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Asymmetric Effects of Monetary Policy Shocks on the Gender Wage Gap: Evidence from Pakistan

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Abstract

The gender wage gap is widely acknowledged as a long-standing challenge in the labor market, but the impact of monetary policy on the gender wage gap has been relatively under-studied. This research examines Asymmetric Effects of Monetary Policy Shocks on Gender Wage Gap in Pakistan over the period 1990-2020. A nonlinear autoregressive distributed lag (NARDL) model is used to analyze the skilled and unskilled gender wage gaps and to break down monetary policy shocks into positive, negative, and large, small categories. All models are tested for long-run cointegration using the bounds test. Bounds test is used to test the long run cointegrating relationships across all models. The results indicate that shock impact depends on both the direction and magnitude of the shock and varies across skill groups. In the skilled gap, large tightening has no effect, and large easing widens the gap in both short and long run. Importantly, small tightening widens the gap a lot and small easing narrows the gap a little, but in a not very powerful way. The rate of adjustment is slow, ranging from 32-67 percent of any deviation in equilibrium corrected annually. For the unskilled gap, large tightening narrows the gap in the long run, large easing widens it in both horizons, small tightening widens it, and small easing narrows

it. The rate of adjustment is much faster (82-85 percent per year), which is associated with flexible informal labor markets. Labor force participation and share of the working-age population narrow the skilled gap, and expansion of the services sector narrows the unskilled gap, among the controls. The results indicate that monetary policy is female biased. Expansionary policy has a greater positive impact on men, because it is primarily male-dominated industries that expand, and mild tightening affects women, with less bargaining power, more. Thus, besides the monetary policy, measures that preserve women's relative wages, including women's access to credit and enforcement of minimum wages for women, should be undertaken. For the unskilled gap, both large positive and negative shocks are significant. The effect of female labor force participation on wage gaps is always negative and significant for all specifications. There is also a risk of increased wage inequality in the implementation of contractionary policies, as female workers might not have institutional support when the economy tightens, therefore there is a need to implement gender sensitive macroeconomic policies.

Keywords: monetary policy shocks, gender wage gap, asymmetric effects, nonlinear ARDL, skilled and unskilled labor, Pakistan

JEL codes: E52, J16, J31, C22

1. Introduction

1.1. Background of the study

Gender inequality in the labor market has been one of the most pressing socio-economic issues of the modern day. Women still earn less than men, despite taking into account observable differences in education, experience, occupation and working hours, across nearly all economies (Sawicka et al., 2025). The gender wage gap is not only a result of differences in human capital at the individual level, but of systematic and systematic forces at the structural, institutional, and macroeconomic levels that work against women's labor (Amano-Patiño et al., 2025). In developing economies like Pakistan, these are compounded by low participation of women in the labor force, high rates of informal employment and social norms that limit women's access to better paid jobs. It is therefore important, both academically and practically, to understand what factors contribute to the gender wage gap in this kind of context and what policy levers can be used to tackle it (Maqsood et al., 2024).

Monetary policy is one of the macroeconomic factors that can influence labor market outcomes, and in particular has been under-researched as a driver of gender wage gaps (Ernst et al., 2025). The policies of central banks affect aggregate demand, credit conditions, the level of employment, and inflation, and these all have differential effects on different workers, depending on their sectoral location, skill levels, and contractual relationships. Credit becomes more costly, investment contracts and labor demand decline as a result of tightening monetary policy but not equally for men and women (Hasanova, 2025). Monetary contractions may have a disproportionate impact on female workers, who are overrepresented in vulnerable, informal and low productivity jobs, and suffer larger relative wage losses. Likewise, monetary expansion could create employment and wage growth that is not equally shared among the genders (Vuckovic et al., 2025).

The asymmetry of monetary policy, i.e. the difference in the magnitude, direction and persistence of the effects of positive shocks compared to negative shocks, is also of interest in the context of how monetary policy influences gender wage gaps (Ca'Zorzi et al., 2023). In the classical linear macroeconomic models, the reaction of the economy to policy shocks is symmetric, but empirical evidence for many economic relationships has been growing to show that this is not the norm. Firms are less willing to cut wages than to raise them; workers in protected sectors are less vulnerable to recessions than workers in exposed sectors; and the impact of policy shocks can differ by shock size and by the state of the economy (Jordà et al., 2024). The nonlinearities suggest that the gender wage gap could react differently to expansionary and contractionary monetary policies, which require an empirical model that is able to take into, account such asymmetries (Apostolakis & Giannellis, 2024).

Pakistan is a unique example in this regard. Although there have been significant advances in female education over the past few decades, and some progress in female participation in the labor force, the country still has some of the lowest levels of female economic participation in the world. The female labor force participation rate has been in the range of 21.4 percent in 2020-21 to 24.4 per cent in 2024-25, where supply-side factors such as cultural norms and domestic responsibilities have been a constraint, while demand-side factors such as discrimination, occupational segregation and limited access to formal employment have also been a factor (Andlib et al., 2022). In the formal sector, women are mainly employed in services, education and health, and manufacturing and high-paying professional occupations are still largely male. In this context, monetary policy

shocks can have different gender impacts, which can exacerbate the gender gap (Amber & Chichaibelu, 2023).

Over the years, the State Bank of Pakistan has adopted contractionary and expansionary monetary policies to deal with inflation, balance of payments pressures, and macroeconomic stabilization goals. These policy tools have affected a broad spectrum of output, employment and the distribution of incomes. However, to date, no study has systematically investigated the effect of these monetary policy shocks, especially in their asymmetric nature, on the gender wage gap in Pakistan (Kumar et al., 2025). The present study aims to fill this void in the literature by offering a rigorous empirical analysis of the relationship between the asymmetric monetary policy–gender wage gap, based on a nonlinear modeling framework appropriate for time series data with mixed orders of integration.

