

ASYMMETRIC EFFECT OF MONETARY POLICY IN PAKISTAN



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CERTIFICATE

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Dedication

To the love of my parents, for always supporting me!

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I want to convey my heartfelt thanks to my dear mother. Her appreciation for wisdom and knowledge has consistently illuminated my path towards becoming a better academic every day. Her lessons on curiosity and love for learning inspire me more than words can describe. I am also deeply thankful to my father, whose wisdom, thoughtful insights, and knowledgeable character have been a continuous source of energy, strength, and encouragement. Their steadfast support and trust in me form the essential foundation of my journey.

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ABSTRACT

The research examines whether the effects of monetary policy (MP) shocks are asymmetric on inflation and output. It uses quarterly data from Pakistan covering the period from 1980Q4 to 2024Q4. The local projection method (LPM) (Jordà, 2005) produces the impulse response functions. This study enhances understanding of state-dependent policy effects by using the local projection method to assess the nonlinear responses of output and inflation to MP shocks. It also offers a theoretical contribution by utilizing interest rates to evaluate MP shocks. The linear results show that monetary policy initially has an insignificant effect on output but becomes significant later. State-dependent analysis indicates that during economic expansions, shocks have minimal impact on output but become significant at later horizons. In these periods, shocks have minimal effects on inflation; however, during economic downturns, they significantly influence output and generate notable short-term inflationary pressures. The study also explores long-term effects using GDP growth as a state variable. The long-run linear model finds that the response of GDP growth to MP is statistically significant and negative, while the response of inflation is significant and positive. The state-dependent long-run model reveals that shocks substantially affect GDP growth during periods of economic expansion, with their effects on inflation also being significant. During recessions, shocks have little impact on GDP growth, but inflation responses are initially significant and positive, with the late effects being insignificant. The findings suggest a price puzzle and supply-side factors affecting inflation in Pakistan, including lagged monetary policy transmission, credit constraints, fiscal influences, low central bank credibility, sticky prices, and a financial accelerator impacting output. The results highlight the nonlinearity of monetary policy effectiveness, supporting the existence of asymmetric effects on output and inflation. This research advises monetary authorities to consider these factors when designing policies, especially during periods of high or low economic growth.

JEL Classification: E52, E32, E58

Keywords: Pakistan, State-dependent effects, Asymmetry, interest rate shocks, Monetary policy, Local projection method, Business cycle fluctuations.

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CHAPTER I

INTRODUCTION

Are monetary policy (MP) effects symmetric as proposed by classical linear models, or does asymmetry exist in policy effectiveness depending on the economy's state? Since the commencement of the Great Recession in 2008, the asymmetric effects of demand policies have gained considerable recognition, capturing the attention of both policymakers and academia in examining the state-dependent and non-linear effects of policy shocks (e.g., Aye & Gupta, 2012; Barnichon & Matthes, 2016; Tenreyro & Thwaites, 2016; Furceri et al., 2019; Irandoust, 2020; Ravn & Sola, 2004; Lo & Piger, 2005; Ülke & Berument, 2016, among others). Theoretically, economists have long recognized this non-linear effect; for instance, Friedman (1968) asserted that monetary authorities can persistently raise the policy rate to stop inflation, but lowering the policy rate is ineffective in controlling a recession. Cover (1992) utilized a two-step approach for shock identification and employed a VAR model to analyze the causal impact, demonstrating significant evidence of asymmetric effects of MP shocks on output. Following this, subsequent literature highlighted various forms of nonlinearities dependent on the economic state (Lo & Piger, 2005; Tenreyro & Thwaites, 2016; Weise, 1999; Ramey & Zubairy, 2018; Garcia & Schaller, 2002).

Monetary policy asymmetry refers to uneven output responses to the same monetary action. According to economic theories and models, asymmetric monetary policy effects arise from various economic rigidities, such as credit constraints, menu costs, and the discrepancy between unanticipated and anticipated monetary shocks (Lucas, 1972, 1973, 1975), as well as asymmetric indexation of wages and price adjustments (Kandil, 1995). Furthermore, theoretically, uneven monetary policy effects are triggered by expectations and savings, sticky prices, financial market imperfections, and liquidity traps (for a detailed description, see Agénor, 2001). The credit constraint channel is based on financial market imperfections, where a tight monetary policy prevents banks from lending to risky customers due to a lower possibility of debt repayment for those customers. The theory of liquidity traps provides a plausible explanation for the asymmetric impacts of monetary policy. This theory introduces a state-dependent asymmetry, implying that MP is futile in a low-growth period because the real interest rate is insufficient to incentivize holding debt.

Another reason for asymmetric monetary policy effects is the Menu Cost (Mankiw, 1985) which implies that producers sometimes keep their prices at their existing level even if the inflation rises. The short-run aggregate supply curve models utilize sticky prices, indicating that during a recession, monetary policy significantly influences real economic variables. Moreover, during a boom, the monetary policy effects are translated into prices and wages. This causes a state-dependent asymmetry of monetary policy. Kandil (1995) asserts wage indexation as a reason for the uneven monetary policy effects where wages are unevenly or only partially adjusted or indexed to inflation. Abel and Eberly (1993) observed that investment irreversibility forms asymmetric real rigidities. Unanticipated variations in the monetary supply constitute a significant factor affecting the disparate impacts of monetary policy. The predicted money supply is also neutral, as it does not affect the economy's actual economic variables. In contrast, the unexpected money supply is non-neutral because it does affect these variables.

Recognizing that monetary policy effects are asymmetric is vital for achieving the objectives of a country's central bank. Controlling inflation is a primary objective for most national central banks worldwide, including both developed and developing nations. The interest rate (also known as "policy rate") serves as the central monetary institution's policy tool to achieve this objective. However, the interest rate, apart from targeting inflation, also affects economic growth and activity by raising the cost of investment. Intuitively, a monetary authority adopts a loose monetary policy during times of recession and a tight policy when the economy experiences increased activity. In line with this principle, the central monetary institution raises the policy rate to mitigate the upward pressure on inflation by reducing demand, but the literature shows ambiguous results for this policy (Ahmad et al., 2025; Mazhar & Malik, 2024; Sapkota, 2024; Ullah et al., 2024). Since 2019, the State Bank of Pakistan (SBP) has raised the interest rate to a historic high of 22 percent in June 2023, aiming to mitigate rising inflation through adjustments to the policy rate. Concurrently, the increased inflation results from the cost-push factors of a higher policy rate (cost channel) in the economy. The policy rate increase does not significantly contribute to curbing the inflation rate nor to enhancing the economy's stability. Now, the question arises in Pakistan: Does monetary policy have a symmetric or asymmetric effect on output and the inflation rate? Figure 1.1 illustrates that GDP growth and policy rate are not directly correlated.

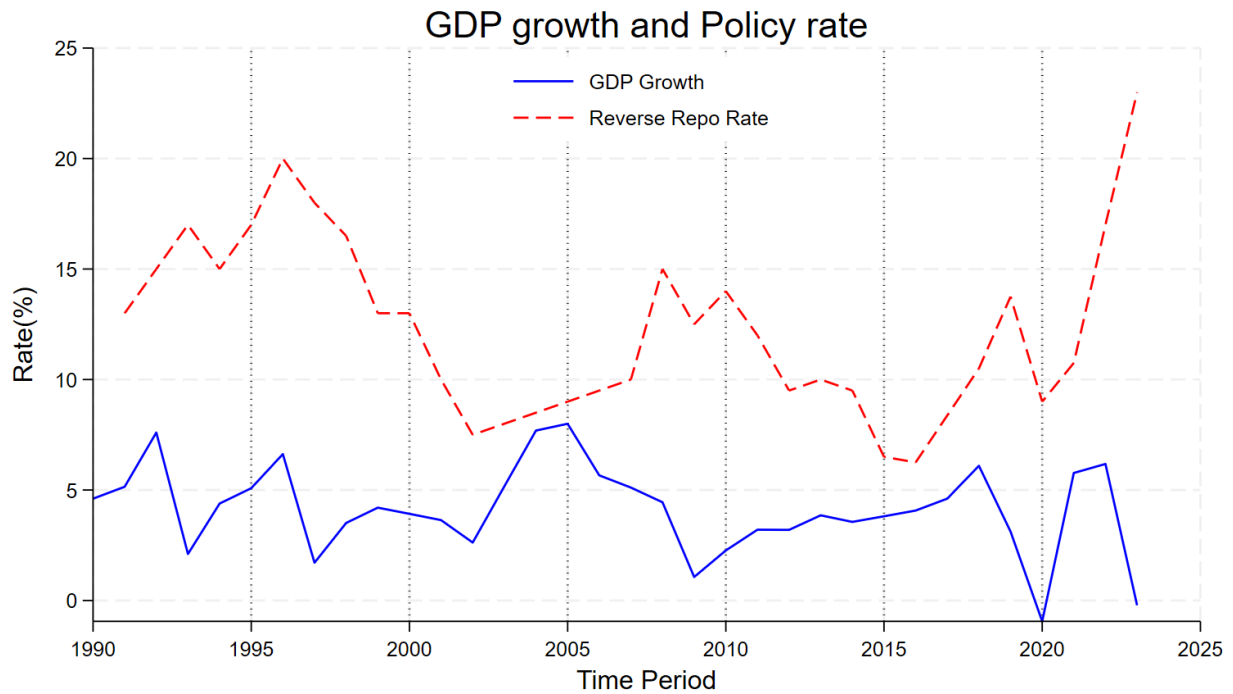


Figure 1.1. GDP growth rate and policy rate over time in Pakistan

Note: A dotted line illustrates the policy rate (reverse repo rate), while a solid line indicates Pakistan's GDP growth rate over time.

Source: State Bank of Pakistan

Figure 1.1 illustrates that interest rates significantly decreased from 1996 to 2002, while the GDP growth rate initially decreased for a short period and then increased marginally. Between 2002 and 2005, the output growth rate experienced an increase, even in the context of rising policy rates. Finally, from 2008 to 2016, the policy rate significantly decreases, yet the GDP growth rate, in line with economic theory, persistently increased, albeit at a lower rate. The aforementioned facts suggest that monetary policy has consistently demonstrated an asymmetric effect on output growth rates, indicating a distinct asymmetric relationship between macroeconomic variables and monetary policy fluctuations in Pakistan. Zakir and Malik (2013) also suggested that monetary policy has asymmetric behavior.

This study aligns with the body of literature concerning asymmetric monetary policy. This literature significantly addresses the asymmetric effects of monetary policy on output in contexts marked by fluctuations in economic conditions. Lo and Piger (2005), Tenreyro and Thwaites (2016), Peersman and Smets (2002), Zakir and Malik (2013), and Weise (1999) are empirical

studies that examine and confirm the concept of state-dependent asymmetry effects. These empirical studies support the finding that monetary policy is generally less effective during economic downturns than during economic booms. VAR is the most used methodology for such asymmetry (Aye & Gupta, 2012; Cover, 1992; Lo & Piger, 2005; Morgan, 1993; Weise, 1999). Zakir and Malik (2013) investigated the asymmetric impacts of monetary policy on output in Pakistan. Their paper identified inconsistent effects of policy actions, suggesting that, contrary to traditional theory, expansionary monetary policy does not prevent recessions.

This paper improves the understanding of state-dependent policy effects by applying Jordà's (2005) local projection method, estimating the nonlinear responses of output and inflation to monetary policy shocks. The local projection method offers several advantages over the VAR model, especially in estimating state-dependent outcomes. Moreover, this method offers certain advantages that make it a natural alternative for estimating impulse response functions through vector autoregression (VAR). These advantages include its estimation through simple linear regression, greater robustness to misspecifications, and ease in accommodating experimental nonlinear specifications. This analysis will utilize quarterly data spanning from the fourth quarter of 1980 to the third quarter of 2021 to examine the asymmetric reactions of inflation and output to monetary policy shocks.

The research provides a notable addition to the current body of work regarding the uneven impacts of monetary policy in Pakistan, especially in light of recent debates surrounding the efficacy of such policies during periods of economic decline. There is a significant deficiency in research concerning these asymmetric effects in Pakistan. Only one empirically investigating paper by Zakir and Malik (2013) related to this issue has been found. Nonetheless, a theoretical issue exists in pinpointing the shock; their paper recognized the monetary aggregate as a shock, but Bernanke and Blinder (1992) identified the interest rate as a shock, observing that the money supply is endogenous while the interest rate is exogenous. Furthermore, the shock's nature must be external and not generated within the system. Moreover, their work exhibits certain methodological and state specification deficiencies.

This paper aims to make three significant contributions to existing literature. Initially, it will employ the interest rate as an indicator of monetary policy to detect disturbances. Secondly, a novel methodology will be implemented for analyzing asymmetric effects, specifically the local

projection method as proposed by Jordà (2005). Finally, it will examine the effects of state-dependent monetary policy using a non-linear analytical framework. This study will present current information and conduct an empirical investigation within the context of Pakistan. This issue is of paramount importance for the central bank, as policies predicated on symmetric effects have not yielded the desired outcomes. Based on the available evidence, it appears that there is a scarcity of studies focusing on this particular issue, and a notable absence of recent research examining the prevailing macroeconomic conditions of Pakistan's economy. Consequently, the relevant literature in Pakistan has become outdated due to frequent changes in macroeconomic variables and the country's evolving economic structure.

Results demonstrate that monetary policy has asymmetric effects depending on the state of the economy, and a secular policy change based on conventional symmetrical impacts would be sterile. During the slack time, an increase in the policy rate significantly reduces the output gap, but at the cost of higher inflation. An increase in price in response to an increase in interest rate is known as the price puzzle and is evident in the literature. On the other hand, in the case of a non-slack economy, the impact of a monetary policy change on both output and prices is insignificant. Therefore, during the non-slack period, the stance of the monetary authorities must remain close to the neutral interest rate, as the findings indicate that monetary policy initially has a minimal impact on output but later becomes significant, while having no substantial impact on the inflation rate. An active monetary policy in a non-slack period could lead to inefficient economic outcomes and overheating the economy. Subsequently, in the long run, during the non-slack period, the monetary authority should use the monetary policy cautiously as findings reveal that monetary policy shocks have a significant effect on output and inflation. During the slack period, monetary authorities shouldn't use monetary policy for long-term growth and inflation because the findings illustrate that monetary policy shocks have a slight impact on GDP growth rate, and the impact on inflation is initially significant but later becomes insignificant. So, monetary authorities should actively manage the price level expectations of the economic agent rather than policy intervention.

1.1 Statement of problem

The problem statement is as follows:

In recent times, particularly since 2019, the central monetary institution has initiated an upward adjustment of interest rates, which attained an unprecedented peak of 22 percent in June 2023. The

central monetary authority's main aim in raising the policy rate was to curb the overall price level's growth rate. A decrease in overall demand acts to limit the inflation rate, subsequently influencing total supply and output levels. A study by Zakir & Malik (2013) in Pakistan has analyzed the impact of monetary policy shocks on output levels. This examination employed a linear methodology. However, central banks formulate their policies or articulate their policy rates in a manner that influences the economy linearly. Notwithstanding this, non-linearity exists in the behavior of the effects of policy variables.

1.2 Research problem

The research problem is as follows:

As we have seen, the central monetary authority's upheaval of the policy rate did not affect the economy linearly and was not significantly effective. The study highlights that the efficacy of monetary policy relies on an analysis of monetary policy shocks that is contingent upon the prevailing economic conditions.

1.3 Research objectives

This research's primary objective is as follows.

- To examine whether monetary policy has symmetric or asymmetric effects on the macroeconomy of Pakistan.

1.4 Research questions

This research's primary questions are as follows:

- Does monetary policy impact changes when the state of the economy changes?

1.5 Hypothesis

The hypotheses of this research are as follows:

- H_0 : *Monetary policy has symmetric effect on output and inflation.*

1.6 Explanation of key terms/concepts

The explanation of some of the key terms/concepts are as follows:

1.6.1 State

The state is defined as an economy's economic condition. Two main conditions are identified as the economy's state: recession and expansion (boom).

1.6.2 Shock

A change in policy that affects the economic landscape can be characterized as a shock. Our discussion centers on the impact of monetary policy shocks. Positive monetary policy shocks are sometimes characterized as expansive monetary policy. On the other hand, negative monetary policy shocks are recognized as contractionary monetary policies.

1.6.3 Asymmetry

When the outcomes of monetary policy are unequivocal, this phenomenon is identified as asymmetry within the discipline. The focus of this discussion will be on state-dependent asymmetry. State-dependent asymmetry is characterized as “the monetary policy effects differ with the state of the economy.” Moreover, the efficacy of monetary policy is dependent on the economic conditions.

1.7 Units of data collection

The analysis draws on data from the period spanning 1980Q4 to 2021Q3. The secondary data is sourced from the State Bank of Pakistan (SBP), the Pakistan Bureau of Statistics (PBS), and the International Financial Statistics (IFS).

1.8 Significance of the research

This study investigates the uneven reactions to monetary policy shocks using a state-dependent nonlinear analysis. This analysis seeks to elucidate the factors contributing to the variations in the effects of monetary policy, as demonstrated by traditional linear models. This paper aims to enhance the current body of literature by examining the nonlinear characteristics associated with the efficacy of asymmetric monetary policy. It will assess the disparate impacts of monetary policy through the year 2021. A previous analysis by Zakir & Malik (2013) offered valuable insights into the asymmetric reactions to monetary policy prior to 2011. This research aims to contribute substantially to the academic discussion surrounding Pakistan's monetary policy by applying the local projection methodology developed by Jordà (2005). Our recent analysis indicates that the central bank utilizes interest rates to influence economic activity directly. In June 2023, the interest rate was elevated to 22%, yet this adjustment did not substantially affect the economy. This study

aims to provide a contemporary viewpoint on the state-dependent nonlinear analysis of monetary policy, thus delivering important insights for the central bank's future decisions concerning the policy rate.

1.9 Organization of the study

Chapter 2 of the study delineates the significant literature addressing the conceptual discourse on asymmetry, the monetary policy transmission mechanism, theoretical methodologies, state identification, and shock identification. Chapter 3 encompasses the data sources and technique employed in the research. Chapter 4 examines the outcomes related to the influence of monetary policy shocks on cyclical output and inflation, as well as their effects on GDP growth and inflation rates. Chapter 5 encompasses the conclusion and recommendations.

CHAPTER II

LITERATURE REVIEW

2.1 Conceptual debate of asymmetric policy effects

Monetary policy asymmetric effects are caused by the loss aversion of the banks or expectation uncertainty during a recession or by the stickiness of prices; that is, prices are rigid downward, as highlighted by Barnichon, Matthes, & Sablik (2017). However, the stages of the business cycle (Tenreyro & Thwaites, 2016; Weise, 1999; Peersman & Smets, 2002), monetary policy intervention in relation to the magnitude of its effect on the economy, and lastly unanticipated and anticipated money supply shocks of monetary policy as analyzed by Ravn & Sola (2004) also arises the asymmetric effects. Furthermore, the central monetary authority can reduce interest rates to invigorate economic activity. Nonetheless, as previously mentioned, the concept of “pushing on a string” suggests that merely lowering interest rates may not effectively boost economic performance.

Expectation and savings, sticky prices, financial market imperfections, and liquidity traps theoretically cause asymmetric monetary policy effects. Economic theories and models imply these asymmetric monetary policy effects, including credit constraint, menu cost, and liquidity trap (Morgan, 1993). Subsequently, Investment irreversibility (Abel & Eberly, 1993) and asymmetric indexation of wages and adjustment of prices (Kandil, 1995) are also sources of asymmetry.

The expectations of producers and consumers change throughout the business cycle. In an economic upsurge, the economic agent has positive expectations. In contrast, when there is a recession in the economy, the economic agent will have a more cautious expectation, as indicated by Keynes and Skidelsky (2016). When the expectation of the economic agents is more pessimistic than optimistic during the economic downturn, the consumer will save money for security reasons, and the producers will be less likely to invest and employ money in the economy. It causes the asymmetry of the business cycle, as portrayed by Chen (2015), and monetary policy has asymmetric effects (Florio, 2004; Santoro et al., 2014). Meanwhile, optimism has a less large effect than pessimism, which explains asymmetric effects (Barnichon, Matthes, & Sablik, 2017), which Chen (2015) modelled in loss aversion models. The uncertainty in expectations is linked to precautionary saving, where consumers tend to save more as the future income is uncertain so that

they can smooth their consumption. This uncertainty is mainly caused by the negative economic shock and by imperfections in the insurance markets, as stated by Carroll & Kimball (2001). In this case, the consumer will consume less and save more, generating a countercyclical effect of precautionary savings (Carroll, Slacalek, & Sommer, 2012; Challe & Ragot, 2016).

Monetary policy might be asymmetric due to capacity constraints. Numerous organizations confront imminent expansion hurdles due to production capacity, manpower shortages, and capital shortages. Aggregate demand rises when economic demand approaches its full volume. Meanwhile, lowering interest rates raises inflation rather than output. As the economy reaches maximum capacity, aggregate demand raises prices. Agénor (2000) and Laxton, Meredith, & Rose (1995) found significant Philip curve non-linearity in industrial and emerging countries.

Asymmetric effects may emerge from variations in the money supply, whether anticipated or unanticipated, as explored in the new classical literature. While the expected money supply does not affect the economy, unexpected changes alter real economic activity and variables, leading to an imbalance. This concept is introduced by (Lucas Jr., 1972, 1975; Lucas, 1973), while this is empirically tested and proven by Mishkin (1982), Boschen & Grossman (1982), Barro (1977, 1978), Barro and Hercowitz (1980).

Keynesian nominal wage stickiness is another reason of asymmetric impact. It mostly shows wages are inflexible downward and flexible upward. Due to its downward rigidity, a contractionary monetary policy shock is non-neutral, while a loose one can increase nominal wages. Asymmetry in wage adjustment can occur from various sources. First, nominal salary cuts may be opposed by workers because high inflation makes real wage cuts necessary. This suggests an asymmetry at low inflation. Second, workers prefer upward pay movements because they can raise wages faster than negative wage adjustments. Efficiency wage means increased productivity and lower turnover. The company may raise wages swiftly.

Sticky prices are another cause of the uneven monetary policy effects (Tsiddon, 1993; Caballero & Engel, 1992; Ball & Mankiw, 1994). It indicates that prices are flexible upward but rigid downward. This also identifies that money is non-neutral during the short horizon, as highlighted by Ball and Mankiw (1994). Meanwhile, it is classified among the primary causes of the monetary policy asymmetric effects, as producers will not decrease prices during a recession. However, producers will inflate prices during a boom, which will cause an asymmetry during the business

cycle. Sticky prices are due to the existence of the menu cost model. Larger firms have more power to calculate menu costs or the stickiness of prices than smaller firms with less market power. The consumption possibility will decrease during a recession due to sticky prices that won't adjust according to consumption possibilities. Downward stickiness is empirically found by (Alvarez et al., 2006; Schenkelberg, 2014). The short-run aggregate supply curve also represents pricing rigidity. This implies that during the recession, the monetary has strong economic effects on the real economic variable, whereas, in expansion, the monetary effects are more translated into prices and wages. Moreover, this model suggests that, regarding the impact on actual economic activity, a restrictive monetary policy is more effective than a loose monetary policy (Lo & Piger, 2005; Kakes, 1998b; Weise, 1999).

The presence of price puzzles represents a further factor affecting the effectiveness of monetary policy. The foundational introduction of this concept is credited to Sims (1992). The price puzzle refers to an unexpected rise in the inflation rate following the implementation of contractionary monetary policy. Central banks increase interest rates with a proactive strategy, forecasting potential inflationary trends instead of simply responding to existing economic conditions. Sims further posited in his paper that this phenomenon may occur due to excluded variables in the VAR model, predominantly forward-looking behavior. The study also underscored the critical significance of the timing of monetary policy, which can modify the response to such policy measures. Moreover, the occurrence of price puzzle phenomena in Pakistan is shown empirically by Khan (2008), Javid and Munir (2010), Agha et al. (2005), Nizamani et al. (2016), and Bukhari (2021).

The credibility of the central bank plays a crucial role in assessing the diverse effects of monetary policy. The credibility at stake is primarily characterized by the variations in the information available concerning the central bank's policy actions and stance (Ball, 1994, 1995; Cukierman & Meltzer, 1986; Schaumburg & Tambalotti, 2007; Erceg & Levin, 2003). This scenario has predominantly emerged as a result of the divergent viewpoints held by the private sector, which do not correspond with those of the central monetary authority. The New Keynesian framework fundamentally relies on the assumption of the central bank's credibility. As a result, the private sector generally operates on the premise that the central monetary authority will adhere to established protocols and endeavor to achieve policy goals, as long as the particular targets and

regulations remain undisclosed to the public. Hence, studies utilizing the New Keynesian model may potentially overestimate the efficacy of monetary policy, as illustrated by Goodfriend & King (2016). A notable gap between the policy rate and market expectations undermines the trust in the central monetary authority. Yellen (2016) articulated that monetary policy is credible when “the participant in the market accurately predicts the response of the central monetary authority to an economic shock or news.” Furthermore, when the central monetary authority has cultivated a credible reputation, the private sector is likely to converge around the zero steady state target set by the central bank. This phenomenon additionally contributes to mitigating the self-referential effects of the expectations held by private agents. Empirical research has scrutinized the implications of central bank credibility on macroeconomic stability (Bomfim and Rudebusch, 2000; Johnson, 1997, 1998). In these analyses, the concept of credibility pertains to the observed gap between the anticipated inflation rate and the target rate established by the central bank.

The independence of the Central Bank is essential for the effective execution of monetary policy. Independence is strongly related to inflation targeting (IT). There are various findings from the economy that mainly adopted the monetary authority independence. Empirically, it was found that the advanced economy experienced a weak role in the IT rule, whereas the developing economy experienced a strong and positive outcome by the central bank's independence (Gonçalves & Salles, 2008; Batini & Laxton, 2007). Whereas Brito & Bystedt (2010) concluded that The independence of central banks seems to exert a negligible influence on the implementation of IT regulations in emerging markets. A lower degree of independence in a central bank appears to correlate with improved IT outcomes. In Pakistan, Shareef, Sultan, and Sheikh (2024) identified that the autonomy of the central bank is crucial for promoting a more perpetual macroeconomic environment and reducing the volatility of inflation.

Fiscal policy likewise contributes to the efficacy of monetary policy. This policy additionally aims at regulating inflation and output. Monetarists are convinced that “Inflation is always a monetary phenomenon”. This statement holds true solely in instances of Ricardian equivalence. Eusepi & Preston (2018) concluded that inflation's fiscal foundation is based on imperfect information. Under the imperfect information, the Ricardian equivalence doesn't hold, which suggests that the public debt level and composition significantly influence inflation. FTPL posits that the inflation rate is primarily influenced by fiscal policy, stemming from debt and taxes, rather than by the

money supply. The fundamental premise is that the government consistently operates with a fiscal deficit and is unable to meet its obligations through future revenues. This situation results in an escalation of debt, which subsequently plays a role in heightening inflation aimed at diminishing the real value of that debt. A prolonged debt duration is positively associated with an enhancement in resultant wealth. This will result in a rise in aggregate demand, subsequently driving an increase in the overall price level. This scenario reduces the effectiveness of monetary policy in managing inflation, necessitating a more proactive monetary approach to alter or stabilize the inflationary expectations of economic agents. In instances where fiscal policy does not adequately respond to debt dynamics, unanticipated monetary policy can elevate nominal interest rates, resulting in increased real debt and diminished real balances, thereby adjusting the inflationary landscape. Leeper (1991) asserts that an increase in taxes concurrent with a rise in real debt will lead to a contractionary monetary policy that effectively lowers inflation levels. Furthermore, fiscal policy enhances public confidence in fiat currency, which is essential in influencing price levels. The FTPL faced criticism from Buiters (2022) due to its foundational assumptions regarding the central bank's involvement in debt monetization. However, should the central bank adopt a money supply rule instead of an interest rate rule, the likelihood of debt monetization would persistently diminish, thereby challenging the validity of the non-Ricardian theory.

Imperfection in financial markets is another cause of asymmetric monetary policy effect. This asymmetry arises due to credit rationing when the monetary policy is contractionary, this implies an interest rate increase that would lead the banks not to give loans to those customers, which seems risky, which means their possibility to pay their debt is less, as this leads banks to default. In the present scenario, the impacts of a loose monetary policy seem to be less pronounced relative to those of a tight monetary policy, largely due to the phenomenon of credit rationing, as shown by Barnichon, Matthes, and Sablik (2017). The credit rationing hypothesis is first given by Gertler (1988) and then extended by (Bernanke and Gertler, 1986; Bernanke, Gertler, and Gilchrist, 1994). The bank's decision to ration credit for specific customers may lead to a more pronounced decline in output, thus amplifying the effects of contractionary monetary policy. On the contrary, it is not an absolute constraint that expansionary monetary policy is anticipated to boost consumer borrowing or spending (Morgan, 1993; Barnichon, Matthes, and Sablik, 2017). Further development in such area is being done by (Bernanke, 1990; Bernanke & Gertler, 1986), who emphasized the “financial accelerator” regarding producers or firms. The financial accelerator

means that external financing creates more cost, and firms need more credit during the recession rather than a boom which creates the asymmetrical effect of monetary policy during the economic downturn. (Bernanke, 1990) concluded that when monetary policy changes, it significantly affects the decomposition of assets in banks. The dynamics of the balance sheet channel shape this process. This observation suggests that the response to monetary policy shocks demonstrates an uneven pattern. The balance sheet channel plays a significant role in creating asymmetry also seen by (Peersman & Smets, 2002; Florio, 2004; Lo & Piger, 2005) as well, and the financial accelerator is one of the causes and explanations of the asymmetry as indicated by Kakes (1998b).

The differing effects of monetary policy may be explained by the presence of a liquidity trap. There is no necessity to incur debt when real interest rates are exceedingly low, resulting in a liquidity trap for the economy, as stated by Hicks (1937); such a situation was seen during the 2007-2008 financial crisis, which was triggered by the decreased policy rate. When inflation or deflation is low or economic actors have low expectations, it can lead to a liquidity trap (Akram, 2016). According to the Keynesian IS-LM model and the liquidity trap, monetary policy exerts minimal to no influence during economic recessions, as tested by Morgan (1993). The liquidity trap emerged during the Japanese crisis and the 2007–2008 financial crisis (Akram, 2016), signifying that this acts as a significant factor affecting the various results of monetary policy.

