to the existence of a welfare system, including unemployment benefits, in developed countries. Although these benefits constitute a protection mechanism for households in developed countries during recessions, the income of secondary members compensates for the reduction in

[3] A more recent definition implies that this effect occurs when individuals seek employment, face a reduction in expected wages, and abandon their search efforts. This expected wage is determined by two components: the effective wage and the probability of finding employment, both of which are pro-cyclical; thus, the discouraged worker effect is also pro-cyclical.

Figure 3: Demographic Bonus



Source: Population projections, DANE
This Figure presents the demographic bonus computed as the ratio between the working age population (15 - 64 years) and total population.

household income in developing countries. Thus, it is important to consider not only long-run trends, such as demographic changes and the observed characteristics that capture human capital, but also the cyclical position of the economy.

3 Econometric model

This section introduces the synthetic cohort panel model used in the empirical analysis. This methodology is highly flexible in capturing the differences in participation discussed in the previous section: a higher attachment of younger women to the labor market, life cycle age considerations, a higher attachment of men at all ages, and a predominant added worker effect during difficult periods. Thus, we follow a specification similar to that proposed by Aaronson et al. (2014, 2006) which explains the evolution of the LFP of group g using a set of structural $X_{g,t}$ and cyclical factors C_t:

$$log\Big(\frac{LFP_{g,t}}{1-LFP_{g,t}}\Big) = \beta_g X_{g,t} + \gamma_g C_t + \chi_g + \tau_{g,t-age} + \epsilon_{g,t}, \tag{1}$$

sub-index g corresponds to the combination of gender and age, t indexes years, $LFP_{g,t}$ refers to the LFP of group g in period t, and β_g and γ_g are coefficient vectors that vary for each group. We also include fixed effects to capture each group's participation in the labor force χ_g, which controls for unobserved structural factors that affect LFP throughout the life cycle. Finally, we include the birth cohort fixed effects τ_{t-age}, which capture the changes in preferences, opportunities, or social norms for people born between 1910 and 2009, in the model. Thus, age-based group effects delineated participation patterns for each gender. The

birth cohort effect modifies this baseline, reflecting the varying propensities of different cohorts to engage in labor market participation throughout their life cycle. The dependent variable is the logarithm of the odds ratio of Labor Force Participation, which presents several statistical advantages. Primarily, the linearization of the relationship between the explanatory variables and LFP facilitates estimation using conventional linear regression methodologies. Additionally, this approach addresses boundary issues because the odds ratio can assume any value between negative and positive infinity, and the inverse transformation ensures that the LFP remains constrained between zero and one.

According to Deaton (2019), there are several advantages of using cohort data compared to traditional panel data analysis. First, cohort data can be used to control for unobserved fixed effects, such as characteristics ex ante to the beginning of their work lives, which is the main econometric appeal of this technique. Second, there is no attrition, given that the sample design of household surveys guarantees that there will always be information. Third, this approach is less susceptible to measurement error. Because we focus on aggregates instead of individual information, this reduces the effects of measurement errors and improves the signal-to-noise ratio. In this sense, synthetic cohort panels can be considered Instrumental Variable (IV) methods, where the instruments are grouping variables, the application of which eliminates measurement errors by averaging.

4 Data

The vector of variables is constructed using three data sources. The primary source is household surveys conducted by the Colombian National Administrative Department of Statistics (DANE), which offers the longest time series for analyzing employment, wages, and individual characteristics in Colombia. Between 1984 and 2000, data was collected through the National Household Survey, followed by the Continuous Household Survey between 2001 and June 2006. In 2006, the survey underwent another methodological change and was renamed the Great Integrated Household Survey. In 2021, the Great Integrated Household Survey underwent changes in the definitions of some of its indicators and in the age range of the working-age population, from 12 to 15 years and over. We adjust the indicators by considering the most recent methodological changes. Thus, we focused our analysis on the population between 15 and 74 years old. We also include population projections to include migration and mortality, which are computed by DANE. Finally, we include the output gap computed by the Colombian Central Bank. Table 1 lists the variables used in the estimation.

Human Capital: This category includes five variables: average years of education, the rate of individuals without any education, incomplete primary, incomplete high school, and incomplete undergraduate studies. These variables capture human capital and returns on education, that is, the incentives to participate in the labor market. In addition, individuals with higher human capital tend to extend their participation, even at an advanced age.

Family Structure: This category includes seven variables: the percentage of individuals who are responsible for their households, married, in a free union, the percentage of individuals who live in households with small children aged five years or less, older, 65 years or more, or permanently disabled, and the percentage of house-

Table 1: Variables

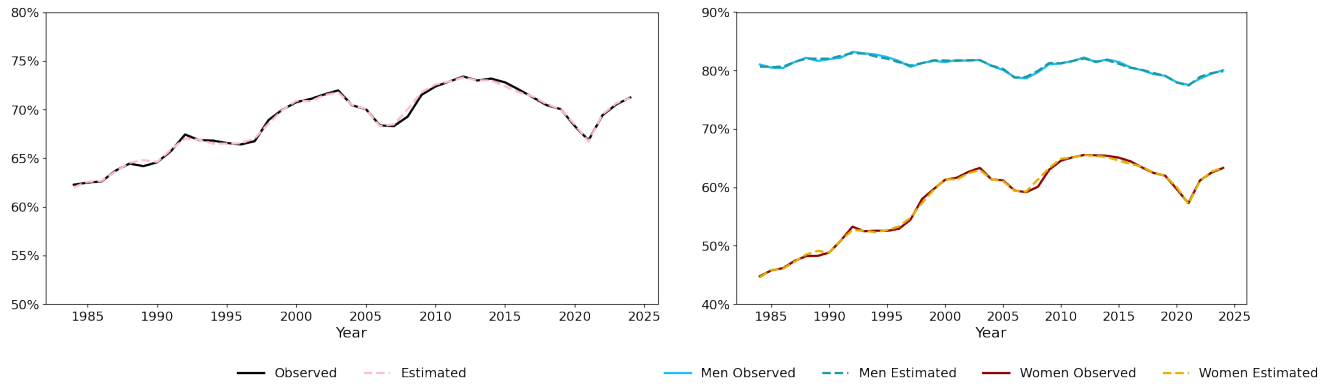
Human Capital		
Average schooling	S	Household Surveys
% without education	$tsedu$	Household Surveys
% with incomplete elementary	$tprin$	Household Surveys
% with complete High School	$tseco$	Household Surveys
% with complete College/Technician	$tsuco$	Household Surveys
% of School attendance	$tase$	Household Surveys
Household Structure		
% of household heads	$tpjefe$	Household Surveys
% in common law marriage	$tunli$	Household Surveys
% of married	$tcasa$	Household Surveys
% living with children less than 6 years old	$tfert05$	Household Surveys
% living with elderly older than 64 years old (no heads)	$tp6599j$	Household Surveys
% living with permanent disabled to work population	$tpprin$	Household Surveys
% with domestic chores help	$tpprsd$	Household Surveys
Non Labor Income		
Average income other members of HH	$Yolh$	Household Surveys
% non-labor income	$tpinot$	Household Surveys
Demographic change		
Mortality rate of group	$tmort7$	Population projections
Net migration of group	$tmigr7$	Population projections
Cyclical component of:		
GDP	$Ygap$	Central Bank
Non-wage employment rate	$ctona$	Household Surveys
% living with unemployed workers	$tpprde$	Household Surveys

