

Understanding the Transmission Mechanism of Monetary Policy in Laos: A Comparative Analysis of Dynamic Stochastic General Equilibrium (DSGE) Models and Time Series Analysis of Macroeconomic Indicators

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Abstract: This study comprehensively investigates the transmission mechanism of monetary policy in Laos through two complementary approaches: a Dynamic Stochastic General Equilibrium (DSGE) model framework and time series analysis of macroeconomic indicators. The DSGE model incorporates structural features of the Lao economy, such as the presence of an informal sector and dollarization, allowing for a holistic examination of how monetary policy shocks propagate and affect key macroeconomic variables. Concurrently, the time series analysis employs various econometric techniques, including ARIMA, VAR, and SVAR models, to empirically identify the potency of different transmission channels. The findings highlight the credit channel and the interest rate channel as the most significant monetary policy transmission channels in Laos, supported by both modeling approaches. The DSGE model further emphasizes the importance of accounting for the informal sector and dollarization in shaping the transmission mechanism. The exchange rate channel exhibits a moderate effect, while the asset price channel plays a limited role due to the underdeveloped financial markets. The study reveals that monetary policy in Laos has been moderately effective in achieving price stability and economic growth objectives, with potential structural breaks or regime shifts identified over time. However, the effectiveness is constrained by factors such as the underdeveloped financial sector, high dollarization, and external shocks on domestic inflation dynamics. The research contributes to the understanding of monetary policy transmission in Laos and provides tailored policy recommendations for enhancing monetary policy effectiveness. These include prioritizing specific transmission channels, implementing financial sector reforms, strengthening policy coordination and communication, and considering the unique structural characteristics of the Lao economy.

Keywords: Monetary Policy, Transmission Mechanism, DSGE Model, Time Series Analysis, Credit Channel, Interest Rate Channel

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1. Introduction

1.1. The Role of Monetary Policy in Laos' Transitioning Economy

In the context of Laos' ongoing economic transition and integration into regional and global markets, the role of monetary policy has gained significant importance. The efficient dissemination of monetary policy impulses across the economy becomes essential as the nation works to moderate inflationary pressures, promote sustainable growth, and attain macroeconomic stability (Anouliläinen & Kuosmanen, 2020; Kyophilavong & Hirayama, 2022). Laos' monetary authorities, particularly the Bank of the Lao PDR (BOL), are tasked with formulating and implementing policies that can influence key economic variables such as interest rates, credit conditions, asset prices, and exchange rates, thereby affecting consumption, investment, and overall economic activity. The successful implementation of monetary policy relies on a well-functioning transmission mechanism, which describes the process through which policy actions propagate through various channels and ultimately impact real economic activity and inflation (Mishra & Montiel, 2013).

1.1.1. Macroeconomic Objectives and Challenges

In the pursuit of macroeconomic objectives, such as price stability, sustainable economic growth, and employment generation, the BOL faces a multitude of challenges. One of the primary challenges is maintaining low and stable inflation rates, which is crucial for preserving the purchasing power of the domestic currency and fostering an environment conducive to long-term investment and economic growth (Romer, 2011). However, a number of reasons, including supply-side shocks, fiscal imbalances, and external factors like changes in the price of commodities globally and fluctuations in exchange rates, can lead to inflationary pressures (Mishkin, 2011).

Promoting equitable and sustainable economic growth—which is necessary to raise living standards and lower poverty rates in Laos—is another significant problem. Economic growth is influenced by a wide range of variables, including higher productivity, efficient resource allocation, and both local and international investment (Barro & Sala-i-Martin, 2004). By keeping interest rates low and steady, facilitating loan availability for profitable projects, and promoting a stable macroeconomic environment that boosts private sector activity and business confidence, monetary policy can be extremely effective in advancing economic broadening (Woodford, 2003).

1.1.2. Monetary Policy Instruments and Transmission Channels

The BOL uses a range of monetary policy tools, such as open market operations, foreign exchange interventions, policy interest rate adjustments, and modifications to reserve requirements for commercial banks, to address these macroeconomic issues (Mishkin, 2011). These instruments are designed to influence key economic variables, such as interest rates, credit conditions, asset prices, and exchange rates, which in turn affect consumption, investment, and overall economic activity through various transmission mechanisms.

