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Abstract

This study measures the responsiveness of female labour participation to changes in the economic cycle at the extensive margin in Latin America. The results provide new evidence regarding the cyclical behaviour of the female labour force participation, making it possible to determine which countries validate the traditional hypotheses of the added and discouraged worker. Another significant finding is that these effects vary during cycles of economic expansion and recession and become stronger when reaching a certain threshold. Therefore, contradictory hypotheses to the added and discouraged worker emerged, which is referred to as subtracted and encouraged workers, both of which are formally validated by examining these effects throughout the economic cycles.

Keywords

Added worker effect, discouraged worker effect, unemployment rate, labour force participation rate, economic cycle.

JEL Codes: E24, C10, J21, J64, J68.

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1. Introduction

One of the most interesting topics in labour economics focuses on analysing the cyclical behaviour of labour force participation (LFP). Initial investigations sought to determine the true magnitude of unemployment at a given economic stage and explored some of the hypotheses that arose from observing economic cycles. Long (1953), (1958) suggested that the discouraged worker hypothesis forecasts procyclical LFP behaviour. In contrast, Woytinsky (1940) argued that the added worker hypothesis is associated with countercyclical LFP behaviour, particularly that of female homemakers and children of school age, which are both traditionally inactive.

Examining these relationships is essential for policymakers as they can reflect the true dynamics of labour markets, particularly during economic recessions. As suggested by Martín-Román (2022), if the discouraged worker hypothesis (procyclical effect) is valid, unemployment rates tend to be underestimated. In contrast, if the added worker hypothesis (countercyclical effect) is valid, recessions tend to be overestimated. Related research in developed countries has not reached a consensus regarding which effect predominates for the female population. Studies such as Başlevent & Onaran (2003), Congregado et al. (2014), Gałecka-Burdziak & Pater (2016) and Bredtmann et al. (2018) validated the added worker hypothesis for women, consequently suggesting that activity rates are countercyclical. Conversely, Darby et al. (2001), Lee & Cho (2005), Fuchs & Weber (2017) and Evans (2018) validated the discouraged worker hypothesis, identifying the rate of participation as procyclical.

Minimal formal evidence regarding the cyclical behaviour of women's LFP has been produced for the Latin American region; however, our literature review revealed that notable research by Cerrutti (2000), Hernández & Romano (2011), Ontaneda Jiménez et al. (2022) and Fernandes & De Felício (2005). These studies are aligned with the predominance of the countercyclical effect on female LFP, validating the added worker hypothesis in recessionary phases of the economic cycle. In contrast, during expansions, authors such as Serrano et al. (2019) have demonstrated that the female participation rate in Latin America is countercyclical and reflects a subtracted worker effect (i.e. what some authors call the inverse of the added worker). For instance, Paz (2009) found a procyclical reaction, validating the added worker effect.

This research measures the responsiveness of female labour participation to changes in male unemployment rates (which are the cyclical indicator of the labour market used in this research) at the extensive margin in Latin America, in

periods of recession and economic expansion. The findings demonstrate whether female LFP react procyclically or countercyclically based on a time series analysis for six selected Latin American countries from 2006 to 2019, with quarterly periodicity. The added and discouraged worker hypotheses and opposing effects (subtracted and encouraged) are investigated.

The primary contribution of this paper is determining whether female LFP reacts symmetrically to different phases of the economic cycle in Latin American countries. Considering a single cyclical sensitivity for both upturns and downturns could disguise two opposing reactions. It is also possible that insignificant overall cyclical sensitivity is actually a compounding effect of strong sensitivity in one of the cyclical regimes and a weak one in the other. This study addresses this issue by estimating different cyclical sensitivities for each state of the cycle.

In addition, two different types of cyclical regime shifts are considered. First, regime-switching is imposed exogenously, conventionally considering that one is in an expansionary phase in which the unemployment rate is in decline and the other is in a contractionary or recessionary phase in which the unemployment rate is rising. Second, regime-switching is allowed to occur endogenously using threshold regression methodology. In this way, the cyclical reactions of the LFP rate that could go unnoticed in a conventional cyclical analysis can be detected. This is particularly important for countries where LFP only reacts to extreme circumstances in the business cycle. The implications for constructing economic policy to detect and accurately determine the thresholds of regime shift are obviously extremely significant.

The remainder of this paper is composed of five sections. Section 2 presents a literature review regarding the topic. Section 3 details the countries under study, the periods under analysis and the methodology applied. The results obtained are presented in the section 4. Finally, section 5 presents the conclusions and economic policy recommendations associated with the research findings.

2. Literature review

Table 1 presents 17 studies that have examined the cyclical behaviour of female LFP on a global scale since 2000. Among these studies, seven focused on Latin America, including Argentina, Mexico, Brazil and Ecuador. The remaining 10 analysed developed countries such as the United States, France, Japan, Sweden, Germany, the United Kingdom, Turkey, the Republic of Korea, Spain, Italy, Poland and Australia. Each study is classified by author, data used, the

country of analysis and the econometric approach applied. The cyclical reaction of the female LFP rate has been disaggregated for periods of economic recession and expansion.

Table 1: Literature review on female LFP rate and phases of the economic cycle.