holds that live with people who perform domestic services. Finally, the existence of domestic services reduces the need to allocate time to domestic chores and signals that there are good financial resources. Non-labor income: This category captures sources that allow individuals to finance non-participation in the labor market and includes two variables: the percentage of individuals with non-labor income and the average real income from other workers in their households, deflated by the CPI of each city in 2008. To avoid problems caused by truncation in the reporting of income in the National Household Survey prior to 2001, we follow Nuñez and Sánchez (1999).

Demographic change: This category comprises two variables: mortality and migration rates. These series allow us to capture changes in demographic composition and are published by DANE in their vital statistics.

Cyclical Variables: To control for the effects of the business cycle on the decisions of each group, we

Figure 4: Estimated vs observed Labor Force Participation



(a) Aggregate

(b) By Gender

Source: Authors' calculations
This figure compares the observed LFP and estimates of Equation 1

include three variables. The output gap from Banco de la República, the cyclical component of the occupation rate of non-wage workers, is highly associated with participation, as discussed by Lasso-Valderrama (2020). Finally, we included a variable that captures the percentage of households with unemployed workers.

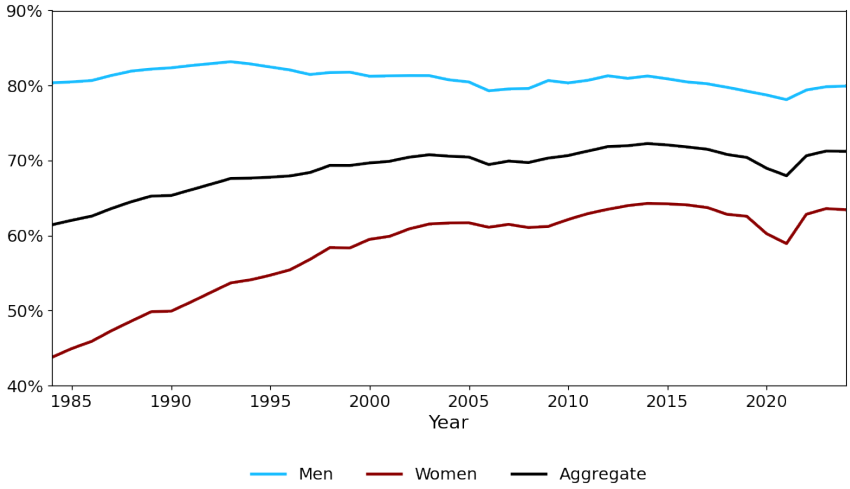
5 Estimates of participation

The left Panel of Figure 4 presents the estimates of the aggregate LFP by simultaneously estimating for all groups in Equation 1 using a panel data approach and a White-corrected covariance matrix to correct for heteroscedasticity. The aggregate LFP is computed as the participation rate of each group g weighted by its importance in the working-age population. The solid black line corresponds to the observed series, and the dotted line represents the estimate. As can be seen, there is a very good fit, with large differences between 1988 and 1990. The fit by gender is also very close, with some differences in women's behavior (right panel). The blue line corresponds to the estimated LFP for Men, and the yellow line corresponds to that for women.

5.1 Structural component

Figure 5 presents the evolution of the structural participation estimates. To compute these values, the cyclical variables were set to zero; consequently, the structural component reflects the effect of human capital, household structure, non-labor income, demographic change, and constant effects through the life cycle and birth cohorts. The main trends observed in the evolution of the aggregate and gender LFP series are attributable to these structural factors. The structural LFP for men remained relatively constant between 1984 and 2014 at approximately 80%. For women, there was an increase up to 2014, after which the LFP remained at around 64%.

Figure 5: Structural estimates of LFP



Source:Authors' calculations
The figures present the structural component of LFP, this is computed by setting the value of cyclical variables to 0 in Equation 1.

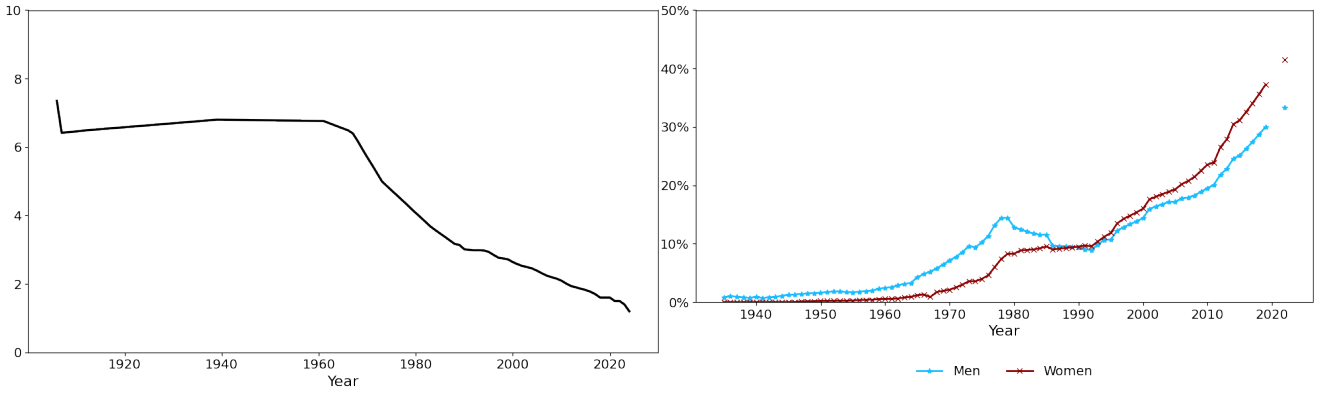
Thus, we can divide the analysis of the evolution of LFP into two sub-periods, 1984–2014 and 2014-2024, according to the trend of women's LFP.