This research also acknowledges that the wage gap gender gap is not a single entity. The gender wage gap varies significantly by skill level, and the skilled gender wage gap and unskilled gender wage gap may be sensitive to monetary policy in different ways. The skilled female workers, who are more likely to be engaged in formal sector jobs, might have different adjustment dynamics than the unskilled female workers, who are more likely to be engaged in informal sector, market responsive jobs with limited bargaining power. This study offers a more detailed examination of the impacts of monetary policy on gender wage outcomes at different points in the labor market by modeling the skilled and unskilled gender wage gaps separately.

This research falls in the context of a wider intellectual movement that advocates increased attention to distributional and equity issues in the typical macroeconomic analysis. The traditional view of monetary policy as a neutral instrument for managing inflation and output stabilization is being replaced by greater awareness of the distinct impacts of policy measures on different groups of the population. During contractionary periods, workers at the bottom of the wage distribution, those in the informal sector and marginalized groups, such as women, may face higher adjustment costs. The introduction of gender as an analytical tool in macroeconomic policy research is therefore not a normative choice, but an empirical one, in order to comprehend the functioning of economies.

1.2. Research Objectives

The objective of the present study is as follows

1. To explore asymmetric impact of monetary policy shocks on skilled gender wage gap in Pakistan in both the short run and long run, broken down by the direction of the shock (positive vs. negative) and magnitude of the shock (large vs. small).
2. To examine the differential effect of monetary policy shocks on the unskilled gender wage gap in Pakistan, which reflects the different transmission channels of the shocks across skill groups.

1.3. Research Questions

We are going to address the following research question on the basis of above-mentioned objectives

1. Is there an asymmetric effect of positive and negative monetary policy shocks on the skilled gender wage gap in the short run and long run in Pakistan and is there an asymmetric effect between big and small shocks in the short run and long run?
2. Do asymmetric monetary policy shocks have differential effects on the unskilled gender wage gap in Pakistan and do these effects vary from the skilled gender wage gap?
3. Is the impact of asymmetric monetary policy shocks joint in both direction and size of the shock and which type of shock has the largest impact on the skilled versus unskilled gender wage gaps in Pakistan?

1.4. Contribution of the Study

This study contributes to the existing literature in novel ways as it investigates the asymmetric impact of monetary shocks on gender wage gaps in the skilled and unskilled labor force in Pakistan in nine occupational groups. To our knowledge, there was no earlier empirical study in Pakistan that has examined this relationship in a systematic manner, narrowing the focus to skilled and unskilled gender wage gap for nine occupations and considering both the sign and size of monetary policy shocks. The study decomposes monetary policy shocks into four components: large positive (Big+), large negative (Big−), small positive (Small+), and small negative (Small−) shocks, enabling an assessment of whether large and small shocks, as well as positive and negative shocks, have different effects on gender wage inequality. The study uses the nonlinear auto-regressive

distributed lag (NARDL) model in methodology to account for these asymmetric effects. The study combines the occupational heterogeneity and size and direction of monetary policy shock, which gives a detailed perspective of how transmission of monetary policy could affect gender wage gaps between skilled and unskilled workers in Pakistan. The outcomes of the findings can guide the State Bank of Pakistan and other policymakers to establish macroeconomic policies taking into consideration the difference of labor market outcomes between skill groups and occupations.

2. Literature Review

The gender wage gap has been the subject of both theoretical and empirical research over many decades and in various disciplines (Zhu, 2025). Initial economic explanations focused on human capital theory, which explained much of the wage gap between men and women as being due to differences in education, work experience, and on-the-job training (Locatelli et al., 2023). As women's educational attainment has caught up with and in some countries already exceeded that of men, however, the role of human capital differences in explaining the gender wage gap has waned, and scholarly interest has turned to structural, institutional and macroeconomic explanations of why the gender wage gap persists. Factors identified include occupational segregation, discriminatory wage-setting practices, monopsony power in female-dominated labor markets, and social norms regarding the division of paid and unpaid labor. Increasingly, the literature has moved beyond questions of the presence of the "gap" to questions about the forces that maintain it and what interventions can make a difference in closing that gap (Ciappei et al., 2023).

The macroeconomic aspects of the gender wage gap have been the focus of increasing research in the last 20 years (Morchio & Moser, 2026). A number of studies have shown that economic booms and busts do not affect employment equally for women and men. In some economies, women have been found to be more likely to see their wages compressed during a recession, while in others, the gender wage gap may even widen during a recession because of the greater share of male workers in cyclically sensitive sectors like manufacturing and construction. This pattern, often referred to as the 'added worker effect', highlights the intricate and context-specific nature of the

relationship between macroeconomic cycles and gender wage outcomes that goes beyond a simple cross-sectional or static approach (Keyes & Platt, 2024).

In the macro-economic literature, monetary policy has become a potential contributor to labor market inequality that has been under-explored. The transmission mechanisms of monetary policy to wages and employment are many and complex (Acemoglu, 2025). Changes in interest rates affect the aggregate demand and therefore the demand for labor in different sectors. Credit conditions influence the investment and the behavior of firms in determining wages. Central banks attempt to control inflation with monetary policy, but inflation works in different ways for different groups of workers, depending on the nominal wage rigidities and bargaining power of each group. Women in low-paid, informal jobs face especially high risks of real wage erosion due to their limited power to negotiate nominal wage increases. On the other hand, a monetary tightening which increases unemployment can lead to higher relative wage losses for female workers for whom labor supply is more elastic (Acemoglu, 2025).

The notion of asymmetric monetary policy effects has been well fleshed out in the macroeconomics literature. Following the pioneering research on nonlinear adjustment in economic time series, later researchers have shown that the real effects of monetary policy are critically dependent on the nature of the monetary policy (expansionary or contractionary) and the magnitude of the policy action (Umair et al., 2024). Large contractionary shocks can lead to non-linear responses in employment and wages, with the latter as firms with liquidity constraints cut wages, while the former as they cut employment. The theoretical underpinnings of these asymmetries are based on menu cost models, efficiency wage theories, and credit channel views, all of which suggest that monetary impulses have state-dependent effects. The ARDL model has emerged as the methodological workhorse for empirical studies of asymmetric monetary transmission (Negt & Haunschild, 2025).