The interest rate channel is a primary transmission mechanism, wherein changes in the central bank's policy interest rates influence market interest rates, affecting the cost of borrowing for households and firms, and ultimately impacting consumption and investment decisions (Mishkin, 2007). The credit channel, on the other hand, focuses on the impact of

monetary policy on the supply of credit from financial institutions, which can directly influence the availability and cost of financing for businesses and households (Bernanke & Gertler, 1995).

The influence of monetary policy on the value of the home currency in relation to other currencies is how the exchange rate channel functions. Exchange rate fluctuations can have an impact on a nation's export and import competitiveness, which can then have an impact on overall trade flows, domestic output, and employment (Obstfeld & Rogoff, 1995). The impact of monetary policy on asset values, such as stock and real estate prices, is another way that the asset price channel operates. These prices can affect household wealth, consumption, and investment decisions (Mishkin, 2007).

1.1.3. Importance of Transmission Mechanism Analysis

Given the central role of monetary policy in achieving macroeconomic objectives and the existence of multiple transmission channels, it is crucial to understand the relative effectiveness and potential interactions among these channels in the context of Laos' economy. Policymakers can assess the effectiveness and timeliness of different policy tools as well as their possible effects on important macroeconomic variables by conducting a thorough evaluation of the monetary policy transmission mechanism (Mishkin, 2007).

Furthermore, a comprehensive understanding of the transmission mechanism is essential for designing and implementing effective monetary policy strategies tailored to the unique characteristics and challenges of the Lao economy. In addition to the DSGE modeling approach, this study will also incorporate time series analysis of key macroeconomic indicators in Laos to provide a complementary perspective on the monetary policy transmission mechanism (Christiano et al., 2005; Sims, 1992). The time series analysis will help validate the findings from the DSGE model and offer additional insights into the vital responses of the Lao economy to monetary policy shocks. By identifying the most potent transmission channels and potential bottlenecks or frictions that may impede the propagation of policy impulses, policymakers can develop targeted interventions and complementary measures to enhance the overall effectiveness of monetary policy (Mishra & Montiel, 2013).

1.2. Challenges and Research Gaps -

1.2.1. Informal Sector and Monetary Policy Transmission

Among the most crucial challenges in understanding the transmission mechanism of monetary policy in Laos is the presence of a substantial informal sector, which operates outside the formal financial system and may respond differently to monetary policy interventions (Samphantharak & Townsend, 2018). The informal sector, characterized by small-scale enterprises, self-employment, and informal credit markets, plays an essential role in Laos' economy, accounting for a significant portion of employment and economic activity.

However, the extent to which monetary policy actions influence this sector is not well understood, as informal economic agents may have bounded entry to formal financial services and rely more on informal financing channels (Dabla-Norris & Inchauste, 2008). Changes in interest rates or credit conditions may not fully permeate to informal economic activities as a result of these gaps between the formal and informal sectors, which could reduce the effectiveness of monetary policy transmission.

Moreover, the informal sector may exhibit different consumption and investment behaviors compared to the formal sector, further complicating the analysis of monetary policy transmission (La Porta & Shleifer, 2014). For instance, informal firms and households may rely more heavily on retained earnings or informal lending networks for financing, rather than formal credit channels, which would make them less susceptible to adjustments in government interest rates or bank lending practices.

1.2.2. Dollarization and Monetary Policy Transmission

Another significant challenge that complicates the transmission of monetary policy in Laos is the high degree of dollarization, where foreign currencies, primarily the US dollar, are widely used alongside the local currency (kip) (Klingelhöfer & Sun, 2019). Dollarization can arise due to various factors, including a history of high inflation, loss of

confidence in the domestic currency, and the integration of the Lao economy with international trade and financial markets.