Authors	Data	Econometric approach	Female LFP rate			
			Countercyclical		Procyclical	
			AWE (+) recession	SWE (-) expansion	DWE (-) recession	ANWE (+) expansion
Cerrutti (2000)	Permanent Household Survey for the metropolitan area of Buenos Aires Years: 1991–1994 Frequency: monthly **Country:** Argentina	Cross-sectional and panel data.	X	-	-	-
Darby *et al.* (2001)	Labour force for OECD countries Years: 1970–1995 **Countries:** US, France, Japan and Sweden	Seemingly Unrelated Regression estimations.	-	-	X	-
Martín-Román & Moral de Blas (2002)	OCDE Statistics: Labour Market and Social Issues Years: 1972–1997 **Countries:** Germany, the United Kingdom, France and Spain	Cointegration techniques.	X FRAN	-	X GER UK ESP	-
Başlevent & Onaran (2003)	Labour force survey Years: 1988–1994 **Country:** Turkey	Bivariate probit model estimation.	X	-	-	-
Parker & Skoufias (2004)	National Survey of Urban Employment Years: 1994–1995; 1998–1999 Frequency: quarterly **Country:** Mexico	Cross-sectional probit equation estimation.	X	-	-	X
Fernandes & De Felício (2005)	Household survey Years: 1985, 1993 and 1999 Frequency: monthly **Country:** Brazil	Panel data estimation.	X	-	-	-
Lee & Cho (2005)	Household surveys, metropolitan level of disaggregation Years: 1997, 1998 and 2001 **Country:** South Korea	Estimation of earnings functions using the Mincer approach.	-	-	X	-
Paz (2009)	Permanent Household Survey Years: 2003–2007 **Country:** Argentina	Balanced panel estimation using probit models.	-	-	-	X
Hernández & Romano (2011)	Household surveys (national and urban) Years: 1987–2009 Frequency: quarterly **Country:** Mexico	Pseudo-panel model, cohort analysis and weighted least squares estimation.	X	-	-	-
Congregado *et al.* (2014)	Time series data Years: 1976–2012	Vector error correction and threshold	X	-	-	-

Authors	Data	Econometric approach	Female LFP rate			
			Countercyclical		Procyclical	
			AWE (+) recession	SWE (-) expansion	DWE (-) recession	ANWE (+) expansion
	Frequency: quarterly **Country:** Spain	cointegration models.				
Addabbo *et al.* (2015)	EU Household surveys on income and living conditions Years: 2007–2012 **Countries:** Italy and Spain	Estimation of labour supply models under a probit approach.	X ES	-	X IT	-
Gałecka-Burdziak & Pater (2016)	Time Series Years: 1994–2014 Frequency: quarterly **Country:** Poland	Application of filters, spectral analysis, unobserved component model approach, time-varying parameters and frequency-domain regression.	X	-	-	-
Bredtmann *et al.* (2018)	Longitudinal data from the EU Statistics on Income and Living Conditions Years: 2004–2011 Aggregate sample of 28 European countries	Probit model estimation.	X	-	-	-
Evans (2018)	Australian Bureau of Statistics time series data Years: 1986–2014 Frequency: monthly **Country:** Australia	Multivariate model estimation of unobserved components and application of filtering techniques.	-	-	X	X
Serrano *et al.* (2019)	Household surveys Years: 1987–2014 **Countries:** Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela	Panel data approach. Fixed effects estimation at country and population group levels.	-	X	-	-
Congregado *et al.* (2020)	Labour force survey Years: 1995–2016 Frequency: quarterly **Country:** Poland	Linear and non-linear model estimation. Estimation of thresholds and time-varying parameters.	X	X	-	-
Ontaneda Jiménez *et al.* (2022)	National Survey on Employment, Unemployment and Underemployment Years: 2000–2019 **Country:** Ecuador	Data analysis in pseudo panels.	X	-	-	-

Notes: AWE = added worker effect; SWE = subtracted worker effect; DWE = discouraged worker effect, ANWE = animated worker effect.

For Latin America, research findings have suggested that there is a predominant added worker effect for women when analysing periods of economic recession, indicating that the female participation rate behaves countercyclically. This dynamic has been corroborated by Fernandes & De Felício (2005) and Ontaneda Jiménez et al. (2022) for Brazil and Ecuador, respectively.

In Mexico, a countercyclical relationship of female LFP rate during recessions is reaffirmed, Hernández & Romano (2011) and Parker & Skoufias (2004) validate the added worker hypothesis in the Mexican economy. Parker & Skoufias (2004) also conclude that in expansionary phases of the economic cycle, the LFP rate of Mexican women is procyclical, thus validating the hypothesis of the encouraged worker.

Female LFP has also been examined for recessions and economic expansions in Argentina. Cerrutti (2000) confirmed a countercyclical reaction and validated the added worker hypothesis during recessions. Paz (2009) demonstrated that during expansions, Argentine women are encouraged to participate in the labour market, affirming a procyclical pattern in LFP rate. Groisman (2011) indicated that the factors that limit or hinder the female population's access to better quality jobs in Argentina still seem to persist.

Using a panel data approach for 18 Latin American economies, Serrano et al. (2019) confirmed that female LFP follows a countercyclical pattern, particularly for married, child-bearing and vulnerable women, revealing an inverse effect on added workers (subtracted effect) in expansionary phases, as female LFP decreased during the period of analysis (1987–2014).

For developed countries, there is a mixed dynamic on the cyclical behaviour of the female LFP. Authors such as Başlevent & Onaran (2003), Congregado et al. (2014) and Gałecka-Burdziak & Pater (2016) have demonstrated countercyclical effects during recessions in Turkey, Spain and Poland (in that order), validating the female added worker hypothesis in those economies. Congruent with these results, Bredtmann et al. (2018) confirmed the added worker effect at both the extensive and intensive margin for all 28 EU countries. Women whose husbands became unemployed reflected a significantly higher probability of entering the labour market, confirming countercyclical behaviour in the female LFP rate. This result differs from that reported by Lee & Cho (2005), who showed a procyclical relationship and a discouraged worker effect for women in South Korea.

In turn, Martín-Román & Moral de Blas (2002) noted that the female LFP rate in France responds countercyclically during recessions. Conversely, Darby et al. (2001) established that female LFP react procyclically in France. In the former case, the added worker hypothesis is validated, while in the latter, the discouraged worker hypothesis is confirmed; moreover, similar effects were also validated by the authors for the United States, Japan and Sweden.

For the Spanish economy, Addabbo et al. (2015) demonstrated that female LFP reacts countercyclically in recessions, confirming the added worker hypothesis. Nevertheless, Martín-Román & Moral de Blas (2002) suggested procyclical behaviour, supporting the discouraged worker effect. Although the results for Spain do not coincide because they were studied in different periods, the two authors agreed that in Italy, Germany and the United Kingdom, the female LFP rate has procyclical behaviour, validating the discouraged worker hypothesis.