The research on the link between monetary policy and labor market inequality in developing countries has produced mixed results, as institutional environments, labor market structures and monetary policy regimes vary widely across countries (Gomes et al., 2023). In certain low and middle-income countries, monetary expansions have been linked to an increase in informal sector jobs and greater wage inequality: inflationary monetary policy has been shown to favour the formal

sector. In other cases, central bank accommodation has been enough to stimulate aggregate demand enough to attract workers who were previously not in the labor force, including women, to work at better wages. The results of these divergent studies highlight the need for country-specific empirical analysis and for studies that are based on country experiences and not just on cross-country panel estimates (Khan & Khan, 2023).

The literature on Pakistan's labour market has shown that there have been long-standing and substantial gender wage gaps in both skilled and unskilled occupations. The literature on the Pakistan labour market consistently shows that the wage gap between female and male workers with similar observable attributes is significant and that a significant proportion of the total wage gap is due to discrimination and structural barriers (Rubab et al., 2025). Research based on household survey data has shown that this disparity is greatest among informal workers and in rural areas and that it has proved difficult to close even with the gains in female education. It is observed that the services sector is a major employer of female workers, and that the sectoral composition is an important structural factor affecting female wages (Ul-Haq et al., 2023).

The overall body of work on monetary policy in Pakistan has focused on the effectiveness of monetary transmission mechanisms in impacting output, inflation and credit aggregates while largely ignored the distributional aspects (Jafree, 2023). The research on the policy interventions of SBP has found that there were significant lags in monetary transmission and the health and liquidity situation of the banking sector played a crucial role in determining the effectiveness of the policy impulses. While distributional issues have been touched upon in the literature on inflation in Pakistan, the impact of the monetary policy shocks on the gendered outcomes of wages through labour market channels is yet to be formally empirically analyzed (Khalil & Haneef, 2025).

The importance of female labor force participation as a determinant and a mediating variable in the monetary policy gender wage gap relationship is also emphasized in the literature (Laoufi & Benounissa, 2025). The adverse wage effects of contractionary monetary shocks may be mitigated by higher female participation rates, due to compositional effects that enhance the bargaining power of females, and to an increase in the female labor supply. In contrast, it is possible that labour force attachment of women is more elastic and socially contingent in some economies, so

that in times of monetary tightening, this could lead to a selective reduction in the participation of women in the labour force (Yousuf et al., 2026). The relationship between monetary policy, female labor force participation, and the gender wage gap is therefore a three-way interaction that is difficult to separate empirically, and is what this study tackles by using the female labor force participation rate as an important explanatory variable along with monetary policy shock indicators (Jeheen, 2022).

3. Theoretical Framework

Wages are affected by Monetary policy via the interest rate, credit and aggregate demand channels. A rate increase reduces investment and demand for labor, particularly in industries sensitive to interest rate changes like construction, manufacturing and trade, and vice versa. The credit channel (Bernanke and Blinder, 1988; Bernanke and Gertler, 1995) further notes that credit-constrained firms, mostly small and informal, adjust most and that these adjustments include hours, bonuses, piece rates, hiring and promotion, and base pay. Such effects do not have to be symmetrical. Downward nominal wage rigidity implies that a tightening is reflected in employment and hours but not in wages, and vice versa an easing is reflected in wages but not in employment and hours. In contrast, the effect of a tightening is immediate, while the impact of an easing depends upon the willingness of banks and firms to lend and borrow (Cover, 1992). Menu costs and/or state-dependent adjustment (Ball and Mankiw, 1994) suggest that small shocks are worked out at the margin, whereas larger shocks are made because the cost of adjustment is overcome, bringing about a change in hiring behavior, in prices and in expectations. This is captured by the nonlinear ARDL approach (Shin, Yu and Greenwood-Nimmo, 2014) and then breaks down this into four categories – magnitude-1 and 2 partial sums by sign. The reason for the effects being different by gender is that men and women are exposed to these channels in different ways. Occupational segregation is the phenomenon that pushes men to work in cyclical sectors (industry, construction, transport, finance), and women into education, health, agriculture and home-based work. Labor market segmentation (Doeringer and Piore, 1971) suggests that firms that reduce the hours or piece rates first are likely to hire more women, who are less attached to the labor force, and discrimination (Becker, 1957) suggests that firms that cut wages are more likely to cut the pay or hours of women who have weaker bargaining power. The shock also varies between segments of skill. In Pakistan, adjustment is mainly through hiring and cyclical earnings; skilled employment

is largely formal, and wages are determined through pay scales and contracts. Much of the employment is unskilled and it is informal, and wages react rapidly to demand and credit conditions. Theories suggest that (i) tightening and easing, as well as large and small shocks, have differential impacts on the gender wage gap; (ii) easing helps men more than women, through the cyclical sectors; (iii) small shocks help unskilled workers more than skilled workers, through hours, bonuses, and piece rates, and (iv) that unskilled gaps respond more quickly than skilled gaps.

4. Research Methodology

4.1. Research Design

This study is based on a quantitative time-series design to investigate the asymmetric effects of monetary policy shocks of varying direction and size on skilled-unskilled gender wage gaps in Pakistan during 1990–2020. The study uses Nonlinear Autoregressive Distributed Lag (NARDL) model that is most appropriate to deal with the short run and long run asymmetric relationship between the variables with mixed order of integration I(0) and I(1) as revealed by the unit root test.

4.2. Data and Variables

This study employs annual data of Pakistan from 1990 to 2020 obtained from the Pakistan Bureau of Statistics (PBS), ILOSTAT, the State Bank of Pakistan (SBP), and the World Development Indicators (WDI). The dependent variables are the skilled and unskilled gender wage gaps (SKGWG and USKGWG) computed as the difference between the natural logarithm of real males' and females' wages in each occupational group. The occupational groups 1 to 3 (managers, professionals, and technicians and associate professionals) are considered skilled, and 4 to 9 are considered unskilled after ISCO-08. Monetary policy shocks are the first difference of the SBP policy rate. A positive change is a contractionary shock; A negative change is an expansionary shock. Shocks are separated into large positive, large negative, small positive and small negative shocks based on the cutoff value of 2.5 percentage points. Their cumulative partial sums are built according to Shin, Yu and Greenwood-Nimmo (2014) with the inclusion of size asymmetry, as is discussed by Ravn and Sola (2004). The working-age population share (15–64 years) and female labor force participation (LNLFPR) are controls in the skilled wage-gap model. The services sector

share (SER) and inflation (INF) are included in the unskilled wage gap model. Business cycle fluctuations (blau and kahn, 2017) are controlled for by including GDP growth (GRGDP) in both the models. If no annual wage is observed for a year, the wage for that year is estimated by linear interpolation.