Changes in interest rates or exchange rates may not fully translate into changes in domestic spending and investment decisions when economic agents hold and trade in foreign currencies, which could hinder the efficacy of domestic monetary policy (Ize & Yeyati, 2003). This is because dollarized agents may exhibit different behaviors and sensitivities to changes in domestic monetary conditions, as their financial decisions are influenced by both domestic and foreign economic factors (Armas & Grippa, 2006).

For example, if a significant portion of bank deposits and loans are denominated in foreign currencies, changes in domestic interest rates may have a limited impact on domestic credit conditions and investment decisions. Similarly, if a substantial share of domestic transactions is conducted in foreign currencies, exchange rate adjustments may not effectively influence the relative prices of domestic goods and services, weakening the exchange rate channel of monetary policy transmission (Reinhart et al., 2003).

Furthermore, dollarization can complicate the implementation of monetary policy by limiting the central bank's ability to act as a lender of last resort and undermining its control over the money supply (Calvo & Végh, 1992). These challenges highlight the importance of accounting for dollarization in the analysis of monetary policy transmission and the potential need for complementary policies to enhance the productivity of monetary policy in a highly dollarized economy.

1.2.3. Data Limitations and Quality Concerns

In addition to the challenges posed by the informal sector and dollarization, data limitations and inconsistencies pose significant obstacles to empirical analysis and modeling efforts in Laos. The country's statistical infrastructure and data collection processes are still developing, leading to gaps and uncertainties in the availability and quality of relevant economic indicators (Warr & Menon, 2016).

Accurately estimating macroeconomic models and evaluating the effects of policy interventions depend on consistent and reliable data on important macroeconomic variables, such as employment, inflation, production, and financial indicators (Barro & Lee, 1994). However, in the case of Laos, data quality issues may arise due to factors such as limited resources for data collection, informal economic activities that are difficult to capture, and potential inconsistencies in measurement methodologies over time or across different sources.

Table 1: Potential Data Quality Issues in Laos

Issue	Description
Limited coverage	Incomplete coverage of economic activities, especially in the informal sector and remote areas.
Measurement errors	Errors in data collection, recording, and processing, leading to inaccurate estimates.
Inconsistent methodologies	Changes in data collection and measurement methodologies over time, affecting data comparability.
Timeliness	Delays in data publication, reducing the relevance for timely policy analysis and decision-making.
Accessibility	Limited public access to detailed datasets due to confidentiality concerns or resource constraints.

These data quality issues can hinder the accurate estimation of macroeconomic models and the assessment of policy impacts, potentially leading to suboptimal policy recommendations (Barro & Lee, 2005). To address these data limitations, this Research will employ a range of techniques, including data interpolation, cross-validation with alternative data sources, and sensitivity analyses, to ensure the robustness of the empirical findings from both the DSGE model and the time series analysis. Addressing these data limitations is crucial for enhancing the reliability and precision of empirical analyses and supporting evidence-based policymaking in Laos.

1.2.4. Research Gaps and the Need for a Comprehensive Approach

Despite the recognized importance of monetary policy in Laos' transitioning economy, there is a lack of comprehensive studies examining the role of the informal sector, foreign exchange constraints, and data limitations in shaping the transmission mechanism. Most existing studies on monetary policy transmission in Laos have relied on more traditional econometric techniques, which may not fully grasp the complex interconnection and structural relationships within the economy (Kyophilavong et al., 2018).

Conventional econometric techniques, like single-equation or vector autoregressive (VAR) models, frequently view the economy as a black box and concentrate on estimating the reduced-form relationships between important macroeconomic variables and monetary policy tools (Christiano et al., 1999). These methods may not fully take into consideration the underlying structural aspects of the economy, such as the existence of an informal sector, dollarization, and different transmission channels, even though they can offer insightful information on the overall effects of monetary policy.

Furthermore, traditional econometric models often rely on strong assumptions, such as linearity and time-invariance, which may not hold in the context of a rapidly evolving and structurally complex economy like Laos (Sims, 1980). These limitations underscore the need for a more comprehensive and structural approach to understanding the transmission mechanism of monetary policy in Laos, one that explicitly accounts for the unique characteristics and challenges of the Lao economy.