There is a presence of mixed evidence regarding the asymmetric reactions to shocks in monetary policy. Cover (1992) examined the diverse effects of both positive and negative monetary policy shocks, a finding corroborated by the studies of Kandil (1995), Morgan (1993), De Long et al. (1988), Thoma (1994), and Karras (1996). However, the effects of both expected and unexpected monetary policy shocks on output result in variations in nominal demand (Frydman & Rappoport, 1987; Barro, 1977; Mishkin, 1982). Thoma (1994) posits that the adverse impacts of monetary policy shocks on output are markedly more pronounced during phases of robust economic expansion compared to times of sluggish growth. Research conducted by Ravn and Sola (1996) illustrates that the effects of minor monetary policy shocks differ from those arising from substantial shocks. Garcia & Schaller (2002) explored the idea that the effects of monetary policy are more significant during periods of economic contraction than during phases of growth. The execution of asymmetric monetary policy presents a variety of unique challenges. A significant amount of empirical evidence indicates that contractionary monetary policy generally proves to be

more effective than expansionary policies. The evidence for this conclusion is corroborated by a range of studies carried out over the years, including those by Cover (1992), Garcia & Schaller (2002), Peersman & Smets (2002, 2005), Karras (1996), Tan & Habibullah (2007), Santoro et al. (2014), Barnichon & Matthes (2016), and Kilinc & Tunc (2019). Nevertheless, a specific study suggests that the magnitude of monetary policy is of greater significance, whereas the direction of the policy seems to be of lesser importance, as observed by Ravn & Sola (1996). The effectiveness of asymmetric monetary policy is contingent upon the prevailing economic conditions, as demonstrated by the work of Weise (1999), Tenreyro and Thwaites (2016), and Lo and Piger (2005), among others. Arden et al. (2000) contend that the prevailing economic conditions and the direction of policy are critical elements in assessing the effects of asymmetric monetary policy. Furthermore, a considerable body of research has focused on analyzing the uneven reactions to monetary policy shocks in developing and emerging economies, as investigated by Aye & Gupta (2012).

2.2 Monetary policy transmission mechanism

The non-linear transmission mechanism of monetary policy results in disparate impacts on output. Keynes (1936) supported the traditional asymmetry that a contraction has larger real effects on output than expansions. This is due to the nominal rigidities in the labor market which implies a contractionary demand shock prevents wages from falling, which thus leads to involuntary unemployment. In contrast to this view, when there is an expansionary shock in the economy, the nominal wages are easily adjusted upwards. Meanwhile, this leads to asymmetric responses. This channel is illustrated within the modern general equilibrium model (Abbritti & Fahr, 2013; Benigno & Fornaro, 2019; Schmitt-Grohé & Uribe, 2016; Benigno & Antonio Ricci, 2011; Kim & Ruge-Murcia, 2009; Fagan & Messina, 2009).

The models with the presence of menu cost also led to asymmetry. The channel of this menu cost model is that large shocks lead to small effects, making firms adjust prices. In contrast to this view, smaller shocks don't cause the firms to make price adjustments, which leads to a substantial effect (Alvarez, Le Bihan, & Lippi, 2016; Ball & Mankiw, 1994; Ball & Romer, 1990; Golosov & Lucas Jr, 2007; Midrigan, 2011).

The interplay between monetary policy and its effects on real production and economic activity is a subject that elicits considerable debate in the field of monetary economics. The primary

distinctions in the impact of monetary policy on real output and economic activity are identified as neoclassical and non-neoclassical transmission mechanisms (Boivin, Kiley, & Mishkin, 2010). The neoclassical transmission channel asserts that interest rates play a crucial role in the monetary policy transmission mechanism, especially in the context of perfectly competitive financial markets. Investment spending and the capital costs faced by consumers and businesses fluctuate in response to changes in interest rates. Conversely, the non-neoclassical perspective emphasizes the inefficiencies inherent in the financial market, particularly concerning credit mechanisms. Additional monetary policy strategies encompass frameworks associated with credit and interest rates.

The economy is significantly influenced by monetary policy via the interest rate mechanism, encompassing adjustments in the short-term interest rate. The changes in question have substantial implications for the cost of capital, investment trends, the housing market, inventory levels, and the consumer durable goods sector. Bernanke and Gertler (1995) elucidated that this channel primarily affects aggregate demand, consequently influencing the economy's production and output levels.

The execution of monetary policy affects the behavior of the credit market via the credit channel. The aim of monetary policy is to influence the availability of bank credit and the financial status of borrowers. The scale of an enterprise is crucial in assessing its economic health (Bernanke & Gertler, 1995; Bernanke & Blinder, 1988). As a result, smaller enterprises necessitate greater access to credit, given their elevated transaction and information costs relative to larger corporations. The ability to manage loan servicing is affected by the size of banking institutions, as noted by Kashyap and Stein (1994). In the framework of contractionary monetary policy, smaller financial institutions typically issue a reduced volume of loans relative to their larger counterparts, highlighting the mechanics of restricted credit or banking lending channels.

The efficacy of monetary policy is contingent upon the temporal lags that manifest prior to its influence on economic outcomes. Friedman (1961) posited that the impact of monetary policy on economic conditions is observed only after a considerable lag. The variability of these lags is contingent upon the prevailing financial and economic circumstances. Friedman (1961) and his associates contended that policymakers must accurately estimate these lags prior to the implementation of the policy. They argue that even when considering the lags, the potential for

economic instability remains, as these lags may exacerbate economic cycles rather than mitigate them. Subsequent empirical studies have validated the significant impact of variable and extended lags on the efficacy of monetary policy (Nachane & Lakshmi, 2002; Gruen et al., 1997; Tanner, 1979). The delays can be classified into two distinct categories in relation to the attainment of the overarching objective of monetary policy: namely, outside delays and inside delays. Inside delays refer primarily to the duration required to recognize necessary monetary policy and its definitive application. These lags tend to be relatively shorter in nature. Conversely, outside lags primarily denote the time required for monetary policy to impact economic conditions, which are typically longer and can be statistically estimated through various methodologies. Numerous factors contributing to delays are inherent within the framework of monetary policy. The immediate impact of interest rates in the money market is rapid, whereas the responses in the realms of deposits and lending are typically more incremental (Lowe, 1995). Second, the issue of investment irreversibility, as discussed by Dixit and Pindyck (1994), indicates that investments are largely irreversible due to the value of waiting, particularly in uncertain circumstances. Fluctuations in interest rates affect the valuation of this option, adversely impacting the timing of investment choices. Third, the gradual adjustment of the exchange rate serves as a crucial element that contributes to lag effects in monetary policy, resulting in a delayed impact on tradable goods and sectors. Given the interconnected nature of the economy, each sector is linked to another, leading to gradual adjustments within the economic framework. A multitude of studies has conducted empirical analyses concerning the impact of temporal lags in the context of monetary policy (Mayer, 1967; Tanner, 1979; Nachane and Lakshmi, 2002).

The literature presents evidence of the proposed mechanism that leads to asymmetry in monetary policy transmission: Recessions are characterized by a decrease in household behavior towards holding durable items. If the durable goods sector mostly drives the reaction, then monetary policy effects will be higher during booms than recession as identified by McKay & Wieland (2021). During the boom, the Philip curve flattens. In a recession, it steepens, which advocates that monetary policy during a boom will have a gargantuan effect on output, as indicated by Vavra (2014). Significant alterations in monetary policy are expected to exert a considerable influence on price levels, while macroeconomic models that incorporate price stickiness indicate only minor fluctuations in output. Given that minor shocks do not prompt firms to adjust their prices, these shocks will result in variations in output, as indicated by Ascari and Haber (2022).

2.3 Monetary policy shocks and analytical technique

The empirical examination of the uneven impacts of monetary policy has been developed through several theoretical models and their further adaptations (Agénor, 2000; Boivin & Giannoni, 2002; Cover, 1992; Gogas, Pragidis, & Tabak, 2018; Granger & Terasvirta, 1994; Granger & Teräsvirta, 1995; Karras, 1996; Lenz, 1997; Ülke & Berument, 2016; Weise, 1999; Zakir & Malik, 2013). Cover (1992) applied a two-step procedural approach utilizing the vector autoregression (VAR) technique. The analysis commenced with a focus on the internal components of the money supply mechanism, followed by an assessment of the residual to gauge the effects of monetary policy. The second procedure examines the consequences of both negative and positive outcomes of monetary policy. He concluded that the two shocks are distinct, with the negative monetary policy shock demonstrating a significantly higher intensity compared to the positive one. Karras (1996) and Lenz (1997) employed the same equation and methodology, reinforcing the existence of differential effects. Granger and Teräsvirta (1995) introduced smooth transition techniques. In the subsequent analysis, Weise (1999) employed logistic smooth transition vector autoregression (LSTVAR) to examine the asymmetric impacts of monetary policy on output and price levels. At the same time, structural models incorporating reduced-form parameters were created to enable a seamless transition between different regimes. Agénor (2000) evaluated the extent of the asymmetric effects of monetary policy by applying a small-scale vector autoregression model. Boivin and Giannoni (2002) employed the general equilibrium macroeconomic model within the vector autoregression impulse response function to interpret changes. Similar to Rotemberg (1997), they employed the model to ascertain that “monetary policy is less powerful.” This approach permits modifications to the model's backward-looking and frictional behaviors. Zakir and Malik (2013) utilized the same two-step methodology developed by Cover (1992), integrating innovations pertinent to Pakistan to analyze the asymmetric effects of monetary policy. Ülke and Berument (2016) conducted an analysis of the asymmetric effects of monetary policy in Turkey utilizing a nonlinear vector autoregression model as established by Kilian and Vigfusson (2011). Gogas, Pragidis, and Tabak (2018) performed an examination of the effects of monetary policy asymmetry in the United States and Brazil, employing a comparative methodology that contrasts logistic smooth transition vector autoregression (LSTVAR) with exponential smooth transition vector autoregression (ESTVAR). The vector autoregression (VAR) models examine the short-term asymmetries present among variables.

Granger and Yoon (2002) illustrated multivariate hidden cointegration, while Larsson, Lyhagen, and Löthgren (2001) presented likelihood-based panel co-integration as other theoretical approaches to the monetary policy's asymmetric effects. Irandoust (2020) uses such technique due to its particular advantages. The advantages of hidden co-integration are that it gives a long-run relationship and a distinct co-integration relationship when analyzing asymmetry. The delineation of data is an economically advantageous gain.

The Markov switching regime functions as a theoretical framework for analyzing the varied effects of monetary policy (Hamilton, 1989, 1990). Garcia and Schaller (2002), alongside Kakes (1998a), implement this methodology, which relies on a univariate model focused on industrial production and the growth rate of output. This technique offers several advantages: primarily, it facilitates the analysis of asymmetries and nonlinearities. Secondly, greater emphasis is placed on the recession coefficient, primarily indicative of the economic contraction that accompanies it. Thirdly, the Hamiltonian outlines the most favorable recession scenario as indicated by the existing dataset. The results demonstrate a non-uniform effect on interest rates across different phases of the business cycle. Ravn and Sola (2004) employed this methodology to examine the asymmetries inherent in the monetary policy framework of the United States. Their proposition indicates that the money supply undergoes a regime-shifting mechanism, resulting in alterations to both the average and the variability of the money supply. Peersman and Smets (2002) utilized the Bayesian framework through the Markov chain Monte Carlo simulation technique, as detailed by Chib and Greenberg (1996) and Smith and Roberts (1993). The central emphasis was on evaluating industrial production within the Eurozone countries. Their findings indicate a divergence in monetary policy and, for most nations, the negative consequences of unforeseen shocks.

Jordà (2005) advocates for the use of the local projection method to estimate impulse response functions, presenting it as a theoretical framework to analyze the differential impacts of monetary policy. This method is employed by Stenner (2022) and Tenreyro & Thwaites (2016) due to its specific advantages. The benefits include their estimation via simple linear regression, greater robustness to misspecifications, and the ability to readily incorporate experimentation with nonlinear specifications. Tenreyro and Thwaites (2016) undertook an analysis to explore the reduced efficacy of monetary policy in the context of economic downturns. Furthermore, Stenner (2022) examined the dynamics of monetary policy asymmetry in relation to the United Kingdom.

2.4 State identification

Identifying states is crucial in non-linear analysis, enabling the capture of both past and present economic conditions. Additionally, it influences conditional behavior, enhancing our understanding of policy regimes. State-dependent models are vital since they assume that transitions between regimes or dynamics occur endogenously. Crossing a threshold effectively triggers the policy. Moreover, it is crucial to establish state variables that reflect the anticipatory behaviors of economic agents, given that anticipated future changes in the variable shape their present choices. State identification primarily involves identifying variables that represent the economy's state. (Beaudry & Koop, 1993; Thoma, 1994) Throughout the business cycle, the rate of real production growth served as a measure reflecting the current economic landscape. A switching variable is used in economic models that switch between different regimes or states. It mainly portrays the business cycle in recession and boom. Further, we can consider fluctuations in inflation as well. Kandil (1995) characterized state identification as authentic economic development by analyzing price and wage inflation in conjunction with the asymmetry of real output growth across nineteen industrialized nations. Garcia and Schaller (2002) employed the state variable to represent the output growth rate. The study extends Hamilton's (1989) framework to analyze the implications of monetary policy on state transitions and evaluates the impact of monetary policy shocks on output growth. Irandoust (2020) noted that the key state variables encompass investment, employment, and output. This assertion rests on the premise that once equilibrium is achieved, both output and investment stabilize at a consistent level. There is still a basis on which employment and output are higher. A transient boost in investment has modified capital stock in the long term, resulting in heightened production and employment. As Collignon (2007) emphasized, a non-neutrality in money related to unemployment exists. This became a reason he identified that investment, unemployment, and output can be used as state identification as they can show the regimes of recession and boom. Monetary policy shocks similarly affect total factor productivity and capital accumulation (Jordà et al., 2020; Gopinath et al., 2017; Moran & Queralto, 2018; Benigno & Fornaro, 2018). König (2018) identified the state as the unemployment and output. They analyzed the state's asymmetric response regarding output and unemployment. (Agénor, 2000; Ravn & Sola, 2004) used negative and positive output gaps to check the monetary policy asymmetric effects. The theoretical considerations were that the aggregate supply curve is convex which means it bends inward. The status of the economy is characterized by output,

influenced by theoretical considerations of asymmetric effects. Still, unemployment is also a possibility to check the asymmetric effect and take this as a state of the economy. According to Okun's law, a variation in output has a negative relationship with a variation in unemployment. It is worth investigating to check the asymmetric effects as there is a correlation between output and unemployment (Barnichon et al., 2017; Garibaldi, 1997). Ülke & Berument (2016) analyzed the asymmetric effect on certain macroeconomic variables in Turkey: exchange rate, inflation, and output. Kaufmann (2002) used the Austrian gross domestic product to represent the state. Peersman and Smets (2002) used the industrial production growth rate for state identification. In their 2013 study, Zakir and Malik performed an analysis of the implications of asymmetric monetary policy on the industrial output of Pakistan, which is recognized as a crucial economic factor. Gogas, Pragidis, and Tabak (2018) analyzed the economic landscape using an industrial production index, which functions as a barometer for identifying phases of recession and expansion. Simultaneously, this index operates as a dependent variable within the framework of regression analysis.

2.5 Shock identification

Identifying shocks is crucial to addressing endogeneity in models. When an exogenous variable correlates with other endogenous variables, it causes bias and inconsistent parameter estimates, undermining causal inference. If the shock is linked to other exogenous shocks, it results in a shock identification problem, preventing unique estimation of the model's structural parameters. This identification issue also muddles the impulse response function, complicating the interpretation of individual shocks. Common shock identification methods include Cholesky decomposition, the Narrative method, DSGE models, sign restrictions, Factor-Augmented VARs, Restrictions at Longer Horizons, High-Frequency Identification, and Other Contemporaneous Restrictions. The literature shows ambiguity in defining shock; some researchers equate it with an innovation, as Sims (1980) asserts, describing it as an atheoretical concept. Cochrane critiques Romer & Romer (2004), suggesting a shock is merely an instrument. In simultaneous equations, shocks are typically structural disturbances. Bernanke (1986) emphasized that shocks must hold economic significance and indicated that primitive exogenous shocks should not correlate with other external shocks, current or lag endogenous variables, or exhibit unexpected behavior in predicting future external variables. Techniques like Factor-augmented VAR, restrictions at longer horizons, sign constraints, high-frequency identification,

narrative methodologies, external instruments or proxy SVAR, and Cholesky decomposition are common identification strategies.

Cholesky's decomposition imposes restrictions on contemporaneous coefficients with an alternative set of zero iterative restrictions. "Triangularization" was introduced by Sims (1980) as a common identification method in macroeconomics. The policy variable serves as the focal point for extracting shocks, with two prominent alternatives available for consideration. The policy variable exhibits a lack of responsiveness to endogenous variables within the given period, resulting in a lag in policymaking due to the time required to adjust to prevailing economic conditions. This lack of reaction constrains decision-making, thus the Cholesky ordering places the policy variable first, making it independent of other endogenous variables in the period, as it reacts only to the past. Blanchard and Perotti (2002) demonstrate that government expenditure does not directly react to fluctuations in economic activity and output. Secondly, the impact of policy shocks does not uniformly influence all other endogenous variables within the same period, suggesting a gradual endogenous adjustment to these shocks. This constraint leads to the decision to position the policy variable at the end of the Cholesky ordering. Bernanke and Blinder (1992) utilized this methodology to demonstrate that the federal funds rate constitutes a monetary policy shock.

Another restriction is structural VAR, which employs economic theory to impose constraints on parameters using external estimates (Bernanke, 1986; Blanchard & Watson, 1984).

The narrative method (Romer & Romer, 2010) constructs a series linking identified reasons with specific variable changes through historical documents. Friedman and Schwartz (2008) employ this for monetary policy data, utilizing oil shocks and FOMC minutes for monetary shock series.

High-frequency identification is another method for identifying shocks. A range of empirical investigations (Bagliano & Favero, 1999; Piazzesi & Swanson, 2008; Kuttner, 2001; Gertler & Karadi, 2015; Gürkaynak, Sack, & Swanson, 2005; Nakamura & Steinsson, 2013; Cochrane & Piazzesi, 2002) employ this methodology in conjunction with fluctuations in interest rates (Federal Funds Future) to discern unanticipated Federal Reserve policy interventions based on their timing.

External methods or proxy SVAR is another approach that inculcates the external series for identifying a shock. The technique was developed and implemented by Mertens and Ravn (2013) as well as Stock and Watson (2012). Nonetheless, narrative shocks, DSGE model shocks, and high-frequency information shocks exemplify externally induced shocks, which constitute the primary advantage. External series need to complete two conditions to be identified as valid instruments of shocks because they are noisy measures of actual shock. Firstly, relevance relates to the relationship between the external instrument and the policy shocks. Secondly, exogeneity indicates no correlation between structural shocks and the external instrument utilized.

One can identify shocks by imposition of the restriction at a longer horizon. The important long-run restriction imposition is being used and applied by (Blanchard & Quah, 1988; King et al., 1987; Shapiro, 1988). This mostly illustrates the temporal impacts of a shock instrument. The initial premise regarding monetary policy is that its effects on the economy manifest more swiftly than they do over the long run. The outcomes observed within the limited sample size present further issues for consideration.

Sign restriction is another identification of shock. The shock identification or specification method is mainly called correct when the impulse responses produced from it are reasonable. Sign restriction is mainly used in different contexts, while in policy context, it is used in monetary and fiscal policies. Many researchers' new papers used sign restriction using the Bayesian method (Ahmadi & Uhlig, 2015; Arias, Rubio-Ramirez, & Waggoner, 2014; Baumeister & Hamilton, 2015).

Factor-augmented VARs identify shocks by addressing the belief that VAR variables can't fully capture relevant information. Researchers have developed dynamic factor models using FAVAR (Bernanke et al., 2005; Stock & Watson, 2002), effectively capturing all relevant information across various series. Many implementations still depend on the Cholesky decomposition. Ahmadi and Uhlig (2015) utilized FAVAR's sign restriction.

The primary purpose of DSGE models is identification, as introduced by (Smets & Wouters, 2003; Smets & Wouters, 2007). This involves constructing a detailed model and extracting the full spectrum of implied shocks related to monetary policy, fiscal measures, government spending, technological advancements, markup variations, and risk premiums. The next phase includes constructing impulse response functions from these shocks, widely used by researchers

(Justiniano, Primiceri, & Tambalotti, 2010, 2011; Christiano, Eichenbaum, & Evans, 2005; Schmitt-Grohé & Uribe, 2012).

2.6 Summary and research gap

The effects of asymmetric monetary policy on the economy are widely discussed. Some studies examine its impact on the economy:

Table 2.1. Overview of previous studies

Author	Methodology	Findings
Weise (1999)	VAR	Monetary policy shocks, whether expansionary or contractionary, produce similar effects, but differing magnitudes result in asymmetric impacts.
Boivin and Giannoni (2002)	VAR	Monetary policy's diminished influence lacks evidence.
Ravn and Sola (2004)	VAR	The real effects are due to small tight monetary shocks.
Aye and Gupta (2012)	VAR	Monetary policy shocks show immediate short-term effects, but their impact on prices and output is asymmetric, with a delayed but lasting influence.
Ülke and Berument (2016)	VAR	Loose monetary policy has lesser effects on economic performance compared to tight monetary policy, but the direction of policy matters, too.
Tenreyro and Thwaites (2016)	Smooth transition local projection technique (STLPM)	Monetary policy is less effective during a recession, particularly regarding expenditure and investment. Unlike loose monetary policy, tight policy works better. However, no contractionary shocks were observed during a recession, and this asymmetry didn't clarify their results.
Furceri, Mazzola, and Pizzuto (2019)	Local projection technique	The higher contractionary impacts of tight monetary policy in the US states with smaller businesses, small banks, high manufacturing shares, and higher house prices.
Debortoli et al. (2020)	SVAR	Expansionary monetary policy significantly affects prices, but its impact on output is modest. Conversely, loose monetary policy contrasts with tight monetary policy.

Ultimately, a specific analysis investigates the implications of asymmetric monetary policy on the economic landscape of Pakistan. Utilizing insights from existing literature, Zakir and Malik (2013) examined the non-linear effects of monetary policy on economic output. The analysis delineated

three distinct categories of asymmetry: those pertaining to economic conditions, policy direction, and policy magnitude. Employing a revised VAR model based on Cover's (1992) work, which utilized quarterly data spanning from 1977 to 2011, revealed asymmetrical impacts of policy actions. The study concluded that positive monetary shocks may not be effective in mitigating economic downturns, noting that output responds more significantly to smaller shocks. Additionally, tight monetary policy shocks lower output and should be applied cautiously.

Furthermore, a research gap exists in Pakistan's monetary policy literature. The literature on monetary policy in Pakistan predominantly relies on VAR, GARCH analysis, linear analysis, and traditional time series approaches; however, recent scholarly research has shifted its focus toward transmission mechanisms such as interest rate, exchange rate, and credit channels (Naz, Subhani, & Aslam, 2024; Ahmad, Hussain, Khan, & Bibi, 2025). Meanwhile, these studies do not extend to modeling the state-dependent impact of monetary policy shocks on output and inflation. Despite evidence from international scholarly works indicating that changes in business cycle phases influence the effect of policy (Tenreyro & Thwaites, 2016; Ramey & Zubairy, 2018), the Jordà (2005) local projection method, which is widely adopted in various economies to capture nonlinear and state-dependent impacts (Barnichon & Matthes, 2018), has yet to be applied in Pakistan. This omission presents a significant research gap, as it neglects the cyclical asymmetries in monetary policy impact and potentially misjudges the capacity of monetary policy in an economy characterized by frequent supply shocks, external vulnerabilities, and financial instability. The application of Jordà's technique would offer a nuanced understanding of how monetary policy functions during recessions versus expansions within Pakistan's economy.

Additionally, there is a theoretical gap: Zakir and Malik (2013) used the money supply as a measure of monetary policy shock. This study will identify monetary policy disturbances through interest rates, as indicated by Bernanke and Blinder (1992), emphasizing the crucial role of interest rates in the effectiveness of monetary policy compared to the money supply. The money supply is considered endogenous, driven by the internal dynamics of the economic system. Conversely, the interest rate, functioning as an external shock, should be kept outside the internal system dynamics.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Data

This analysis utilizes quarterly data from the fourth quarter of 1980 through the fourth quarter of 2024 to evaluate the impulse response of inflation and output. Table 3.1 presents the variables utilized in the estimation process.

Table 3.1. Data description

Variables	Definition	Source
Interest rate (i)	1. Call money rate: The percentage rate for loans with shorter payback durations.	State Bank of Pakistan (SBP)
Output	<ol style="list-style-type: none">Industrial production (IP): The industrial production index focuses primarily on manufacturing, the entire manufacturing sector's production within the economy.Gross domestic product (GDP): Within a specified period, usually one year, representing the aggregate monetary value of all goods and services produced within a country's borders.GDP Growth rate: This indicates the rate of growth in a country's GDP over a defined period, usually one year.	<ol style="list-style-type: none">Industrial production: International Financial Statistics (IFS)Gross domestic product and GDP growth rate: State Bank of Pakistan
Inflation rate	A key measure of inflation is the variation in the average prices of a basket of goods and services, as measured by the consumer price index (CPI).	International Financial Statistics (IFS)
Deficit	Deficit (d): It's calculated by subtracting expenditure from revenue.	Ministry of Finance

All variables are employed in logarithmic form, except for the inflation rate and the call money rate. The analysis utilizes the call money rate as an interest rate, primarily functioning as a short-term interest rate within the market framework. The analysis incorporates industrial production into the core model, while gross domestic product serves as the basis for the sensitivity assessment.

Moreover, the incorporation of the GDP growth rate into the baseline model serves to elucidate the impacts of long-term disturbances.

The call money rate functions as a gauge of liquidity and reflects shifts in the stance of monetary policy. A heightened call money rate indicates restricted liquidity circumstances. This variable serves as a proxy for interest rates, which are considered an external shock variable. This event can be classified as an external shock, as it operates independently of the existing market conditions. The industrial production index, quarterly gross domestic product (GDP), and GDP growth rate function as critical metrics for evaluating output levels. The industrial production index functions as a primary gauge of economic activity, appreciated for its accurate representation of the impacts of monetary policy on the economy, as highlighted by Lo & Piger (2005). Christiano, Eichenbaum, and Evans (1999) demonstrated that industrial production within the manufacturing sector reacts more significantly to monetary policy shocks compared to the aggregate output of the economy. An increase in industrial production indicates an expansion in economic performance, while a decline points to a reduction in economic activity. This offers a rationale for the utilization of industrial production within the framework of state identification, as it clearly delineates the economic business cycle. The principal role of GDP is to reflect the economic status of a country. A decrease in GDP indicates a contraction in economic activity, whereas an increase points to growth in the economy. This serves as an essential indicator for evaluating economic circumstances, activity, and production levels. Given that GDP is assessed on an annual basis, it becomes essential to translate it into quarterly metrics. Moreover, GDP serves as a critical variable in sensitivity analysis aimed at identifying states. The growth rate of GDP functions as a fundamental measure of economic output, reflecting the overall health of the economy over time. The State Bank of Pakistan conducts a thorough assessment of GDP growth rates to comprehend the long-term implications and objectives of its monetary policy. A well-adjusted monetary policy is crucial for attaining enduring sustainability. This serves as a rationale for utilizing the GDP growth rate as a variable for state identification in the analysis of the long-term effects of monetary policy shocks. The consumer price index (CPI) will act as an indicator of inflationary movements. The Consumer Price Index serves as an indicator of inflationary trends and offers valuable insights into the cost of living, whereas the central bank utilizes interest rate policies to regulate inflationary pressures. The analysis utilizes the Consumer Price Index as an indicator of inflation to assess the effects of monetary policy shocks on inflation across both short-term and long-term perspectives.

The deficit will affect the interest rate reaction function, responding to fluctuations in interest rates. Furthermore, a notable relationship is evident between the deficit and interest rates.

3.1.1 Quarterization of GDP

For Pakistan, the data on GDP, GDP growth rate, and deficit are primarily available on an annual basis. Industrial production, call money rate, and inflation rate are reported quarterly. Quarterly data is more relevant and important in this literature, as the effects of shocks can be observed. Consequently, there is a lagged effect in the realization of shocks for which high-frequency data is necessary to examine the effects of shocks more thoroughly. If one uses annual frequency data, the shock effects will be muted. Furthermore, econometric techniques require more degrees of freedom, indicating a larger number of observations. This study quarterizes the data for GDP, deficit, and GDP growth rate. Some methods are advantageous for robust quarterization of annual frequency data. The disaggregation from lower to higher time frequency using time series has been conducted by (Boot et al., 1967; Chow & Lin, 1971; Harvey & Chung, 2002; Litterman, 1983; Moauro & Savio, 2005).

Boot et al. (1967) used for switching low-frequency time series data to high-frequency data using ARIMA and state space model setup where the inherent time series information is used in disaggregation. Their study extended the work of Lisman & Sandee (1964). Lisman & Sandee (1964) based it on the fact that if we put no assumption on the quarterly data, then a smooth trend can be attained. A simple procedure is used, which is that the quarterly data must be equal to the annual total, which means quarterly data will be the weighted average of the annual data. The advantage of this procedure is its simplicity. Boot et al. (1967) employed ARIMA to analyze and compare the Lisman-Sandee method with the first and second difference methods. They recognized the necessity of accounting for symmetrical, trend, and cyclical factors. They identified that in the Lisman and Sandee method, one of the main disadvantages is that there are no quarterly values for the first and last year of the series.

The disaggregation problem was addressed in dynamic linear models (DLMs) and generalized least squares (GLSs) by Chow and Lin (1971), Harvey and Chung (2002), Litterman (1983), and Moauro and Savio (2005). Their study converted annual data into quarterly data using co-moving time series which is based on macro-economic theory. Chow & Lin (1971) identified the process of converting quarterly data from annual data using regression based on the best linear unbiased

estimator (BLUE). The main aim of this process is to compute the high-frequency data, ensuring consistency while utilizing associated indicator series. This approach reduces the squared error in the process of distributing annual data across quarterly intervals. And we often use GLS for such constraints. In this method, we must ensure that the quarterly value equals the annual value.

Moauero and Savio (2005) provided a methodology for disaggregating annual time series into quarterly ones using a multivariate structural time series model. The researchers conducted an empirical analysis employing temporal disaggregation, multivariate structural time series models, a state space framework, and a Kalman filter. Temporal disaggregation involves the decomposition of a time series into its constituent quarterly elements. The multivariate structural time series model is considered a pertinent framework into the broader scope of time series analysis. It plays a role in improving accuracy. The state space framework concurrently converts the observed data into a representation of the latent state. This enables the incorporation of trends, seasonal fluctuations, and irregular elements in the analysis of time series data. Nevertheless, the Kalman filter provides an estimation of the underlying states. This method enables the breakdown of the series into its constituent parts.