4.3. Model Specification

Following, Shin, Yu, and Greenwood-Nimmo (2014), the monetary policy shocks are first split into positive and negative cumulative partial-sum processes to account for sign asymmetry. The decomposition is then extended to investigate whether the size of the policy changes is another source of asymmetric transmission, as suggested by Ravn and Sola (2004). Thereby the monetary policy shock is split into four partial-sum components referred to as large contractionary, large expansionary, small contractionary and small expansionary monetary policy shocks. This extension allows to study, simultaneously, the asymmetry of monetary policy shocks with respect to both the sign and the magnitude on the skilled and unskilled gender wage gaps in Pakistan. To estimate the connection between monetary policy shocks (size and sign) on gender wage gap across skill level, we have adopted the model based on the study of Goshit et al. (2020). Below is the explanation of the model's general form.

Model I jointly examines sign and size asymmetry. Model II isolates the effects of large monetary policy shocks, whereas Model III examines the effects of small monetary policy shocks.

4.3.1. Long-run Sign- and Size-Asymmetric NARDL Model

The empirical models are as follows:

Skilled Gender Wage Gap:

$$\mathrm{SKGWG_t} = \alpha_0 + \alpha_1 MPS_t^{+b} + \alpha_2 MPS_t^{-b} + \alpha_3 MPS_t^{+s} + \alpha_4 MPS_t^{-s} + \alpha_5 \mathrm{AGE_T} + \alpha_6 \mathrm{lNLFPR_t} + \alpha_7 \mathrm{GRGDP_t} + \mathrm{t}\ \mathrm{E_T} \quad (1)$$

$$\mathrm{USKGWG_t} = \alpha_0 + \alpha_1 MPS_t^{+b} + + \alpha_2 MPS_t^{-b} + \alpha_3 MPS_t^{+s} + \alpha_4 MPS_t^{-s\mathrm{ll}} + \alpha_5 \mathrm{SER_T} + \alpha_6 \mathrm{GRGDP_T} + \alpha_7\ \mathrm{iNF_t} + \varepsilon_t \quad (2)$$

where MPS_t^{+b}, MPS_t^{-b}, MPS_t^{+s} and MPS_t^{-s} denote cumulative large contractionary, large expansionary, small contractionary and small expansionary monetary policy shocks, respectively at time t. AGE denotes the working-age population (15–64 years), LNLFPR is the natural logarithm of labor force participation rate, SER is the services sector share, GRGDP is GDP growth rate and INF is inflation at time t. The coefficients α_1–α_4 are asymmetric coefficients on the four monetary policy partial sum components. Sign and size asymmetry are confirmed when these coefficients are statistically different from each other and α_5, α_6 and α_7 are coefficients on model-specific control variables.

The coefficient ρ represents the speed of adjustment towards the long-run equilibrium and is expected to be negative and statistically significant. The coefficients θ1–θ4 capture the short-run asymmetric effects of the four monetary policy shock components at lag 0 to q, and ε_t white noise error term.

4.4. Cointegration and Estimation

The research uses the F-bound test for the investigation of long-run cointegrating relationships. After confirming the cointegration, the NARDL models are estimated for the skilled and unskilled gender wage gaps in three forms: NARDL Model I (all shocks), NARDL Model II (big shocks), and NARDL Model III (small shocks). The Wald test is applied to formally test for directional and size asymmetries. To test the model adequacy, the following diagnostic tests are carried out: Breusch–Pagan–Godfrey test for heteroskedasticity, LM test for serial correlation, and CUSUM test and CUSUM of squares test for structural stability.

5. Empirical Results

The empirical results are reported to evaluate the asymmetric impact of monetary policy shocks on skilled and unskilled gender wage gaps in Pakistan. The NARDL estimates differentiate between large and small shocks and between positive and negative shocks, and the results are reported in the tables below and discussed in terms of their short-run and long-run impacts.

5.1. Descriptive Statistics

The descriptive statistics of the gender wage gap variables, monetary policy shocks variables and control variables are presented in Table 1.

Table 1: Descriptive Statistics

Variable	Mean	Max	Min	Std. Dev.
AGE 15–64	58.7210	62.1400	55.4900	2.4167
LFPR	15.8957	20.6450	10.2200	3.0404
GRGDP	4.0412	7.7586	-1.1019	2.0541
SKGWG	0.1798	0.4893	-0.1376	0.1684
USKGWG	0.3802	0.5426	0.1510	0.0989
MPS	1.9355	5.7500	0.0000	1.5206
SER	50.0938	56.2192	43.0293	4.4644
INF	8.055713	18.57381	2.495077	3.794433

The descriptive statistics for all key variables are given in Table 1. The female labor force participation rate was around 15.90 per cent, ranging from 10.22 per cent to 20.65 per cent, indicating the low level of women's participation in the economy in Pakistan. The skilled gender wage gap is 0.18, and positive and negative values are present, while the unskilled wage gap is 0.38 and is consistently positive, suggesting that there is a more stable structural disadvantage for unskilled female workers. Average GDP growth was 4.04 percent and services accounted for around 50 percent of the economy on average.

5.2. Unit Root Test

This research has employed Augmented Dickey -Fuller (ADF) test to check the order of integration of all variables. The results show that some variables are stationary at level I(0) while others are

stationary at the first differences I(1) and none are stationary at the second difference at I(2) which is necessary condition for the ARDL bounds testing approach.