In congruence with Gałecka-Burdziak & Pater (2016) for Poland, Congregado et al. (2020) validated that the female LFP rate in Polish economy is countercyclical during periods of crisis, confirming an added worker effect. Conversely, Evans (2018) validated the discouraged worker hypothesis in recessions for Australia, arguing that the female participation rate responds procyclically. The author also analysed times of economic expansion in Australia, finding procyclical dynamics in LFP rate. Consequently, in this phase of the economic cycle, Australian women corroborate the discouraged worker hypothesis. Congregado et al. (2020) revealed countercyclical behaviour in times of economic boom, suggesting a subtracted worker effect. This implies that when the opportunities for the head of the household to find work rise, women cease working and return to the daily activities of the family unit.

As described previously, the literature on this topic is primarily related to developed countries, despite the mixed results on the cyclical reaction of the female LFP. For developing countries such as those in Latin America, the research has focused on Brazil, Ecuador, Mexico and Argentina. In these cases, the analyses were dominated by recessionary periods.

This research offers new insights that enable a better understanding of the performance of female LFP in Latin American labour markets, informing the construction of strategic macroeconomic policies. The study not only explores the aforementioned relationships in recessionary phases to validate the classic hypotheses of the added and discouraged worker but also analyses expansionary

phases to examine the existence of what have been called subtracted and encouraged worker effects.

3. Data and methodology

3.1. Data

Time series corresponding to the period between 2006 and 2019 with quarterly frequency is used, which were obtained from the Center for Distributive, Labor and Social Studies (CEDLAS) & World Bank (2022) database of the National University of La Plata in Argentina. These include the following.[1]

$$\textit{Female labour force participation rate (FLFPR)} = \frac{\textit{Labour force}}{\textit{Working age population}}$$

$$\textit{Male unemployment rate (MUR)} = \frac{\textit{Unemployed population}}{\textit{Labour force}}$$

Table 2 presents the selected countries and the periods of analysis, according to the available information provided by CEDLAS & World Bank (2022). In addition, the number of recessions or expansions detected throughout the cycles under analysis for each country is included. Due to the close correlations between the labour market and economic cycles, a recession cycle is assumed when the male unemployment rate increases and an economic expansion cycle when it decreases, a consideration that is further clarified in the methodology section.

Table 2: Selected economies and periods of analysis.

Country	Period	Observations	Recessions	Expansions
Chile	2006T1:2019T4	56	31	25
Colombia	2009T3:2018T4	38	14	24
Ecuador	2010T1:2019T4	40	18	22
Mexico	2009T3:2019T4	42	12	30
Peru	2006T1:2019T4	56	24	32
Uruguay	2007T1:2019T4	52	26	26

Source: CEDLAS & World Bank (2022)

[1] Due to limited access to information, the study focuses on adults between 25 and 64 years old.

A sample of six countries out of a group of 13 that are part of the Latin American labour market data report published by CEDLAS & World Bank (2022) are selected, as a periodic data series without methodological changes in household surveys during the period of analysis is available for these countries. For the remaining countries, the data series are very short term and include data gaps.

To provide a general overview of the evolution of these variables, Figure 1 presents the series in levels and the first variations. The latter case is based on an inter-annual comparison to avoid the results losing consistency due to possible seasonality issues. Notably, although there is a certain degree of volatility between periods, Latin American women engaged in higher LFP from 2006 to 2019, with an average maximum level of approximately 68% from 60% (+8 percentage points; p.p.).

In Peru, the female activity rate increased by 9 p.p. between 2006 and 2019 (66% versus 75%), while in Mexico, the increase is around 4 p.p. on average, reaching a participation rate of 55% in 2019. In the Ecuadorian case, certain peaks and troughs are observed over the period of analysis, the female activity rate was at its lowest point at the end of 2013, with 60% participation from 67% at the beginning of 2010; however, by 2019, this indicator reached around 66%, which was 6 p.p. higher than 2013.

Chile started with a female LFP rate of 48% in 2006 and reached 62% in 2013 (+14 p.p.), despite the mixed trends during the review period. However, this growth rate slowed down in the following seven years, placing Chilean women's LFP rate at around 64% until 2019 (marginal increase of +2 p.p.). In Uruguay and Colombia, a similar trend occurred, until 2012, an increase of 6 p.p. is observed, placing female LFP for those countries at 76% and 69%, respectively. This indicator, though, remained at a 75% average for Uruguay and 69% for Colombia from 2012 onwards.

Higher female LFP occurred in the context of economic slowdown and recessions in some cases. CEPAL (2019) confirmed that since 2015, Latin America has presented a generalised economic slowdown which resulted in the sustained deterioration of employment. Male unemployment rates in several economies of the region increased, which is the case for Ecuador, Mexico and Peru. This dynamic could signify a possible added labour effect on women in these economies. Given the loss of employment for men as heads of households, female homemakers could join the economically active population to compensate for the loss of family income.