This study uses the Chow & Lin (1971) method to disaggregate the annual frequency data of GDP, GDP growth rate, and deficit. An indicator series is needed through which the method transforms the series into quarterly data. The indicator series must be in co-movement with the annual frequency series. For GDP and GDP growth rate, the indicator series used is industrial production, whereas for deficit, the indicator series is the interest rate.

The methodology of disaggregating annual frequency data into quarterly data, as proposed by Chow and Lin (1971), possesses certain limitations. Wei and Stram (1990) demonstrated that this method necessitates an indicator series of high frequency; however, many economic variables lack such an indicator, complicating the disaggregation of annual series in the absence of real-time quarterly high-frequency data. Moreover, Silva and Cardoso (2001) argued that this disaggregation framework assumes a linear relationship between the indicator series and the series requiring quarterly segmentation. Nonetheless, many economic variables do not exhibit a symmetric relationship, which may cause the model to overlook the dynamic interactions often observed among economic variables. Additionally, this method presumes a simple autoregressive process of order 1 (AR(1)) for residuals, although a more sophisticated ARIMA process can be employed to

$$X_{t+h} = I_{t-1}[\alpha_{A,h} + \psi_{A,h}(L)Y_{t-1} + \beta_{A,h}shock_t] + (1 - I_{t-1})[\alpha_{B,h} + \psi_{B,h}(L)Y_{t-1} + \beta_{B,h}shock_t] + \varepsilon_{t+h} \text{ for } h = 0,1,2,3, \dots \dots \dots (3.2)$$

This study estimates a series of regressions for every horizon. In the above equation, “*I*” is a binary variable (dummy) that shows the economic state. It is an indicator that determines the economy’s state at time t-1 and takes values of 1 and 0. The economic state specifies 1 and 0, which is expansion and recession. In the model, we allow all coefficients to change according to the change in the economic state. Here, hence we are allowing that X_{t+h} forecast to change according to changes in the economy's state. In this method, the only severe complication comes from the error term’s serial correlation, which is influenced by successive leading. This is a leading of a predicted variable. To cater to such issues, the study will use our standard Newey-West correction (Newey & West, 1986). We use the dependent variable as the industrial production log form.

The Local Projection approach does not impose restrictions on the configuration of the impulse response function, which represents a considerable advantage. Compared to non-linear vector autoregression and Structural Vector Autoregression (SVAR), it is less influenced by misspecification. All variables are unnecessary to enter the equation, meaning the specification would be more parsimonious. At the same time, another big advantage is that the variable that is on the left side will not be required in the same form on the right side. Local Projection does not have a uniform dominance over the standard vector autoregression in formulating the impulse response functions. As it has no imposition of restriction that the impulse response functions of h and $h+1$ are linked, the estimates are unpredictable because of efficiency loss. Secondly, with an increase in horizons, one loses observation at the end of the sample. Thirdly, sometimes, oscillation is shown at the longer horizon in impulse responses. Our state-dependent analysis is mainly short-run, and we are not focused on the long-run horizons.

3.2.1 Shock identification

The independent variable in this study is defined as a monetary policy shock. In contrast, Zakir and Malik (2013) employed the money supply as a measure of monetary policy shock. This analysis will pinpoint monetary policy disturbances through interest rates, as highlighted by Bernanke and Blinder (1992), stressing the essential function of interest rates in the efficacy of

monetary policy relative to the money supply. The money supply is considered to be endogenous, shaped by the internal dynamics of the economic system. Conversely, the interest rate, acting as an external shock, ought to be maintained outside the internal dynamics of the system. This examination will first delineate the response framework of monetary policy and subsequently derive the sequences of both unanticipated and anticipated monetary policy shocks.

The interest rate process is given as follows:

$$\Delta i_t = \sum_{i=1}^{n1} \alpha_{1i} \Delta i_{t-i} + \sum_{i=1}^{n2} \alpha_{2i} \Delta x'_{t-i} + D_t + \varepsilon_t \dots \dots \dots (3.3)$$

Now, the monetary policy shock, which is unexpected, can be derived as,

$$\varepsilon_t = \Delta i_t - [\sum_{i=1}^{n1} \alpha_{1i} \Delta i_{t-i} + \sum_{i=1}^{n2} \alpha_{2i} \Delta x'_{t-i} + D_t] \dots \dots \dots (3.4)$$

In the equation, Δi_t is the interest rate growth rate over time t, α_{1i} is the regressand coefficient where the regressand is lagged, whereas α_{2i} is the coefficient of all other variables. However, the Δi_{t-i} is the dependent variable lagged values, while $\Delta x'_{t-i}$ is another variable vector that includes IP, CPI and primary deficit. Meanwhile, the dummy variable is added, D_t . This variable (D_t) controls misspecification if there are any outliers in the money supply residual.

3.2.2 State identification

This research uses as its starting point the concept that monetary policy does not affect output or simply has a marginal effect over the long term to find the state variable. According to Friedman (1968), Lucas Jr. (1972), Mankiw, Kneebone, & McKenzie (2023), and Taylor (1993), monetary policy does indeed have an impact in the short term. However, it has little bearing on the economy in the long run. Therefore, Lo & Piger (2005) took the transitory output rather than the total output. The output equation below is specified by Lo & Piger (2005). The output equation is given as:

$$y_t = y^p + y_t^T \dots \dots \dots (3.5)$$

$$y_t^T = y_t - y^p \dots \dots \dots (3.6)$$

$$y_t^T = \Omega_0 + \sum_{i=1}^{r1} \Omega_{1i} y_{t-i}^T + \sum_{i=1}^{r2} \Omega_{2i} z'_{t-i} + \vartheta_t \dots \dots \dots (3.7)$$

Here in the equation y_t^T is the output that is transitory over time t . whereas Ω_0 is the intercept and Ω_{1i} is the coefficient of the dependent variable, which has lagged values. While Ω_{2i} is the coefficient of the vector of the other related variables. Meanwhile z'_{t-i} is a vector of all other related variables.

Five methodologies are available for estimating the output gap: the linear trend method, the quadratic trend method, the Hodrick-Prescott filter, the production function method, and the structural vector autoregressive (SVAR) approach. The linear trend model forecasts potential output based on the premise of a steady growth rate. In this framework, the output gap represents the percentage difference between actual output and the projected trend model. The quadratic trend approach involves regressing the logarithm of gross domestic product on time and the square of time, while also including a constant term in the model. The cyclical output is calculated by assessing the disparity between the logarithm of actual output and the estimated values. The Hodrick-Prescott method suggests a gradual trajectory for GDP growth over time, dividing GDP into its potential and cyclical elements, with a smoothing parameter set at 1600 for quarterly data, as introduced by Hodrick and Prescott in 1997. The production function approach links GDP growth to inputs including capital, labor, and total factor productivity, utilizing the Cobb-Douglas production function for estimation purposes. The residual obtained from the logarithmic transformation undergoes smoothing via the HP filter to derive potential output, while the disparity between actual and potential output constitutes the cyclical output. The structural vector autoregressive methodology, rooted in the contributions of Blanchard and Quah (1988), combines theoretical models with statistical methods to differentiate between transitory and enduring components of output. The BQ method exclusively considers supply-side shocks, effectively neutralizing any demand-side shocks in the analysis. This approach first computes the reduced-form VAR and identifies the structural shocks, then produces responses to clarify the manner in which output responds to these shocks. Ultimately, it disaggregates output into its transitory and enduring elements.

The output gap determines the transient level of output. The assessment of this output gap employs the HP filter (Hodrick & Prescott, 1997) alongside the quadratic trend model. ul Haq Satti and Malik (2017) illustrated that linear trend models fail to accurately capture the dynamics of the business cycle, as they tend to exaggerate its intensity and introduce end sample bias. Conversely,

the remaining four methods serve as reliable indicators for assessing business cycle fluctuations in Pakistan. Nonetheless, the production function methodology and the quadratic time trend model produce outcomes that are more consistent with the observed fluctuations in the business cycle.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Shock identification

The Vector AutoRegression (VAR) model is employed to assess the shock using a two-step approach. The Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SIC) function as methodologies for evaluating the most suitable lag length. The VAR model is structured to include a total of four lags, as dictated by the established criteria for lag length. The assessment of the stationarity of the variables is performed through the application of the Dickey-Fuller test. The examination reveals that the interest rate holds steady at its existing level, while both the deficit and industrial production exhibit stationarity when evaluated at the first difference. Moreover, the consumer price index exhibits stability at the second difference. The ε_t generated by the equation predominantly signifies the shock element, particularly the monetary policy shock.

Figure 4.1 illustrates the monetary policy shock generated by the two-step methodology using the VAR model, showing a pronounced rise followed by a decline in interest rates from 1993 to 2000. Subsequently, the shock means reverting. All of the fluctuations move around the mean. Furthermore, the stability test confirms the stationarity of the shock.

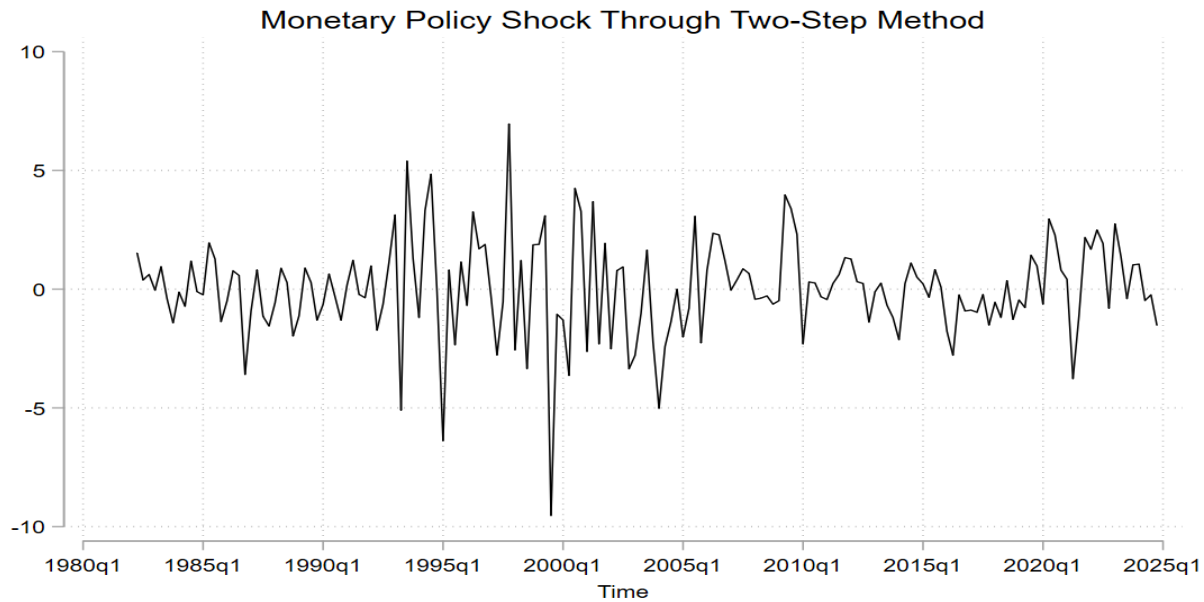


Figure 4.1 Monetary policy shock through the two-step method

There are some spikes in the interest rate from 1993 to 2000. The economy at that time was torn by a higher budget deficit, a high inflation rate, and external factors. The rising inflation rate has necessitated the application of interest rates as a mechanism to address the upward trend in prices. The connection between inflation and interest rates is highlighted by the Fisher hypothesis. Furthermore, Pakistan was suffering from a fiscal deficit. The fiscal deficit was, in turn, causing inflation. This demanded a higher interest rate, which can compensate the lenders as the government was taking domestic debt to match their expenses and crowding out private investment. Some of the external factors also has a contribution to the interest rate abnormal behaviour. The external factors encompassed the unstable global economic environment, fluctuations in oil prices, and the Asian financial crisis of 1997, which led to reduced investment and constrained economic conditions.

The approach of change in interest rate is utilized for performing sensitivity analysis. Figure 4.2 illustrates the computed monetary policy shock obtained through this methodology. Change in interest rate results in sudden changes in the shock, while the overarching trend continues to align with the mean.

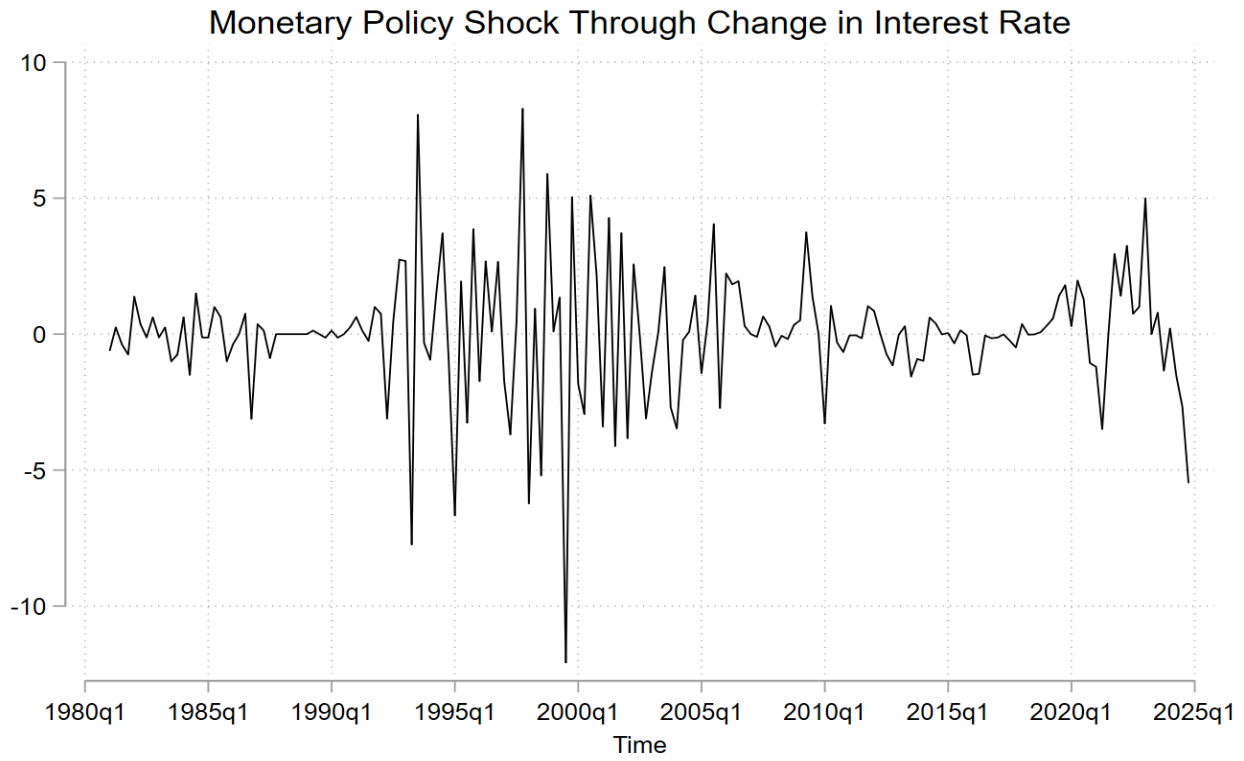


Figure 4.2. Monetary policy shock through a change in interest rate

4.2 State identification

The quadratic trend model is used to determine the output gap. Industrial production is taken as a proxy for output. The quadratic trend model predicts the potential output. For calculating the cyclical output, this study used the methodology of Lo & Piger (2005). The cyclical output is calculated by subtracting the actual output from the potential output. Figure 4.3 illustrates the cyclical and potential output calculated through the quadratic trend model.

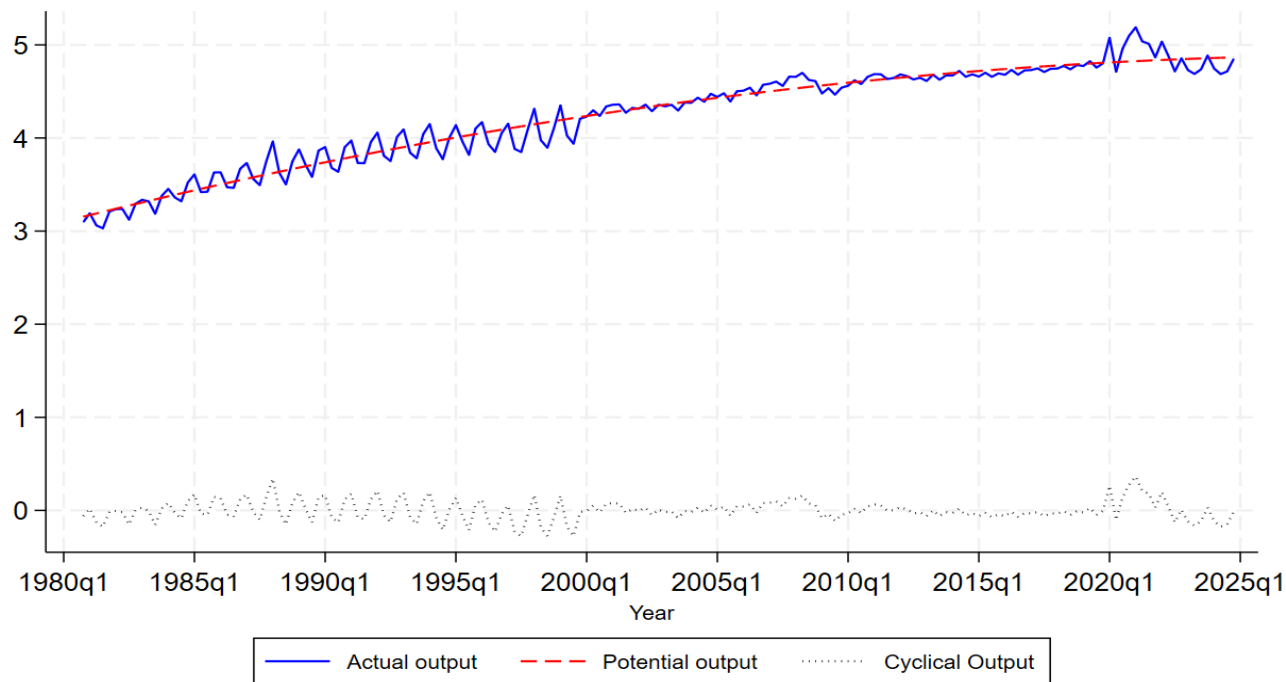


Figure 4.3. Cyclical output using a quadratic trend model

The black dotted line represents cyclical output, which has been detrended and only indicates fluctuations in the business cycle. Subsequently, the blue line represents the actual output, and the red dashed line represents the potential output.

For sensitivity analysis, this study modified the methodology used to estimate cyclical output. Cyclical output is also generated by changing the trend to linear and cubic. The graph displays cyclical output calculated using the HP filter, along with the trend being changed to linear and cubic, based on industrial production data available in the appendix. Other graphs with different state variables are also added in the appendix; the state variable is GDP, and the methods used are the HP filter, the quadratic trend model, and experimenting with different trends, such as linear and cubic. The graphs based on GDP are also available in the appendix.

Furthermore, this study aimed to investigate the cyclical fluctuations in inflation as well. The appendix provides the graphs generated for cyclical inflation based on the HP filter, quadratic trend model, and experimentation with changing the trends to linear and cubic to check for changes in the results.

4.3 Impact of Monetary Policy Shock

This analysis utilizes the Local Projection Method to assess the impulse response function (IRF) of cyclical output and inflation in reaction to exogenous monetary policy (MP) shocks over a span of 20 horizons. Following this, two models are constructed: a linear model and a state-dependent non-linear model. The impulse responses are generated on robust estimates which avoid the potential risk of serial correlation and heteroskedasticity. Additionally, disturbances are illustrated through the two-step approach to interest rate fluctuations. The two-step approach derives the MP reaction function utilizing the VAR model, from which the residual is subsequently extracted. This residual is then employed as an external shock, tackling endogeneity issues associated with the shock by identifying the unexplained element of the MP response function derived from fluctuations in interest rates. The analysis of cyclical output and inflation employs a quadratic time trend model, which is designed to focus solely on the short-term economic responses, particularly those variations linked to the business cycle. Figure 4.4 below presents the IRF of cyclical output and inflation in response to a MP shock.

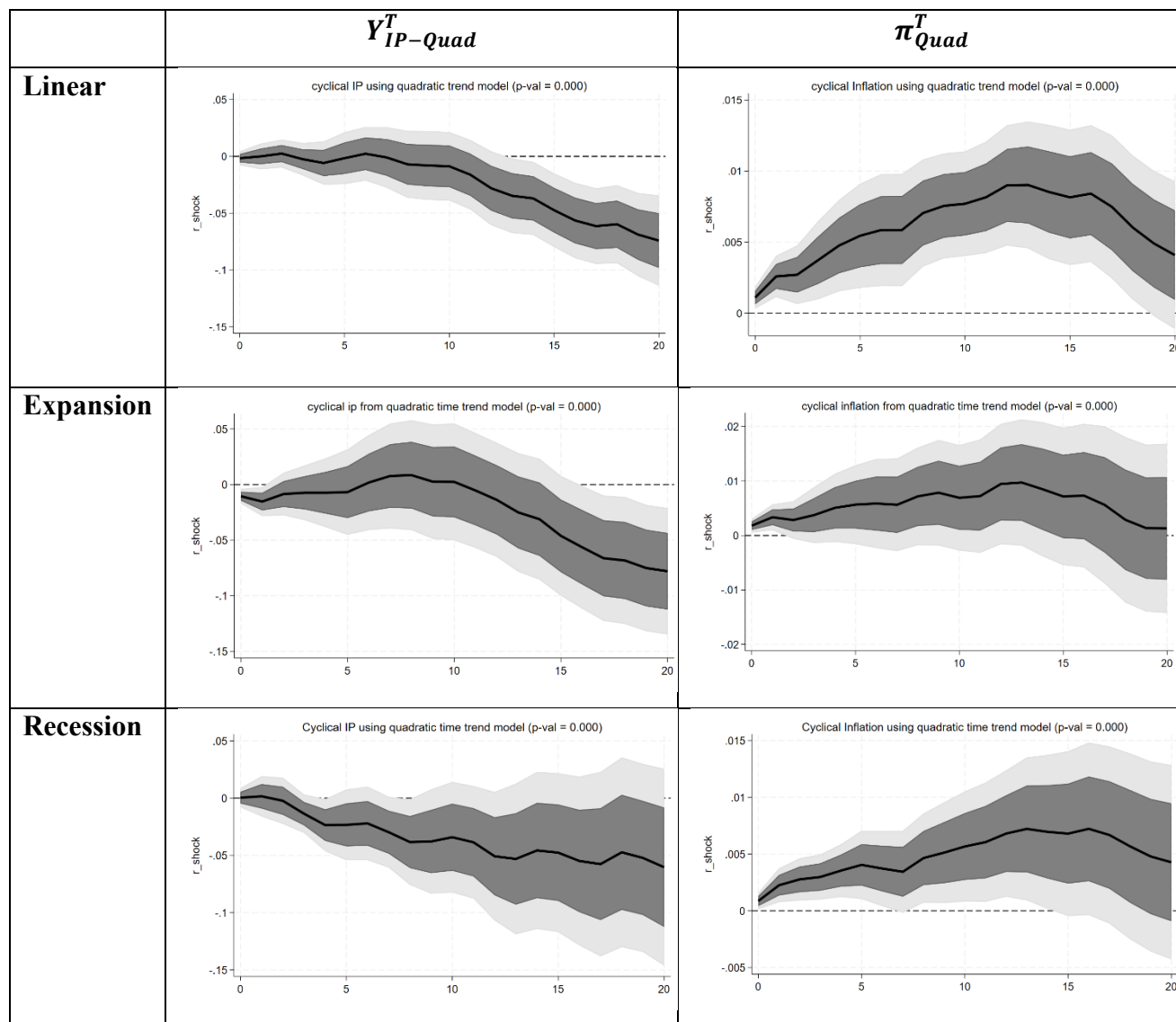


Figure 4.4. Response of cyclical output and inflation to two-step interest rate shock

Note: The illustration presents the impulse responses of cyclical industrial production and inflation in reaction to an interest rate shock, derived through a two-step methodology. The cyclical elements of industrial output and inflation are ascertained via a quadratic time trend model. The local projection method evaluates the impulse responses over a duration of 20 horizons. The dark grey bands represent a 90% confidence interval, while the light grey bands indicate a 95% confidence interval. Two models are evaluated: one characterized by linearity and the other by state dependence. The model that depends on the state integrates both phases of recession and expansion.

Figure 4.4 demonstrates that the linear IRF of cyclical fluctuations in output in response to an MP shock exhibits an insignificant effect until the 10th horizon but then becomes significant after the 10th horizon and remains significant till the 20th horizon. Empirical studies conducted by Aye and Gupta (2012), Khundrakpam (2017), and Zakir and Malik (2013) examine and substantiate the

asymmetrical effects of MP shocks. A potential explanation for this could be the delayed effects of MP transmission, as noted by Atiq-ur-Rehman et al. (2022) and Agha et al. (2005). Additionally, alternative explanations may involve the presence of inefficiencies within the exchange rate and credit markets, which can diminish the impact of MP, as highlighted in the research conducted by Choudhri, Jan, and Malik (2015) and Ullah, Wajid, and Khan (2016). Furthermore, the analysis that accounts for varying economic states illustrates the effects of MP shocks on output in both periods of economic expansion and contraction. During the expansionary phase, the response of cyclical output to an MP shock is initially significant for two horizons and then becomes insignificant till the 15th horizon but later becomes significant after the 15th horizon and remains significant till the 20th horizon. Conversely, in a recessionary phase, the initial impulse response of cyclical output to MP remains insignificant for three horizons. However, the effect becomes significant for the 4th, 5th, and 6th horizons, then again becomes insignificant for the seventh horizon, and returns significant for the 9th and 10th horizons, and later becomes insignificant from the 9th to the 20th horizons. Meanwhile, the effect is in a negative direction. This suggests that production decreases as a result of MP disturbances in the context of an economic downturn. This may suggest a delayed response to MP measures. Furthermore, it underscores the importance of MP during a recession and emphasizes the need for careful implementation. The observed outcomes are consistent with the empirical evidence presented by Zakir and Malik (2013). The findings presented here are consistent with the empirical evidence gathered from various international studies (Morgan, 1993; Bernanke, 1990; Bernanke & Gertler, 1986; Garcia & Schaller, 2002; Kaufmann, 2002; Barnichon, Matthes, and Sablik, 2017). Empirical studies (Shah et al., 2011; Ahmed et al., 2013; Khan & Nishat, 2011) offer potential theoretical frameworks indicating that both firms and households face heightened financial constraints. This situation results in a pronounced impact on consumption and investment, often referred to as the financial accelerator. Additionally, factors such as sticky prices, nominal wage rigidity, and liquidity constraints contribute to a suppression of demand.

Moreover, Figure 4.4 demonstrates that the linear model indicates the impact of a MP shock on cyclical inflation is significant and later in the start of 20th horizons becomes insignificant. The MP shocks create a positive effect on inflation. The possible theoretical reason may be the weaker credibility of central banks, as highlighted by studies (Choudhri, Jan, and Malik, 2015; Ullah, Wajid, & Khan, 2016). The positive effect on inflation may be due to supply-side and cost-push

factors. On the supply side, cost-push factors (Choudhary et al., 2016) and price stickiness (Choudhary et al., 2016; Munir, 2017) contribute to more persistent inflation, complicating the central bank's targeting policy. Khan and Gill (2010) highlighted that inflation is primarily influenced by the depreciation of the exchange rate and the increasing cost of imports. The interaction of these elements leads to inflationary pressures stemming from cost-push and supply-side dynamics. Choudhary et al. (2016) noted that exchange rate shocks and cost-push factors are incorporated into prices more meticulously than demand-pull shocks and financial costs. Furthermore, the analysis that accounts for different states of the economy demonstrates the response of cyclical inflation to MP shocks in both expansionary and recessionary phases. During a period of economic expansion, the response of cyclical inflation to shock is initially significant for three horizons and later remains insignificant for 17 horizons. Conversely, during a recessionary phase of the economy, the initial impulse response of cyclical inflation to MP shocks is statistically significant and positive for six horizons, then becomes insignificant for the 7th horizon, and then becomes significant for 7th to 16th horizons, but later after the 16th horizon remains insignificant till the 20th horizon. The possible theoretical reasons may be supply-side pressure, the lagged adjustment mechanism of MP, and the price puzzle. Numerous studies (Rashid et al., 2019; Ilyas et al., 2023; Javid & Munir, 2010; Atiq-ur-Rehman et al., 2022; Agha et al., 2005) elucidate these theoretical frameworks, highlighting phenomena such as the price puzzle, the credit channel—where fluctuations in interest rates primarily affect borrowing costs, subsequently influencing prices—and the lagged adjustment mechanism inherent in MP. The reasons are underscored on a global scale by the works of Sims (1992), Christiano, Eichenbaum, and Evans (1999), Balke and Emery (1994), Barnichon, Matthes, and Sablik (2017), Bernanke and Gertler (1986), and Nachane and Lakshmi (2002).

4.3.1 Robustness analysis

The strength of the results is evaluated by revising the impulse response function through a monetary policy shock induced by a change in the interest rate. The analysis of robustness is conducted to assess the effects of monetary policy shocks on cyclical output and inflation by altering the methodology used for shock identification. Figure 4.5 below illustrates the impulse responses of the monetary policy shock with respect to cyclical output and inflation, analyzed through both linear and state-dependent models.