Table 2: Unit Root Test Results (ADF)

Variables	Level	Ist Difference	Result
SKGWG	-2.296	-4.558	I(1)
USKGWG	-3.373	-4.685	I(1)
MPS	-4.693	-	I(0)
AGE (15–64)	-5.869694	-	I(0)
LNLFPR	-1.748	-5.835	I(1)
GRGDP	-3.015	-6.374	I(1)
SER	-1.211	-4.417	I(1)
INF	-2.563	-5.893	I(1)

The results of Augmented Dickey-Fuller (ADF) unit root test are reported in Table 2. The variables are stationary at level I(0): MPS, GRGDP and Age (15-64); and integrated at first difference I(1): SKGWG, USKGWG, LNLFPR AND SERVICES. All variables are not integrated at second difference I(2) which is a prerequisite for the bounds testing approach used in NARDL.

Table 3: F-Bounds Test – Dependent Variable: SKGWG

Statistics	Model I (All Shocks)	Model II (Big Shocks)	Model III (Small Shocks)
F-Statistics	4.32	6.24	5.04
I(0) 5%	2.27	2.91	2.91
I(1) 5%	3.28	4.193	4.193

I(0) 1%	2.88	4.134	4.134
I(1) 1%	3.99	5.761	5.761
I(0) 10%	1.99	2.407	2.407
I(1) 10%	2.94	3.517	3.517

The skilled gender wage gap models' F-bounds test results are reported in Table 3. The F-statistics for Models I, II, and III are 4.32, 6.24, and 5.04, respectively, which are all greater than the 5% significance level upper bound for I(1) in all three models, thus affirming the stability of the long run cointegrating relationship in all three models. This confirms the applicability of the NARDL model and allows for sensible long-run asymmetric effects estimation.

Table 4: Long-Run Estimates – Dependent Variable: SKGWG

Variable	**Model I (All Shocks)**	**Model II (Big Shocks)**	**Model III (Small Shocks)**
MPS^{+b}	-0.0087 (0.0112)	-0.0307 (0.0276)	—
MPS^{-b}	-0.0336** (0.0132)	-0.0412* (0.0217)	—
MPS^{+s}	0.1404*** (0.0406)	—	0.1669*** (0.0539)
MPS^{-s}	0.1252** (0.0528)	—	0.0127 (0.0287)
LNLFPR	-1.2887*** (0.3278)	-1.5827*** (0.5189)	-1.6366*** (0.4499)

AGE (15–64)	-0.1004**	0.0672	-0.0006
	(0.0435)	(0.0852)	(0.0311)
GRGDP	1.2711	-5.2584*	2.3834
	(1.3843)	(2.8981)	(1.4150)
Constant	2.7348**	-6.4232	-3.6609
	(1.3507)	(5.5322)	(2.2515)

Note: *p<0.10, **p<0.05, ***p<0.01; standard errors in parentheses.

Table 4 shows the coefficient estimates for the skilled gender wage gap in the long run. The skilled gender wage gap is persistently widened by moderate expansionary monetary policy, a fact that is confirmed by the positive and significant effect of small positive monetary shocks MPS^{+b} in both Model I and Model III. This is in line with the argument of Apostolakis and Giannellis (2024) that small positive shocks have disproportionate wage premium effects in formal sector jobs that have a disproportionate share of skilled male workers.

The large negative monetary shock MPS^{-b} is negative and significant in both Models I and II, suggesting that large contractionary monetary shocks reduce the long run skilled wage gap. The results are consistent with the findings of Jordà et al. (2024), who showed that the impact of large contractionary shocks is stronger on occupational wage premia in high-skill and male-dominated occupations. The coefficient for $MPS^{-s}$is positive and significant in Model I, and positive and insignificant in Model III. This is not a true sign reversal; it merely represents a decrease in precision of the estimate when small shocks are separated from the variance caused by large shocks.

The female labor force participation rate (LNLFPR) is negative and significantly different from zero in all three models in both the short and long run, which is consistent with the idea that an increase in the female labor force participation rate has a strong effect on the reduction of the skilled gender wage gap via compositional and bargaining-power channels (Laoufi & Benounissa,

2025). The short-run estimates for lnlfpr are similar to the long-run estimates for all specifications. The effect of Age (15-64) is negative and significant in Model I in the long run, consistent with the increased participation of women in skilled occupations in the presence of a larger working-age population, while it is positive and insignificant in Model II, which may be due to the masking of a demographic effect in the presence of large shocks where monetary transmission dominates. The sign of GDP growth is positive in Model I and negative and significant in Model II, suggesting a shift in sign across models: under mixed shock conditions, GDP growth slightly opens the skilled wage gap, possibly by increasing the wage premiums in the male-dominated formal sectors, while under large shock conditions only, GDP growth narrows the gap by boosting overall formal sector employment, including women skilled workers, as indicated in the positive sign of the skilled wage gap in Model II (Ca'Zorzi et al., 2023).

Table 5: Short-Run Estimates – Dependent Variable: SKGWG

Variable	**Model I (All Shocks)**	**Model II (Big Shocks)**	**Model III (Small Shocks)**
ΔMPS^{+b}	-0.0074 (0.0098)	0.0053 (0.0131)	—
ΔMPS^{-b}	-0.0357** (0.0123)	0.0069 (0.0101)	—
ΔMPS^{+s}	0.1312*** (0.0383)	—	0.0526** (0.0215)
ΔMPS^{-s}	0.1193*** (0.0397)	—	0.0085 (0.0162)
ΔLNLFPR	-0.6513*** (0.1837)	-0.5016** (0.2041)	-0.7129*** (0.1959)

ΔGRGDP	1.0796 (1.1638)	-1.04019 (1.1358)	-1.0269 (1.12279)
ΔAGE_15_64	-0.5927*** (0.1671)	-0.5585*** (0.0891)	-0.4687*** (0.16824)
ECM (-1)	-0.3193*** (0.0467)	-0.5649*** (0.07403)	-0.6696*** (0.0988)
constants	2.3399** (1.1153)	-3.6288 (2.6555)	-2.4512 (1.4962)

Note: *p<0.10, **p<0.05, ***p<0.01; standard errors in parentheses.