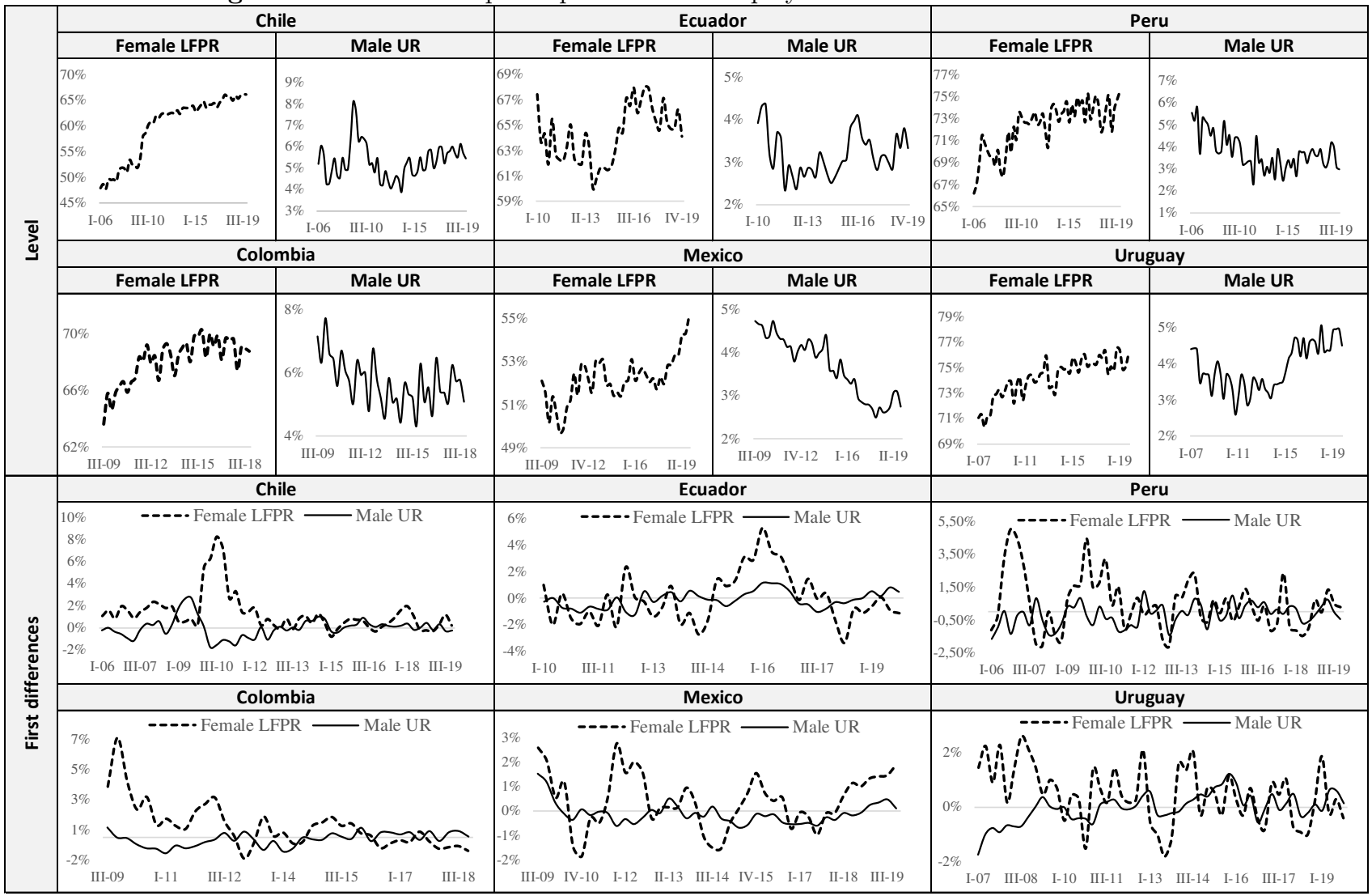
In Ecuador, the unemployment rate among men reached peak levels ranging between 3% and 4% at the end of 2019, compared to the 2% recorded at the end of 2011. In some periods between 2009 and 2019, Mexico reflected a loss of jobs for males; for example, between 2012 and 2013 (from 3% to 4%), as well as between 2018 and 2019 (from 2% to 3%). Peru performed similarly, with relatively high unemployment rates of around 5% between 2006 and 2010, while between 2011 and 2019, the rate increased from 2% to 4% on average.

In Chile, Colombia and Uruguay, the male unemployment rate was similar to the countries previously mentioned, increasing in most of the analysis periods. The context of stagnant female LFP from 2015 onward suggests that given the difficulty of finding work for the head of household, women did not seek employment. This finding evolution suggests a possible discouraged worker effect in women in these economies.

Figure 2 presents the relationship between the variation in female LFP and male unemployment rate for the six countries studied, as a first approximation to validate these effects. The scatter plot diagrams reveal positive relationships between these two indicators for Ecuador, Mexico and Peru, suggesting that at the global level (during the entire period of analysis for each country) the female LFP reacted in a countercyclical manner. For Chile, Colombia and Uruguay, the dynamics between the variables are negative, signifying a possible procyclical trajectory. However, these relationships are not stable if the overall period of analysis of each country is disaggregated into expansionary and recessionary cycles. There are relationships that change in some countries, as suggested by the linear trend lines that adjust the points related to the variables under study.