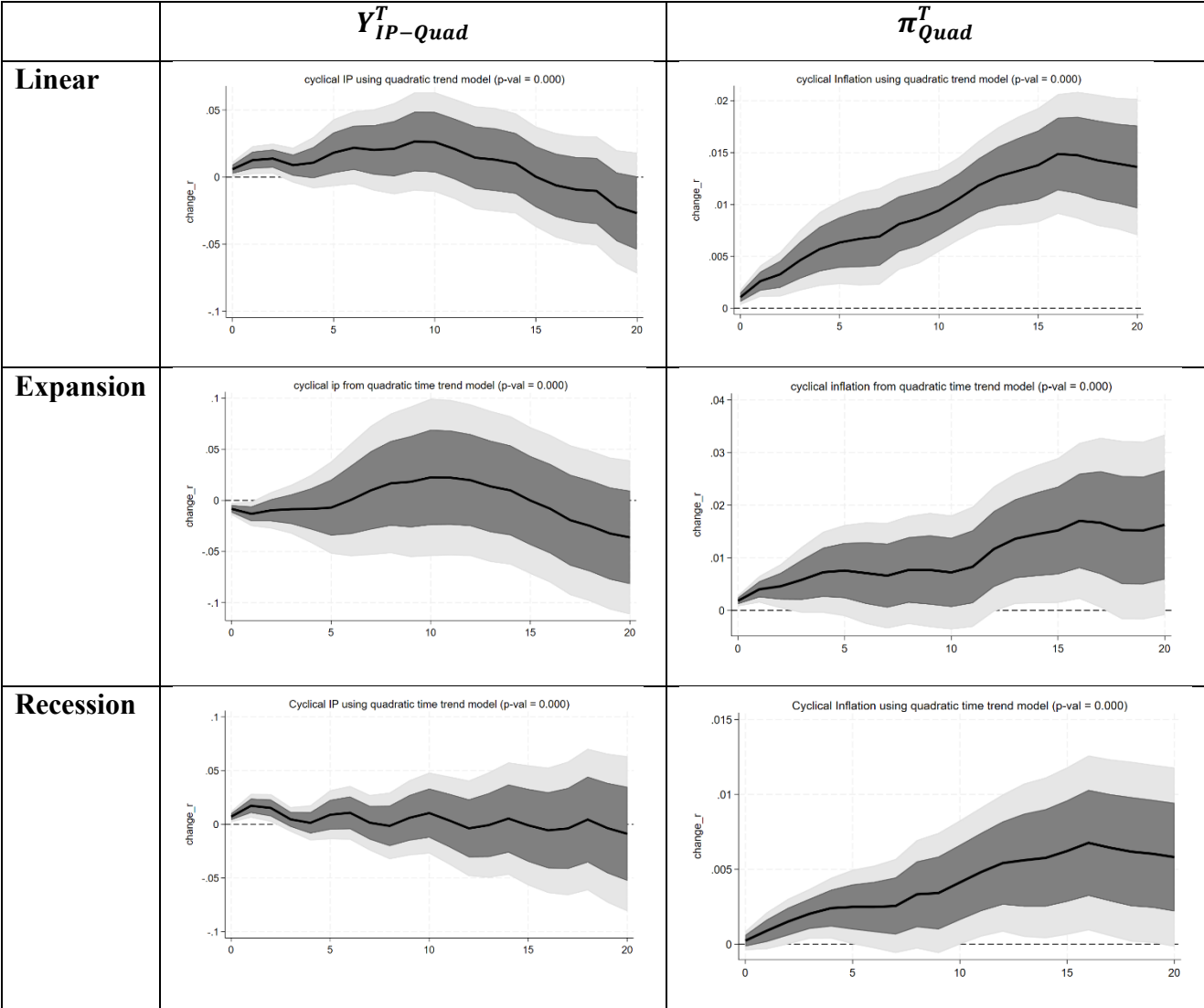


Figure 4.5. Response of cyclical output and inflation to a change in interest rate shock

Note: The graph illustrates the reaction of cyclical industrial production and inflation to a shock in interest rates, determined by fluctuations in the interest rate. The cyclical elements of industrial output and inflation are obtained through the application of a quadratic time trend model. The local projection method is utilized to assess the impulse responses across a time frame of 20 periods. The dark grey bands indicate a 90% confidence interval, while the light grey bands denote a 95% confidence interval. This analysis includes two distinct frameworks: a linear framework and a state-dependent framework. The state-dependent model encompasses both recessionary and expansionary phases.

Figure 4.5 demonstrates that the linear model reveals the cyclical output's response to an MP shock exhibits a hump-shaped pattern in connection with a change in interest rate. The impact is initially significant for 3 horizons and then becomes insignificant for the 17 horizons. This observation indicates that MP is essential for regulating the demand side of the economy, whereas raising interest rates appears to be ineffective in reducing current output levels. Moreover, the state-

dependent model illustrates how cyclical output reacts to MP shocks in both periods of economic expansion and contraction. During the expansionary phase, the cyclical output's reaction to MP shocks is initially significant; nonetheless, the impact becomes statistically insignificant from the 3rd to the 20th horizon. In contrast, throughout the recessionary phase, the impact of MP shocks on cyclical output is particularly significant during the first two periods. It continues to show insignificance over the next 18 periods. Possible explanations for this phenomenon could include a delayed effect of MP transmission mechanisms. Furthermore, additional elements that may play a role encompass corporate outlooks, consumer forecasts, investment climates, domestic political factors, creditor trustworthiness, and the accessibility of credit.

Additionally, Figure 4.5 illustrates that the linear model reveals a significant response of cyclical inflation to MP shocks, with a notable sustained increase in cyclical inflation observed over 20 horizons. The theoretical justification can be linked to the price puzzle phenomenon, which emerges from the interdependence of monetary variables and supply-side dominant factors that affect inflation. Furthermore, the state-dependent models demonstrate how cyclical inflation reacts to MP shocks across both expansionary and recessionary periods within the economic cycle. During the expansionary phase, the initial response of cyclical inflation to MP shocks is significant for the first four horizons. Then it becomes insignificant from the 4th to the 11th horizon and becomes significant from 11 to the 17th horizon, but after the 17th horizon, the effect becomes insignificant till the 20th horizon. In contrast, throughout the recessionary phase, the impact of cyclical inflation in response to MP shocks is initially insignificant but then significant from the 2nd to the 6th horizon and becomes insignificant for 3 horizons from the 6th to the 9th horizon and then becomes significant from the 9th to the 19th horizon and then becomes insignificant for the 20th horizon. This indicates that monetary shocks have a diminished effect on inflationary pressures in times of recession. Possible factors could encompass cost-push phenomena, limitations in supply, and the rigidity of prices on the downside.

The strength of the findings is further analyzed by estimating the IRF through variations in the interest rate and employing a two-step methodological shock. The state variable is modified to include cyclical industrial production calculated using the Hodrick-Prescott (HP) filter, cyclical GDP derived from the Quadratic trend model, and the HP filter. Furthermore, the sensitivity

analysis is also conducted using three lags and four lags, rather than two lags, to verify the reliability of the results. For all these, check Appendix A.

4.4 Monetary policy shock impact on growth rates

This paper analyzes the impact of MP shocks on short-term cyclical output and inflation, while also exploring the long-term consequences for GDP growth and inflation rates. The growth rate of GDP evaluates the enduring effects of the MP shock on economic output. The determination of the MP shock employs a two-step methodology. Figure 4.5 below presents the IRF concerning GDP growth and inflation rates within both linear and state-dependent frameworks (expansion and recession).

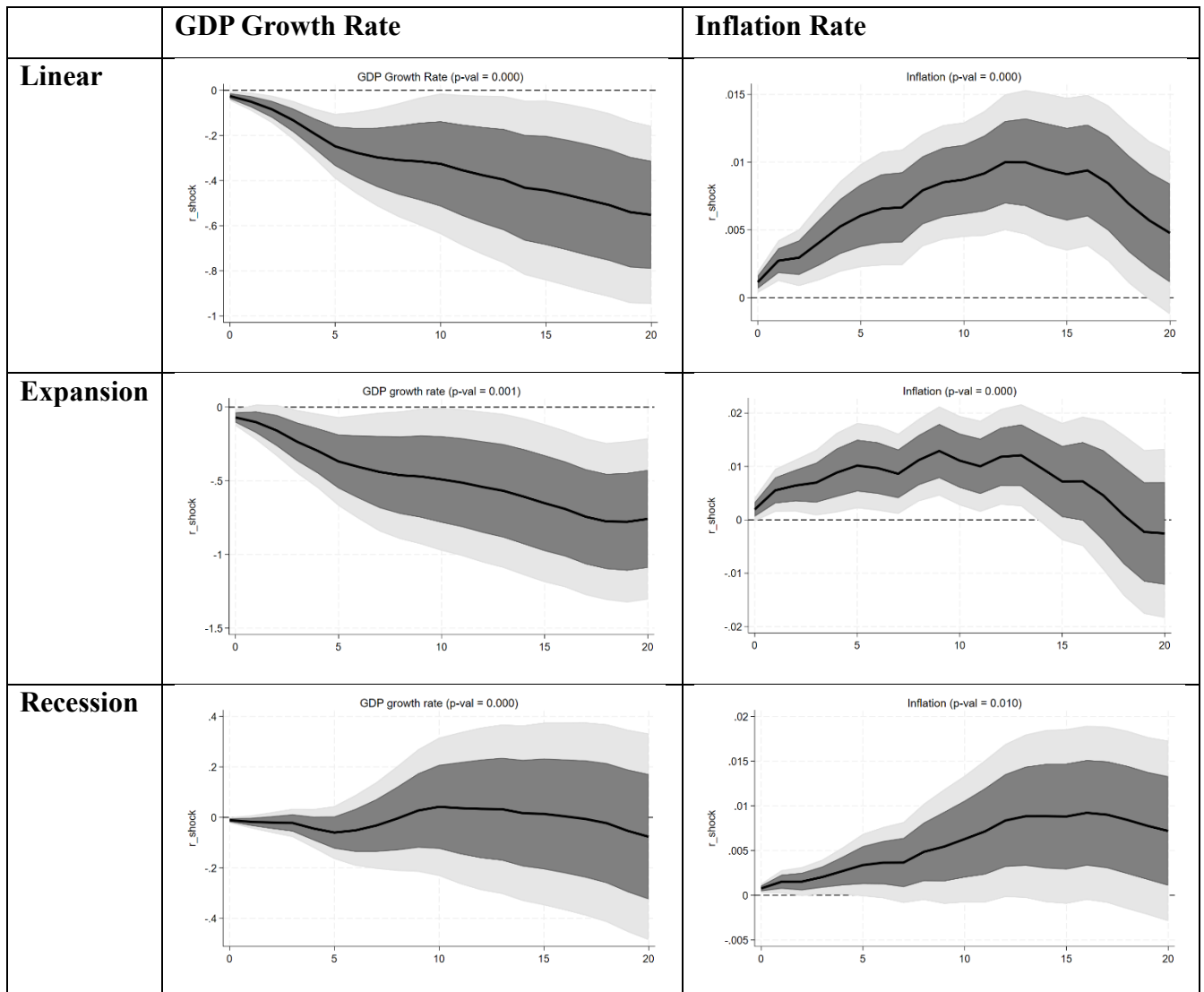


Figure 4.6. Response of GDP growth rate and inflation rate to a two-step interest rate shock

Note: The presented figure demonstrates the impulse responses of the growth rate of Gross Domestic Product (GDP) and the inflation rate in reaction to an interest rate shock, calculated through a two-step methodology. The local projection method is utilized to assess these impulse responses across a span of 20 horizons. The dark grey bands denote a 90% confidence interval, while the light grey bands indicate a 95% confidence interval. Two distinct models exist: one characterized by linearity and the other by state dependence. The state-dependent model includes both periods of economic contraction and growth.

Figure 4.6 demonstrates that the linear model indicates the IRF of the GDP growth rate to a MP shock is significantly negative across 20 horizons. The state-dependent model illustrates how the GDP growth rate reacts to a MP shock across both expansionary and recessionary phases of the economic cycle. During the expansionary phase, the growth rate of GDP exhibits a negative response, akin to the linear model. Furthermore, the impact is statistically significant. Conversely, in the recessionary phase of the economy, the GDP growth rate shows insignificance of effect across all 20 horizons. The likely theoretical justification for the linear model is that MP exhibits asymmetric effects, which a linear model cannot adequately represent. Moreover, the efficacy of MP tends to be greater in periods of economic expansion compared to recessions. This may be attributed to the robust transmission mechanisms present during expansions, where economic agents exhibit heightened responsiveness in the face of capacity constraints and demand pressures. On the other hand, a plausible theoretical explanation during periods of recession could be that the transmission mechanism of MP is less effective. In periods of elevated economic uncertainty, both households and firms tend to exhibit reduced responsiveness.

Moreover, Figure 4.6 demonstrates that the linear model indicates a statistically significant positive impulse response of the inflation rate to MP shocks, with the effect becoming insignificant only at the 20th horizon. The state-dependent model illustrates how the inflation rate reacts to MP shocks in both expansionary and recessionary economic conditions. During the expansionary phase, the inflation rate's reaction to MP shocks remains significant for 15 horizons and then becomes insignificant for onward horizons till the 20th. In the context of a recessionary phase, the inflation rate initially exhibits a notable positive response to monetary policy shocks for the five horizons. Then it remains insignificant for the next 15 horizons till the 20th horizon. The potential theoretical explanation for the observed positive significant effect could be attributed to the presence of the price puzzle phenomenon alongside supply-side factors. Conversely, in periods of expansion, the likely theoretical explanation could stem from the dynamic adjustment of the inflation rate, as firms tend to maintain their prices when markups are elevated and demand conditions are robust.

4.4.1 Robustness analysis

The robustness analysis explores the IRF by re-evaluating it in light of the change in interest rate, which is considered the MP shock. Figure 4.7 below illustrates the IRF of GDP growth and inflation rates in reaction to a change in interest rates, analyzed through both linear and state-dependent models during phases of economic expansion and contraction.

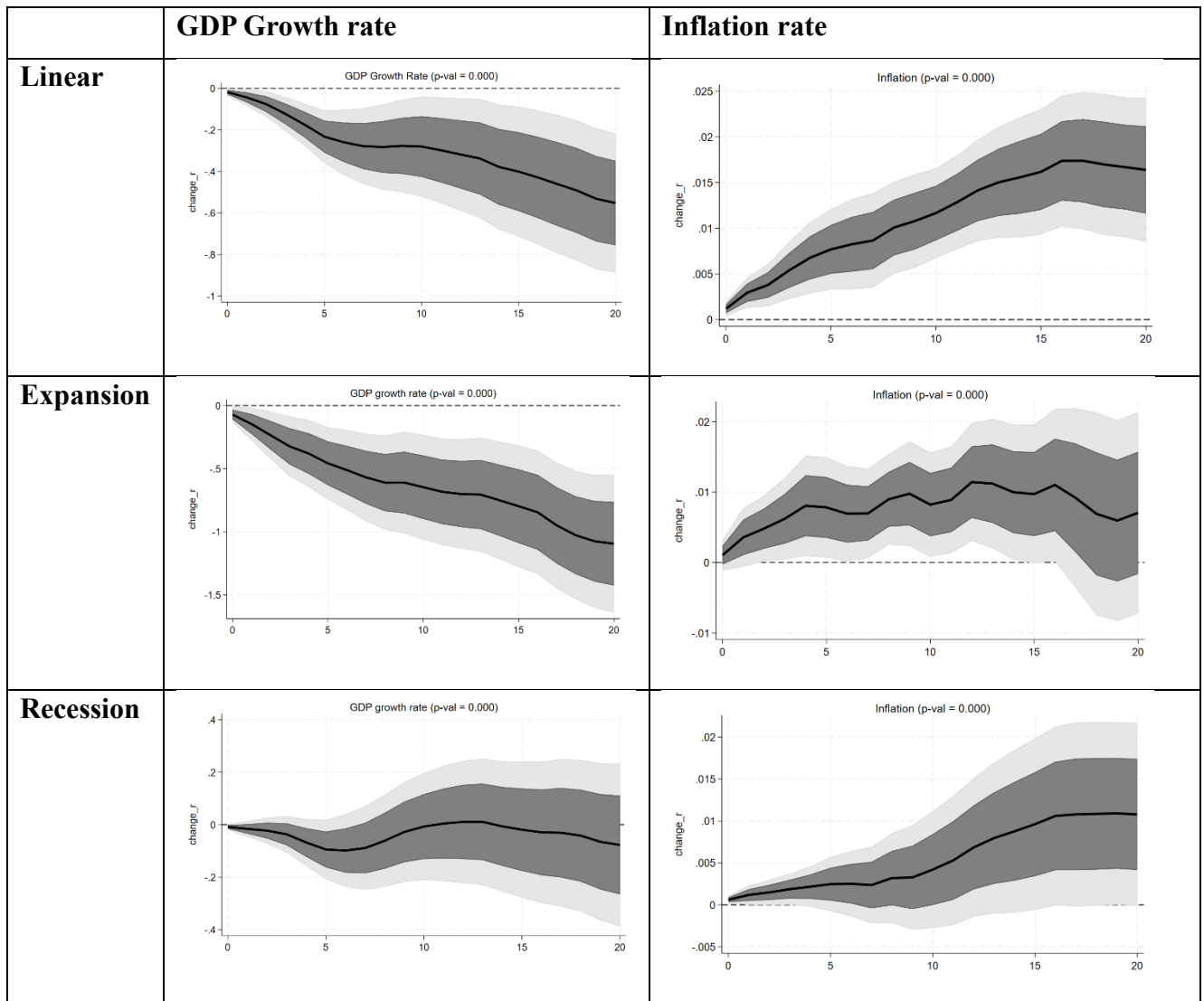


Figure 4.7. Response of GDP growth rate and inflation rate to change in interest rate shock

Note: The illustration presents the impulse responses of GDP growth and the inflation rate in response to a fluctuation in the interest rate shock, employing the local projection technique over a span of twenty horizons. The dark gray bands represent a 90% confidence interval, while the light gray bands indicate a 95% confidence interval. Two models are introduced: the first is linear, while the second is a state-dependent model that integrates both recessionary and expansionary phases.

Figure 4.6 demonstrates that the linear model reveals the response of the GDP growth rate to MP shocks is notably significant for all 20 horizons. Furthermore, the state-dependent models clarify how the GDP growth rate reacts to monetary policy shocks in both the expansionary and recessionary phases of the economic cycle. During the expansionary phase, the inflation rate's reaction to MP shocks remains significant for 15 horizons and then becomes insignificant for onward horizons till the 20th. Conversely, in the context of a recessionary phase, the GDP growth rate's reaction to MP shocks is notably insignificant across all twenty horizons examined. The significant responses observed in the linear model may be attributed to the fact that economic agents typically respond more acutely to upward rate changes, as the price rigidity model corroborates. Furthermore, the notable response of the GDP growth rate during expansion, relative to during recession, could be explained by the behavior of firms and households acting as active borrowers. Additionally, the response to the inflation rate is statistically insignificant across all horizons. This observation may stem from firms' reluctance to adjust their prices during periods of expansion due to prevailing demand conditions. Conversely, the lack of significance during recessionary periods may be attributed to the unresponsiveness of economic agents to policy changes during economic downturns, driven by their pessimistic outlook, credit constraints, and diminished marginal efficiency of capital.

Furthermore, Figure 4.7 demonstrates that the linear model reveals a notable positive reaction of the inflation rate to MP shock across 20 horizons. Consequently, the state-dependent model clarifies how the inflation rate reacts to MP shock in both the expansionary and recessionary phases of the economic cycle. During the expansionary phase, the inflation rate's reaction to the MP shock is negligible across the 20 horizons analyzed. In contrast, in the context of a recession, the inflation rate initially exhibits a notable positive response to monetary policy shocks for the five horizons. Then it remains insignificant for the next 15 horizons till the 20th horizon. The favorable reaction of the inflation rate within the linear model could be linked to endogeneity, the price puzzle, and supply-side influences. Moreover, the findings from the linear model indicate the asymmetrical effects associated with MP shocks. The minimal reaction observed during expansion phases, as opposed to recessions, can be explained by firms' reluctance to modify their pricing strategies in light of demand fluctuations, particularly when inflation expectations remain stable. Conversely, the significant positive effect during the recession may originate from the predominance of supply-side factors and expectation-based pricing, which is calibrated to a perceived signal of future

inflation. Additionally, this situation indicates reverse causality, suggesting that a modification in interest rates produces a favorable change in inflation. Such phenomena may be interpreted as manifestations of the price puzzle.

Further sensitivity analysis also examines the monetary policy effectiveness on GDP growth rate and inflation over 3 lags and 4 lags rather than using 2 lags. For this check, see appendix A.

4.5. Annual analysis of monetary policy shock

An inquiry has arisen regarding whether the discretization of variables influences the information contained within the data. Furthermore, there are inherent limitations associated with the discretization technique that may potentially distort the data. This research employed annual data, as published, to evaluate the impact of monetary policy shocks on cyclical output and inflation, as well as to estimate their effects on GDP growth and the inflation rate. Subsequently, the study utilized both the two-step method and the change-in-interest-rate shock variation to assess the impact on an annual basis. The analysis demonstrates that both approaches produce similar effects; however, the effects observed in the annual data are more pronounced and persistent. The visibility and duration of these effects are attributed to the infrequency of the data. For additional reference, please consult the results provided in the appendix, where they are included (Figures A22, A23, A24, A25).

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

In Pakistan, the overall MP serves as an essential instrument for the central monetary authority to address the complexities of the economy, especially concerning inflation and output across various economic conditions. Since 2019, there has been a significant example of proactive engagement by monetary policy. In response to rising price levels, the central monetary authority has initiated a trajectory of increasing interest rates, commonly known as the policy rate. The upward trend in interest rates persisted until June 2023, culminating in a peak of 22 percent, marking a historical high. The implementation of this restrictive MP was a response to ongoing economic instability. Driven by various economic factors, this study aims to examine the asymmetric impact of MP on both output and inflation. This study primarily investigates the question: “Does monetary policy influence changes in response to shifts in the economic landscape?” This analysis utilizes quarterly data spanning from the fourth quarter of 1980 to the fourth quarter of 2024 and applies the local projection technique (Jordà, 2005) to produce IRF across a 20-period horizon. Furthermore, this approach presents specific benefits that position it as a viable alternative for estimating IRF via vector autoregression (VAR). The benefits include the ability to estimate it using straightforward linear regression, its robustness to model misspecifications, and its capacity to facilitate experimentation with nonlinear specifications. The IRF is produced for both the short-run and long-run scenarios. This empirical study employs a quadratic time trend model and the Hodrick-Prescott filter to analyze the cyclical component of output and inflation in the context of the short-run IRF. This study employs the growth rates of output and inflation to analyze the long-run IRF. The method of Quarterization proposed by Chow & Lin (1971) is employed to convert annual data on GDP, GDP growth rate, and deficit into quarterly figures. Furthermore, in the context of state identification, this analysis employs the methodology established by Lo & Piger (2005). Following this, the identification of shock is conducted via the MP reaction function employing a two-step approach through the VAR model, as utilized by Zakir and Malik (2013). The response of MP is contingent upon the interest rate. According to the findings of Bernanke and Blinder (1992), the interest rate variable serves as a MP shock, as it accounts for a significant portion of the fluctuations observed within the economy.

The findings of the study validate the asymmetrical impact of MP shocks. Furthermore, the foundational model for short-run IRF, employing interest rate shocks via a two-step approach, reveals that the reaction of cyclical output is significant in the initial period and later period. However, the effect between the periods is insignificant. In contrast, the reaction of cyclical output is notably significant over some horizons during the recessionary phase of the economy. The potential theoretical explanations for the insignificant output response during periods of expansion could stem from a diminished marginal impact of interest rates, lessened financial friction, an ineffective transmission mechanism, as well as the influence of business and consumer expectations, fiscal dominance, and prevailing political and economic instability. Furthermore, the theoretical underpinnings of the importance of output during a recession may encompass the financial accelerator mechanism (where firms and households face heightened financial constraints, resulting in a more pronounced impact on consumption and investment), price stickiness, state-dependent expectations, loss aversion, nominal wage rigidity, and liquidity constraints, all of which contribute to a decline in demand. Moreover, the reaction of cyclical inflation is initially significant but becomes insignificant over most of the horizons. In contrast, during the recessionary phase, the response of cyclical inflation is significant for the first six horizons before becoming statistically insignificant. Then it becomes significant for another nine horizons and then becomes insignificant at the last horizon. The insignificant reaction of inflation in times of economic expansion could be attributed to the presence of anchored expectations. Furthermore, the theoretical foundations for the initial importance of cyclical inflation during a recession can be linked to price puzzles, the credit channel—where interest rates influence borrowing costs, subsequently impacting prices—and the delayed adjustment process of MP.

This study further examined the long-term effects of MP shocks on both output and inflation metrics. The long-term indicator of inflation is the variation in price levels, whereas the GDP growth rate signifies economic output. The linear model substantiates the asymmetrical effects of MP shocks on GDP growth and inflation rates over the long term. The foundational model for long-term IRF, utilizing an interest rate shock via a two-step approach, reveals that the reaction of GDP growth is markedly negative during the economic expansion phase. The response of GDP growth is insignificant during the recessionary phase of the economy. The fundamental theoretical explanation for the observed negative statistical significance of GDP growth during the expansionary phase lies in the robustness of the transmission mechanism. Economic agents tend

to exhibit heightened responsiveness in the presence of capacity constraints and demand pressures. The effectiveness of policy measures is improved when credit constraints are more stringent and resource utilization is maximized. The theoretical rationale for the initial negative significance of output during the recessionary phase may be attributed to the diminished responsiveness of households and firms in the context of elevated economic uncertainty. Furthermore, the inflation rate's response is significant at most of the horizons but is insignificant at the end of the horizons in the expansion phase. In contrast, it exhibits a consistently significant positive response across some of the horizons in the recessionary phase. Consequently, the theoretical rationale for the lack of significance of the inflation rate during periods of expansion may stem from the adjustments made to inflation in a stable environment. Companies tend to maintain their pricing structures when the markup is elevated and demand conditions exhibit greater intensity. Furthermore, there are counterbalancing elements, including robust demand dynamics, a constrained labor market, and the delayed effects of MP adjustments. Additionally, the theoretical rationale for the positive significance of the inflation rate during a recession may stem from the "pushing on a string" concept, which suggests that in periods of economic slack, consumers exhibit reduced sensitivity to interest rate fluctuations, thereby reinforcing nominal rigidities. This situation is further influenced by the predominance of supply-side factors, expectation-driven inflation, and the occurrence of the price puzzle phenomenon, which indicates a reverse causality between interest rates and the inflation rate.

The key policy recommendations based on the findings suggest that the central bank should implement a monetary policy (MP) that responds to changing economic conditions, as the effects of such policies vary with the state of the economy. An important aspect for the State Bank of Pakistan is adopting a nonlinear, state-dependent framework to enhance the effectiveness of MP.

Results demonstrate that monetary policy has asymmetric effects depending on the state of the economy, and a secular policy change based on conventional symmetrical impacts would be sterile. During the slack time, an increase in the policy rate significantly reduces the output gap, but at the cost of higher inflation. An increase in price in response to an increase in interest rate is known as the price puzzle and is evident in the literature. This phenomenon is often attributed to the foresight of central banks; they raise interest rates in anticipation of future inflation, which then materializes. Consequently, cautious monetary policy entails making data-driven, incremental policy

adjustments accompanied by clear communication to manage market expectations. On the other hand, in the case of a non-slack economy, the impact of a monetary policy change on both output and prices is insignificant. Therefore, during the non-slack period, the stance of the monetary authorities must remain close to the neutral interest rate, as the findings indicate that monetary policy initially has a minimal impact on output but later becomes significant, while having no substantial impact on the inflation rate. An active monetary policy in a non-slack period could lead to inefficient economic outcomes and overheating the economy. Subsequently, in the long run, during the non-slack period, the monetary authority should use the monetary policy cautiously as findings reveal that monetary policy shocks have a significant effect on output and inflation. During the slack period, monetary authorities shouldn't use monetary policy for long-term growth and inflation because the findings illustrate that monetary policy shocks have a slight impact on GDP growth rate, and the impact on inflation is initially significant but later becomes insignificant. So, monetary authorities should actively manage the price level expectations of the economic agent rather than policy intervention.

The limitations of this study are primarily due to the data. Most of the variables are not recorded quarterly, which results in using Chow and Lin estimation techniques to quarterizes variables such as GDP, GDP growth rate, and deficit. Subsequently, Chow and Lin's method also has some limitations. Another primary limitation concerns the directional asymmetry of MP. Due to the scarcity of data points, estimating the IRF, which indicates the effectiveness of MP in different economic states, has been hindered. The data limitations have also constrained the study's ability to assess the impact entirely, as numerous variables were unavailable at quarterly intervals.

REFERENCES

- Abbritti, M., & Fahr, S. (2013). Downward wage rigidity and business cycle asymmetries. *Journal of monetary economics*, 60(7), 871-886.
- Abel, A. B., & Eberly, J. C. (1993). A unified model of investment under uncertainty. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Agénor, P.-R. (2000). *Monetary policy under flexible exchange rates: an introduction to inflation targeting* (Vol. 124). World Bank Publications.
- Agénor, P. R. (2001). *Asymmetric effects of monetary policy shocks*. *World Bank Working Paper*, 20433.
- Agha, A. I., Ahmed, N., Mubarik, Y. A., & Shah, H. (2005). *Transmission mechanism of monetary policy in Pakistan*. *SBP-Research Bulletin*, 1(1), 1-23.
- Ahmadi, P. A., & Uhlig, H. (2015). *Sign restrictions in Bayesian FAVARs with an application to monetary policy shocks* (No. w21738). National Bureau of Economic Research.
- Ahmed, W., CHOUDHARY, M., Khan, S., MAHMOOD, S., & Zoega, G. (2013). Sticky Wages in a Developing Country: Lessons from Structured Interviews in Pakistan1. *Discussion Papers in Economics*, 2, 13.
- Ahmad, B., Hussain, A., Khan, F., Bibi, N., & Saeed, A. (2025). Interest Rate Enigma: Cracking the Code in Pakistan's Retail Banking. *International Journal of Business and Management Sciences*, 6(1), 393-411.
- Akram, T. (2016). Japan's liquidity trap. *Levy Economics Institute, Working Papers Series, Working Paper*, (862).
- Alvarez, L. J., Dhyne, E., Hoeberichts, M., Kwapil, C., Le Bihan, H., Lünemann, P., Martins, F., Sabbatini, R., Stahl, H., & Vermeulen, P. (2006). Sticky prices in the euro area: a summary of new micro-evidence. *Journal of the European Economic association*, 4(2-3), 575-584.
- Arden, R., Cook, S., Holly, S., & Turner, P. (2000). The asymmetric effects of monetary policy: Some results from a macroeconometric model. *The Manchester School*, 68(4), 419-441.
- Arias, J., Rubio-Ramirez, J. F., & Waggoner, D. F. (2014). Inference based on SVARs identified with sign and zero restrictions: Theory and applications.
- Ascari, G., & Haber, T. (2022). Non-linearities, state-dependent prices and the transmission mechanism of monetary policy. *The Economic Journal*, 132(641), 37-57.
- Atiq-ur-Rehman, M., Nasim, I., Ayub, M., & Ibraheem, R. (2022). Transmission Lags of Monetary Policy: Probing into Pakistan's Untamed Inflation. *iRASD Journal of Economics*, 4(2), 329-336.
- Aye, G. C., & Gupta, R. (2012). Are the effects of monetary policy asymmetric in India? evidence from a nonlinear Vector Autoregression Approach. *Trends in Applied Sciences Research*, 7(7), 565.