Table 5 shows the short-run dynamics of the gender wage gap. The error correction term is negative and highly significant in all models, ranging from −0.32 in Model I to −0.67 in Model III, which means that 32 to 67 percent of the long-run deviations are corrected each period. This moderate speed of adjustment is due to nominal wage rigidities and formal sector contractual arrangements that inhibit the convergence of nominal wages after monetary shocks (Ca'Zorzi et al., 2023).

The short run estimates are in agreement with the long run estimates for this variable, and $MPS^{+b}$is positive and significant in both models, in agreement with the long run direction. In the short run Model I's MPS^{-b} is negative and significant, as expected, given the long run sign; the short run estimates are consistent with the long run estimates. In Model II, however, the value of $MPS^{-b}$is positive and small in the short run even though it is negative in the long run. In model II, this sign reversal between the short run and the long run could be a short-run effect of the stimulus, which initially pushes real wages up for skilled male workers by suppressing inflation, followed by a long-run effect of the stimulus that compresses real wages.

The short run estimate of MPS^{+s} is positive and significant in Model I, and positive and insignificant in Model III, with the same sign as the long run estimate in Model I, but the short run significance is greater than the long run in the same model, indicating a particularly large shortrun widening of the gap after small negative shocks, before partial reversion. In all three models, age_15_64 is negative and significant, suggesting that the skilled wage gap declines with an expansion of the working-age population, because they boost female participation in the skilled labor force. The short run estimates are consistent with the long run estimates, and D (lnlfpr) is negative and significant in all models.

Table 6: F-Bounds Test – Dependent Variable: USKGWG

Statistics	**Model I (All Shocks)**	**Model II (Big Shocks)**	**Model III (Small Shocks)**
F-Statistics	4.92	5.57	4.94
I(0) 5%	2.685	3.058	3.058
I(1) 5%	3.95	4.223	4.223
I(0) 1%	3.713	4.28	4.28
I(1) 1%	5.326	5.84	5.84
I(0) 10%	2.254	2.524	2.524
I(1) 10%	3.388	3.56	3.56

The results of the F-bounds test for the unskilled gender wage gap are presented in Table 6. The F-statistics for Models I, II and III are 4.92, 5.57 and 4.94 respectively, which are all greater than the upper critical bound for I(1) at the five percent significance level, thus indicating stable long run cointegration for all the three models. The slightly larger F-statistics than in the skilled wage gap models indicate a similarly strong long-run equilibrium relation in the unskilled part.

Table 7: Long-Run Estimates – Dependent Variable: USKGWG

Variable	**Model I (All Shocks)**	**Model II (Big Shocks)**	**Model III (Small Shocks)**
MPS^{+b}	-0.0386** (0.0146)	-0.0611*** (0.0153)	—
MPS^{-b}	-0.0253** (0.0105)	-0.0545*** (0.0108)	—
MPS^{+s}	0.0595** (0.0211)	— 	0.0685*** (0.0141)
MPS^{-s}	0.0231 (0.0135)	— 	0.0499*** (0.0157)
SER	-0.0149** (0.0068)	-0.0321*** (0.0065)	-0.0081 (0.0069)
GRGDP	-1.8096 (1.3288)	-2.9028* (1.4299)	1.2198 (0.8728)
INF	-0.0099 (0.0079)	0.0084 (0.0055)	-0.0128** (0.0059)
CONSTANT	1.3047*** (0.3380)	2.0558*** (0.3211)	0.9349*** (0.2444)

Note: *p<0.10, **p<0.05, ***p<0.01; standard errors in parentheses.

The long-run coefficient estimates of the unskilled gender wage gap are reported in table 7. MPS^{+b} and MPS^{-b} are both negative and significant in both Models I and II, suggesting that large monetary shocks of either sign decrease the unskilled gender wage gap in the long run. This symmetry of sign across direction, along with significance on both sides, implies that large monetary interventions lead to labour market adjustments that are benefitting for unskilled female workers irrespective of the direction of the shock. This aligns with the findings from developing economies that suggest that large monetary shocks can affect the segmented wage structures that are usually linked to the wage advantage of men in informal labor markets (Gomes et al., 2023).

In both Models I and III, small positive shocks MPS^{+s} are positive and significant, suggesting that moderate expansionary monetary policy increases the unskilled wage gap by increasing male wages in informal and semi-formal jobs more than female wages. This negative sign, as opposed to large positive shocks, is a nonlinearity of sizes: large positive shocks increase the gap by stimulating demand in a wide range of sectors, including female-dominated sectors, while small positive shocks mainly boost employment in male-dominated sectors. This size asymmetry is consistent with the menu-cost and credit-channel arguments, which suggest that the impact of different shock sizes on the labor market depends on the shock's size (Apostolakis & Giannellis, 2024). MPS^{-s} is positive but insignificant in Model I, and becomes positive and significant in Model III, with the same sign in both models, due to the increased precision of isolating small shock variation. The direction of the change is uniform, and there is no true direction reversal for this variable.

The services sector share has a negative and significant sign in Models I and II but becomes negative and insignificant in Model III. The sign is uniform for all three models, and the unskilled wage gap is found to be reduced by a larger services sector due to a larger share of women in the sector in all three models; the unskilled wage gap is not significant in Model III, which may be due to less variation when the small-shock effect on services employment is isolated. The short-run estimates of services are consistent with the long-run estimates for all the models. The sign reversal between the small-shock environment and the others is apparent in GDP growth, which is negative in Models I and II (significant only in Model II), but positive and insignificant in Model III. This indicates that in a small monetary shock regime, economic growth slightly increases the unskilled wage gap by raising the wages of unskilled male workers more than the wages of

unskilled female workers, while in a mixed or big shock regime, economic growth mainly lowers the male wage premia with a wider aggregate demand effect. Inflation (inf) is negative in Models I and III, and positive in Model II, but in all three models, the inflation is insignificant. A special note on the sign reversal between Models II and III for inflation is warranted: Under big shocks, inflation could push unskilled wage differentials down by eroding nominal male wage advantages, under a small-shock environment, inflation could push unskilled wage differentials down more precisely, possibly through real wage erosion affecting male informal workers disproportionately (Kumar et al., 2025).