5.1.1 Evolution of LFP 1984 - 2014

The marked increase in the aggregate LFP during the initial period is primarily attributed to the growing integration of women into the workforce, a global phenomenon that occurred in the latter half of the 20th century. Amador et al. (2013) suggest that this process was particularly pronounced in Colombia, where female LFP rose from the second-lowest in Latin America in 1980 to the highest by 2004. Since gaining the right to vote in 1954, Colombian women have been increasingly participating in society. Iregui-Bohórquez et al. (2024) highlights that several factors have contributed to this greater labor market engagement. Medical advancements, including widespread access to contraceptives, improved maternal healthcare, and the introduction of formula milk, have enabled women to exercise greater control over their reproductive health, leading to decreased fertility rates and increased educational attainment, Figure 6. Consequently, the fertility rate began to decline after 1965, reaching just over one child per woman by 2015. Additionally, higher education enrollment among younger women has surged, increasing from less than 5% in 1978 to over 45% in 2022, with women surpassing men in enrollment after 1990

Furthermore, the costs associated with Labor Force Participation decreased as technological advancements in household appliances and the availability of childcare services, such as those provided by the Colombian Institute of Family Welfare childcare centers after 1970, reduced the burden of domestic responsibilities. Simultaneously, shifts in social and cultural norms, including the elimination of 'marriage bars,' have expanded opportunities for women across various sectors. Moreover, the Colombian economy's transition towards a

Figure 6: Estimates and observed Labor Force Participation



(a) Fertility Rate

(b) Enrollment in higher education

Source: Iregui et al 2021.

service-oriented model facilitated women's entry into service-sector jobs, which favored skills beyond physical labor. Finally, government policies, including anti-discrimination legislation, quota systems, and family support policies, have further advanced gender equality.

Shifts in women's labor market participation have led to a greater proportion of households in which women are the primary earners. This trend can be attributed to rising divorce rates and women's increased economic independence. However, women's participation as secondary earners has significantly increased. For instance, Calderón et al. (2011) discuss how women's earnings play a crucial role in providing financial support in households displaced by violence because of the increased need to finance essential consumption in poverty. In conclusion, women born in recent decades have experienced a significant increase in benefits, such as enhanced access to education and healthcare, alongside a reduction in costs due to technological advancements and policy changes. Combined, these factors explain why women born in recent cohorts enter the job market, obtain better jobs, and create a better professional work-life.

5.1.2 Evolution of structural LFP 2014 - 2024

During this period, structural estimates show a decline in Labor Force Participation of 1.20 pp for men and 0.70 pp for women, yielding an aggregate reduction of 0.91 pp in the LFP. Several factors may explain this behavior. First, we analyze how much of this factor could be attributable to aging (change in the composition of the working population) and change in participation rates for specific age groups. To this end, we focus on three distinct age groups: (1) youth (15-24 years), where many individuals balance education and labor market entry; (2) prime-age workers (25-54 years); and (3) older individuals (55–74 years). Thus, we decompose the aggregate change in the participation rate as follows:

$$LFP_{2024} - LFP_{2014} = \sum_{G}(\alpha_{G,2024} - \alpha_{G,2014}) \times \frac{(LFP_{G,2014} + LFP_{G,2024})}{2} + \sum_{G}(LFP_{G,2024} - LFP_{G,2014}) \times \frac{(\alpha_{G,2014} + \alpha_{G,2024})}{2} \quad (2)$$

Where LFP_{year} refers to the aggregate LFP for $year \in \{2014, 2024\}$, G indicates the age group for $G \in \{15-24, 25-54, 55-74\}$, $\alpha_{G,year}$ represents the share of group G in the working-age population in *year*, and $LFP_{G,year}$ is the participation rate of group G in *year*.

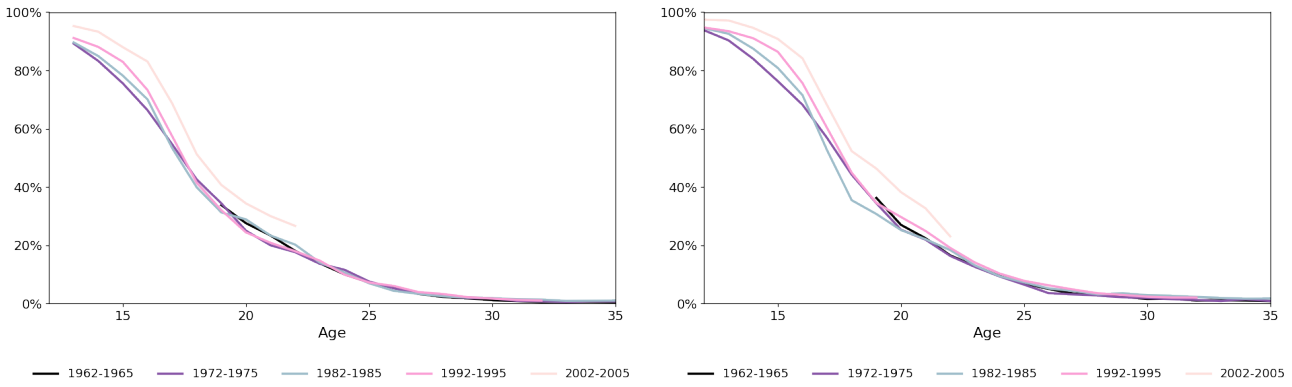
The first element on the right-hand side of the equation captures the contribution of changing population shares, whereas the second term reflects the contribution of each age group to the total change due to variations in the LFP. Table 2 summarizes these results. As we can observe, the reduction in aggregate participation is mainly explained by younger individuals, both because their share is lower due to population aging and because they participate less in 2024 than they did in 2014. The other groups positively contributed to the aggregate LFP; however, their combined effect did not compensate for the reduction caused by younger individuals.