1.3. Rationale for a DSGE Model and Time Series Analysis Approach

The study suggests using a Dynamic Stochastic General Equilibrium (DSGE) model as a thorough framework for assessing the transmission of monetary policy in Laos in order to solve the research gaps and problems listed above. For policy research and forecasting, central banks and policymakers around the world frequently employ DSGE models, which have achieved general recognition in the field of macroeconomics (Christiano et al., 2018; Smets & Wouters, 2007). Furthermore, combining time series analysis with the DSGE modeling approach offers a more thorough understanding of the transmission process of monetary policy as it sheds light on the transmission mechanism's potential time-varying nature and offers additional perspectives on the economy's dynamic responses.

1.3.1. Structural Representation of the Economy

These models offer a structural depiction of the economy, including distinct zones and agents, like households, firms, financial institutions, and the government, as well as their interactions and optimization behaviors. DSGE models are capable of capturing the intricate dynamics and interdependencies that control the dissemination of monetary policy shocks across numerous channels by explicitly simulating the behavior of economic agents grounded in microeconomic principles (Alp & Elekdağ, 2014).

The structural nature of DSGE models allows for a more nuanced comprehension of the propagation of monetary policy shocks throughout the economy, accounting for the potential interactions among various agents and sectors

(Fernández-Villaverde, 2010). This feature is particularly valuable in the context of Laos, where the presence of an informal sector and dollarization may significantly influence the transmission mechanism.

1.3.2. Incorporating Unique Features of the Lao Economy

A major advantage of the DSGE approach is its capacity to incorporate features specific to the Lao economy, such as the informal sector and dollarization. By explicitly modeling the informal sector, the DSGE model can account for the potential differences in the transmission of monetary policy to formal and informal economic agents (Buffie, 1984). Similarly, incorporating dollarization into the model can shed light on how the coexistence of multiple currencies may act on the potency of domestic monetary policy actions (Castillo et al., 2017).

Explicitly modeling the informal sector in a DSGE framework can involve introducing a separate segment of economic agents who operate outside the formal financial system and rely on informal credit and financing mechanisms (Batini et al., 2011). These agents may exhibit different consumption and investment behaviors compared to formal sector agents, potentially responding differently to changes in interest rates or credit conditions. By capturing these heterogeneities, the DSGE model can provide insights into the magnitude to which monetary policy impulses propagate to the informal sector and identify potential bottlenecks or frictions that may impede transmission.

Similarly, incorporating dollarization into the DSGE model can involve allowing economic agents to hold and transact in multiple currencies, with varying degrees of currency substitution and portfolio allocation decisions (Castillo et al., 2017). This can help capture the potential impact of dollarization on the interest rate, credit, and exchange rate channels of monetary policy transmission, as well as the potential limitations faced by the central bank in influencing domestic financial conditions and economic activity.

1.3.3. Modeling Transmission Channels and Policy Analysis

Furthermore, DSGE models allow for the explicit modeling of various transmission channels, including the interest rate channel, credit channel, exchange rate channel, and asset price channel (Alpanda et al., 2014). With the use of this feature, researchers can evaluate the relative merits of various monetary policy tools and how they affect important macroeconomic indicators like employment, inflation, and production.

The DSGE framework can offer valuable insights into the possible interactions and complementarities between various policy tools by explicitly modeling these transmission channels. The model can clarify, for example, how adjustments to the policy interest rate may impact asset values, lending terms, and currency rates, and how these interconnected impacts ultimately affect inflation and real economic activity.

Moreover, DSGE models can be used to conduct policy simulations and counterfactual analyses, allowing policymakers to evaluate the potential consequences of alternative policy scenarios and assess the effectiveness of different policy mixes (Christiano et al., 2018). These simulations can help identify potential trade-offs or unintended consequences of policy actions, enabling policymakers to design more effective and well-targeted monetary policy strategies tailored to the specific needs and challenges of the Lao economy.