Table 8: Short-Run Estimates – Dependent Variable: USKGWG

Variable	**Model I (All Shocks)**	**Model II (Big Shocks)**	**Model III (Small Shocks)**
ΔMPS^{+b}	-0.0095 (0.0112)	0.0092 (0.0083)	—
ΔMPS^{-b}	-0.0185** (0.0087)	-0.0179** (0.0073)	—
ΔMPS^{+s}	0.0476*** (0.0144)	—	-0.0282 (0.0269)
$M\Delta PS^{-s}$	0.01887 (0.0114)	—	0.0796*** (0.0265)
ΔGRGDP	0.0593 (0.8019)	-1.2309** (0.5546)	1.0256** (0.5058)
ΔSER	-0.0147**	-0.0272***	-0.0168** (0.0057)

	(0.0062)	(0.0068)	
ΔINF	-0.0081 (0.0062)	-0.0068 (0.0039)	0.0109** (0.0048)
ECM (-1)	-0.8165*** (0.1084)	-0.8473*** (0.1235)	-0.8408*** (0.1286)
constants	1.0653*** (0.3371)	1.7419*** (0.3643)	0.7019*** (0.2321)

Note: *p<0.10, **p<0.05, ***p<0.01; standard errors in parentheses.

Table 8 shows the short-run dynamics of the unskilled gender wage gap. The error correction coefficient is negative and very significant in all the models ranging from Model I to Model II, which means that the deviations from the long-run equilibrium are corrected by about 82 to 85 per cent in each period. This is significantly greater than the adjustment speed of skilled jobs, which is indicative of the flexible wage structures and less binding nature of informal and unskilled jobs in Pakistan, as seen in other developing economies (Khan & Khan, 2023).

The short-run estimates of MPS^{-b} are negative and significant and agree with the long-run sign of this variable and short-run estimates in both models. MPS^{+b} is negative, but insignificant in Model I and positive but insignificant in Model II, which implies a sign reversal between the two models. Neither estimate is statistically significant, but the reversal could be due to short-run compositional differences: In Model I, the small shocks dampen the partial effect of large positive shocks, while in Model II, the isolated big-shock environment has a positive but imprecise immediate wage effect on male workers through construction and trade demand.

MPS^{+s} is positive and significant in Model I in the short run, which is consistent with the direction in the long run and the short run estimates are similar to the long run estimates in Model I. In Model III, however, MPS^{+s} becomes negative and small, indicating a sign change from the positive long-run effect in Model III. The long-run divergence of the small positive shock impact on the

unskilled gap is due to slow structural adjustments in the informal wage premia, rather than short-run transmission, which is only temporarily muted or reversed in a small-shock-only environment. The short-run estimates in Model III are similar to the long-run estimates; $MPS^{-s}$is positive and significant in Model III, but not significant in Model I and is of the same sign in both models. In the short run, GDP growth exhibits a sign reversal between Models II and III, with negative and significant GDP growth in Model II and positive and significant GDP growth in Model III. This is similar to the long-run sign pattern and indicates that the short-run impact of the direction of growth on the unskilled wage gap depends on the shock regime (as discussed under Table 7). The sign of inf is negative in Models I and II, but positive and significant in Model III, as would be expected from the long-run pattern, further emphasizing the regime-dependent nature of inflation in the small shock case. In all three models, the short-run elasticity of services is negative and significant, thus supporting the hypothesis that growth in the services sector consistently decreases the unskilled gender wage gap in the short run.

Table 9: Wald Test for Asymmetric Effects – Dependent Variable: SKGWG

Type of Asymmetry	**Null Hypothesis**	**Model I (All)**	**Model II (Big)**	**Model III (Small)**
Direction (Big)	$MPS^{+b} = MPS^{-b}$	F(1,19)=4.6457 (p=0.0425)	F(1,19)=0.0055 (p=0.9418)	—
Direction (Small)	$MPS^{+s} = MPS^{-s}$	F(1,19)=6.6950 (p=0.0176)	—	F(1,21)=5.5341 (p=0.0285)
Size (+)	$MPS^{+b} = MPS^{+s}$	F(1,19)=13.7267 (p=0.0014)	—	—
Size (−)	$MPS^{-b} = MPS^{-s}$	F(1,19)=8.9175 (p=0.0073)	—	—
Joint Asymmetry	All coefficients equal	F(2,19)=7.8436 (p=0.0031)	—	—

The results of the Wald tests for asymmetric effects in the skilled gender wage gap are presented in Table 9. For large shocks, the results are statistically significant in Model I (p=0.043) and confirm the presence of a directional asymmetry, as positive and negative large monetary shocks have different long-run effects on the skilled wage gap. The positive shock increases the gap and the negative shock decreases it, and the amount of the shocks is quite different, as Apostolakis and Giannellis (2024) have documented the asymmetric wage premium dynamics in formal sector employment. In Model II, the directional asymmetry is not significant (p=0.942), which implies that the positive and negative shocks move in the same direction, but with different magnitudes when big shocks are analyzed in isolation.

In Model I (p=0.018) and importantly in Model III (p=0.029) directional asymmetry is confirmed for small shocks. This is an interesting result as in the previous specification the directionality of small shocks was not significant for Model III, but the new results do show that even if analyzed separately, the positive and negative versions of small shocks do have significant impacts on the skilled wage gap. This reinforces the evidence of the nonlinear NARDL specification in all model specifications. In Model I, the magnitude of the shock is as important as its direction for skilled gender wage outcomes, as evidenced by size asymmetry for both positive (p=0.001) and negative (p=0.007) shock comparisons. The overall nonlinear model of the skilled wage gap is supported by the joint asymmetry test, which is highly significant (p=0.003).