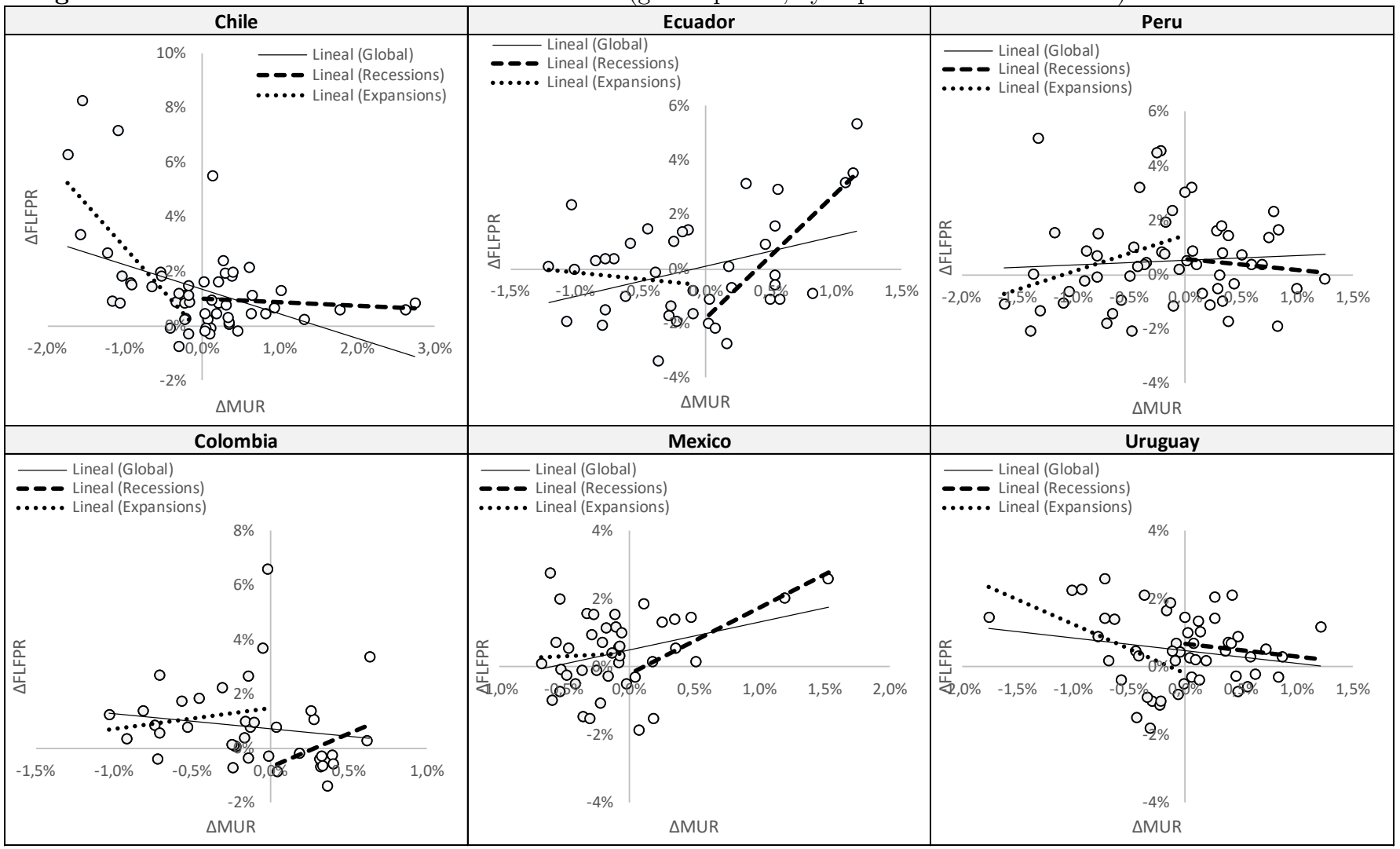
These results are intended to be formally examined applying a methodological strategy with greater robustness. Subsection 3.2 details the methodology we implement, formulating econometric models to more accurately specify the trends and relationships described in this section.

Figure 1: Labour force participation and unemployment rates in selected economies



Source: CEDLAS & World Bank (2022).

Figure 2: Correlation between ΔFLFPR and ΔMUR (global period, by expansions and recessions) in selected economies



Source: CEDLAS & World Bank (2022).

3.2. Methodology

3.2.1 Econometric approach

The proposed model is theoretically supported as follows:

$$\Delta FLFPR_{jt} = \alpha_j + \beta_j \Delta MUR_{jt} + \varepsilon_{jt} \quad (1)$$

where $FLFPR_{jt}$ represents the female LFP rate in country j in period t. $\Delta FLFPR_{jt}$ is the difference between the female LFP rate in country j in quarter t compared with the same period of the previous year (i.e. $\Delta FLFPR_{jt} = FLFPT_{jt} - FLFPR_{jt-4}$). A similar approach is applied for $\Delta MUR_{jt} = MUR_{jt} - MUR_{jt-4}$, being MUR_{jt}, which represents the male unemployment rate of country j in period t. The coefficient α_j in model 1 represents the average annual change of the female LFP rate in country j when the change in male unemployment remains stable. Parameter β_j represents the average annual change in the female LFP rate of country j when the change in male unemployment remains stable. Finally, ε_{jt} is a random variable containing the error of the equation estimation for country j in the period t.

The rationale behind the exclusion of the female unemployment rate to explain the participation decision of this stratum in the labour market is to avoid possible endogeneity problems in the proposed formal model. The use of the male unemployment rate as a cyclical indicator is a fairly conventional procedure within labour economics. The underlying perspective is that males have higher and more stable LFP rates; thus, variations in unemployment are primarily the consequence of changes in labour demand. Male unemployment is also considered to be a good measure of how stressed the labour market is and how easy or difficult it is to find a job.

Consequently, as part of the stated objectives, with the estimation of the parameter β in equation (1), it is possible to validate the hypotheses of added and discouraged workers among women for each of the selected countries in the corresponding sample period. Values of $\beta > 0$ confirm the added worker hypothesis, while values of $\beta < 0$ validate the discouraged worker hypothesis.

The use of the male unemployment rate to explain the relationships described above also leverages the benefits of this indicator for examining the dynamics of the female LFP in depth throughout the expansion and recession cycles of the economies under analysis. Model 2 is formulated in this regard to quantify the sensitivity of parameter β to recessions and expansions in each economy. Two *dummy* variables associated with the cyclical phase of model 1 are applied, as follows:

$$\Delta FLFPR_{jt} = \alpha_{1j} D_1 + \alpha_{2j} D_2 + \beta_{1j} D_1 \Delta MUR_{jt} + \beta_{2j} D_2 \Delta MUR_{jt} + \varepsilon_{jt} \quad \mathbf{(2)}$$

Here, D_1 assumes the value of 1 in the phases of recession or contraction of economic activity (when the male unemployment rate increases) and 0 for expansions (when the male unemployment rate decreases), while D_2 is equal to 1 minus D_1. Hence, β_1 in model 2 captures the responses of female activity rates when country *j*'s economy is depressed, while β_2 will reflect the influence of the expansionary phases of the cycle on this group. Thus, for the values of $\beta_1 > 0$ and $\beta_1 < 0$, the added and discouraged worker hypothesis is validated, respectively. $\beta_2 > 0$ confirms a subtracted worker effect, while $\beta_2 < 0$ validates the encouraged worker effect.

Finally, to deepen the results derived from the estimation of equation 2, a third model is estimated using the threshold regression methodology applied in seminal studies developed by Tong & Lim (1980), Tong (1983) and Hansen (1999). This econometric approach defines a direct form of non-linear regression with linear specifications and the regime shift that occurs when an observed variable crosses unknown thresholds, as noted by Congregado et al. (2021). Therefore, this econometric approach enables the determination of whether the asymmetries that occur in the cyclical sensitivity of the female LFP rate occur for values different from those set exogenously in the specification of equation (2). Subsequently, the thresholds will be endogenously determined and do not necessarily have to be associated with the value $\Delta MUR_{jt} = 0$. An accurate understanding of these values is extremely important from the perspective of economic policy since it allows policymakers to determine when to start implementing corrective public policy measures.