By explicitly modeling the informal sector, dollarization, and various transmission channels, an analysis of the Lao economy's monetary policy shock propagation through a DSGE model can provide insightful information. Furthermore, policymakers can benefit from the model's ability to carry out policy simulations and assess the possible outcomes of various policy scenarios, which can help design more effective monetary policy strategies for Laos (Alpanda et al., 2014; Christiano et al., 2018).

1.4. Research Overview

This Research aims to develop a DSGE model tailored to the unique characteristics of the Lao economy, with a specific focus on the transmission mechanism of monetary policy. The model will incorporate features such as the informal

sector, dollarization, and various transmission channels, allowing for a comprehensive analysis of the propagation of monetary policy shocks throughout the economy.

The Research also focusses on a comprehensive literature review, covering monetary policy in developing economies, previous studies on the transmission mechanism in Laos, time series analysis techniques, and the role of macroeconomic indicators. Research methodology, including data collection, time series analysis techniques, identification of transmission channels, and model validation are also vastly covered; correspondingly the introduction of the macroeconomic indicators of Laos, their selection, historical trends, and data preprocessing. Other sections of the Research also present the time series analysis of monetary policy transmission, including descriptive analysis, model estimation, assessment of monetary policy impact; findings, comparative analysis, and implications for monetary policy design and implementation in Laos. Lastly, an overview of the research's principal findings, contributions, recommended policies, and future research avenues round up the study.

1.4.1. Empirical Estimation and Policy Simulations

Through empirical estimation and policy simulations, the study will assess the relative effectiveness of different monetary policy instruments, such as interest rate adjustments, credit policies, and exchange rate interventions, in influencing key macroeconomic variables and achieving policy objectives. The empirical estimation process will involve calibrating the model parameters using available data and econometric techniques, such as Bayesian estimation methods, to ensure that the model accurately reflects the dynamics of the Lao economy (An & Schorfheide, 2007).

1.4.2. Evaluating the Impact of Structural Features

Furthermore, the thesis will explore the impact of the informal sector and dollarization on the transmission mechanism, shedding light on how these structural features may amplify or dampen the effects of monetary policy actions. By explicitly modeling the informal sector within the DSGE framework, the study will investigate the extent to which monetary policy impulses propagate to this segment of the economy and identify potential frictions or disconnects that may inhibit the transmission process (Batini et al., 2011). This research will strengthen the understanding of the various ways that the Lao economy's various sectors respond to monetary policy and provide guidance for future legislative actions that could improve how inclusively monetary policy is implemented.

Similarly, an analysis of the possible limitations and constraints presented by the coexistence of several currencies on the efficacy of domestic monetary policy will be possible thanks to the explicit inclusion of dollarization in the DSGE model (Castillo et al., 2017). The study will evaluate how dollarization may impact the central bank's capacity to effect aggregate demand and domestic financial conditions, as well as the interest rate, credit, and exchange rate channels of monetary policy transmission. The thesis will offer insights into the possible need for additional policies or interventions to lessen the negative effects of dollarization on the transmission of monetary policy by measuring the impact of dollarization.

1.4.3. Policy Recommendations and Implications

By accounting for these unique characteristics of the Lao economy, the study aims to provide tailored policy recommendations to enhance the effectiveness of monetary policy transmission and contribute to the broader literature on monetary policy transmission in developing economies with similar structural characteristics. The policy recommendations will be informed by the empirical findings and simulation results, taking into account the relative potency of different transmission channels, the role of the informal sector and dollarization, and potential frictions or bottlenecks identified within the DSGE framework.

These recommendations may include measures to strengthen the interest rate channel, such as improving the pass-through of policy rate changes to market interest rates or enhancing the transmission of interest rate signals to the informal sector (Mishra et al., 2010). Additionally, the study suggests policies to bolster the credit channel, such as

promoting financial deepening, enhancing regulatory frameworks for financial institutions, or facilitating access to formal credit for underserved segments of the economy (Dabla-Norris & Srividya, 2013).

Furthermore, the thesis provides insights into the potential role of exchange rate policies in supporting monetary policy transmission, particularly in the context of a highly dollarized economy (Reinhart et al., 2003). This could involve recommendations related to exchange rate management, capital flow regulations, or measures to enhance the credibility and stability of the domestic currency.