Table 2: Contribution to the change in structural LFP 2014 - 2024

Age range	Population share	LFP	Total
15 to 24	-2.72	-1.91	-4.63
25 to 54	0.34	0.42	0.76
55 to 74	2.47	0.49	2.96
Total	0.09	-1.00	-0.91

Thus, the first element that explains the reduction in LFP is aging, as there are fewer young individuals. Additionally, we inspect why there is a reduction in LFP for young individuals. The main explanatory factor is the increasing trend observed in educational enrollment, as demonstrated in the previous section and illustrated in Figure 7. The figure displays school attendance patterns by age and cohort for men (left panel) and women (right panel), revealing three notable findings. First, compared to the cohort born between 1972 and 1975, the younger cohort shows significantly higher attendance rates beginning at age 12 (middle school), with increases of approximately 3.7% for both genders relative to older cohorts. This gap widens to approximately 16% by age 16, the typical high school completion age in Colombia. Second, the gender participation gap persists through ages 20-22, reaching 10% during a typical university completion period. Third, these patterns reflect not only increased enrollment in higher education but also earlier educational engagement, starting due to improvements in school retention. Thus, younger cohorts have contributed less to participation in the labor market in recent years.

Figure 7: School attendance by age and Cohort



(a) Men

(b) Women

Source: Authors' calculations.

5.1.3 What explains the evolution of the Structural Gender Gap

We can also analyze the evolution of the gender gap in LFP during our period of analysis, following the methodology of Kröger and Hartmann (2021) to decompose the gender gap in 1984, 2004, and 2024 into observable and unobservable characteristics. Their approach extends the previous decompositions of Kitagawa (1955), Oaxaca (1973) and Blinder (1973) to allow the use of a panel data framework. Although the main idea is similar to that of the estimates in Equation 1, there are three differences. First, we modify the dependent variable to $LFP_{g,t}$ to enable a comparison of each component's contribution. Second, all cyclical variables were excluded. Finally, as the estimation is conducted for each year, we aggregate the birth cohorts into ten-year groups.

Table 3: Decomposition of the Gender Gap in LFP 1984 - 2024

	1984	2004	2024
Endowments	0.286	0.192	0.13
Coefficients	0.382	0.141	0.121
Interaction	-0.244	-0.104	-0.071
Total	0.424	0.229	0.18

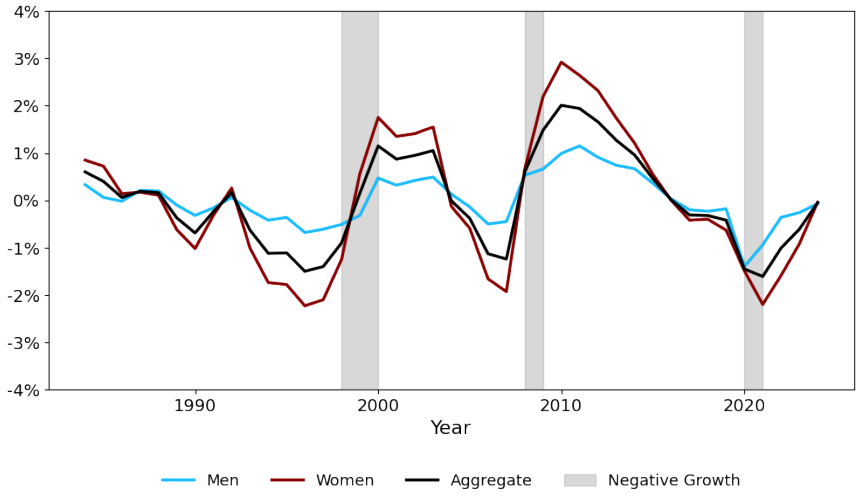
Table 3 decomposes the gender gap into three components: In the first row, we explore the extent to which the gap is explained by observable characteristics. As shown, the importance of observables decreased over time from 28.6 pp to 13 pp. The second row shows the change in the coefficients among the groups at these three points, which also decreases the importance of explaining the gender gap from 38.2 to 12.1 pp. Finally, the interaction term in the third row guarantees that all components add up to the total in the fourth row. Analyzing the evolution of endowments, the proportion of household heads is the characteristic that explains the gender gap at the three points, as shown in columns 1-3 of Table A.1 in Appendix A.

Additionally, the variables related to human capital also decrease their contribution to the gender gap; while all of them account for 10.1 pp in 1984, their joint contribution falls to 0.1 pp in 2024. Completing high school is the variable that contributed the most to this behavior. This result highlights how women close the gap in Human Capital in the labor market. The remaining endowments did not significantly contribute to the gender gap. Regarding the role of unobservable characteristics in explaining the reduction in the gender gap, we observe that human capital reduces it. The most important reduction is presented in the schooling years, for which differences in parameters fall from 45.2 pp in 1984 to 2.3 pp in 2024. In addition, incomplete elementary schools show a similar pattern but with a lower reduction in magnitude. Another coefficient that reduces the contribution to the gap is the one with respect to the percentage of married people; in 1984, it contributes to the gender gap by 18.5 pp; in 2004, the effect goes in the opposite direction and explains -12.5 pp.

5.2 Cyclical Behavior

We also compute the cyclical component of participation as the difference between the estimated and structural participation rates. Figure 8 presents the evolution of the aggregate and gender cyclical components of the LFP. Economic fluctuations significantly affect labor participation. Notably, we observe increases in participation following the 1991, 1996, 1999, and 2008 periods, which Arango et al. (2015) identified as indicative of a recession. Consistent with this study's findings, participation exhibited a greater increase during recessions than during expansions, suggesting that the added worker effect dominates the response to business cycle fluctuations.