- Bagliano, F. C., & Favero, C. A. (1999). Information from financial markets and VAR measures of monetary policy. *European economic review*, 43(4-6), 825-837.
- Ball, L., & Mankiw, N. G. (1994). Asymmetric price adjustment and economic fluctuations. *The Economic Journal*, 104(423), 247-261.
- Ball, L. (1995). Disinflation with imperfect credibility. *Journal of Monetary economics*, 35(1), 5-23.
- Ball, L., & Romer, D. (1990). Real rigidities and the non-neutrality of money. *The Review of Economic Studies*, 57(2), 183-203.
- Balke, N. S., & Emery, K. M. (1994). Understanding the price puzzle. Federal Reserve Bank of Dallas Economic Review, Fourth Quarter, 15-26.
- Barnichon, R., & Matthes, C. (2016). Gaussian mixture approximations of impulse responses and the non-linear effects of monetary shocks.
- Barnichon, R., Matthes, C., & Sablik, T. (2017). Are the effects of monetary policy asymmetric. *Richmond Fed Economic Brief*, 3, 1-4.
- Barro, R. J. (1977). Unanticipated money growth and unemployment in the United States. *Beihfte zu Kredit und Kapital*, 186.
- Barro, R. J. (1978). Unanticipated money, output, and the price level in the United States. *Journal of political economy*, 86(4), 549-580.
- Barro, R. J., & Hercowitz, Z. (1980). Money stock revisions and unanticipated money growth. *Journal of monetary economics*, 6(2), 257-267.
- Batini, N., & Laxton, D. (2007). Under what conditions can inflation targeting be adopted? The experience of emerging markets. Series on Central Banking, Analysis, and Economic Policies, no. 11.
- Baumeister, C., & Hamilton, J. D. (2015). Sign restrictions, structural vector autoregressions, and useful prior information. *Econometrica*, 83(5), 1963-1999.
- Beaudry, P., & Koop, G. (1993). Do recessions permanently change output? *Journal of monetary economics*, 31(2), 149-163.
- Benigno, G., & Fornaro, L. (2018). Stagnation traps. *The Review of Economic Studies*, 85(3), 1425-1470.
- Benigno, G., & Fornaro, L. (2019). *The Keynesian Growth Approach to Macroeconomic Policy and Productivity*.
- Benigno, P., & Antonio Ricci, L. (2011). The inflation-output trade-off with downward wage rigidities. *American economic review*, 101(4), 1436-1466.
- Bernanke, B., & Blinder, A. (1992). The Federal Funds Rate and the Channels of Monetary Transmission. *American economic review*, 82(4), 901-921.
- <https://EconPapers.repec.org/RePEc:aea:aecrev:v:82:y:1992:i:4:p:901-21>

- Bernanke, B. S. (1986). Alternative explanations of the money-income correlation. *Carnegie-Rochester Conference Series on Public Policy*, 25, 49-99. [https://doi.org/https://doi.org/10.1016/0167-2231\(86\)90037-0](https://doi.org/10.1016/0167-2231(86)90037-0)
- Bernanke, B. S. (1990). The federal funds rate and the channels of monetary transmission. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Bernanke, B. S., & Blinder, A. S. (1988). Credit, money, and aggregate demand. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Bernanke, B. S., Boivin, J., & Elias, P. (2005). Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. *The Quarterly Journal of Economics*, 120(1), 387-422.
- Bernanke, B. S., & Gertler, M. (1986). Agency costs, collateral, and business fluctuations. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Bernanke, B. S., & Gertler, M. (1995). Inside the black box: the credit channel of monetary policy transmission. *Journal of Economic perspectives*, 9(4), 27-48.
- Bernanke, B. S., Gertler, M., & Gilchrist, S. (1994). The financial accelerator and the flight to quality. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Blanchard, O., & Perotti, R. (2002). An empirical characterization of the dynamic effects of changes in government spending and taxes on output. *The Quarterly Journal of Economics*, 117(4), 1329-1368.
- Blanchard, O., & Watson, M. W. (1984). Are Business Cycles All Alike? *Macroeconomics: Prices*.
- Blanchard, O. J., & Quah, D. (1988). The dynamic effects of aggregate demand and supply disturbances. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Boivin, J., & Giannoni, M. P. (2002). Has monetary policy become less powerful? *FRB of New York Staff Report*(144).
- Boivin, J., Kiley, M. T., & Mishkin, F. S. (2010). How has the monetary transmission mechanism evolved over time? In *Handbook of monetary economics* (Vol. 3, pp. 369-422). Elsevier.
- Bomfim, A. N., & Rudebusch, G. D. (2000). Opportunistic and deliberate disinflation under imperfect credibility. *Journal of Money, Credit and Banking*, 707-721.
- Boot, J. C. G., Feibes, W., & Lisman, J. H. C. (1967). Further Methods of Derivation of Quarterly Figures from Annual Data. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 16(1), 65-75.
- Boschen, J. F., & Grossman, H. I. (1982). Tests of equilibrium macroeconomics using contemporaneous monetary data. *Journal of monetary economics*, 10(3), 309-333.

- Brito, R. D., & Bystedt, B. (2010). Inflation targeting in emerging economies: Panel evidence. *Journal of Development Economics*, 91(2), 198-210.
- Buiter, W. H. (2002). The fiscal theory of the price level: A critique. *The Economic Journal*, 112(481), 459-480.
- Bukhari, S. (2021). Measuring Monetary Policy Effects in Pakistan: An FAVAR Approach. *Research Mosaic*, 1(2), 01-11.
- Caballero, R. J., & Engel, E. (1992). Price rigidities, asymmetries, and output fluctuations. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Carroll, C., Slacalek, J., & Sommer, M. (2012). Dissecting saving dynamics: measuring credit, wealth and precautionary effects.
- Carroll, C. D., & Kimball, M. S. (2001). Liquidity constraints and precautionary saving. In: National Bureau of Economic Research Cambridge, Mass., USA.
- Challe, E., & Ragot, X. (2016). Precautionary saving over the business cycle. *The Economic Journal*, 126(590), 135-164.
- Chen, Y. (2015). Loss Aversion and Business Cycle Asymmetry. *University of Maryland*.
- Chib, S., & Greenberg, E. (1996). Markov chain Monte Carlo simulation methods in econometrics. *Econometric theory*, 12(3), 409-431.
- Chow, G. C., & Lin, A.-I. (1971). Best linear unbiased interpolation, distribution, and extrapolation of time series by related series. *The Review of Economics and Statistics*, 372-375.
- Choudhri, E. U., Jan, A., & Malik, H. (2015). Monetary Policy in Pakistan. *Effectiveness in Inflation Control and Stabilization*, 01-37.
- Choudhary, M. A., Faheem, A., Hanif, M. N., Naeem, S., & Pasha, F. (2016). Price setting & price stickiness: A developing economy perspective. *Journal of Macroeconomics*, 48, 44-61.
- Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Chapter 2 Monetary policy shocks: What have we learned and to what end? In *Handbook of Macroeconomics* (Vol. 1, pp. 65-148). Elsevier. [https://doi.org/https://doi.org/10.1016/S1574-0048\(99\)01005-8](https://doi.org/https://doi.org/10.1016/S1574-0048(99)01005-8)
- Christiano, L. J., Eichenbaum, M., & Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of political economy*, 113(1), 1-45.
- Cochrane, J. H., & Piazzesi, M. (2002). The fed and interest rates—a high-frequency identification. *American economic review*, 92(2), 90-95.
- Collignon, S. (2007). Long run effects of short-term non-neutrality of money. *Discussion Pa series (in preparation)*, Institut für Makroökonomie und Konjunkturforschung (IMK) in Hans Böckler Stiftung, Berlin/Dfese/c.Äw.

- Cover, J. P. (1992). Asymmetric effects of positive and negative money-supply shocks. *The Quarterly Journal of Economics*, 107(4), 1261-1282.
- Cukierman, A., & Meltzer, A. H. (1986). A theory of ambiguity, credibility, and inflation under discretion and asymmetric information. *Econometrica: journal of the econometric society*, 1099-1128.
- De Long, J. B., Summers, L. H., Mankiw, N. G., & Romer, C. D. (1988). How does macroeconomic policy affect output? *Brookings Papers on Economic Activity*, 1988(2), 433-494.
- Debortoli, D., Forni, M., Gambetti, L., & Sala, L. (2020). Asymmetric effects of monetary policy easing and tightening.
- Dixit, A. K., & Pindyck, R. S. (1994). *Investment under uncertainty*. Princeton university press.
- Erceg, C. J., & Levin, A. T. (2003). Imperfect credibility and inflation persistence. *Journal of monetary economics*, 50(4), 915-944.
- Eusepi, S., & Preston, B. (2018). Fiscal foundations of inflation: imperfect knowledge. *American Economic Review*, 108(9), 2551-2589.
- Fagan, G., & Messina, J. (2009). Downward wage rigidity and optimal steady-state inflation.
- Florio, A. (2004). The asymmetric effects of monetary policy. *Journal of Economic Surveys*, 18(3), 409-426.
- Friedman, M. (1968). The Role of Monetary Policy. *The American Economic Review*, 58(1), 1-17.
- Friedman, M. (1961). The lag in effect of monetary policy. *Journal of Political Economy*, 69(5), 447-466.
- Friedman, M., & Schwartz, A. J. (2008). A monetary history of the United States, 1867-1960.
- Frydman, R., & Rappoport, P. (1987). Is the distinction between anticipated and unanticipated money growth relevant in explaining aggregate output? *The American Economic Review*, 77(4), 693-703.
- Furceri, D., Mazzola, F., & Pizzuto, P. (2019). Asymmetric effects of monetary policy shocks across US states. *Papers in Regional Science*, 98(5), 1861-1892.
- Garcia, R., & Schaller, H. (2002). Are the effects of monetary policy asymmetric? *Economic inquiry*, 40(1), 102-119.
- Garibaldi, P. (1997). The asymmetric effects of monetary policy on job creation and destruction. *Staff papers*, 44(4), 557-584.
- Gertler, M. (1988). Financial structure and aggregate economic activity: an overview.
- Gertler, M., & Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, 7(1), 44-76.
- Gogas, P., Pragidis, I., & Tabak, B. M. (2018). Asymmetric effects of monetary policy in the US and Brazil. *The Journal of Economic Asymmetries*, 18, e00108.
- Golosov, M., & Lucas Jr, R. E. (2007). Menu costs and Phillips curves. *Journal of political economy*, 115(2), 171-199.

- Gonçalves, C. E. S., & Salles, J. M. (2008). Inflation targeting in emerging economies: What do the data say?. *Journal of Development Economics*, 85(1-2), 312-318.
- Goodfriend, M., & King, M. (2016). *Review of the Riksbank's Monetary Policy 2010-2015*. Sveriges riksdag.
- Gopinath, G., Kalemli-Özcan, Ş., Karabarbounis, L., & Villegas-Sanchez, C. (2017). Capital allocation and productivity in South Europe. *The Quarterly Journal of Economics*, 132(4), 1915-1967.
- Granger, C., & Terasvirta, T. (1994). *Modelling Non-Linear Economic Relationship* (Vol. 61). <https://doi.org/10.2307/1060764>
- Granger, C., & Yoon, G. (2002). Hidden cointegration. U of California. *Economics Working Paper*, (2002-02), 10.
- Granger, C. W. J., & Teräsvirta, T. (1995). Modelling Nonlinear Economic Relationships.
- Gruen, D., Romalis, J., & Chandra, N. (1999). The lags of monetary policy. *Economic Record*, 75(3), 280-294.
- Gürkaynak, R. S., Sack, B., & Swanson, E. (2005). The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models. *American economic review*, 95(1), 425-436.
- Hamilton, J. D. (1985). Historical causes of postwar oil shocks and recessions. *The Energy Journal*, 6(1), 97-116.
- Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica: journal of the Econometric Society*, 357-384.
- Hamilton, J. D. (1990). Analysis of time series subject to changes in regime. *Journal of econometrics*, 45(1-2), 39-70.
- Harvey, A., & Chung, C.-H. (2002). Estimating the Underlying Change in Unemployment in the UK. *Journal of the Royal Statistical Society Series A: Statistics in Society*, 163(3), 303-309. <https://doi.org/10.1111/1467-985x.00171>
- Hicks, J. R. (1937). Mr. Keynes and the "classics"; a suggested interpretation. *Econometrica: journal of the Econometric Society*, 147-159.
- Hodrick, R. J., & Prescott, E. C. (1997). Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking*, 29(1), 1–16. <https://doi.org/10.2307/2953682>.
- Hoover, K. D., & Perez, S. J. (1994). Post hoc ergo propter once more an evaluation of ‘does monetary policy matter?’ in the spirit of James Tobin. *Journal of monetary economics*, 34(1), 47-74.
- Ilyas, S., Ali, M., Dilawar, S., Abbas, A., & Sheikh, M. R. (2023). Monetary Policy Effectiveness in Pakistan: A Reassessment of Four Transmission Channels. *Bulletin of Business and Economics (BBE)*, 12(3), 964-981.

- Irاندوست, M. (2020). The effectiveness of monetary policy and output fluctuations: An asymmetric analysis. *Australian Economic Papers*, 59(2), 161-181.
- Javid, M., & Munir, K. (2010). The price puzzle and monetary policy transmission mechanism in Pakistan: Structural vector autoregressive approach. *The Pakistan Development Review*, 449-460.
- Johnson, D. R. (1997). Expected inflation in Canada 1988-1995: an evaluation of Bank of Canada credibility and the effect of inflation targets. *Canadian Public Policy/Analyse de Politiques*, 233-258.
- Johnson, D. (1998). The credibility of monetary policy: international evidence based on surveys of expected inflation. *Price Stability, Inflation Targets, and Monetary Policy*, 361-395.
- Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American economic review*, 95(1), 161-182.
- Jordà, Ò., Singh, S. R., & Taylor, A. M. (2020). The Long-Run Effects of Monetary Policy. *Macroeconomics: Aggregative Models eJournal*.
- Justiniano, A., Primiceri, G. E., & Tambalotti, A. (2010). Investment shocks and business cycles. *Journal of monetary economics*, 57(2), 132-145.
- Justiniano, A., Primiceri, G. E., & Tambalotti, A. (2011). Investment shocks and the relative price of investment. *Review of Economic Dynamics*, 14(1), 102-121.
- Kakes, J. (1998a). Monetary transmission and business cycle asymmetry.
- Kakes, J. (1998b). *Monetary transmission and business cycle asymmetry*.
- Kandil, M. E. (1995). Asymmetric Nominal Flexibility and Economic Fluctuations. *Southern Economic Journal*, 61, 674.
- Karras, G. (1996). Are the output effects of monetary policy asymmetric? Evidence from a sample of European countries. *Oxford Bulletin of Economics and Statistics*, 58(2), 267-278.
- Karras, G., & Stokes, H. H. (1999). Why are the effects of money-supply shocks asymmetric? Evidence from prices, consumption, and investment. *Journal of Macroeconomics*, 21(4), 713-727.
- Kashyap, A. K., & Stein, J. C. (1994). Monetary policy and bank lending. In *Monetary policy* (pp. 221-261). The University of Chicago Press.
- Kaufmann, S. (2002). *Is there an asymmetric effect of monetary policy over time? A Bayesian analysis using Austrian data*. Springer.
- Keynes, J. M. (1936). The general theory of employment, interest and money. In: Macmillan.
- Keynes, J. M., & Skidelsky, R. (2016). *The Essential Keynes*. Penguin Publishing Group.
<https://books.google.com.pk/books?id=Tv4WCAAAQBAJ>
- Khan, R. E. A., & Gill, A. R. (2010). Determinants of inflation: A case of Pakistan (1970-2007). *Journal of economics*, 1(1), 45-51.

- Khan, K., & Nishat, M. (2011). Permanent income hypothesis, myopia and liquidity constraints: A case study of Pakistan. *Pakistan Journal of Social Sciences*, 31(2), 299-307.
- Khan, M. U. H. (2008). Short run effects of an unanticipated change in monetary policy: Interpreting macroeconomic dynamics in Pakistan. *State Bank of Pakistan Working Paper*, 22, 51-8.
- Khundrakpam, J. K. (2017). Examining the asymmetric impact of monetary policy in India. *Margin: The Journal of Applied Economic Research*, 11(3), 290-314.
- Kilian, L., & Vigfusson, R. J. (2011). Are the responses of the US economy asymmetric in energy price increases and decreases? *Quantitative Economics*, 2(3), 419-453.
- Kilinc, M., & Tunc, C. (2019). The asymmetric effects of monetary policy on economic activity in Turkey. *Structural Change and Economic Dynamics*, 51, 505-528.
- Kim, J., & Ruge-Murcia, F. J. (2009). How much inflation is necessary to grease the wheels? *Journal of monetary economics*, 56(3), 365-377.
- King, R. G., Plosser, C. I., Stock, J. H., & Watson, M. W. (1987). Stochastic trends and economic fluctuations. In: National Bureau of Economic Research Cambridge, Mass., USA.
- König, J. (2018). Asymmetric effects of monetary policy.
- Kuttner, K. N. (2001). Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. *Journal of monetary economics*, 47(3), 523-544.
- Larsson, R., Lyhagen, J., & Löthgren, M. (2001). Likelihood-based cointegration tests in heterogeneous panels. *The Econometrics Journal*, 4(1), 109-142.
- Laxton, D., Meredith, G., & Rose, D. (1995). Asymmetric effects of economic activity on inflation: Evidence and policy implications. *Staff papers*, 42(2), 344-374.
- Leeper, E. M. (1991). Equilibria under 'active' and 'passive' monetary and fiscal policies. *Journal of monetary Economics*, 27(1), 129-147.
- Lenz, C. (1997). Asymmetric effects of monetary policy in Switzerland. *REVUE SUISSE D ECONOMIE POLITIQUE ET DE STATISTIQUE*, 133, 441-454.
- Litterman, R. B. (1983). A Random Walk, Markov Model for the Distribution of Time Series. *Journal of Business & Economic Statistics*, 1(2), 169-173. <https://doi.org/10.2307/1391858>
- Lisman, J. H. C., & Sandee, J. (1964). Derivation of quarterly figures from annual data. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 13(2), 87-90.
- Lo, M. C., & Piger, J. (2005). Is the response of output to monetary policy asymmetric? Evidence from a regime-switching coefficients model. *Journal of Money, Credit and Banking*, 865-886.
- Lowe, P. (1995). What Determines the Degree of Pass-Through?| RDP 9504: The Link Between the Cash Rate and Market Interest Rates. *Reserve Bank of Australia Research Discussion Papers*, (May).

- Lucas Jr, R. E. (1972). Expectations and the Neutrality of Money. *Journal of economic theory*, 4(2), 103-124.
- Lucas Jr, R. E. (1975). An equilibrium model of the business cycle. *Journal of political economy*, 83(6), 1113-1144.
- Lucas, R. E. (1973). Some international evidence on output-inflation tradeoffs. *The American Economic Review*, 63(3), 326-334.
- Mankiw, N. G., Kneebone, R. D., & McKenzie, K. J. (2023). *Principles of Macroeconomics, 9th Edition*. Cengage Canada. <https://books.google.com.pk/books?id=Hm22EAAAQBAJ>
- Mankiw, N. G. (1985). Small menu costs and large business cycles: A macroeconomic model of monopoly. *The Quarterly Journal of Economics*, 100(2), 529-538.
- Mayer, T. (1967). The lag in the effect of monetary policy: some criticisms. *Economic Inquiry*, 5(4), 324-342.
- Mazhar, A., & Malik, A. M. (2024). Growth Imperatives of Monetary Policies in Pakistan: Historical Analysis. *Pakistan Research Journal of Social Sciences*, 3(2).
- McKay, A., & Wieland, J. F. (2021). Lumpy durable consumption demand and the limited ammunition of monetary policy. *Econometrica*, 89(6), 2717-2749.
- Mertens, K., & Ravn, M. O. (2013). The dynamic effects of personal and corporate income tax changes in the United States. *American economic review*, 103(4), 1212-1247.
- Midrigan, V. (2011). Menu costs, multiproduct firms, and aggregate fluctuations. *Econometrica*, 79(4), 1139-1180.
- Mishkin, F. S. (1982). Does anticipated monetary policy matter? An econometric investigation. *Journal of political economy*, 90(1), 22-51.
- Moauro, F., & Savio, G. (2005). Temporal disaggregation using multivariate structural time series models. *The Econometrics Journal*, 8(2), 214-234.
- Moran, P., & Queralto, A. (2018). Innovation, productivity, and monetary policy. *Journal of monetary economics*, 93, 24-41.
- Morgan, D. (1993). Asymmetric effects of monetary policy. *Economic Review*, 78(Q II), 21-33. <https://EconPapers.repec.org/RePEc:fip:fedker:y:1993:i:qii:p:21-33:n:v.78no.2>
- Munir, K. (2017). Dynamic effects of monetary policy on output and prices in Pakistan: a disaggregate analysis. *Journal of the Asia Pacific Economy*, 23(1), 99–118. <https://doi.org/10.1080/13547860.2017.1354517>
- Nachane, D. M. (2002). Changing Monetary Policy Lags and Liberalisation in India. *The Indian Economic Journal*, 50(1), 6-16.

- Nakamura, E., & Steinsson, J. (2013). *High frequency identification of monetary non-neutrality*. National Bureau of Economic Research.
- Naz, M., Subhani, W., & Aslam, S. (2024). Does Volatility Transmission Between Stock and Foreign Exchange Markets in Pakistan Reveal Asymmetry?. *Asian Finance Research Journal (AFRJ)*.
- Newey, W. K., & West, K. D. (1986). A simple, positive semi-definite, heteroskedasticity and autocorrelationconsistent covariance matrix.
- NIZAMANI, A. R., KARIM, Z. A., ZAIDI, M. A. S., & KHALID, N. (2016). The Effectiveness of Monetary Policy in Small Open-Economy: An SVAR Study for Pakistan. *International Journal of Economics & Management, 10*(2).
- Peersman, G., & Smets, F. (2002). Are the effects of monetary policy in the euro area greater in recessions than in booms. *Monetary transmission in diverse economies, 28-48*.
- Peersman, G., & Smets, F. (2005). The industry effects of monetary policy in the euro area. *The Economic Journal, 115*(503), 319-342.
- Piazzesi, M., & Swanson, E. T. (2008). Futures prices as risk-adjusted forecasts of monetary policy. *Journal of monetary economics, 55*(4), 677-691.
- Rashid, A., Shah, M. A. R., & Mansoori, M. T. (2019). An empirical investigation of the credit channel of monetary policy: Islamic versus conventional banks of Pakistan. *NUML International Journal of Business & Management, 14*(2), 1-15.
- Ravn, M. O., & Sola, M. (1996). A reconsideration of the empirical evidence on the asymmetric effects of money-supply shocks: Positive vs. negative or big vs. small? *Available at SSRN 56134*.
- Ravn, M. O., & Sola, M. (2004). Asymmetric effects of monetary policy in the United States. *Review-Federal Reserve Bank of Saint Louis, 86*, 41-58.
- Romer, C. D., & Romer, D. H. (2004). A new measure of monetary shocks: Derivation and implications. *American economic review, 94*(4), 1055-1084.
- Romer, C. D., & Romer, D. H. (2010). The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks. *American economic review, 100*(3), 763-801.
- Rotemberg, J. (1997). An Optimization-based Econometric Framework for the Evaluation of Monetary Policy. *NBER Macroeconomics Annual/The MIT Press*.
- Santoro, E., Petrella, I., Pfajfar, D., & Gaffeo, E. (2014). Loss aversion and the asymmetric transmission of monetary policy. *Journal of monetary economics, 68*, 19-36.
- Sapkota, P. (2024). Monetary Indicator and Economic Growth of SAARC Countries. *Journal of Interdisciplinary Studies, 13*(1), 17-31.
- Schaumburg, E., & Tambalotti, A. (2007). An investigation of the gains from commitment in monetary policy. *Journal of monetary economics, 54*(2), 302-324.

- Schenkelberg, H. (2014). The determinants of sticky prices and sticky plans: evidence from german business survey data. *German Economic Review*, 15(3), 353-373.
- Schmitt-Grohé, S., & Uribe, M. (2016). Downward nominal wage rigidity, currency pegs, and involuntary unemployment. *Journal of political economy*, 124(5), 1466-1514.
- Schmitt-Grohé, S., & Uribe, M. (2012). What's news in business cycles. *Econometrica*, 80(6), 2733-2764.
- Shah, H., Saeed, A., & Hassan, A. (2011, July). *The financial accelerator: An emerging market story* (SBP Working Paper Series No. 41). State Bank of Pakistan, Research Department.
<https://ideas.repec.org/p/sbp/wpaper/41.html>
- Shareef, F., Sultan, S., & Sheikh, M. R. (2024). Examining the Influence of State Bank of Pakistan's Autonomy on Macroeconomic Stability: A Comprehensive Analysis of Pre and Post-Autonomy Periods. *Annals of Social Sciences and Perspective*, 5(1), 75-101.
- Shapiro, M. (1988). Sources of Business Cycle Fluctuations. *NBER Macroeconomics Annual*, 3.
- Shen, C.-H. (2000). Are the effects of monetary policy asymmetric? The case of Taiwan. *Journal of Policy Modeling*, 22(2), 197-218.
- Silva, J. S., & Cardoso, F. N. (2001). The Chow-Lin method using dynamic models. *Economic modelling*, 18(2), 269-280.
- Sims, C. A. (1980). Macroeconomics and Reality. *Econometrica*, 48(1), 1-48.
<https://doi.org/10.2307/1912017>
- Sims, C. A. (1992). Interpreting the macroeconomic time series facts: The effects of monetary policy. *European economic review*, 36(5), 975-1000.
- Smets, F., & Wouters, R. (2003). An estimated dynamic stochastic general equilibrium model of the euro area. *Journal of the European Economic association*, 1(5), 1123-1175.
- Smets, F., & Wouters, R. (2007). Shocks and frictions in US business cycles: A Bayesian DSGE approach. *American economic review*, 97(3), 586-606.
- Smith, A. F., & Roberts, G. O. (1993). Bayesian computation via the Gibbs sampler and related Markov chain Monte Carlo methods. *Journal of the Royal Statistical Society: Series B (Methodological)*, 55(1), 3-23.
- Stenner, N. (2022). The asymmetric effects of monetary policy: Evidence from the United Kingdom. *Oxford Bulletin of Economics and Statistics*, 84(3), 516-543.
- Stock, J. H., & Watson, M. W. (2002). Forecasting using principal components from a large number of predictors. *Journal of the American statistical association*, 97(460), 1167-1179.
- Stock, J. H., & Watson, M. W. (2012). *Disentangling the Channels of the 2007-2009 Recession*.

- Tan, S.-H., & Habibullah, M. S. (2007). Business cycles and monetary policy asymmetry: An investigation using Markov-switching models. *Physica A: Statistical Mechanics and its Applications*, 380, 297-306.
- Tanner, J. E. (1979). Are the lags in the effects of monetary policy variable?. *Journal of Monetary Economics*, 5(1), 105-121.
- Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*,
- Tenreyro, S., & Thwaites, G. (2016). Pushing on a string: US monetary policy is less powerful in recessions. *American Economic Journal: Macroeconomics*, 8(4), 43-74.
- Thoma, M. A. (1994). Subsample instability and asymmetries in money-income causality. *Journal of econometrics*, 64(1-2), 279-306.
- Tsiddon, D. (1993). The (mis) behaviour of the aggregate price level. *The Review of Economic Studies*, 60(4), 889-902.
- ul Haq Satti, A., & Malik, W. S. (2017). The Unreliability of Output-Gap Estimates in Real Time. *The Pakistan Development Review*, 56(3), 193–219.
- Ülke, V., & Berument, M. H. (2016). Asymmetric effects of monetary policy shocks on economic performance: empirical evidence from Turkey. *Applied Economics Letters*, 23(5), 353-360.
- Ullah, K., Wajid, A., & Khan, F. A. (2016). The impact of institutional quality on monetary policy in Pakistan. *Global Journal of Management and Business Research*, 6(3), 1-11.
- Ullah, M. F., Latif, S., Syed, A. A., & Hassan, S. A. (2024). Role of Monetary Policy in Asset Price Inflation: A Comparative Study of Developed and Developing Economies. *Journal of Asian Development Studies*, 13(2), 850-858.
- Vavra, J. (2014). Inflation dynamics and time-varying volatility: New evidence and an ss interpretation. *The Quarterly Journal of Economics*, 129(1), 215-258.
- Weise, C. L. (1999). The asymmetric effects of monetary policy: A nonlinear vector autoregression approach. *Journal of Money, Credit and Banking*, 85-108.
- Yellen, J. L. (2006). Luncheon Keynote Speech to the Annual Washington Policy Conference Sponsored by the National Association for Business Economics (NABE).
- Zakir, N., & Malik, W. S. (2013). Are the effects of monetary policy on output asymmetric in Pakistan? *Economic Modelling*, 32, 1-9.