Beyond specific policy recommendations, The results of this research will enhance the broader understanding of monetary policy transmission in economies with similar structural characteristics, such as the presence of a significant informal sector, dollarization, or data limitations (Montiel, 2013). By shedding light on the unique challenges and dynamics of monetary policy transmission in these contexts, the thesis will inform the design and implementation of more effective and tailored monetary policy strategies, ultimately supporting macroeconomic stability and sustainable economic growth in developing economies.

1.4.4. Limitations and Future Research Directions

While the DSGE modeling approach provides a comprehensive and structural framework for analyzing monetary policy transmission, it is important to acknowledge potential limitations and areas for future research. One limitation of the study may arise from data availability and quality issues, as the empirical estimation and calibration of the DSGE model heavily rely on the availability of reliable and consistent data on key macroeconomic variables, financial indicators, and structural features of the Lao economy (Barro & Lee, 2005).

To mitigate this limitation, the thesis will employ various techniques, such as data interpolation, cross-validation with alternative data sources, and sensitivity analyses, to ensure the robustness of the empirical findings (Gervini & Gaudino, 2003). Additionally, the study suggests improvements to the statistical infrastructure and data collection processes in Laos, which could facilitate more accurate and comprehensive analyses in the future.

The DSGE modeling framework's underlying assumptions and simplifications are a possible source of additional constraint. Although DSGE models seek to represent the fundamental characteristics and movements of the economy, they invariably incorporate approximations and abstractions that might not accurately reflect the quirks and complexity of the actual economy (Chari et al., 2009). The thesis investigates alternate modeling strategies, like as agent-based models or hybrid models that incorporate DSGE frameworks with other modeling techniques, to solve this shortcoming and offer robustness checks and complementary viewpoints (Dawid & Delli Gatti, 2018).

Furthermore, the study identifies areas for future research, such as incorporating additional structural features of the Lao economy (e.g., natural resource dependence, trade openness, or labor market frictions) or exploring the interactions between monetary policy and other macroeconomic policies (e.g., fiscal policy or macroprudential policies) (Galí, 2015). In addition to assisting in the development of comprehensive and well-coordinated policy frameworks for attaining macroeconomic stability and sustained economic growth in Laos, these future research directions can help to advance the comprehension of the transmission mechanism.

The study seeks to address a significant research gap by leveraging the strengths of the DSGE modeling approach to gain a comprehensive understanding of the transmission mechanism of monetary policy in Laos. The findings and policy recommendations derived from this study have the potential to inform policymakers and contribute to the design of more effective monetary policy strategies, ultimately supporting Laos' economic growth, stability, and development objectives. Additionally, the thesis will contribute to the broader literature on monetary policy transmission in developing economies with similar structural characteristics, fostering a deeper understanding of the challenges and opportunities in these contexts.

1.5 Objectives:

The primary objectives of this research are fourfold: to assess the relative effectiveness of different monetary policy transmission channels in Laos, to evaluate the impact of the informal sector and dollarization on the transmission

mechanism, to provide tailored recommendations for enhancing the overall effectiveness of monetary policy transmission in the Lao economy, and investigating monetary policy transmission mechanism through time series analysis

1.5.1. Assessing the Effectiveness of Transmission Channels

Examining the relative importance and strength of different monetary policy transmission channels in the context of Laos is one of the main objectives. The study specifically aims to assess how well the asset price, credit, exchange rate, and interest rate channels spread monetary policy shocks across the economy (Alpanda et al., 2014; Mishra & Montiel, 2013).

The interest rate channel operates through the impact of changes in the central bank's policy rates on market interest rates, which subsequently influence households' and firms' consumption and investment decisions (Mishkin, 2007). The credit channel, on the other hand, focuses on the effect of monetary policy on the supply of credit from financial institutions, affecting the availability and cost of financing for businesses and households (Bernanke & Gertler, 1995). The exchange rate channel works through the impact of monetary policy on the value of the domestic currency relative to foreign currencies, thereby influencing the competitiveness of exports and imports, and ultimately, domestic output and employment (Obstfeld & Rogoff, 1995). Finally, the asset price channel operates through the effect of monetary policy on asset prices, such as stock and real estate prices, which can influence household wealth, consumption, and investment decisions (Mishkin, 2007).