Taking this approach into consideration, model 3 is formulated as follows:

$$\Delta \mathrm{FLFPR}_{jt} = (\alpha_{1j} + \beta_{1j} \Delta \mathrm{MUR}_{jt}) \left(\Delta \mathrm{MUR}_{jt} | c_1\right) + (\alpha_{2j} + \beta_{2j} \Delta \mathrm{MUR}_{jt}) \left(\Delta \mathrm{MUR}_{jt} | c_2\right) + \varepsilon_{jt} \quad \mathbf{(3)}$$

Here, the female LFP rate variation of country *j* in period *t* ($\Delta \mathrm{FLFPR}_{jt}$) is finally explained by the male unemployment rate variations of country *j* in period *t* ($\Delta \mathrm{MUR}_{jt}$), when the economy is exposed to different regimes (c_1 and c_2) during the periods of analysis. In this way, β_1 will illustrate the effect produced by the variation of male unemployment in country *j* on the female LFP rate when in the presence of a c_1, while β_2 will reflect the magnitude of this effect when a c_2 regime is applied.

In summary, the threshold regression methodology will allow us to detect how the obtained coefficients (β_1 and β_2) change over the expansion or recession cycles proposed in model 2 from the imposition of regimes (c_1 and c_2) in model 3.

3.2.2 Series properties

Considering that the model variables are modelled in differentiated versions and not in levels, it is highly probable that their residuals will be stationary. This will reveal the short term sensitivities that will enable us to know how female LFP reacts to changes in the male unemployment rate and, consequently, to the economic cycle.

However, given the nature of the (time series) variables to be used, the coefficients obtained by estimating the econometric models using ordinary least squares (OLS) could be subject to spurious regression. Therefore, it is necessary to verify the degree of stationarity of the stochastic processes using unit root tests to confirm that the variables described in section 3.1 are integrated to the same order.

Different unit root tests are conducted based on the characterisation of each time series to be tested. In addition to the conventional augmented Dickey–Fuller (ADF) unit root test, the Phillips–Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests are included in Table 3. The purpose of these tests is to provide greater consistency in the results, since the ADF test can be biased towards indicating the presence of a unit root on certain occasions when the series does not have one. In particular, in the presence of heteroscedasticity, the ADF test tends to derive erroneous conclusions. Table 3 presents the results obtained from the application of these tests.

As expected, the great majority of the series in differences is an integrated series of order 0. However, in the Chilean and Mexican cases, the variation in the female activity rate indicated the presence of unit root when applying the ADF and PP tests in the first case and the ADF in the second; therefore, the analysis continues and is supported by validated stationarity with the KPPS test for Chile, as well as the PP and KPSS tests for Mexico.

Table 3: Unit root test.

Country	Variables	Test Equation Specification	ADF (H0 = unit root)	PP (H0 = unit root)	KPSS (H0 = stationarity)
Chile	ΔFLFPR	C-T	–2.87	–3.14	0.09
	ΔMUR	Without C-T/For KPSS with C	–2.96***	–2.96***	0.07
Colombia	ΔFLFPR	C-T	–3.37*	–4.40***	0.10
	ΔMUR	C-T	–3.35*	–5.21***	0.07
Ecuador	ΔFLFPR	Without C-T/For KPSS with C	–3.24***	–3.33***	0.14
	ΔMUR	C-T	–3.54**	–3.39*	0.08
Mexico	ΔFLFPR	Without C-T/For KPSS with C	–0.98	–3.13***	0.09
	ΔMUR	Without C-T/For KPSS with C	–4.10***	–4.08***	0.26
Peru	ΔFLFPR	C	–4.18***	–4.34***	0.22
	ΔMUR	C-T	–6.55***	–6.91***	0.05
Uruguay	ΔFLFPR	C-T	–5.90***	–5.87***	0.09
	ΔMUR	C-T	–4.27***	–4.30***	0.14

Notes: ADF and PP tests are based on the critical values of MacKinnon (1996). The KPSS test is based on the critical values of KPSS. H0 = null hypothesis, C = constant and T = linear trend. Δ denotes the variable at its first difference. *, ** and *** indicate that the null hypothesis is rejected at 10%, 5% and 1% levels, respectively. Figures without * indicate that the null hypothesis is accepted, at least at 1%, 5% or 10% levels.

In summary, $\Delta FLFPR_{jt} \sim$ I(0); $\Delta MUR_{jt} \sim$ I(0). Using this finding, the OLS methodology is employed to validate the added and discouraged worker hypotheses and opposing subtracted and encouraged effects, as well as the cyclical activity of female LFP during the period of analysis. The regression results from the OLS application under this specification will confirm the stationarity of the disturbance or error, reflecting a non-spurious and robust short-run relationship.

4. Results

The estimation results of model 1 are presented in Table 4. As preliminarily indicated by the scatter plot diagrams in Figure 2, female LFP rates react countercyclically throughout the analysis periods in Ecuador and Mexico; therefore, the added worker hypothesis is validated in these economies. This effect is particularly stronger in the case of Ecuador since for each p.p. increase in the variation of the male unemployment rate, the variation of the female LFP rates increases 1.12 p.p. In Mexico, the effect is less than 1 p.p., reaching an 0.83 p.p. of increase for each 1 p.p. increase in the male unemployment rate. In the Peruvian case, a positive coefficient is obtained, indicating countercyclical behaviour; however, it was not statistically significant.

In Chile, Uruguay and Colombia, the reaction of the female LFP rate is procyclical throughout the cycles analysed for each country, although the β

coefficient is only significant in the Chilean case, indicating that the discouraged worker hypothesis is validated at the global level only for Chile. The magnitude of this effect suggests that for each p.p. increase in the variation of the male unemployment rate, the change in the LFP of Chilean women is reduced by 0.90 p.p.

Table 4: Results of Model 1.