Figure 8: Cyclical component of Labor Force Participation



Source: Authors' calculations.

Furthermore, while economic fluctuations have a qualitatively similar impact on the participation of both sexes, discernible differences in magnitude are evident. Specifically, women's participation shows a more

pronounced increase during economic downturns. For example, following the 2008 recession, while men's participation rose by approximately one percentage point, women's participation increased by nearly three percentage points. These observations align with the prevailing influence of the added worker effect on the cyclical response of Labor Force Participation, which amplifies the response of secondary household members, typically younger men and women, to economic shocks. Lasso-Valderrama (2020) provides further support for the added worker hypothesis, demonstrating that transitions from inactivity to unemployment and non-wage employment exhibit countercyclical behavior, with a more pronounced impact on secondary household members and individuals with lower educational attainment. Moreover, our findings are similar to those of Bhalotra and Umaña Aponte (2010) for women in Asia and Latin America, further emphasizing the heightened counter-cyclical response of households with low human capital, particularly those married and lacking significant assets. In Colombia, Cardona-Sosa et al. (2016) demonstrate that the participation of married women increases by 9% and 20% within six months of the household head's job loss, while the likelihood of their children entering the labor market also rises.

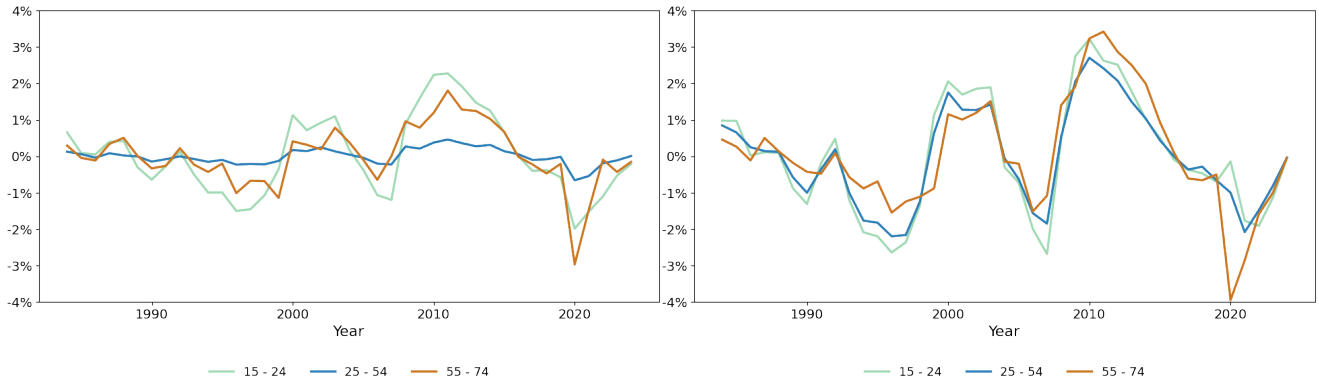
As observed during the COVID-19 pandemic, the cyclical component of the LFP is very important. For men, there was a greater drop in participation, while for women, it was similar to the previous periods of reduction. Interestingly, the recovery in 2021-2024 was weaker than that in previous recessions. This behavior highlights the fact that there was a slow recovery of the labor market and other negative domestic and international shocks that affected the momentum of the economy. However, to check the robustness of our findings, we estimate the cyclical component of the LFP with the effect of pandemics on the structural and cyclical components in Appendix A. Our main results, except for the cyclical trend decomposition of LFP during the pandemic, show that these alternative specifications did not significantly alter the estimated cyclical component. Our estimates suggest that the fall and posterior movement of the LFP cannot be solely attributed to demand or supply factors but are a mixture of both.

Additionally, we examine cyclical labor market behavior by gender and age group, as shown in Figure 9. Our analysis focuses on the same three age groups used to analyze the behavior of structural participation between 2014 and 2024: youth (15-24 years), (2) prime-age workers (25-54 years), and (3) older individuals (55+ years). The left panel reveals significant heterogeneity in men's cyclical responsiveness: while prime-age males show minimal participation fluctuations, both younger and older cohorts exhibit substantial cyclical variations. In contrast, women's participation (right panel) demonstrates higher responsiveness across all age groups, although the effect is lower for those aged 55 years and older, with the notable exception of the pandemic period. These patterns align with the findings of Arango et al. (2015), confirming age-gender behavior in the cyclical LFP.

6 LFP Projections and potential GDP growth

This section explores potential Labor Force Participation scenarios for the next decade and analyzes their impact on potential GDP using a production function approach. We focus on different scenarios for LFP, ranging from

Figure 9: Cyclical component of LFP by age group



(a) Men

(b) Women

Source: Authors' calculations.

current levels to a scenario in which women participate in the labor market at participation rates similar to those of men. We examine alternative scenarios, as evidence from advanced countries does not suggest that the gender gap is always closing. For instance, as Blau and Kahn (2013) suggest, in the US, the process of closing the gender gap in LFP has stalled due to the lack of social programs that actively support women's employment in the labor force. This finding highlights the potential importance of such policies for promoting greater female Labor Force Participation and boosting economic growth, but also the necessity to consider the fiscal costs to do so.

6.1 LFP projections

This section examines three alternative scenarios projecting Labor Force Participation until 2035. Several factors influence future LFP trends, including increased labor market attachment among younger women, rising educational attainment across younger cohorts, increasing life expectancy, migration patterns, the evolution of the gender gap, and the demographic bonus. Most of these factors are explicitly controlled in the model specification. Although not directly modeled, demographic change is implicitly incorporated, as aggregate participation is calculated as the weighted average of participation rates for each demographic group g, where the weights reflect each group's share of the total population. We focus on the "structural" component of the LFP because forecasting cyclical fluctuations is beyond the scope of this analysis. According to Aaronson et al. (2014), this method is preferred for generating projections over the extrapolation of LFP time series for specific groups, as the latter approach combines the effect of different cohorts that may provide inaccurate signals when significant changes in the LFP occur.