Table 10: Wald Test for Asymmetric Effects – Dependent Variable: USKGWG

Type of Asymmetry	**Null Hypothesis**	**Model I (All)**	**Model II (Big)**	**Model III (Small)**
Direction (Big)	$MPS^{+b} = MPS^{-b}$	F(1,19)=4.3535 (p=0.0514)	F(1,19)=3.0133 (p=0.0997)	—
Direction (Small)	$MPS^{+s} = MPS^{-s}$	F(1,19)=4.1478 (p=0.0567)	—	F(1,21)=6.2369 (p=0.0215)
Size (+)	$MPS^{+b} = MPS^{+s}$	F(1,19)=5.1471 (p=0.0358)	—	—

Size (−)	$MPS^{-b}=MPS^{-s}$	F(1,19)=7.2908 (p=0.0146)	—	—
Joint Asymmetry	All coefficients equal	F(2,19)=6.8592 (p=0.0004)	—	—

Table 10 shows the results of the Wald tests for asymmetric effects in the unskilled gender wage gap. The new findings show a much more complex asymmetry than previously thought. Directional asymmetry for large shocks approaches significance in Model I (p=0.051) and is marginally insignificant in Model II (p=0.100), suggesting that positive and negative big monetary shocks have near-differentially significant effects on the unskilled gap. This is a sub-threshold result for Model I, but as the result is on the edge of the 5% threshold, it suggests that the direction of large shocks is relevant at least weakly to the unskilled labor market, unlike the previous specification.

Directional asymmetry for small shocks is also close to the limit of significance in Model I (p=0.057) but is now confirmed as significant in Model III (p=0.0215). This is a significant change from the previous findings: the revised results reinforce the finding of nonlinearity even in the unskilled sector, as the impact of small positive and small negative monetary shocks are statistically different. The results for both positive (p=0.036) and negative (p=0.015) shock comparisons confirm the size asymmetry as the main cause of nonlinearity, even after monetary intervention is taken into account. The most important difference is in the joint asymmetry test; this earlier result was insignificant (p=0.542), but is now highly significant (F=6.86, p=0.0004). This result confirms the NARDL specification for the unskilled wage gap as it does for the skilled gap and suggests that the two nonlinearities in the direction and size of the wage gap are both important determinants of the unskilled gender wage gap in Pakistan (Gomes et al., 2023).

Table 11: Diagnostic Tests

Diagnostic Test	**Dependent Variable: SKGWG**	**Dependent Variable: USKGWG**
Model I – Serial Correlation (LM): Prob F / Prob χ^2	0.3363 / 0.1416	0.5099 / 0.3636
Model I – Heteroskedasticity (BPG): Prob F / Prob χ^2	0.6938 / 0.5597	0.6662 / 0.5601
Model II – Serial Correlation (LM): Prob F / Prob χ^2	0.3153 / 0.2027	0.5869 / 0.4143
Model II – Heteroskedasticity (BPG): Prob F / Prob χ^2	0.4803 / 0.4146	0.3853 / 0.3152
Model III – Serial Correlation (LM): Prob F / Prob χ^2	0.3746 / 0.2875	0.5869 / 0.4143
Model III – Heteroskedasticity (BPG): Prob F / Prob χ^2	0.4960 / 0.4382	0.0997 / 0.1204
Structural Stability (CUSUM / CUSUM^2)	Stable across all models	Stable across all models

All six NARDL models are reported in Table 11 with the results of the diagnostic test. All models with all p-values well in excess of the five percent significance level pass the Breusch-Pagan-Godfrey test for heteroscedasticity and the LM test for serial correlation. The CUSUM and CUSUM of squares tests indicate that the parameters of the model are stable over the sample period for all three model specifications for both of the dependent variables. Overall, these results support the reliability and robustness of the NARDL models estimated for both the skilled and unskilled gender wage gap analyses.

6. Discussion

The results of this study offer strong empirical evidence that monetary policy shocks have an asymmetric impact on the gender wage gap in Pakistan and the direction of the asymmetry varies across skilled and unskilled labor markets. The gender wage gap is consistently larger following small positive monetary shocks, especially among skilled workers, implying that moderate expansionary policy could have a disproportionate effect on male workers, possibly through wage premium effects in formal sector employment. Large negative shocks, on the other hand, are associated with a narrowing of the skill wage premium, which is in line with the idea that contractionary shocks lower the wage premium of professional jobs that are male dominated. In unskilled labor markets, size seems to be more important than direction, meaning the strength of monetary interventions is more important than the direction of the monetary interventions for unskilled gender wage outcomes. The most consistently important structural moderators of the wage gap are the female labor force participation rate and the share of services in the economy, suggesting the need for supply-side and sectoral policies to complement monetary policy in achieving gender wage equity. The overall findings show the distributional impact of macroeconomic policies and call for focusing more on gendered labor market outcomes in the deliberations of monetary policy in Pakistan.

7. Conclusion

This study has shown that monetary policy shocks in Pakistan have asymmetric and skill-specific impact on the gender wage gap. The researcher finds that small positive shocks tend to increase the skilled gender wage gap; large negative shocks decrease it, and for the unskilled wage gap, size asymmetry prevails over directional asymmetry using NARDL framework annual time series data. The presence of long-run cointegration is found for all six model specifications, and the error correction mechanism suggests that the models have significant and relatively rapid long-run adjustment processes, especially in the unskilled labor market. Gender wage gaps are consistently and significantly smaller when women participate in the labor force and when services sectors grow. Females' participation in the labor force and services sector development are strong structural factors that consistently lower both skilled and unskilled gender wage gaps. These results reinforce the idea that monetary policy is a non-gender policy tool and the gender-specific impact

of monetary policy needs to be taken into consideration in the Pakistan's macroeconomic policy framework.

The researcher suggests the State Bank of Pakistan add distributional and gender-equity analysis to its monetary policy impact analysis, especially in determining the intensity of the monetary policy interventions. Structural policies that increase the share of women in the labor force and that boost the importance of services in the economy, consistently moderate the negative impact of monetary shocks on the gender wage gap, and should be given priority. Labor market institutions need to be further developed to offer better wage protection to unskilled female workers, who are particularly exposed to monetary asymmetries related to their size. Gender disaggregated labor market monitoring should be incorporated into future policy frameworks to ensure timely and evidence-based responses to wage differentials as they emerge in monetary tightening cycles.

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