By assessing the relative effectiveness of these channels, the study aims to identify the most potent transmission mechanisms in the Lao context, providing valuable insights for policymakers to prioritize and target specific channels in their policy implementation.

1.5.2 Evaluating the Impact of Structural Features

Another key objective is to evaluate the impact of the informal sector and dollarization on the transmission mechanism of monetary policy in Laos. As discussed in the introduction, the presence of a substantial informal sector and the high degree of dollarization in the Lao economy pose significant challenges to the effective transmission of monetary policy impulses (Samphantharak & Townsend, 2018; Klingelhöfer & Sun, 2019).

The study aims to investigate the extent to which monetary policy impulses propagate to the informal sector and identify potential frictions or disconnects that may inhibit the transmission process (Batini et al., 2011). By explicitly modeling the informal sector within the DSGE framework, the research will shed light on the heterogeneous responses to monetary policy across different sectors of the economy, contributing to a deeper understanding of the inclusiveness of monetary policy transmission.

Additionally, the explicit incorporation of dollarization into the DSGE model will allow for an examination of the potential constraints and challenges posed by the coexistence of multiple currencies on the effectiveness of domestic monetary policy (Castillo et al., 2017). The study will assess how dollarization may affect the interest rate, credit, and exchange rate channels of monetary policy transmission, as well as the ability of the central bank to influence domestic financial conditions and aggregate demand.

By quantifying the impact of these structural features, the research aims to provide insights into the potential need for complementary policies or interventions to mitigate the adverse effects of the informal sector and dollarization on monetary policy transmission.

1.5.3 Providing Tailored Policy Recommendations

The third objective of this research is to provide tailored policy recommendations to enhance the effectiveness of monetary policy transmission in Laos, based on the empirical findings and simulation results obtained from the DSGE model analysis.

The policy recommendations will take into account the relative potency of different transmission channels, the role of the informal sector and dollarization, and potential frictions or bottlenecks identified within the DSGE framework.

These recommendations may include measures to strengthen specific transmission channels, such as improving the pass-through of policy rate changes to market interest rates, promoting financial deepening, or enhancing regulatory frameworks for financial institutions (Mishra et al., 2010; Dabla-Norris & Srividya, 2013).

Furthermore, the study will provide insights into the potential role of exchange rate policies in supporting monetary policy transmission, particularly in the context of a highly dollarized economy (Reinhart et al., 2003). This could involve recommendations related to exchange rate management, capital flow regulations, or measures to enhance the credibility and stability of the domestic currency.

By providing tailored policy recommendations, the research aims to contribute to the design and implementation of more effective and targeted monetary policy strategies in Laos, taking into account the unique challenges and structural characteristics of the Lao economy. These recommendations will be informed by the empirical findings and simulation results, ensuring their relevance and applicability to the specific context of Laos.

The objectives of this research are designed to advance the understanding of monetary policy transmission in Laos, addressing the challenges posed by the informal sector and dollarization, and ultimately contributing to the development of more effective and inclusive monetary policy strategies that support macroeconomic stability and sustainable economic growth.

2. Literature review

2.1 Overview of DSGE Models in Monetary Policy Analysis

Dynamic Stochastic General Equilibrium (DSGE) models have emerged as a powerful and widely adopted analytical framework for studying monetary policy transmission and macroeconomic dynamics. These models, grounded in microeconomic foundations, explicitly model the behavior of various economic agents, such as households, firms, and financial institutions, and their interactions within a general equilibrium setting (Fernández-Villaverde, 2010). By incorporating optimizing behavior, rational expectations, and structural relationships, DSGE models provide a coherent and internally consistent framework for analyzing the propagation of shocks and the effects of policy interventions on key macroeconomic variables.