Our first scenario, the "Aging" scenario, isolates the impact of population aging. Here, we assume constant participation rates for each demographic group (by gender) at the values observed in 2024. Aggregate participation is then projected from 2025 to 2035 using population projections from DANE as weights for each

group's participation rate. Thus, in this scenario, only shifts in population composition drive changes in the aggregate LFP. The second, or "Baseline," scenario projects the LFP under conditions similar to those observed in recent years. We set the values of the structural factors to the average observed values from 2023 to 2024. Cohort effects (τ_c) for new labor market entrants have been fixed on average over the past 10 years.

Finally, the "Higher Women's LFP" scenario explores the impact of closing the gender gap in LFP by up to 50% of its 2024 value, achieved through increased female labor force attachment. Female participation is projected using a weighted average of the estimated parameters for both men and women: $\beta_g^* = \lambda_t \beta_{m,g} + (1 - \lambda_t)\beta_{w,g}$. To determine the 2035 LFP target, we considered recent LFP rates in OECD countries. World Bank data indicate that Norway, Australia, Canada, and Germany have female participation rates between 73 and 75 percentage points (pp) in 2024, implying a gender gap between 4 and 7.2 pp. We use this as a benchmark, aiming to halve the 2024 gender gap by 2035, resulting in a gap of 9.2 pp. This targeted reduction reflects the gradual nature of these changes and the need for accompanying policies that support women's participation. As discussed by Blau and Kahn (2013), the reduction in the US gender gap has stalled, highlighting the importance of such supportive programs for women. Therefore, our target is below the OECD average, excluding the US, where female participation has reached 75%.

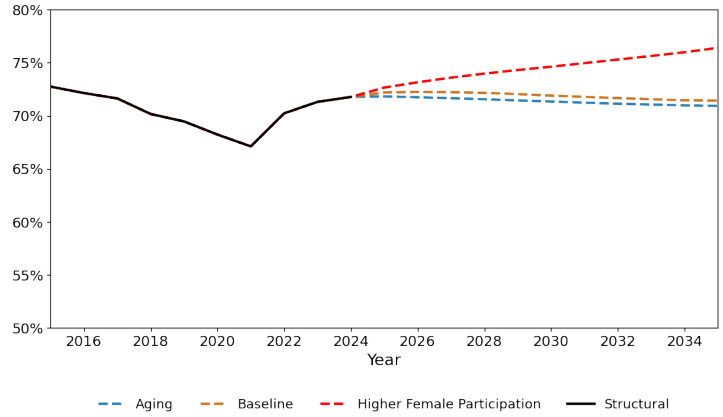
As shown in Figure 10, population aging (red line) is projected to decrease the aggregate LFP by 84 basis points (bp) over the next 11 years. This decline is primarily driven by a 1.74 pp fall in women's participation, reflecting the earlier retirement age for women (57 years). Because female participation declines significantly with age, the increasing proportion of older women in the population reduces aggregate participation. Male participation remained relatively stable in this scenario, decreasing by only eight bp. The baseline scenario (green line) shows a smaller decrease of 34 bp. Although female participation continued to decline (169 bp), male participation increased by 92 bp. Finally, the "Higher Women's LFP" scenario (yellow line) projects a 7.84 pp increase in female participation, with male participation remaining similar to that of the baseline scenario. This scenario resulted in a gender gap of 9.16 pp in the LFP. [4]

6.2 Effect on potential GDP

We now focus on the effect of projected trends in Labor Force Participation on potential output. A higher labor supply can meet the demands of industries more easily, thus improving the efficiency of matching vacant and unemployed workers. This can lead to higher production levels and, consequently, economic growth. We focus on the last two scenarios of the previous section, which reflect the current trends in LFP and the alternative scenario in which the gender gap is reduced by half by 2035. These two scenarios are the most comprehensive and include the effects of the main factors behind the evolution of participation. To this end, we construct a production function for the Colombian economy's potential product ($\bar{Y}_t$). Following Cobo (2005), we use the Cobb–Douglas specification:

[4] We also construct projections using a Vector Autoregression model of order 1 (VAR(1)) model to forecast the value of the structural variables for each group g. Although there are some differences in magnitude, the main trends of the results described in this section are maintained. A summary of the methodology and the results are presented in appendix C.

Figure 10: Projections of Labor Force Participation



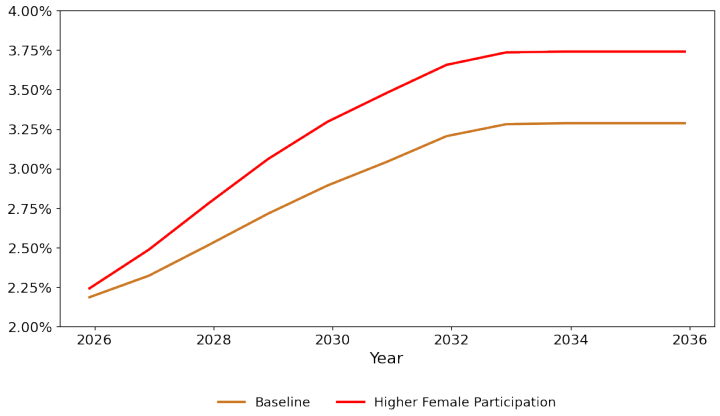
Source: Authors' calculations
This figure presents alternative projections of the structural component of the labor force. Aging focuses only on the effects of demographic change. The baseline adds the projected evolution of explanatory variables. The higher Women LFP considers that the gender gap will reduce by half in 2035.

$$ln(\bar{Y}_t) = lnA_t + \alpha ln(\bar{K}_t) + (1-\alpha) ln(\bar{L}_t) \tag{3}$$

Where A_t represents the evolution of productivity, $\bar{K}_t$ is structural capital, $\bar{L}_t$. The trend in total labor $\bar{L}_t$ can be decomposed into the working-age population W_t, the unemployment trend or NAIRU $\bar{u}_t$, the trend of the Labor Force Participation rate $\overline{LF}_t$, and average schooling s_t; then, we have

$$\bar{L}_t = W_t(1-\bar{u}_t)\overline{LF}_t s_t \tag{4}$$

Figure 11: Estimates of Potential GDP Growth under alternative LFP scenarios



Source: Authors' calculations
Estimates of potential GDP under current projection and higher attachment of women