APPENDICES

APPENDIX A

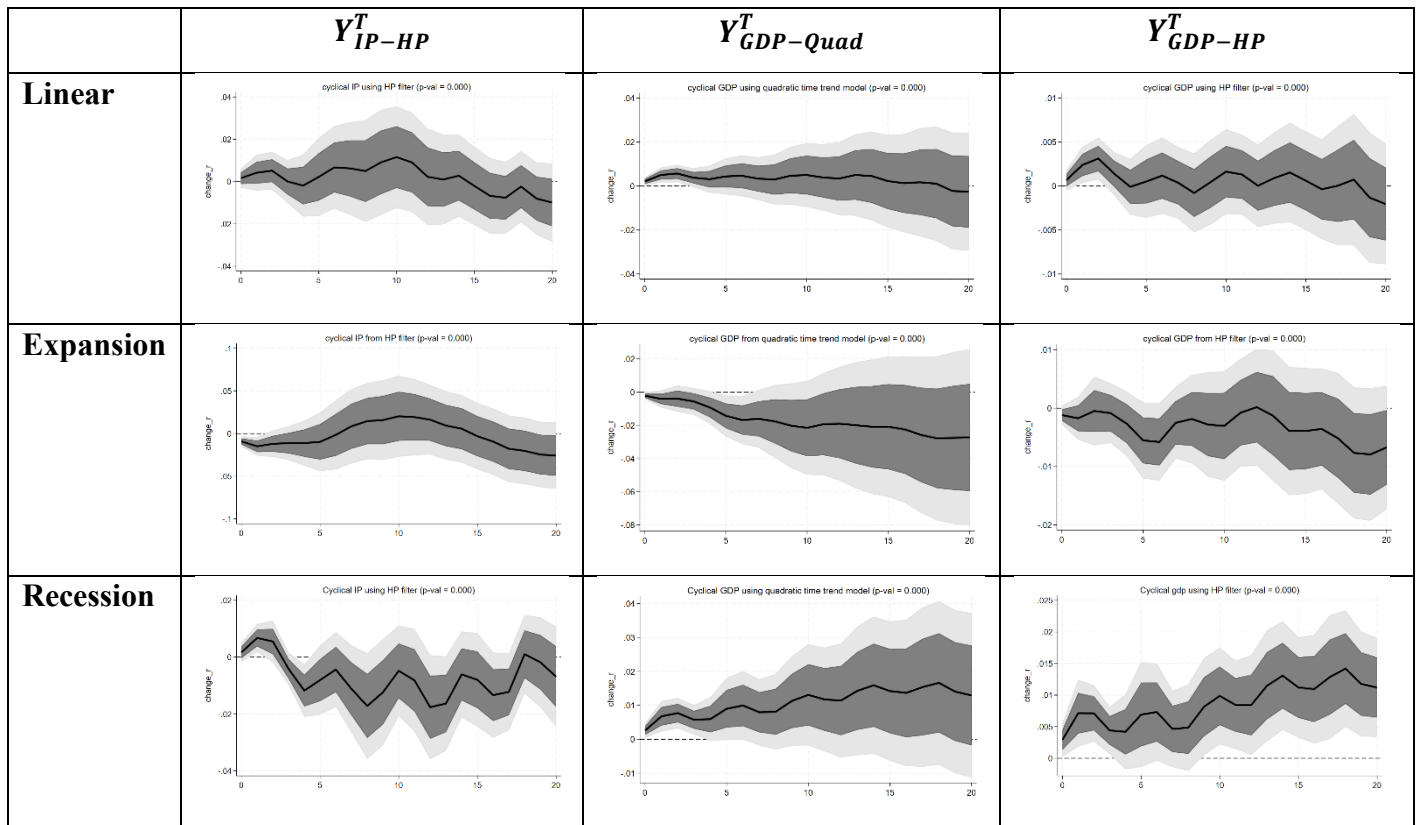


Figure A. 1 Impact of monetary policy shock (change in interest rate) on cyclical output

Note: The figure presents the impulse responses of cyclical industrial production and Gross Domestic Product (GDP) in reaction to a shock in the interest rate, measured by the change in the interest rate. The cyclical aspect of industrial production is determined through the application of the Hodrick-Prescott filter, while cyclical GDP is calculated using two approaches: a quadratic time trend model and a different Hodrick-Prescott filter. The local projection method is employed to assess the impulse responses over a span of twenty horizons. The dark grey bands represent a 90% confidence interval, whereas the light grey bands indicate a 95% confidence interval. Two models are assessed: one that is linear and the other that is contingent on state variables. The state-dependent model incorporates both contractionary and growth phases.

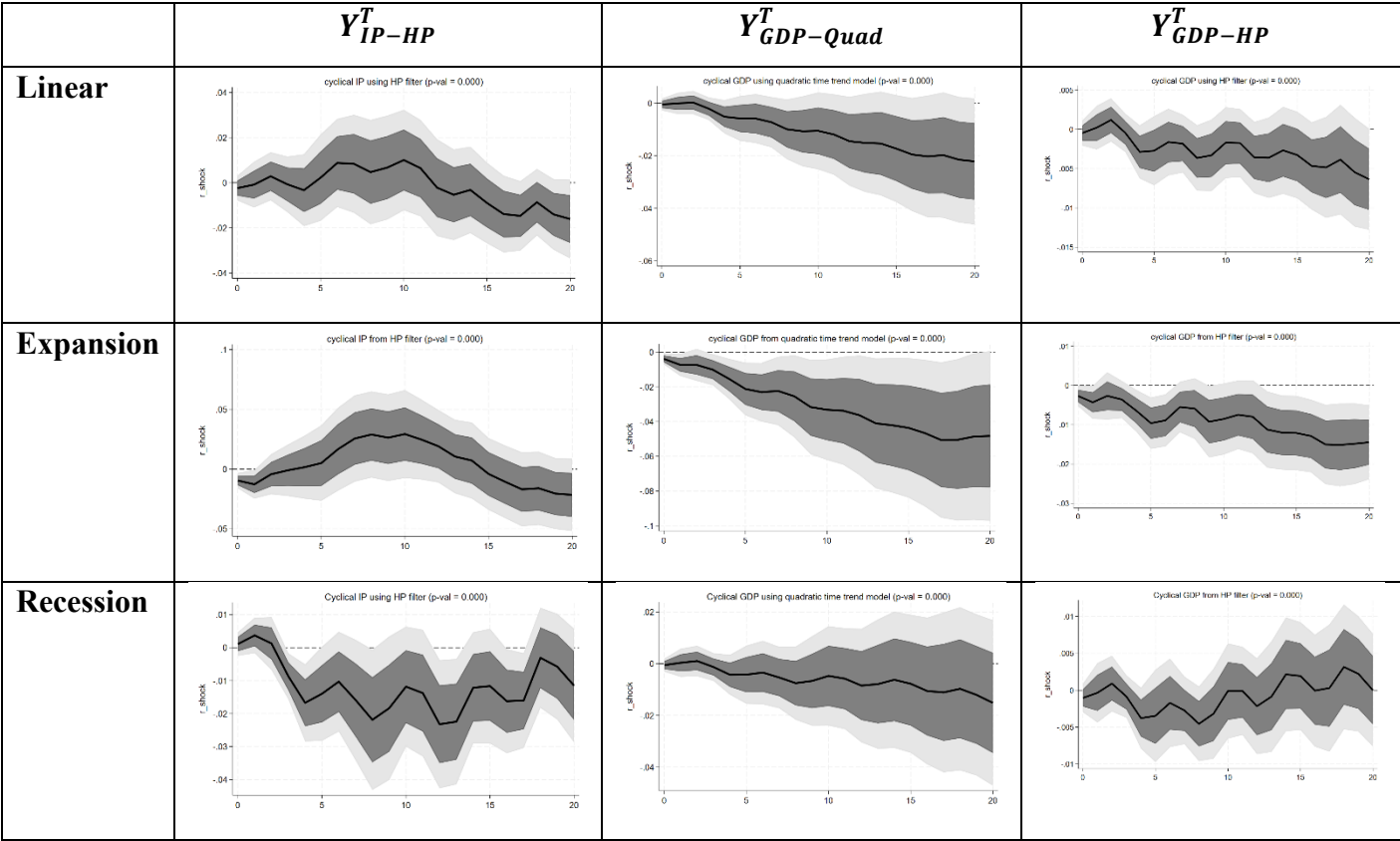


Figure A. 2 Impact of monetary policy shock (the two-step method) on cyclical output

Note: The figure illustrates the impulse responses of cyclical industrial production and gross domestic product (GDP) to an interest rate shock, derived through the two-step method. The cyclical component of industrial production is derived using the Hodrick-Prescott filter, while cyclical GDP is calculated through two distinct methodologies: a quadratic time trend model and an HP filter. The local projection method evaluates the impulse responses over a span of 20 horizons. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

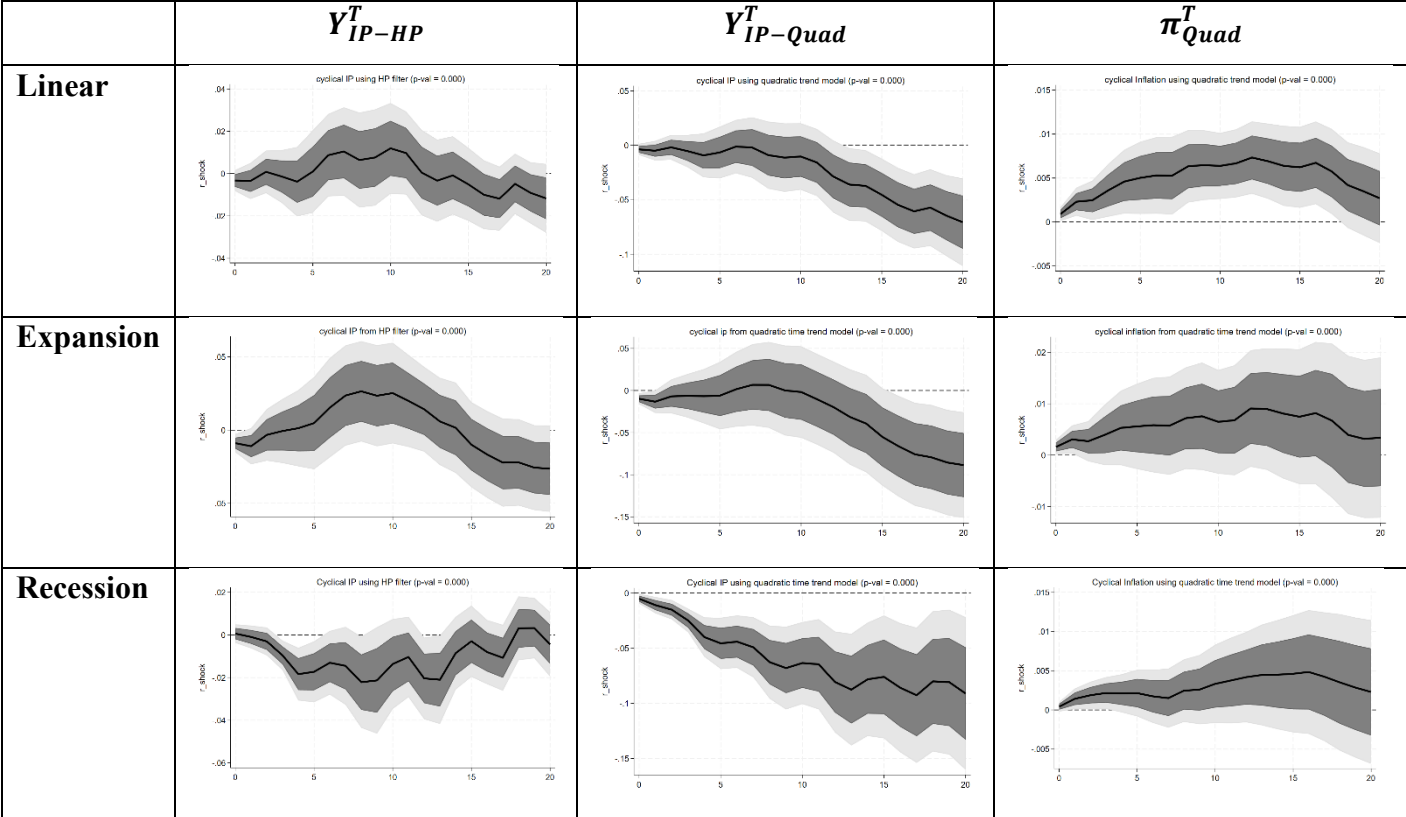


Figure A. 3 Impact of monetary policy shock (the two-step method) on cyclical output and inflation at three lags

Note: The figure illustrates the impulse responses of cyclical industrial production and inflation to an interest rate shock, derived through the two-step method. The cyclical component of industrial production is derived using the Hodrick-Prescott filter and quadratic time trend model, and cyclical inflation is calculated through quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 3 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

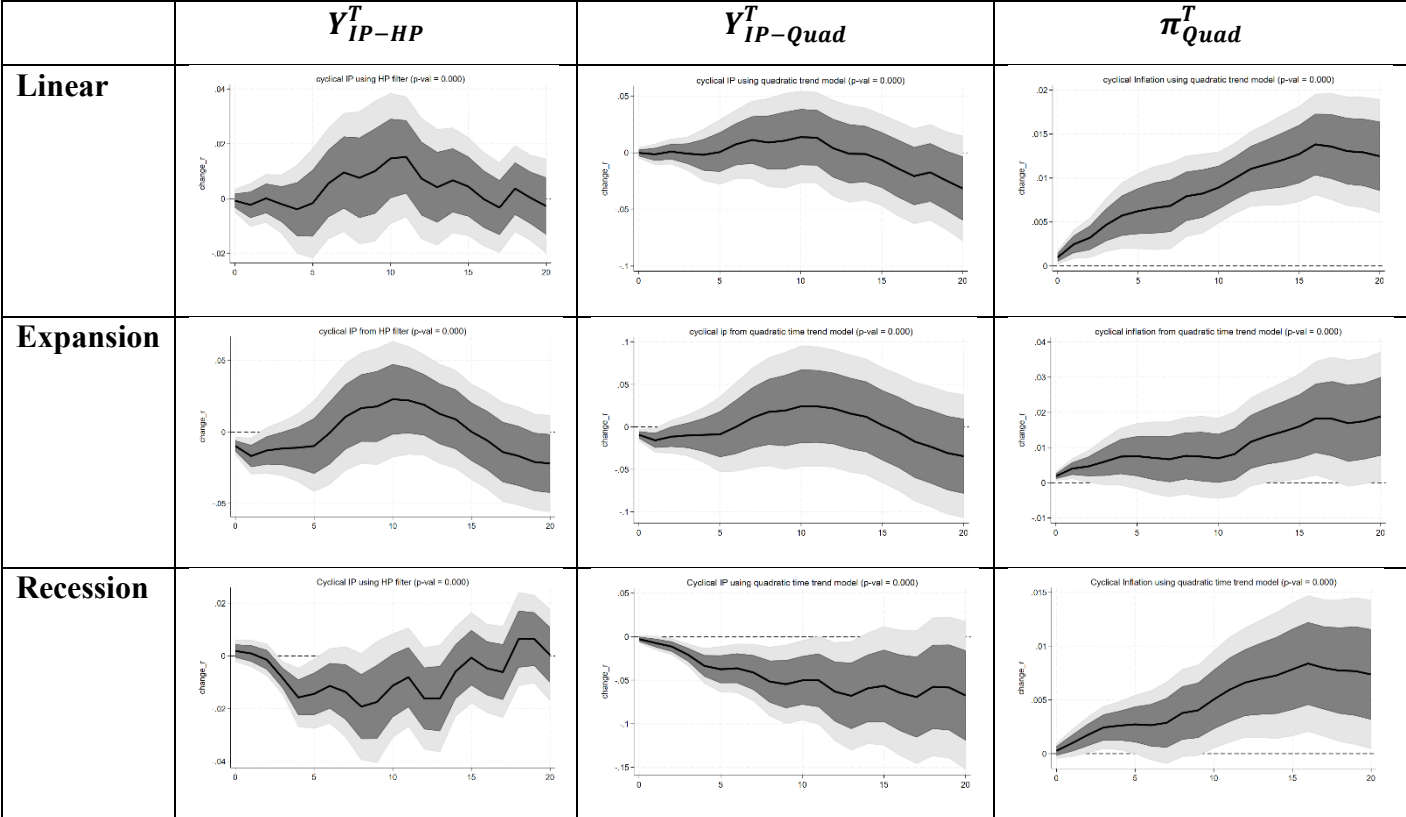


Figure A. 4 Impact of monetary policy shock (change in interest rate) on cyclical output and inflation at three lags

Note: The figure illustrates the impulse responses of cyclical industrial production and inflation to an interest rate shock, derived through the change in interest rate. The cyclical component of industrial production is derived using the Hodrick-Prescott filter and quadratic time trend model, and cyclical inflation is calculated through quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 3 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

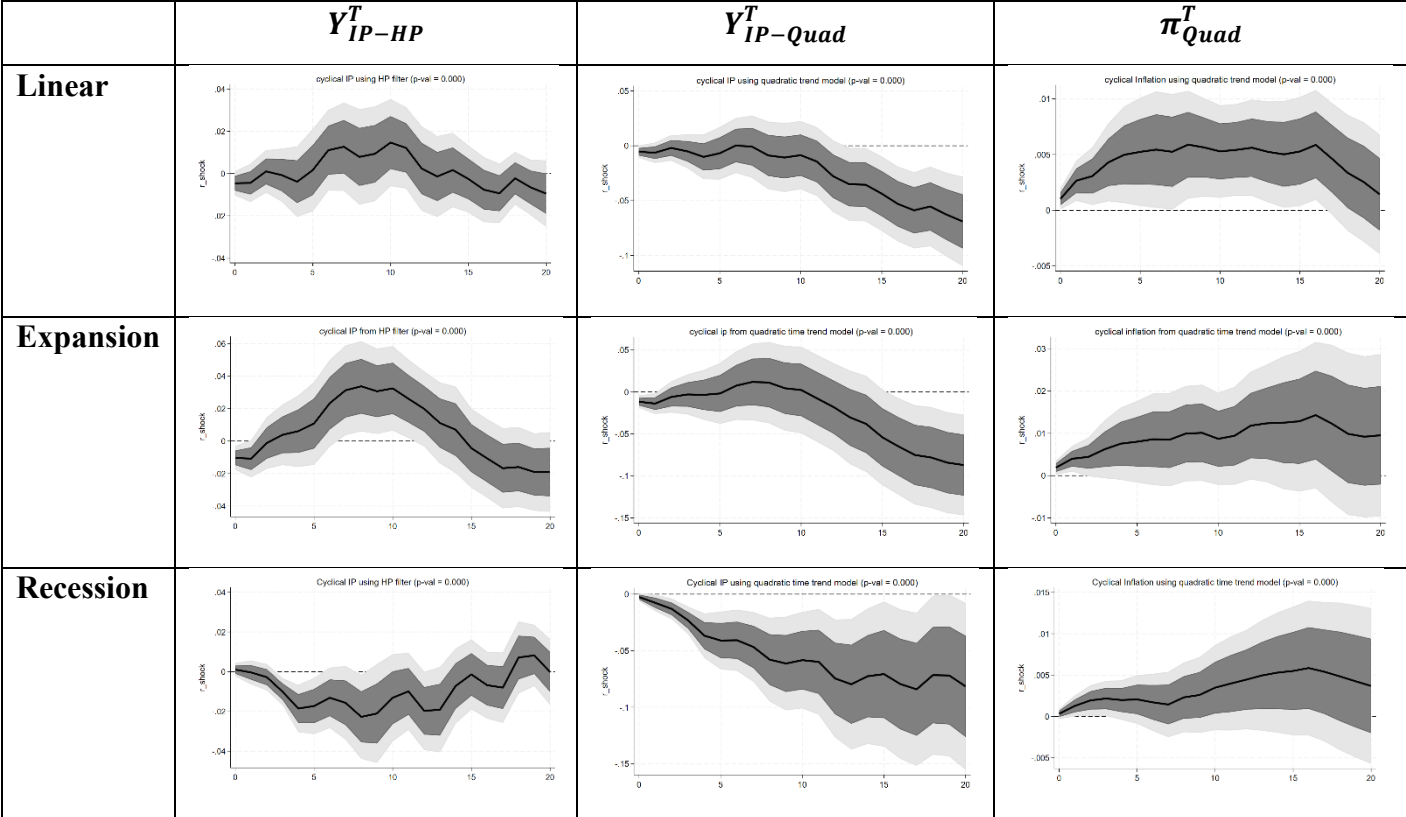


Figure A. 5 Impact of monetary policy shock (the two-step method) on cyclical output and inflation at four lags

Note: The figure illustrates the impulse responses of cyclical industrial production and inflation to an interest rate shock, derived through the two-step method. The cyclical component of industrial production is derived using the Hodrick-Prescott filter and quadratic time trend model, and cyclical inflation is calculated through quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 4 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

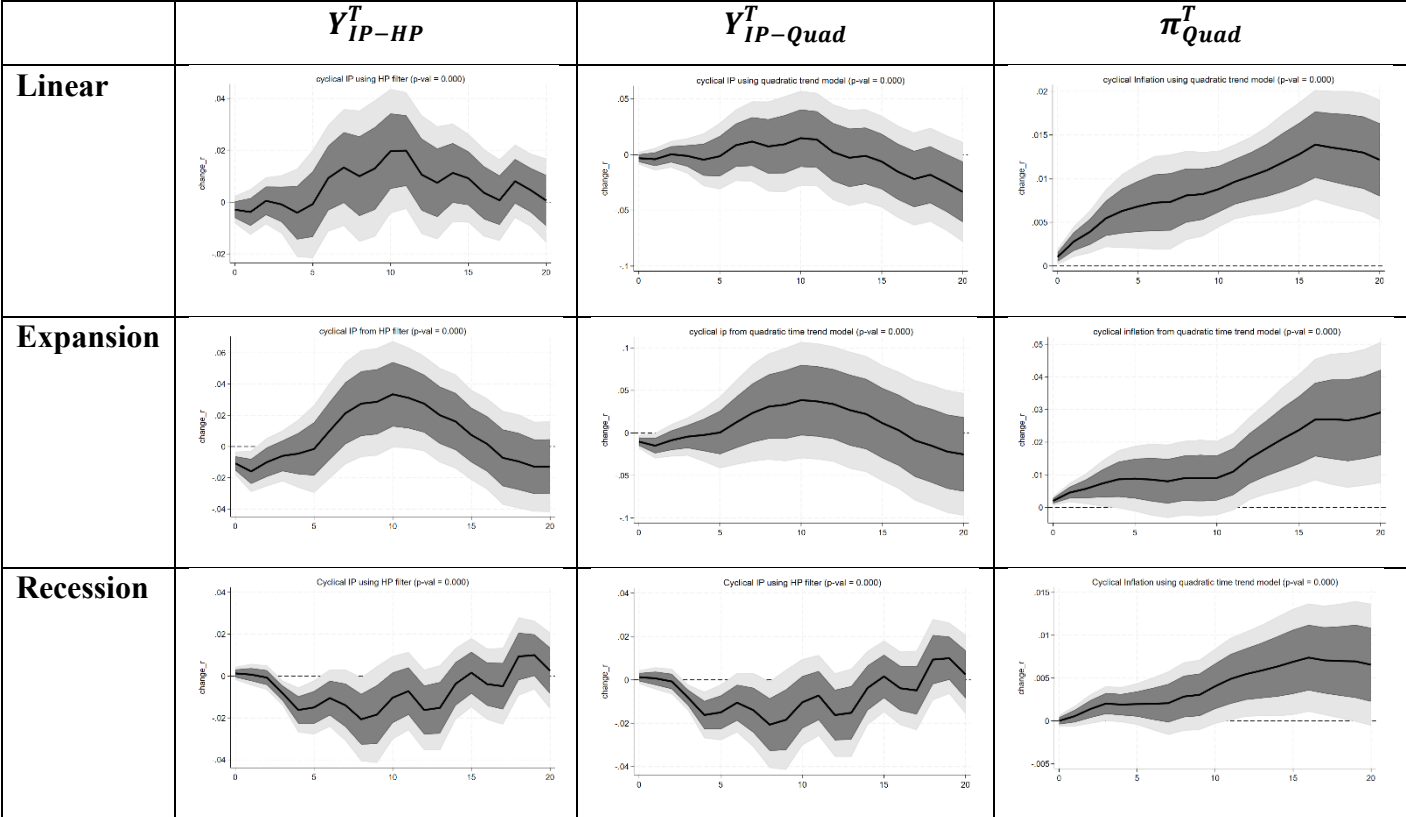


Figure A. 6 Impact of monetary policy shock (change in interest rate) on cyclical output and inflation at four lags

Note: The figure illustrates the impulse responses of cyclical industrial production and inflation to an interest rate shock, derived through the change in interest rate. The cyclical component of industrial production is derived using the Hodrick-Prescott filter and quadratic time trend model, and cyclical inflation is calculated through quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 4 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

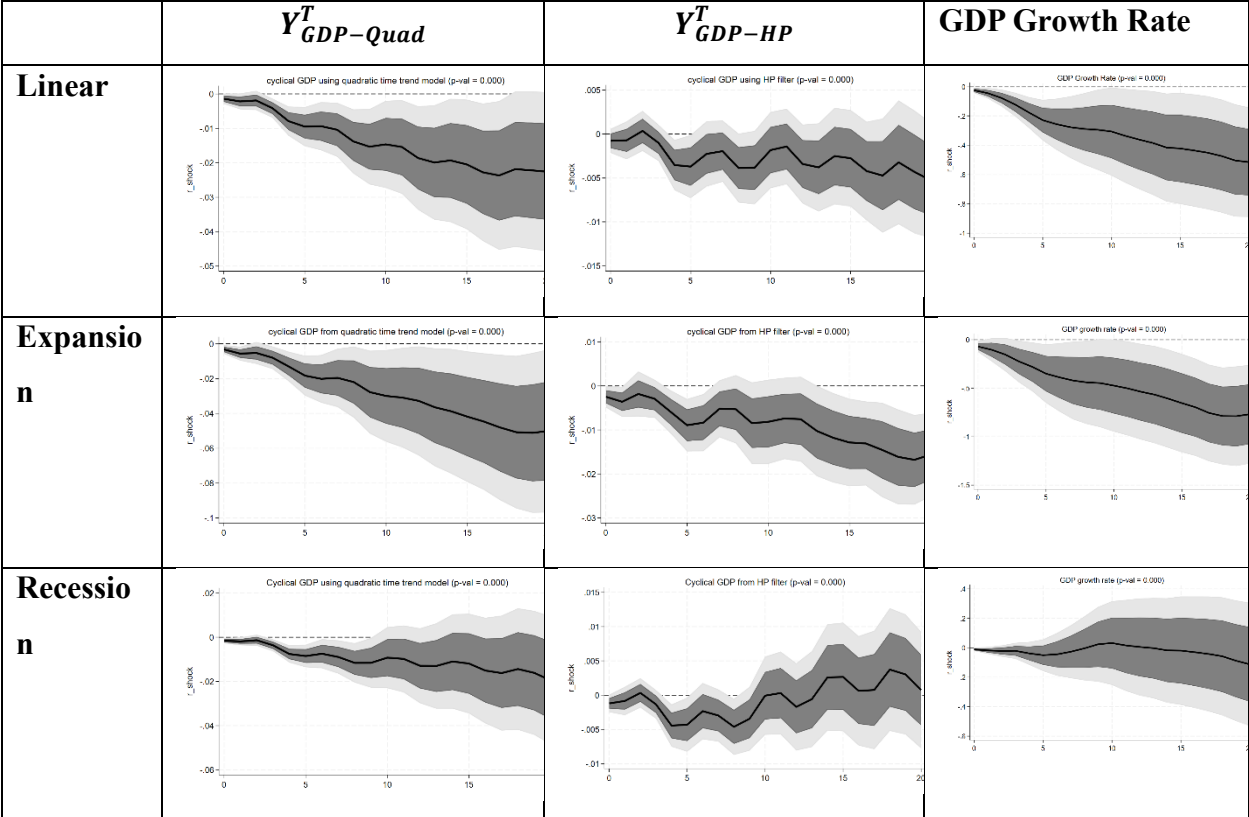


Figure A. 7 Impact of monetary policy shock (the two-step method) on cyclical output (GDP) and GDP growth rate at three lags

Note: The figure illustrates the impulse responses of cyclical GDP and GDP growth rate to an interest rate shock, derived through the two-step method. The cyclical component of GDP is derived using the Hodrick-Prescott filter and quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 3 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

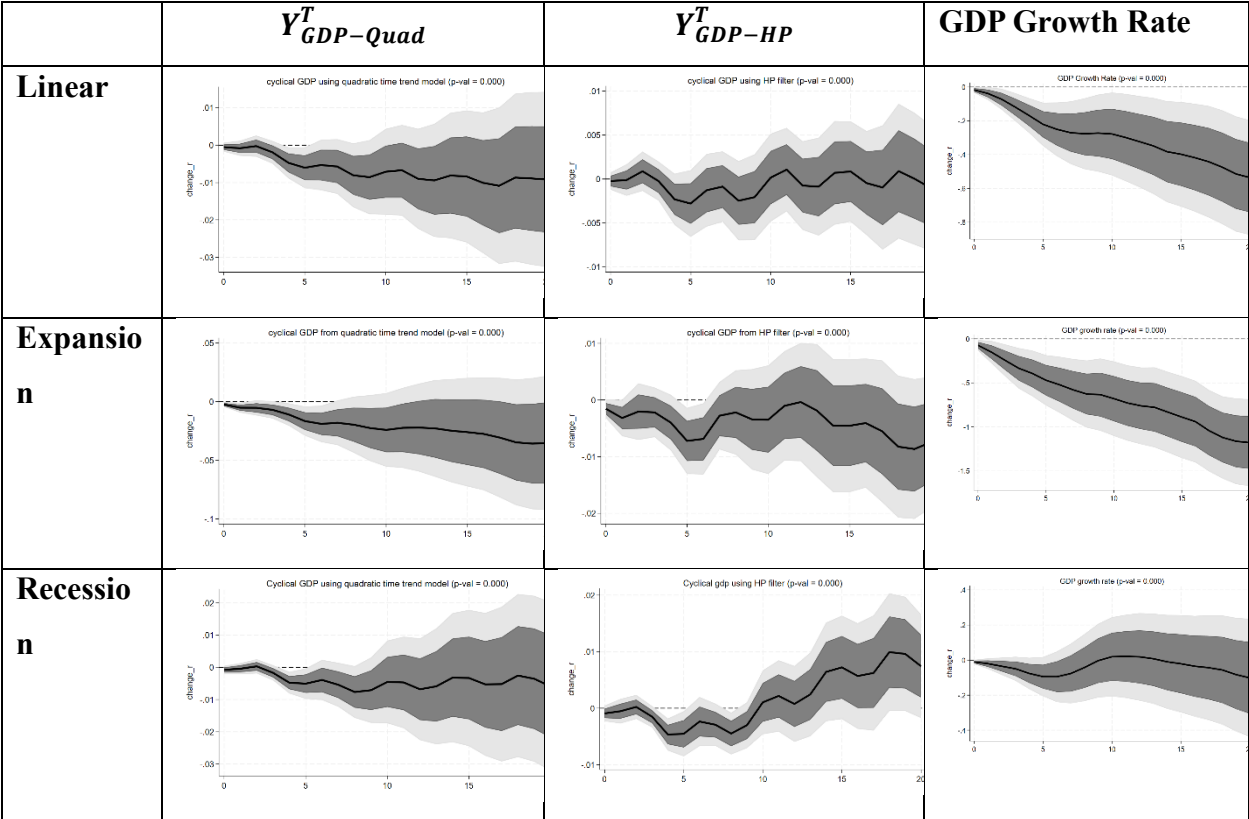


Figure A. 8 Impact of monetary policy shock (Change in interest rate) on cyclical output (GDP) and GDP growth rate using three lags