$\Delta FLFPR_t$							
Parameter		Chile	Colombia	Ecuador	Mexico	Peru	Uruguay
ΔMUR_t	α	0.01***	0.01***	0.00	0.00***	0.00**	0.00***
	β	–0.90***	–0.56	1.12**	0.83**	0.17	–0.37
Observations		56	38	40	42	56	52
R^2		0.20	0.03	0.14	0.11	0.01	0.04

Notes: Δ denotes the variable at its first difference. Significance is expressed as follows: *p < 0.10, **p < 0.05, ***p < 0.01.

Considering the correlations observed in section 3.1, Figure 2, demonstrating that the relationship between the variables under study changes if the period of analysis is disaggregated into recessionary and expansionary cycles, the results of econometric model 2 are presented in Table 5. This model reveals that Peru and Uruguay show a non-significant β coefficient in model 1, model 2 demonstrates that the female LFP rates only react in the expansionary phases of the economic cycle, although at a global level. In the recessionary phases, the coefficients were not statistically significant.

In fact, in Peru, it was observed that women's LFP behaves countercyclically during economic expansions. This dynamic could indicate that when male heads of household find work, women return to the family nucleus and leave the labour force. This subtracted effect is quantified at 1.35 p.p. for every 1 p.p. reduction in the variation of the male unemployment rate in this country. This behaviour is congruent with the findings of Serrano et al. (2019) for a set of 18 Latin American countries, including Peru, although the study only focused on expansionary phases of the economic cycle.

The female LFP rate in Uruguay behaves procyclically in expansionary cycles, given that for every 1 p.p. reduction in the variation of the male unemployment rate, the variation of women's LFP increases by 1.46 p.p. Therefore, the hypothesis that the female stratum in Uruguay is encouraged to look for work when they perceive that men are more likely to find a job during economic booms is validated. This finding is consistent with the results presented

by Parker & Skoufias (2004), Paz (2009) and Evans (2018) for Mexico, Argentina and Australia, respectively.

The discouraged worker effect found for Chile in model 1 has its counterpart in model 2. During economic expansions, a procyclical reaction of the female LFP rate is revealed, validating the encouraged worker effect, which is even substantially more robust than that in Uruguay. For every 1 p.p. reduction in the variation of the male unemployment rate, the variation of the female LFP rate rises by 3.21 p.p. In fact, the robustness of this adjustment improves substantially when the overall dynamics of model 1 are disaggregated by business cycles in model 2 (0.20 to 0.45 in their order). Nevertheless, Chilean female LFP did not exhibit a statistically significant reaction to changes in male unemployment during recessions.

Table 5: Results of Model 2.

$\Delta FLFPR_t$							
Parameter		Chile	Colombia	Ecuador	Mexico	Peru	Uruguay
ΔMUR_t	α_1	0.01***	–0.01	–0.02***	–0.00	0.01	0.01**
	β_1 (RES)	–0.13	2.42	4.59*** (countercyclical) AWE	1.95*** (countercyclical) AWE	–0.42	–0.39
	Data	31	14	18	12	24	26
	α_2	–0.00	0.02***	–0.01	0.00	0.01***	-0.00
	β_2 (EXP)	–3.21*** (procyclical) ANWE	0.80	–0.49	0.20	1.35** (countercyclical) SWE	–1.46*** (procyclical) ANWE
	Data	25	24	22	30	32	26
Total observations		56	38	40	42	56	52
R^2		0.45	0.16	0.38	0.19	0.08	0.15

Notes: Δ denotes the variable at its first difference. RES = recession; EXP = expansion. Significance is expressed as follows: *p < 0.10, **p < 0.05, ***p < 0.01.

The countercyclical relationship registered in model 1 for Ecuador and Mexico is strengthened in model 2. Nonetheless, female LFP in these countries only responds to periods of economic crisis, confirming the traditional effect of added workers in these cycles. In model 2, the magnitude is four times stronger in the Ecuadorian case than in model 1 (4.59 p.p. versus 1.12 p.p.). Similarly, in Mexico, the reaction is more dynamic, moving from 0.83 p.p. in model 1 to 1.95 p.p. in model 2.

These findings are consistent with those of Ontaneda Jiménez et al. (2022) for Ecuador and also align with Cerrutti (2000) and Fernandes & De Felício (2005) for Argentina and Brazil, respectively. Similarly, the validations performed

are congruent with research in developed economies, as demonstrated by Başlevent & Onaran (2003), Congregado et al. (2014), Gałecka-Burdziak & Pater (2016) and Bredtmann et al. (2018). In contrast, this research provides new evidence that contributes to the academic debate regarding the cyclical asymmetries of the female activity rate in Latin America by extending the results validated by Ontaneda Jiménez et al. (2022) and Parker & Skoufias (2004) for Ecuador and Mexico, respectively. The countercyclical effect found in model 2 is confirmed in model 3, with strong sensitivities revealed in both economies.

The threshold regression approach confirms an even more significant added worker effect during recessions for the female stratum in Ecuador when the male unemployment rate is greater than or equal to 0.46%. In the presence of this threshold, the change in female labour participation rises by 5.78 p.p. (higher by 1.19 p.p. than model 2) for every 1 p.p. increase in the male unemployment rate.

However, when the male unemployment rate exceeds the 0.18% threshold, the female activity rate in Mexico rises 1.86 p.p. Although this sensitivity is still robust, compared to model 2, it is marginally lower with a 0.09 p.p. difference (β_1=1.95). This could imply that when a crisis reaches extreme values, access to the labour market becomes more difficult. Consequently, the added worker effect that is driven by women in Mexico becomes less intense at the peak of recessions.

Table 6: Results of Model 3.