This exercise incorporates projections of key demographic and labor market trends. We utilize DANE's projections for the working-age population W_t. The Non-Accelerating Inflation Rate of Unemployment (NAIRU) is projected as the trend of a Hodrick-Prescott filter applied to the unemployment rate, which is projected to converge at 12% over the forecast horizon. Furthermore, we assume that the average number of years of education will increase by utilizing the aggregate projection of the main results. This reflects the recent higher educational attainment of female cohorts and changing population composition. It is important to note some implicit assumptions regarding this exercise. Specifically, we assume that increased female Labor Force Participation will i) not increase the unemployment rate and ii) not alter the capital-to-output ratio (K/Y), which is calibrated at 22%, the average between 1990 and 2020. While these assumptions regarding projections may influence the absolute values of potential growth, they do not affect the comparative analysis of the scenarios.[5]

Figure 11 depicts the annual growth rates of the potential GDP for both scenarios. The key findings of this exercise are as follows: In the baseline scenario, the growth of potential GDP is initially below its long-run trend. This underperformance can be attributed to several factors, including the social unrest episode of 2019, the pandemic, and the slow recovery afterwards due to international supply restrictions associated with the disruption of transportation chains in 2021, the invasion of Ukraine, and national factors, such as the truck strike episode of 2022. Additionally, public investment will be lower in 2023 and 2024. These factors have deteriorated investment and potential growth. Thus, in our baseline scenario, potential GDP growth gradually converges to 3.33% in 2034. Our results are similar to those of IMF (2024) who found that the higher participation of women in the labor market may offset the negative effect of population aging, and if the gender LFP gap is reduced to 10%, economic growth would increase by 0.40 percentage points.

In the scenario of higher female participation, economic growth exhibits a similar increasing pattern. However, the potential GDP growth converges to a higher level of 3.74% per year, due to the enhanced contribution of women to the labor force. This represents a permanent increase of 41 bp in potential GDP compared with the baseline scenario. Finally, there are short-term gains between 2024 and 2035, and potential GDP growth is projected to be 4.5 percentage points cumulatively higher by 2035 in the scenario with increased female Labor Force Participation than in the baseline scenario. In per-capita terms, there is a similar benefit of higher female participation. In 2035, while in the baseline scenario, potential GDP per capita growth is 2.9%, and higher female participation increases annual growth to 3.31%.

These findings highlight the economic benefits of policies that promote a higher LFP for women. Additionally, there are other potential benefits of higher female participation that are not captured by this production function. One example is the direct effect of higher participation on direct contributions to the social security system, which reduces the burden on the public budget to finance healthcare and pension systems. This is a primary topic of interest in Colombia, given that only 25% of workers complete the requirements to obtain a formal pension and approximately 50% of the population is covered by the government in the subsidized regime of healthcare. Thus, lower stress on the government budget may imply lower tax rates on consumption or payroll taxes, which will reduce distortions in the economy and increase output, as suggested by Avila-

[5]The exercise is similar to model an increase the employment rate, given that the employment rate E_t can be defined as $E_t = (1 - \bar{u}_t)\overline{LF}_t$. Thus, the increase in participation of 4.63 corresponds to an increase in the employment rate of 3.50 pp.

Montealegre et al. (2024). According to Ostry et al. (2018), higher female participation has a positive effect on the economy not only because of the higher number of workers, but also because it increases diversity in jobs, which may bring new skills and social interactions; that is, women are a complementary input in the production of the economy. In conclusion, a higher inclusion of women in the labor force could mitigate the adverse effects of population aging prevalent in OECD economies, as discussed by André et al. (2024).

7 Conclusions

This study develops a cohort model to analyze the structural and cyclical determinants of Labor Force Participation for women and men in Colombia between 1984 and 2024. We found that the upward trend in LFP between 1984 and 2014 is mainly explained by women's participation. The importance of observable characteristics (endowments) in explaining the gender gap in LFP has significantly decreased over time, falling from 28.6 percentage points (pp) in 1984 to just 13 pp in 2024. This decline is largely attributable to improvements in women's education. While educational differences accounted for a 10.1 pp gap in 1984, their contribution disappears by 2024. Moreover, we find that the added worker effect is the main force that explains cyclical fluctuations, and that women are more affected by the business cycle.

The results of this study highlight the significant impact of female Labor Force Participation on Colombia's potential GDP growth. Our projections demonstrate that a higher participation of women, particularly closing the gender gap by half, can lead to substantial long-term economic gains. Specifically, the "Higher Women's LFP" scenario projects a 0.41 pp increase in annual potential GDP growth compared to the baseline scenario, culminating in a 3.71% growth rate by 2035. This translates to a 4.5 pp increase in potential GDP relative to the baseline scenario. These findings are consistent with the broader literature that emphasizes the positive correlation between female Labor Force Participation and economic growth André et al. (2024). Although our analysis focuses on the quantifiable economic benefits captured by the production function framework, it is crucial to acknowledge the broader implications of increased female participation in the labor force.

Beyond its direct impact on GDP, increased female Labor Force Participation offers additional benefits that are not fully captured by GDP growth. Higher participation rates have a direct positive impact on contributions to the social security system. This is particularly relevant in the Colombian context, where a relatively small proportion of workers qualify for formal pensions and a substantial portion of the population relies on government-subsidized healthcare. Increased contributions can alleviate pressure on public finances, potentially leading to lower consumption or payroll taxes. As Avila-Montealegre et al. (2024) suggest, reduced tax burdens can further stimulate economic activity by minimizing such distortions. Furthermore, increased female participation can mitigate the negative economic consequences of population aging, a challenge faced by many OECD economies. In conclusion, our analysis provides strong evidence of the economic imperative of policies that promote female Labor Force Participation in Colombia. Future research could explore the specific policy interventions that are most effective in achieving these gains while also considering the associated fiscal costs.