Note: The figure illustrates the impulse responses of cyclical GDP and GDP growth rate to an interest rate shock, derived through the change in interest rate. The cyclical component of GDP is derived using the Hodrick-Prescott filter and quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 3 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

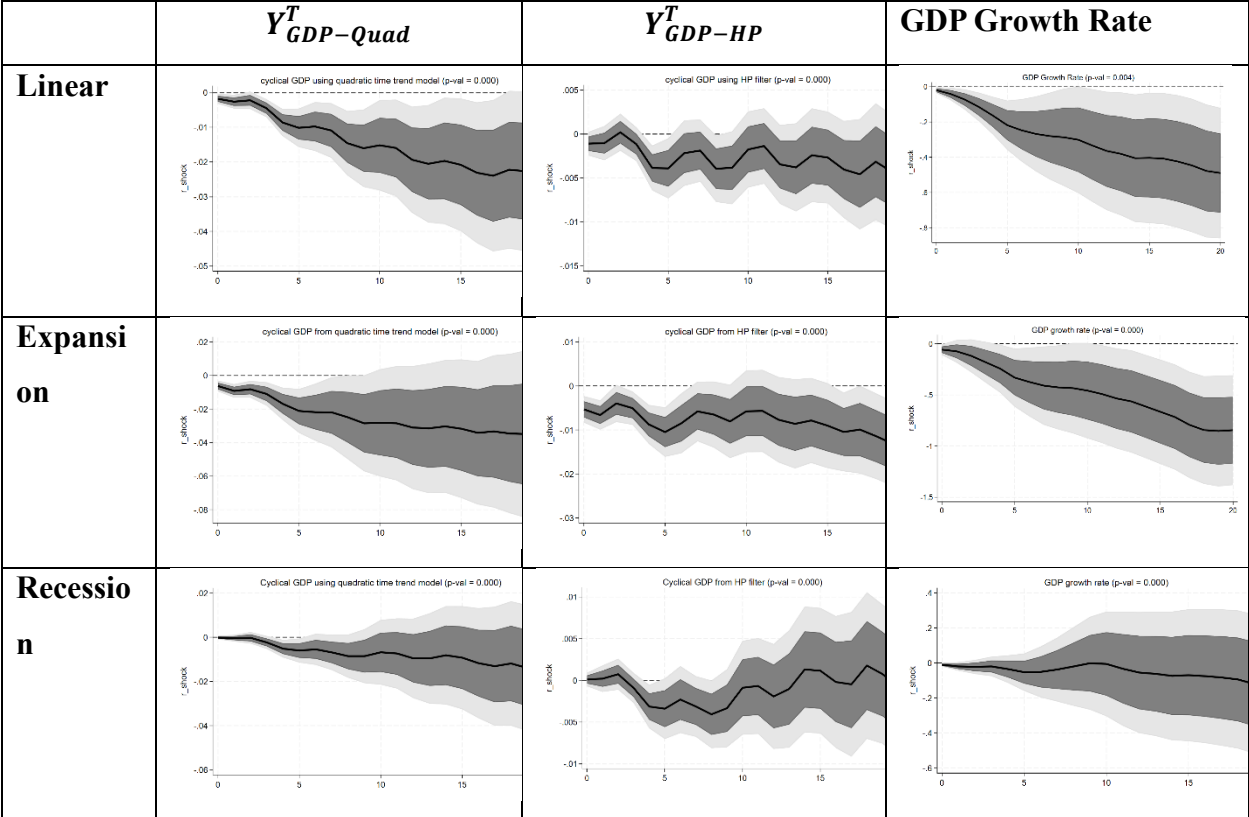


Figure A. 9 Impact of monetary policy shock (the two-step method) on cyclical output (GDP) and GDP growth rate using four lags

Note: The figure illustrates the impulse responses of cyclical GDP and GDP growth rate to an interest rate shock, derived through the two-step method. The cyclical component of GDP is derived using the Hodrick-Prescott filter and quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at 4lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

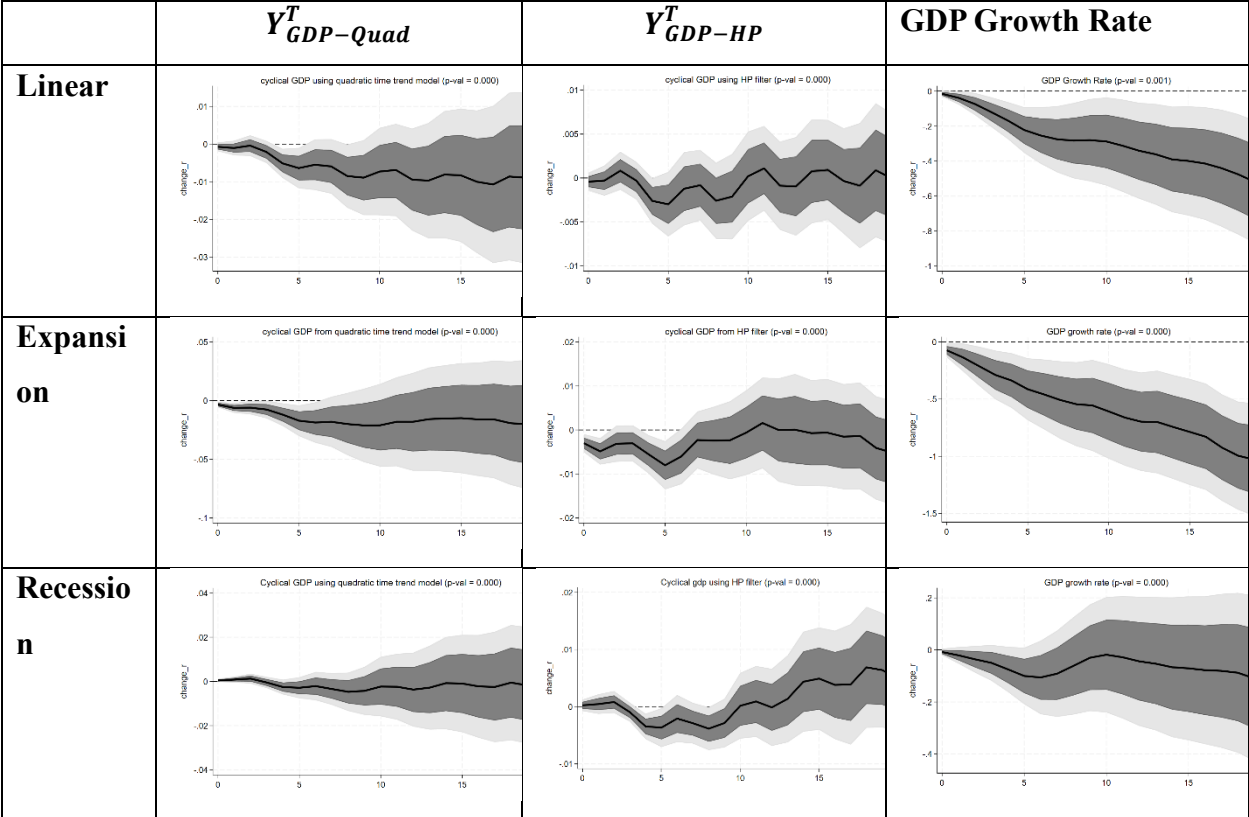


Figure A. 10 Impact of monetary policy shock (Change in interest rate) on cyclical output (GDP) and GDP growth rate using four lags

Note: The figure illustrates the impulse responses of cyclical GDP and GDP growth rate to an interest rate shock, derived through a change in interest rate. The cyclical component of GDP is derived using the Hodrick-Prescott filter and quadratic time trend model. The local projection method evaluates the impulse responses throughout 20 horizons at four lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

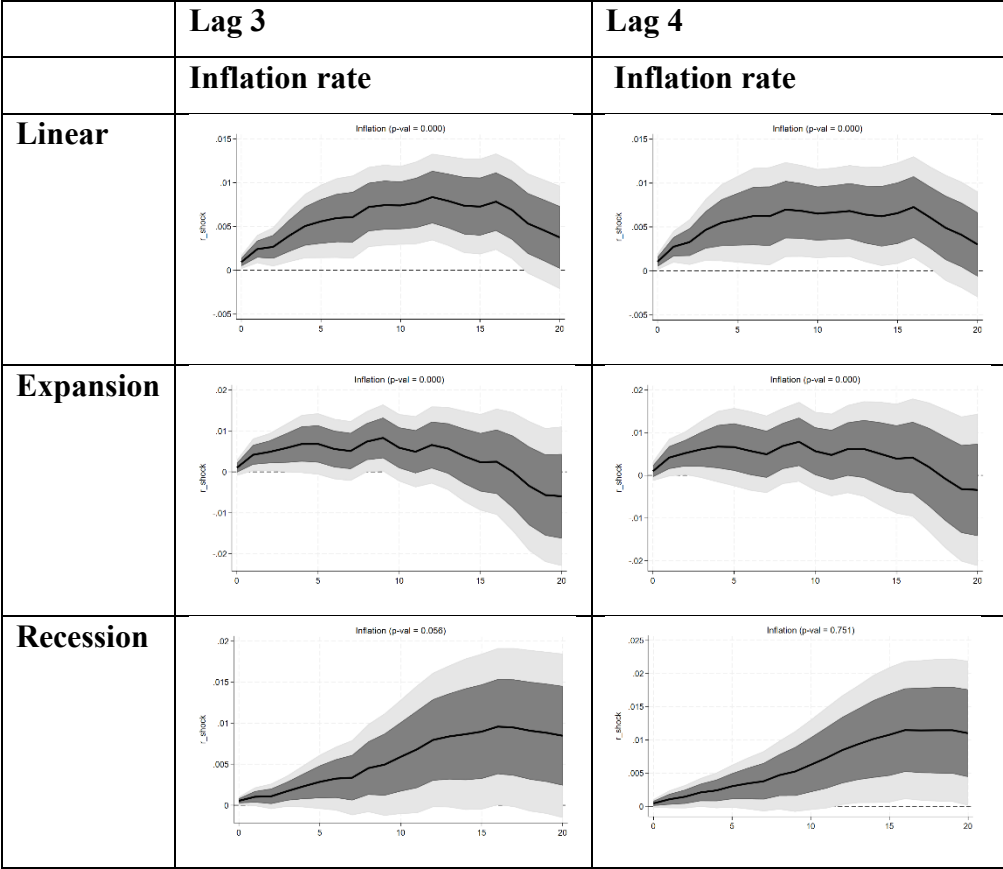


Figure A. 11 Impact of monetary policy shock (the two-step method) on inflation rate using three and four lags

Note: The figure illustrates the impulse responses of inflation rate to an interest rate shock, derived through the two-step method. The local projection method evaluates the impulse responses throughout 20 horizons at 3 and 4 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

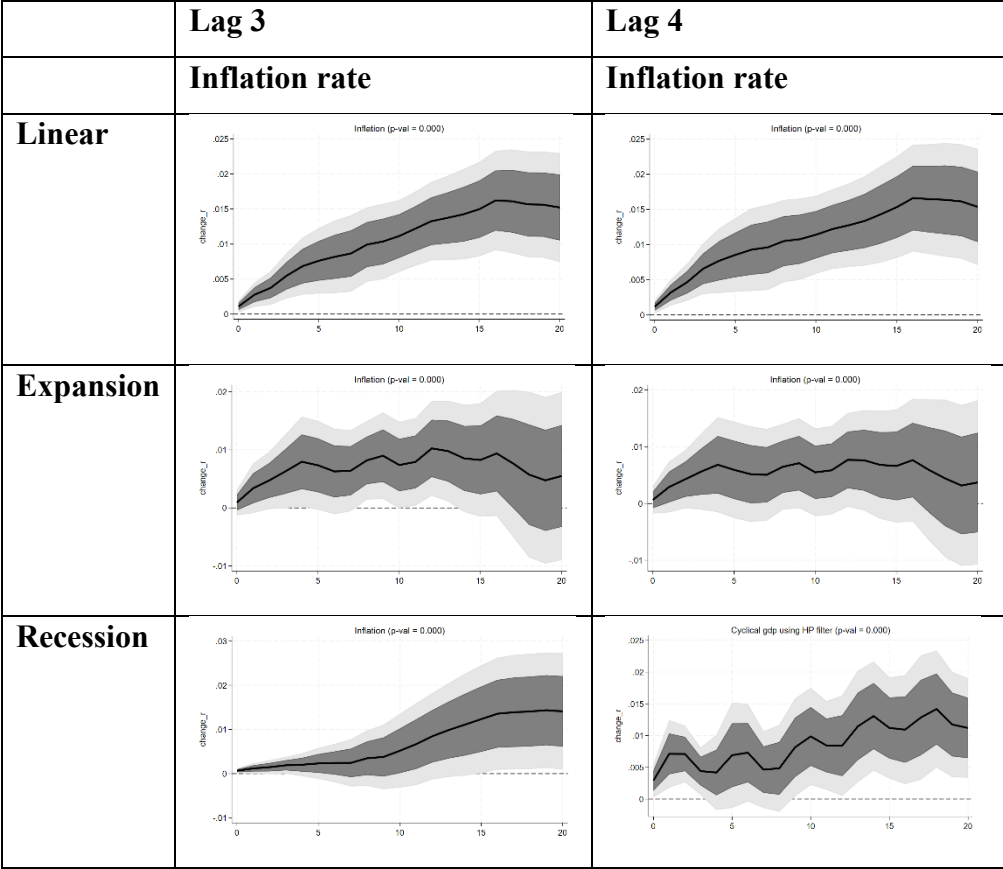


Figure A. 12 Impact of monetary policy shock (change in interest rate) on inflation rate using three and four lags

Note: The figure illustrates the impulse responses of inflation rate to an interest rate shock, derived through the change in interest rate. The local projection method evaluates the impulse responses throughout 20 horizons at 3 and 4 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

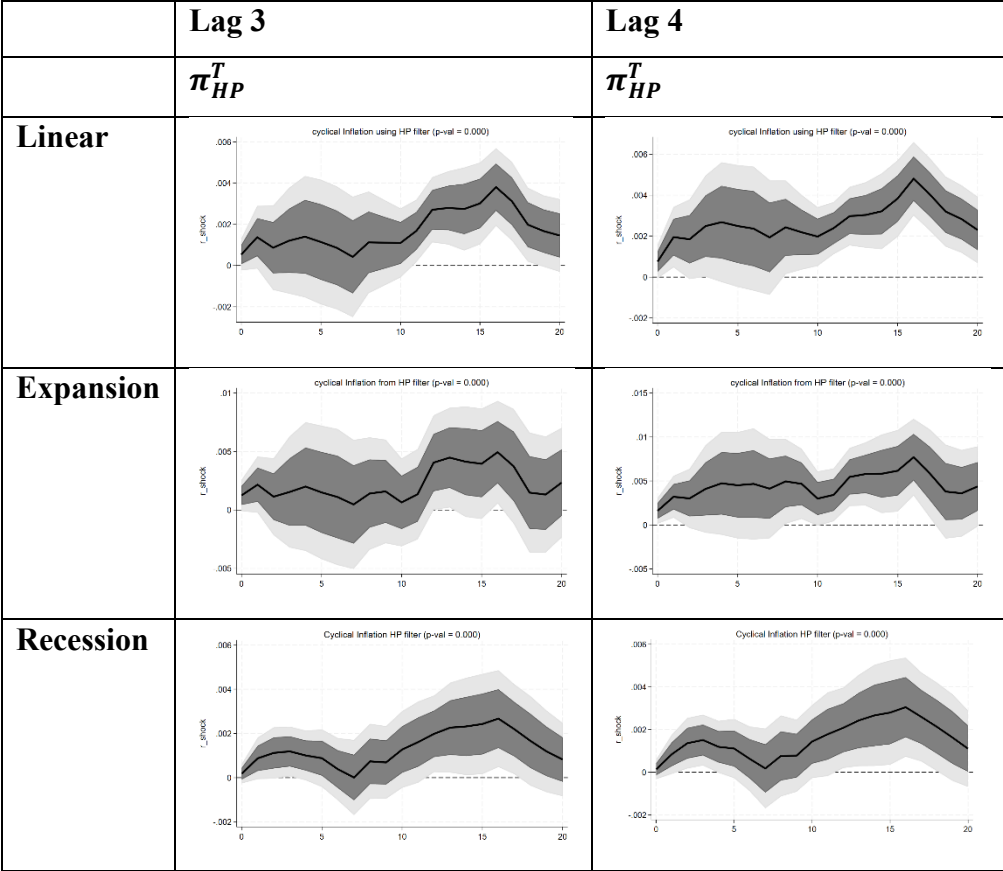


Figure A. 13 Impact of monetary policy shock (the two-step method) on cyclical inflation using three and four lags

Note: The figure illustrates the impulse responses of cyclical inflation to an interest rate shock, derived through the two-step method. The cyclical inflation is calculated through the HP filter. The local projection method evaluates the impulse responses throughout 20 horizons at 3 and 4 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

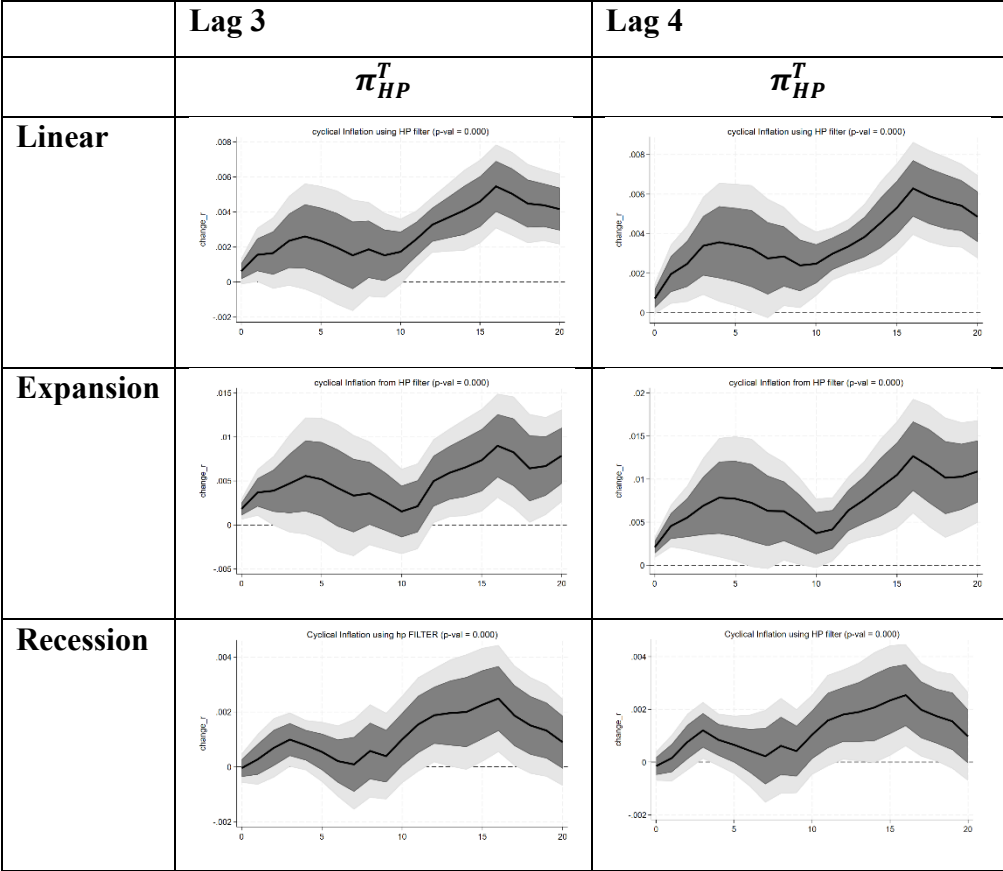


Figure A. 14 Impact of monetary policy shock (change in interest rate) on cyclical inflation at lags three and four

Note: The figure illustrates the impulse responses of cyclical inflation to an interest rate shock, derived through the change in interest rate. The cyclical inflation is calculated through the HP filter. The local projection method evaluates the impulse responses throughout 20 horizons at 3 and 4 lags. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

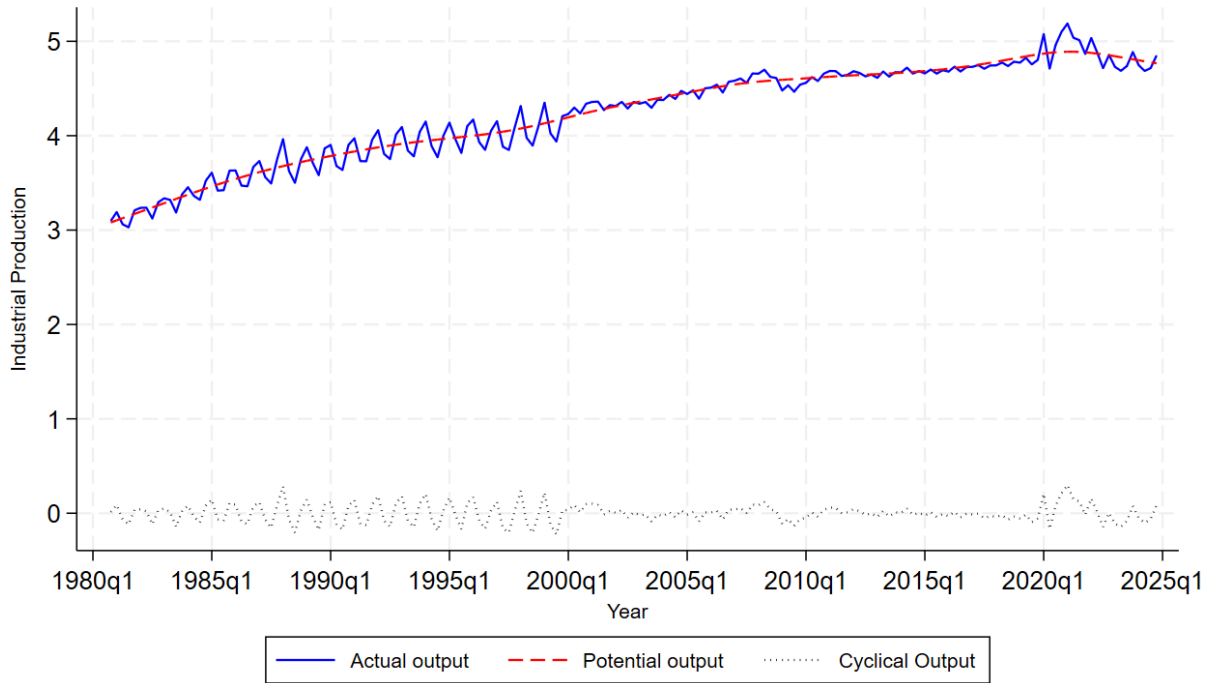


Figure A. 15 Cyclical Industrial production using HP filter

Note: The figure illustrates actual, potential, and cyclical output. Industrial production is used as a proxy for output. The blue line shows the actual output, the red dashed line indicates the potential output, and the black dotted line represents the cyclical output. The HP filter method is used to calculate the potential and cyclical output.

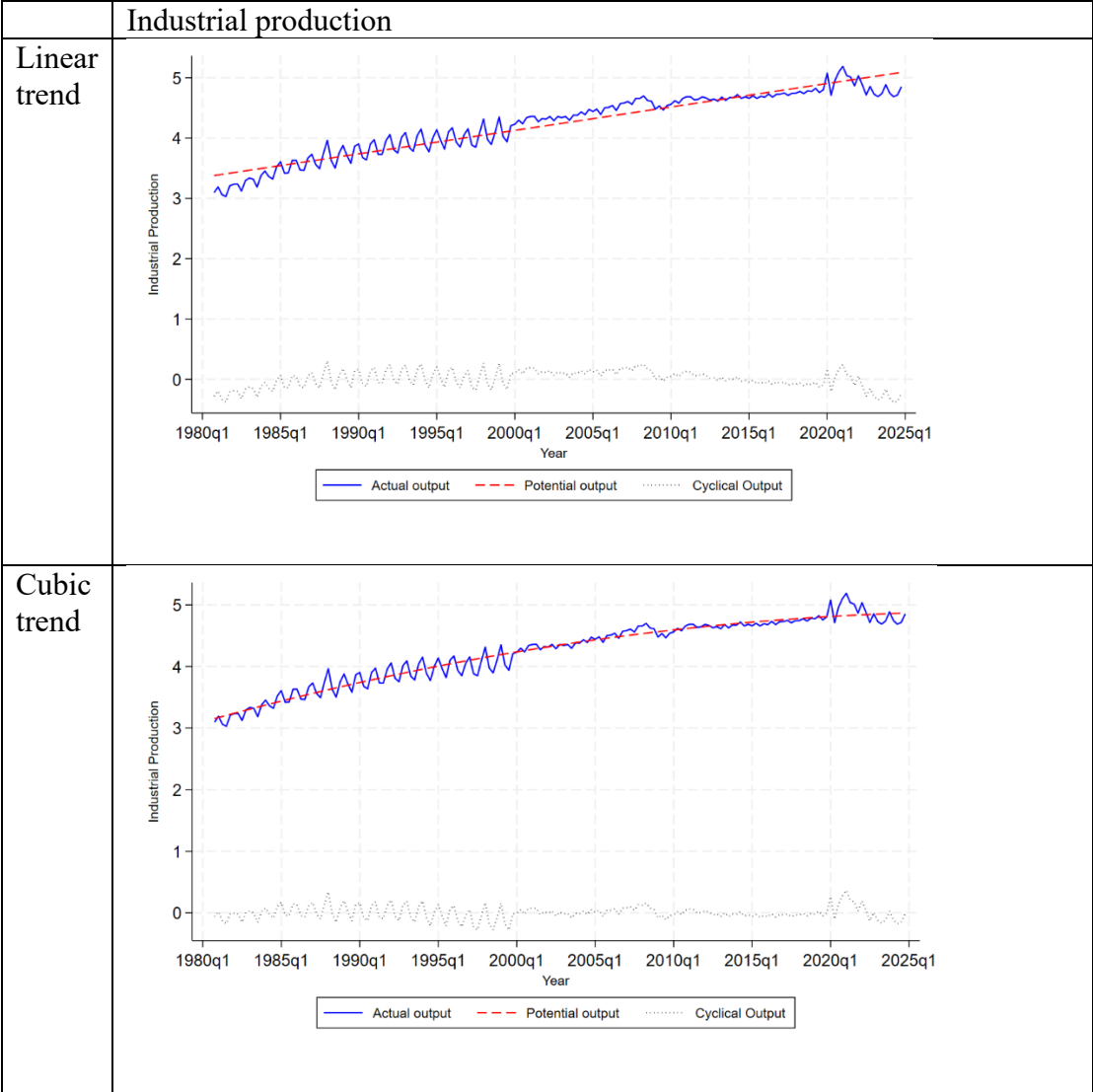


Figure A. 16 Cyclical Industrial production using different trend models

Note: The figure illustrates actual, potential, and cyclical output. Industrial production is taken as a proxy for output. The blue line shows the actual output, the red dashed line indicates the potential output, and the black dotted line represents the cyclical output. The different trend methods are used to calculate potential and cyclical industrial production.

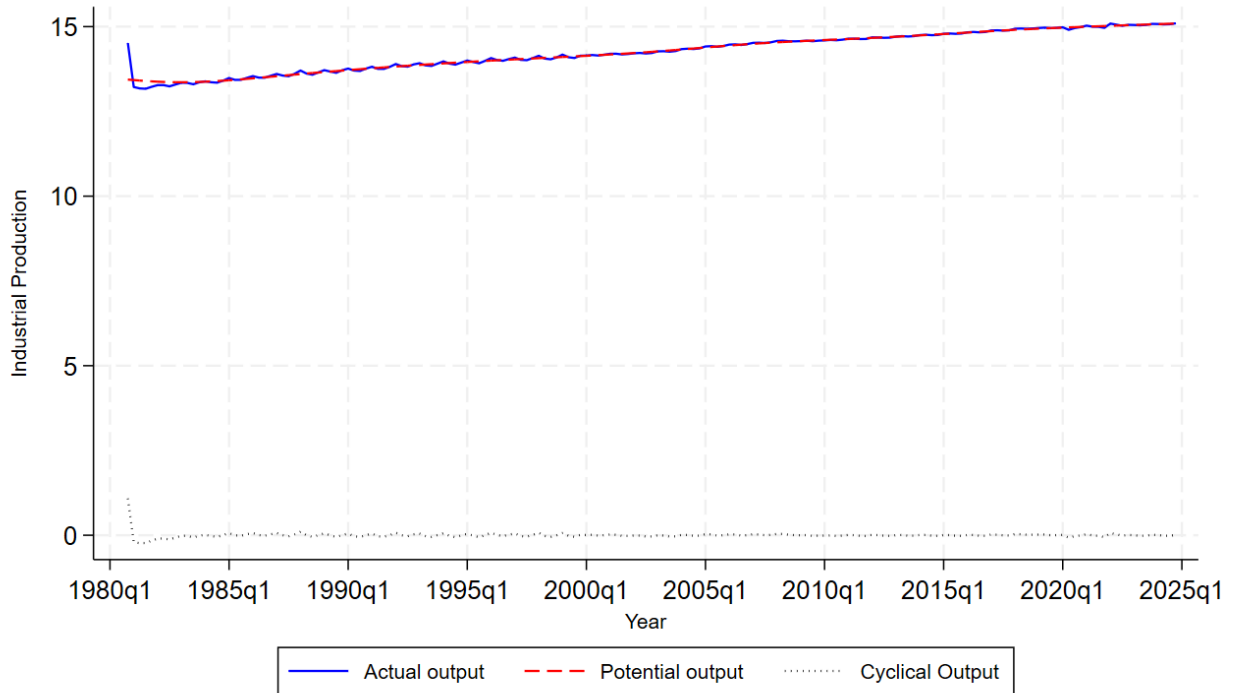


Figure A. 17 cyclical GDP using the HP filter

Note: The figure illustrates actual, potential, and cyclical output. GDP is used as a proxy for output. The blue line shows the actual output, the red dashed line indicates the potential output, and the black dotted line represents the cyclical output. The HP filter method is used to calculate the potential and cyclical output.