$\Delta FLFPR_t$							
Parameter		Chile	Colombia	Ecuador	Mexico	Peru	Uruguay
$(\Delta MUR_t \mid c_1)$	Umbral 1	$c_1 \geq 0.82\%$	$c_1 \geq 0.32\%$	$c_1 \geq 0.46\%$	$c_1 \geq 0.18\%$	$c_1 \geq 0.15\%$	$c_1 \geq 0.12\%$
	α_1	–0.00	–0.04**	–0.03**	–0.01	0.00	0.01*
	β_1	0.01	8.45**	5.78***	1.86**	0.37	–0.53
	Dates	7	9	11	9	20	20
$(\Delta MUR_t \mid c_2)$	Umbral 2	$c_2 < 0.82\%$	$c_2 < 0.32\%$	$c_2 < 0.46\%$	$c_2 < 0.18\%$	$c_2 < 0.15\%$	$c_2 < 0.12\%$
	α_2	0.01***	0.01***	–0.01	0.00	0.01***	0.00
	β_2	–1.63***	0.09	–0.37	–0.10	1.25**	–1.08**
	Dates	49	29	29	33	36	32
Total observations		56	38	40	42	56	52
R^2		0.30	0.50	0.36	0.17	0.10	0.11

Notes: Δ denotes the variable at its first difference. Standard errors are in parentheses, while significance is expressed as follows: *p < 0.10, **p < 0.05, ***p < 0.01.

Regarding Colombia, as in model 1, in model 2, the female LFP is acyclical. The model 2 coefficients in the economic expansion and recession cycles are

statistically insignificant. Applying model 3 (Table 6) under the threshold regression methodology, it is found that the female LFP rate in Colombia only reacts to periods of economic recession when the variation of the male unemployment rate is equal to or higher than 0.32 p.p. The sensitivity shown by the model coefficient under this regime is very strong (almost 9 p.p.), although it only represents the relationship of the model's variables for 9 periods. This confirms a countercyclical reaction and an added worker effect only in the presence of such a threshold.

This result provides new evidence to strategically address Colombian labour market dynamics in an effective way because although policymakers may know how the female LFP reacts in times of economic expansion according to the findings of Serrano et al. (2019), this study provides a baseline for the sensitivity that the female LFP rate will have during recessionary periods.

Imposing certain thresholds, in Uruguay and Chile, the findings of model 2 are corroborated, although with less intensity in the magnitude of the model 3 coefficient during economic expansions. In both countries, the procyclical effect of the female participation rate is consolidated and the encouraged worker hypothesis is validated.

For instance, in Uruguay, when the demand for male employment rises during an economic expansion and the variation in the unemployment rate does not exceed 0.12%, women are encouraged to find a job because they perceive that there are greater opportunities to do so. Nevertheless, this effect loses intensity in the presence of this threshold, showing an increase in the female LFP rate of 1.08 p.p. from the 1.46 p.p. reflected in model 2 (0.38 p.p. less). As for Chile, when the variation in the unemployment rate for men is less than 0.82%, the variation in the female LFP rate increases by 1.63 p.p. (1.58 p.p. less than in model 2; β_2=3.21). This dynamic could be due to the fact that Uruguayan and Chilean women moderate their access to the labour market when economic growth reaches extreme values or when they observe that the opportunities to obtain employment by the head of household increase considerably; that is, they continue to be encouraged to find employment, but progressively less so.

Finally, using the threshold regression approach, in Peru, the subtracted worker effect that is validated in model 2 remains in model 3, but to a lesser extent when the change in the unemployment rate for men is less than 0.15%. For every 1 p.p. increase in the rate of unemployment, the female LFP rate is reduced by 1.25 p.p. (1.35 p.p. in model 2). Therefore, at the peaks of economic

booms, some women will decide not to return to their daily household chores but to continue expanding the family income since, once inserted in the labour market, the opportunities to upgrade employment will be greater. Beyond this assessment, the female participation rate in Peru continues to behave countercyclically in the presence of this threshold.

5. Conclusions and policy recommendations

The results of this research provide new evidence on the cyclical behaviour of female LFP in Latin America. At a global level, it is possible to determine in which countries the added and discouraged worker hypotheses, conventionally studied by the consensus of analysts, are validated. Notwithstanding, one of the most significant contributions of this study was the finding that these effects may vary throughout the analysis periods if they are examined separately from economic expansion and recession cycles. In this way, counter hypotheses to those of the added and discouraged worker are revealed, which are referred to in this research as subtracted and encouraged workers, both of which are also formally validated when examining these effects throughout the economic cycles.

Unlike the approaches adopted by the various authors mentioned above, the findings of this study not only provide policymakers with a guide for strategic action in terms of the labour market during periods of economic expansion or recession but also make it possible to identify how the dynamics of female LFP changes in different value ranges or the imposition of regimes throughout economic cycle.

In times of recession, Ecuador and Mexico exhibited a countercyclical rate of female LFP, reaffirming an added labour effect with this dynamic. However, during expansion, a procyclical behaviour of the female LFP rate is detected in Uruguay and Chile, confirming the added worker hypothesis.

Based on these findings, the application of stimulus policies targeting the productive sector of the economy to hire women who enter the labour force as part of the added worker effect or the encouraged worker effect should be placed on the public agenda. If the labour market is incapable of absorbing this LFP, unemployment rates will rise, thus overestimating the overall unemployment rate in these economies. Furthermore, it is demonstrated that if the variation of the unemployment rate is at least 0.46 p.p. in countries such as Ecuador, these effects will be stronger and may further distort employment statistics.

During expansion, the presence of subtracted labour is evident in Peru, as the female LFP rate reacted countercyclically during these periods. Public leaders monitoring labour dynamics in Peru should consider that if women leave the labour market because their spouses succeeded in finding a job, the level of unemployment in the economy will be underestimated. For women to remain in the labour force, the provision of free childcare services with universal coverage for married women with children should be prioritised, as this would allow them to continue to contribute to the productive sector of the economy without neglecting the most sensitive household tasks.

The most striking case is that of Colombia, where the female LFP rate was acyclical throughout the period of analysis, even when the study was disaggregated by expansionary and recessionary cycles. The female LFP rate was only countercyclical, validating an added worker effect when very extreme variations in the male unemployment rate occurred. Therefore, the labour market in that country should be observed with caution since the female LFP rate reacts sensitively to increases in the male unemployment rate of more than 0.32 p.p., which could overestimate the dimension of the labour statistics in the country.

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