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A Decomposition of the Gender Gap in LFP by variables

This appendix shows the results of the decomposition of the gender gap in participation proposed by Kröger and Hartmann (2021) for each of the variables. Columns 1–3 show the contribution to the gap explained by the difference in endowments; columns 4–6 show the contribution of the difference in coefficients; and the last three columns show the interaction of the previous two factors. In this exercise, to ease computation, cohort groups are pooled in decades.

Table A.1: Contributions to the Gender GAP by variables 1984, 1994, 2024

	Endowments			Coefficients			Interactions		
	1984	2004	2024	1984	2004	2024	1984	2004	2024
S	-0.003	-0.001	-0.001	0.451	0.063	0.023	0.07	0.005	0
tsedu	0.032	0.007	0	0.075	0.015	0.045	-0.03	-0.003	-0.001
tprin	0.006	0.005	0.001	0.097	0.085	0.055	-0.011	-0.012	-0.001
tseco	0.004	-0.003	0	-0.069	-0.015	0.082	-0.006	0	0
tsuco	0.071	0.023	0	-0.043	-0.007	0.012	-0.086	-0.003	0
tase	-0.005	-0.004	0.001	-0.035	-0.024	-0.033	-0.004	-0.002	0.001
tpjefe	0.241	0.177	0.078	-0.103	-0.093	-0.022	-0.283	-0.133	-0.01
tunli	0.031	0.027	0.019	-0.06	-0.048	-0.084	-0.029	-0.015	-0.013
tcasa	-0.03	-0.001	0.023	0.185	-0.049	-0.123	0.077	-0.015	-0.024
*tfert*05	-0.003	-0.001	-0.001	0.027	-0.092	-0.021	0.001	0.008	0.004
*tp*6599*j*	-0.008	0.007	0	-0.094	-0.014	0.053	0.026	0.002	0
tpprin	0.003	0.002	0.001	0.005	0.012	-0.058	0	-0.001	-0.001
tpprsd	-0.002	-0.011	-0.005	-0.066	-0.039	-0.024	0.014	0.013	0.012
Yolh	-0.004	-0.014	0.005	-0.303	0.497	0.145	-0.01	0.025	0.004
tpinot	-0.036	-0.005	0.022	0.001	-0.003	0.066	0	0	-0.007
*tmort*7	-0.009	-0.021	0	0.006	0.029	-0.058	0.003	0.021	-0.038
*tmigr*7	0	-0.001	-0.017	0.002	0.037	-0.016	0	0.004	0.006
tpprde	0	0.002	0.004	0.077	0.014	-0.056	0.004	0	-0.002
1.cohon	0	0	0	0.032	0	0	0	0	0
2.cohon	0	0	0	0.008	0	0	0	0	0
3.cohon	0	0	0	0.005	-0.032	0	0	0	0
4.cohon	0	0	0	0.004	-0.015	0	0	0	0
5.cohon	0	0	0	0.004	-0.016	-0.045	0	0	0
6.cohon	0	0	0	0.001	-0.008	0.006	0	0	0
7.cohon	0	0	0	0	-0.002	-0.004	0	0	0
8.cohon	0	0	0	0	-0.003	-0.014	0	0	0
9.cohon	0	0	0	0	0	-0.014	0	0	0
10.cohon	0	0	0	0	0	-0.001	0	0	0
Intercept	0	0	0	-0.15	-0.181	0.255	0	0	0
Total	0.286	0.192	0.13	0.382	0.141	0.121	-0.244	-0.104	-0.071

B Alternative estimates of cyclical component of LFP

In this section, we analyze alternative specifications to include the COVID-19 pandemic in the main results. While there is no doubt that pandemics significantly affect the demand and supply of the economy and the labor market, there are some doubts about the importance of each of these factors, which may affect the structural and cyclical decomposition of LFP. In our baseline specification, we did not include special consideration of the pandemic and let the estimates of the GDP gap, cyclical component of the non-wage employment rate, and presence of unemployed workers in households capture these dynamics. In this appendix, we compare the evolution of the cyclical component of the LFP of the baseline with an alternative estimate of Equation 1, in which we include as an explanatory variable a dummy variable during the COVID-19 pandemic for all groups; thus, we can estimate how much participation was affected. We can then decide whether to consider this effect cyclical or structural in nature. Given that there is no clarity about the percentage attributable to each component, we create two scenarios: in the first, the effect of the dummy is attributed entirely to cyclical factors, while in the second, it is part of the structural component of LFP.

The cyclical estimates of the LFP under the three scenarios for both genders are depicted in Figure B.1, with data for men on the left panel and data for women on the right panel. As we can see, there are some differences in the estimates prior to the COVID-19 pandemic, which illustrates how handling the pandemic variable can influence estimation. However, the signals in these scenarios are qualitatively similar. With respect to pandemics, our strategy estimates a cyclical component between the effect of attributing the pandemic effect to the cyclical (demand) or structural (supply) components. This suggests that our method successfully allocates portions of the pandemic's impact on both the structural and cyclical components, providing confidence in its effectiveness.

Figure B.1: Estimates of the cyclical component of LFP

(a) Men

(b) Women

This figure compares the cyclical component of alternative specifications of Equation 1

C Alternative Estimates of LFP using VAR models

In our baseline projections, we use the average values for 2023 and 2024 to project the values of the structural variables included in Equation 1. As an alternative, we evaluate the projections of LFP using Vector Autoregression models of order p (VAR(p)) models to forecast the values of each structural variable for each group, including migration and mortality projections published by DANE. First, we check for the stability of the system, and in most of the estimated models, we use the first difference of variables. Second, we check the order of the VAR using the BIC criteria. In most cases, the VAR model was selected (1).

In Table C.1 we compare the change in the aggregate LFP between 2024 and 2035 between the projections of the independent variables made with the average 2023-2024, column 1) and the VAR models (column 2). In the baseline scenario, there is a reduction of 0.34 pp, and in the VAR model, the aggregate LFP is almost constant; however, this difference is not large. In the higher Women's LFP scenario, we observed a close evolution using both methods. Therefore, the projected trends under both scenarios are similar, and the results of the effect on potential GDP are similar.

Table C.1: Change in aggregate LFP between 2035 and 2024

Scenario	Average 2023 - 2024	VAR
Baseline	-0.34	0.02
Higher Attachment	4.63	4.54