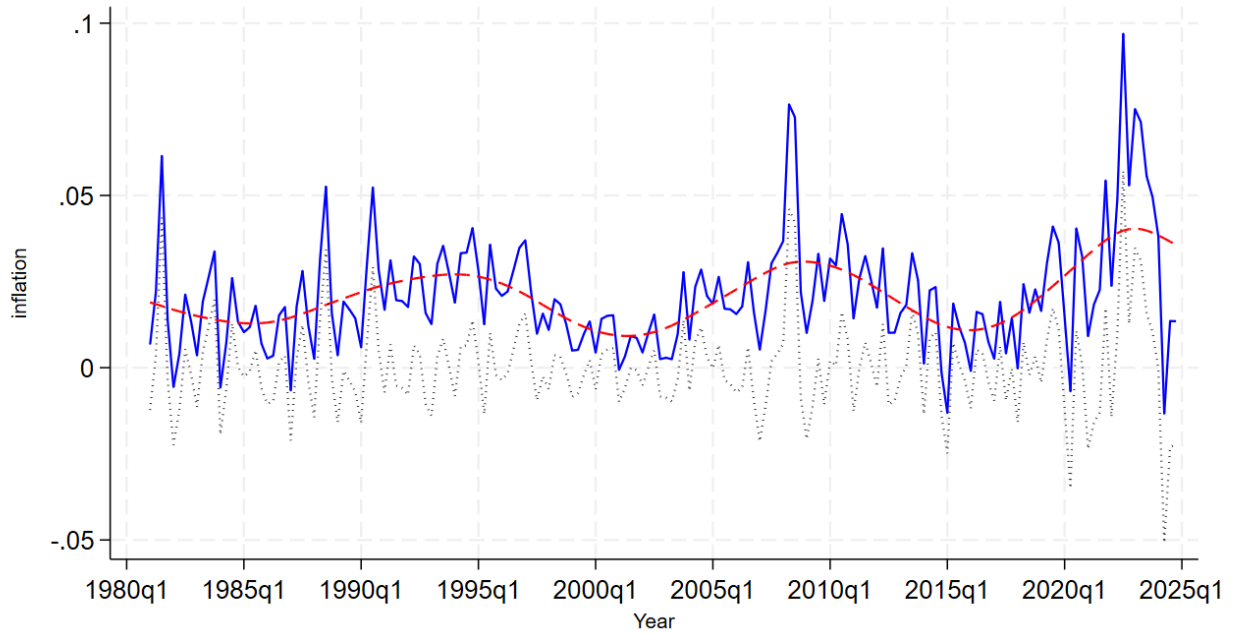


Figure A. 18 Cyclical inflation using the HP filter

Note: The figure illustrates actual, potential, and cyclical inflation. Industrial production is used as a proxy for output. The blue line shows the actual inflation, the red dashed line indicates the potential inflation, and the black dotted line represents the cyclical inflation. The HP filter method is used to calculate potential and cyclical inflation.

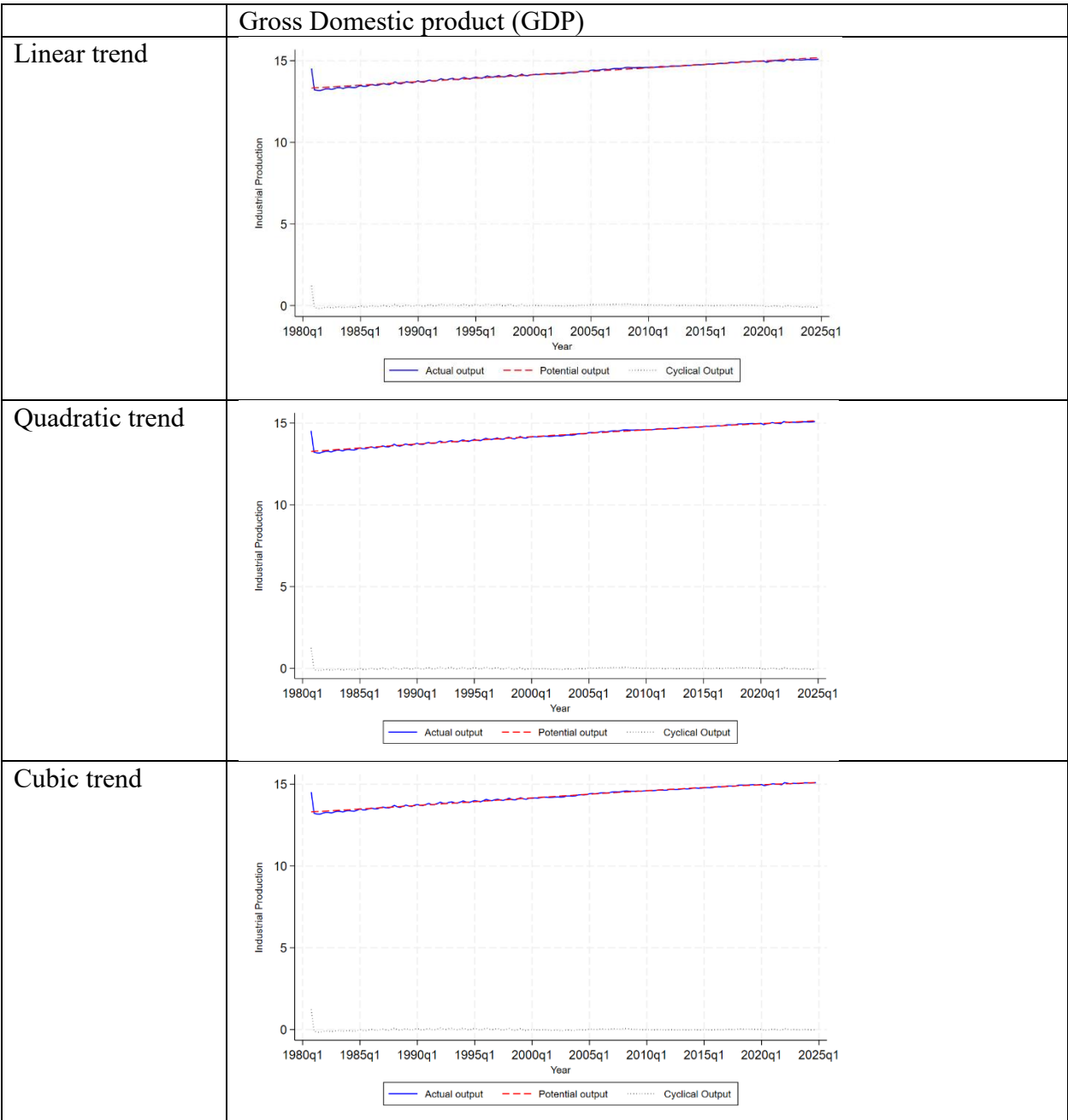


Figure A. 19 Cyclical GDP using different trend models

Note: The figure illustrates actual, potential, and cyclical output. GDP is used as a proxy for output. The blue line shows the actual output, the red dashed line indicates the potential output, and the black dotted line represents the cyclical output. The different methods are used to calculate potential and cyclical.

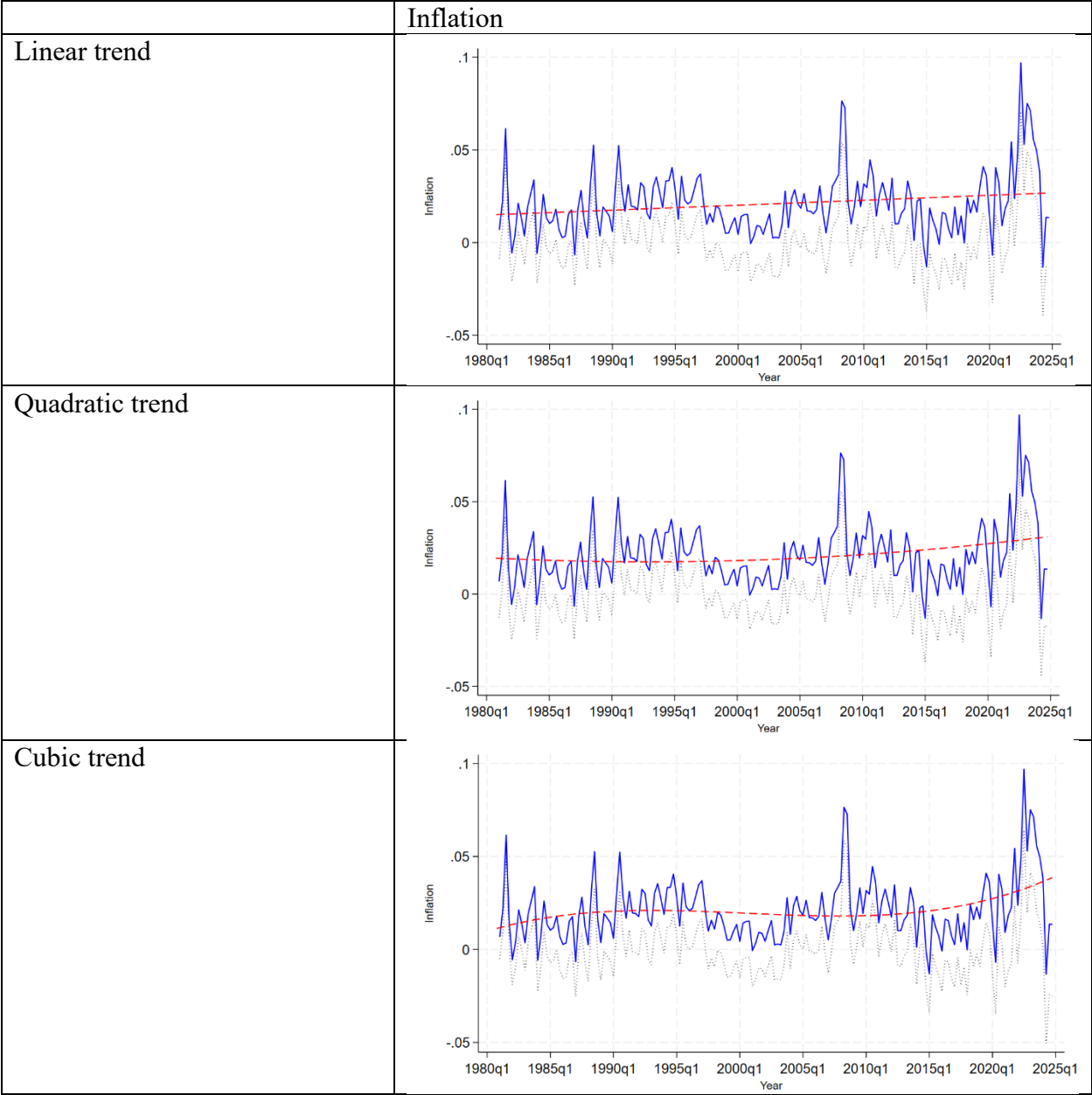


Figure A. 20 Cyclical inflation using different trend models

Note: The figure illustrates actual, potential, and cyclical inflation. Industrial production is used as a proxy for output. The blue line shows the actual inflation, the red dashed line indicates the potential inflation, and the black dotted line represents the cyclical inflation. The different methods are used to calculate potential and cyclical inflation.

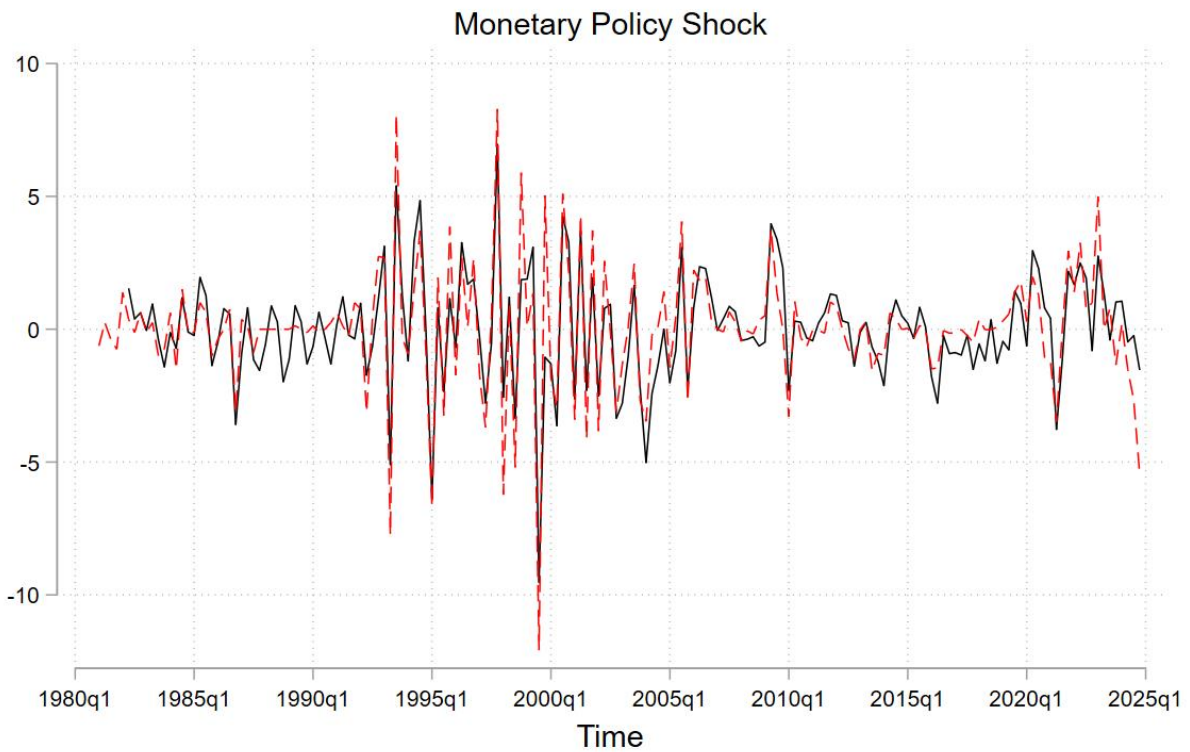


Figure A. 21 Monetary policy shock through the two-step and change in interest rate method

Note: The figure presents the analysis of the monetary policy shock derived from the two-step method alongside the alterations in the interest rate method. The solid black line represents the monetary policy shock obtained through the two-step method. In contrast, the red dashed line illustrates the shock that arises from the alteration in interest rates.

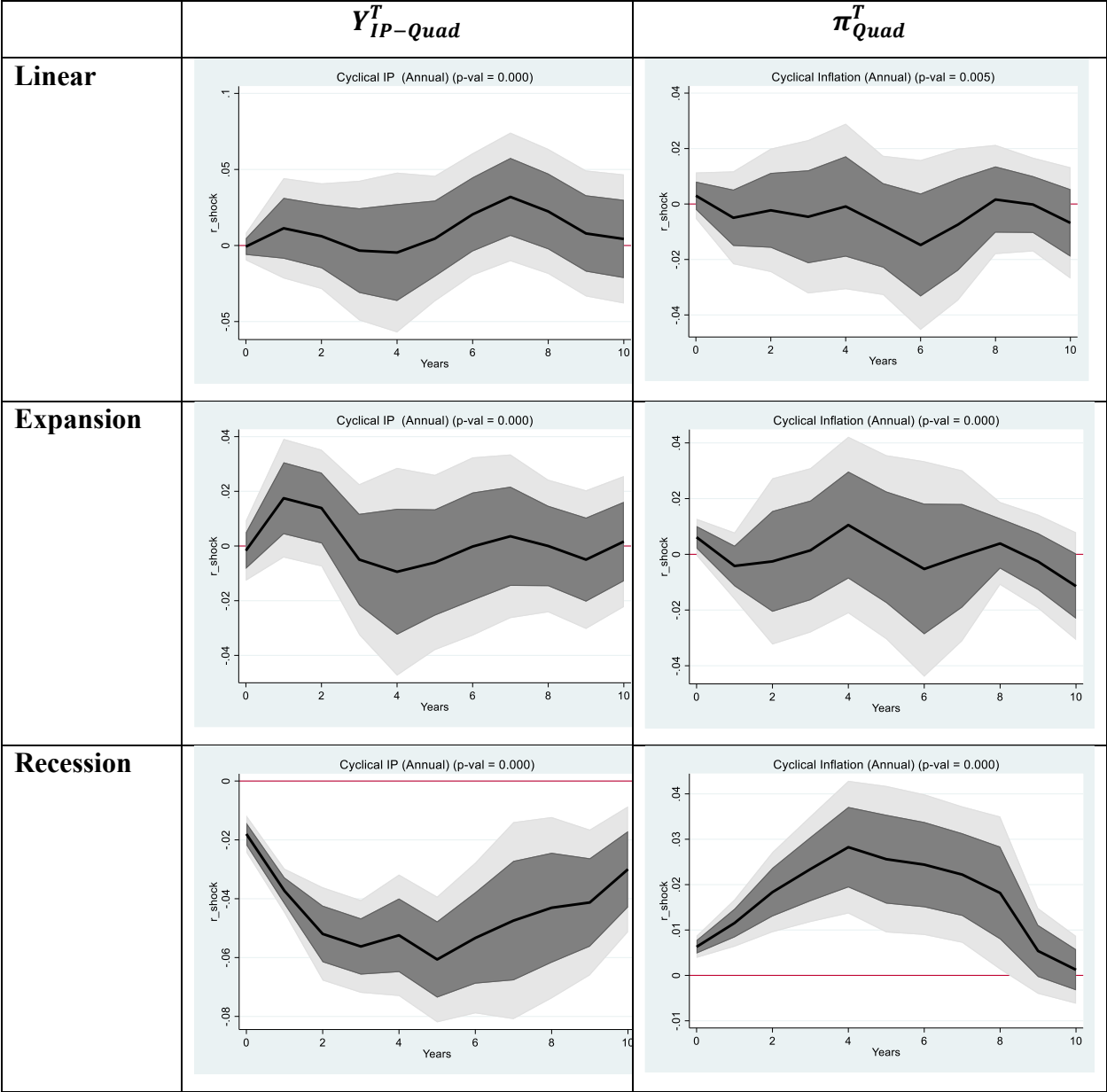


Figure A. 22 Impact of monetary policy shock (the two-step method) on cyclical output and inflation using annual data

Note: The figure illustrates the impulse responses of cyclical output and inflation to an interest rate shock, derived through the two-step method. The analysis is done on annual data. The cyclical output and inflation is calculated through the quadratic trend model. The local projection method evaluates the impulse responses throughout 20 horizons. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

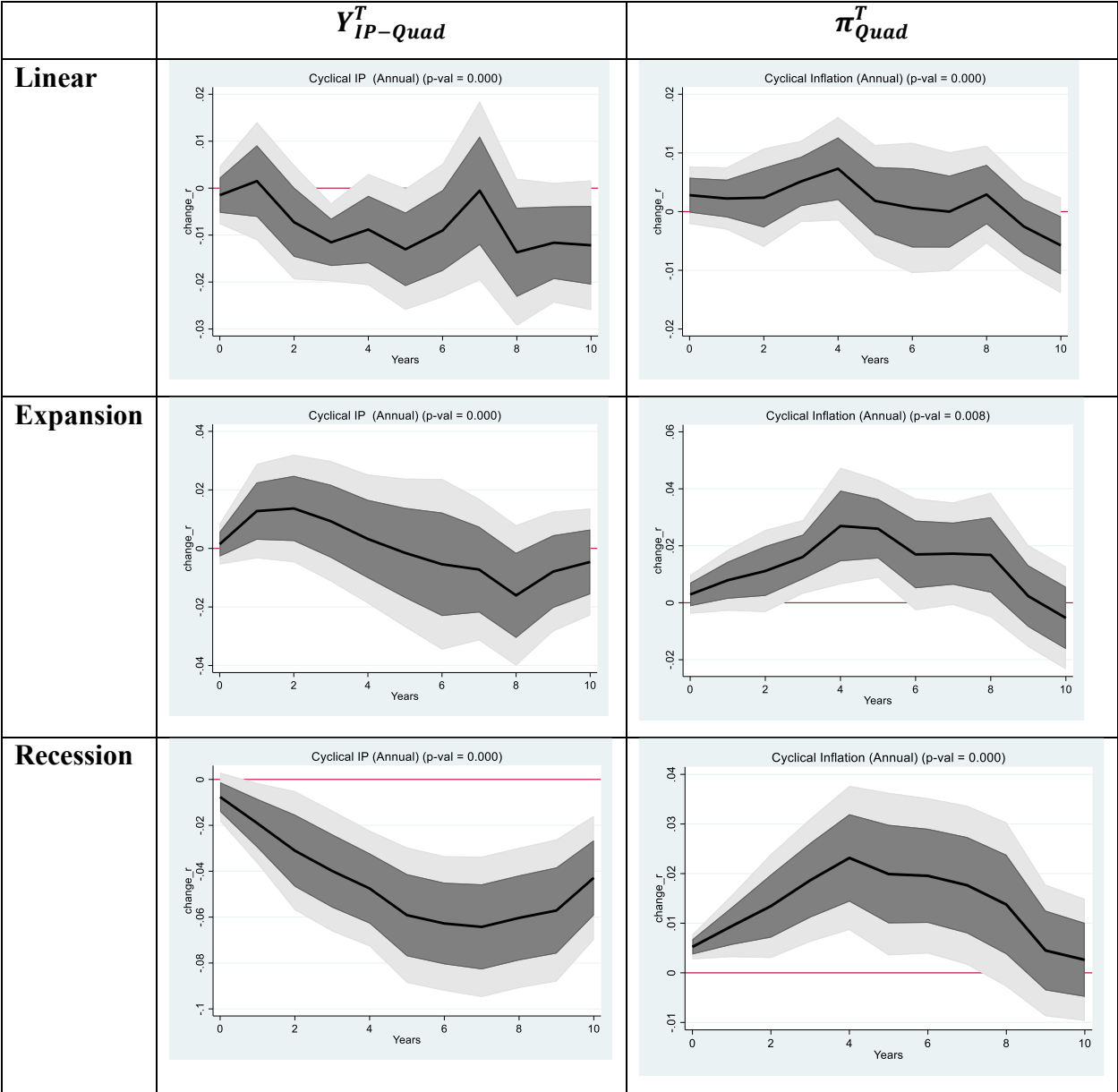


Figure A. 23 Impact of monetary policy shock (change in interest rate) on cyclical output and inflation using annual data

Note: The figure illustrates the impulse responses of cyclical output and inflation to an interest rate shock, derived through the change in interest rate. The analysis is done on annual data. The cyclical output and inflation is calculated through the quadratic trend model. The local projection method evaluates the impulse responses throughout 20 horizons. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phase.

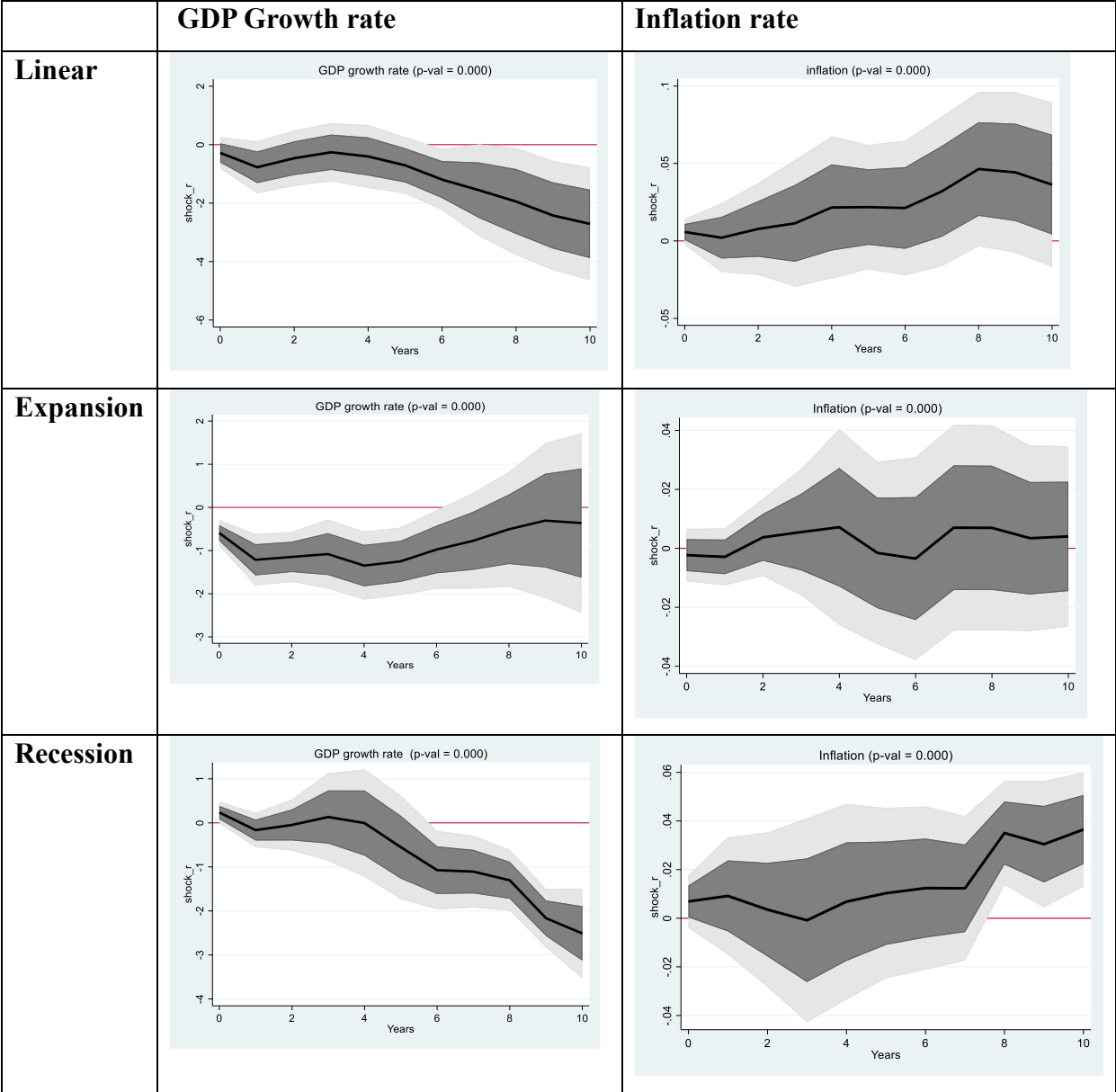


Figure A. 24 Impact of monetary policy shock (the two-step method) on GDP growth and inflation rate using annual data

Note: The figure illustrates the impulse responses of GDP Growth and inflation rate to an interest rate shock, derived through the two-step method. The analysis is done on annual data. The local projection method evaluates the impulse responses throughout 20 horizons. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.

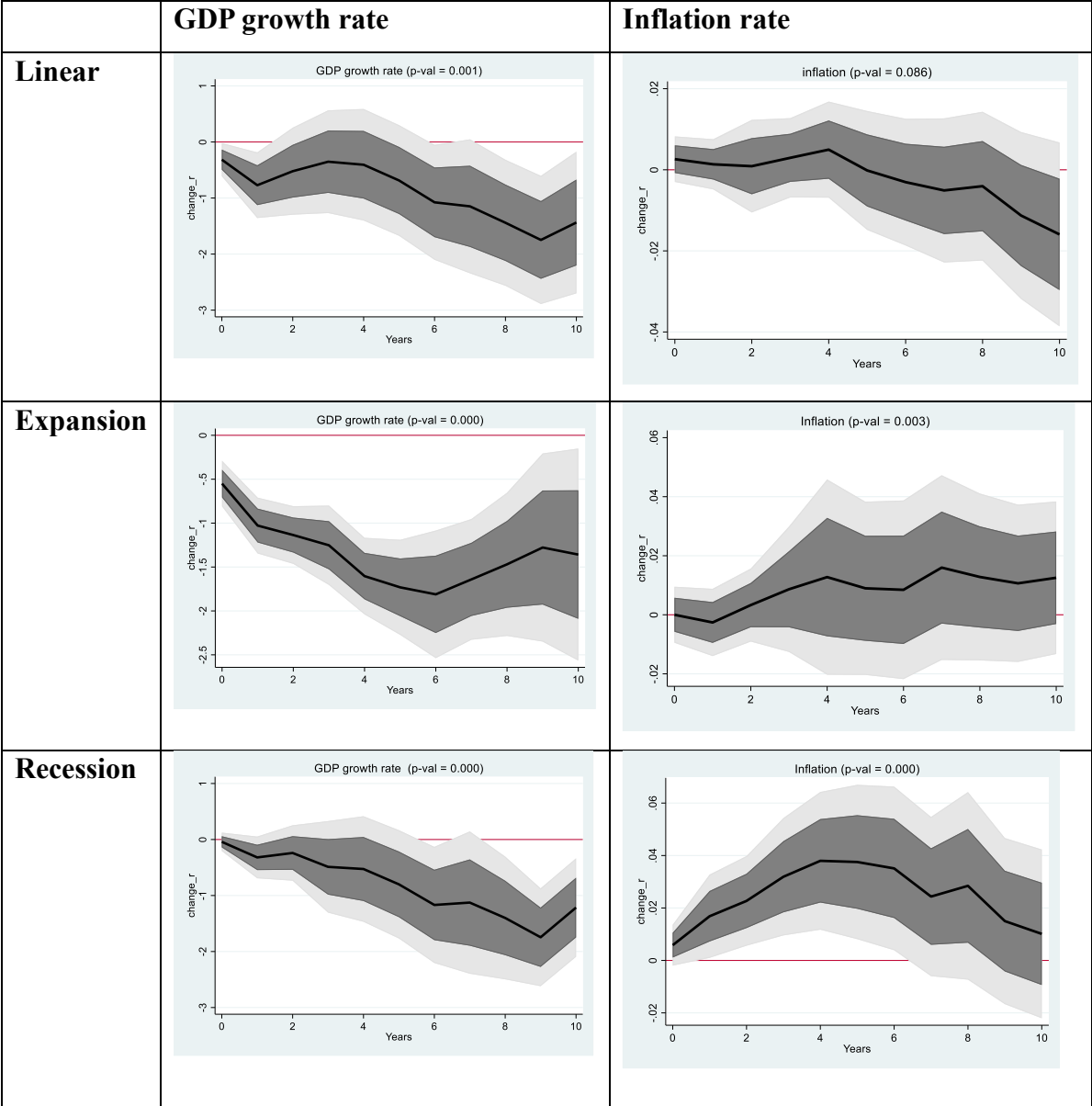


Figure A. 25 Impact of monetary policy shock (change in interest rate) on GDP growth and inflation rate using annual data

Note: The figure illustrates the impulse responses of GDP Growth and inflation rate to an interest rate shock, derived through change in interest rate. The analysis is done on annual data. The local projection method evaluates the impulse responses throughout 20 horizons. The dark gray bands represent a 90% confidence interval, whereas the light gray bands indicate a 95% confidence interval. Two models are present: a linear model and a state-dependent model. The state-dependent model integrates both contractionary and growth phases.