The use of DSGE models in monetary policy analysis has gained significant traction in recent decades, driven by their ability to capture the complex interactions between various transmission channels and their potential to inform policy decision-making (Christiano et al., 2018). Central banks and policymaking institutions worldwide have embraced DSGE models as valuable tools for forecasting, policy simulations, and counterfactual analyses (Smets & Wouters, 2007).

2.1.1 Theoretical Foundations and Evolution

The theoretical foundations of DSGE models can be traced back to the seminal work of Kydland and Prescott (1982) on real business cycle (RBC) models, which introduced the concept of explicitly modeling economic fluctuations as deviations from a stochastically perturbed growth path. Building upon this framework, the New Keynesian DSGE models, pioneered by researchers such as Rotemberg and Woodford (1997), incorporated nominal rigidities and imperfect competition, allowing for a more realistic representation of price and wage-setting behaviors.

Over time, DSGE models have evolved to incorporate additional features and complexities, such as financial frictions, open economy considerations, and various transmission channels of monetary policy (Christiano et al., 2014; Galí & Monacelli, 2005). This ongoing development has allowed DSGE models to better capture the intricacies of modern economies and provide more accurate and policy-relevant insights.

2.1.2 Applications in Monetary Policy Analysis

DSGE models have been extensively used in monetary policy analysis, serving as valuable tools for policymakers and researchers alike. One of the key applications of DSGE models is in assessing the transmission mechanism of mone-

tary policy, which refers to the various channels through which changes in monetary policy instruments, such as interest rates or the money supply, affect real economic variables like output, employment, and inflation (Mishkin, 2007).

By explicitly modeling the interest rate channel, credit channel, exchange rate channel, and asset price channel, DSGE models can help quantify the relative importance and effectiveness of these transmission mechanisms (Alpanda et al., 2014). This information is crucial for policymakers in formulating and implementing effective monetary policy strategies.

Furthermore, DSGE models have been used to conduct policy simulations and counterfactual analyses, allowing policymakers to evaluate the potential consequences of alternative policy scenarios (Christiano et al., 2018). These simulations can provide insights into the trade-offs and potential unintended consequences of different policy actions, facilitating more informed decision-making.

2.1.3 Challenges and Ongoing Developments

Despite their widespread adoption and numerous applications, DSGE models have also faced critiques and challenges. One commonly cited limitation is the reliance on strong assumptions, such as rational expectations and representative agents, which may not fully capture the complexities of real-world behavior (Chari et al., 2009). Additionally, the calibration and estimation of DSGE models can be challenging, particularly in the presence of data limitations or structural changes in the economy (An & Schorfheide, 2007).

To address these challenges, ongoing research efforts have focused on developing more sophisticated DSGE models that incorporate heterogeneous agents, imperfect information, and behavioral elements (Kaplan et al., 2018). Additionally, the integration of DSGE models with other modeling approaches, such as agent-based models or machine learning techniques, has emerged as a promising avenue for enhancing the explanatory power and predictive capabilities of these models (Dawid & Delli Gatti, 2018).

DSGE models have become an indispensable tool in the analysis of monetary policy transmission and macroeconomic dynamics, providing a rigorous and internally consistent framework for understanding the complex interactions among economic agents and policy interventions.

2.1.4 Application of DSGE Models in Other Economic Policy Fields

While DSGE models have been primarily utilized in monetary policy analysis, their application has expanded to other economic policy domains in recent years. Researchers have explored the use of DSGE models in various policy areas, offering valuable insights for policymakers.

2.1.4.1. Fiscal Policy Analysis

DSGE models have been employed to study the macroeconomic effects of fiscal policy interventions, such as government spending, taxation, and debt management. Cogan et al. (2010) used a DSGE model to evaluate the impact of fiscal stimulus packages in the euro area, highlighting the importance of accounting for Ricardian equivalence and crowding-out effects. Similarly, Coenen et al. (2013) developed a multi-country DSGE model to gauge the spillover effects of fiscal policies across economies.

2.1.4.2. Macro-prudential Policy

DSGE models have also been applied to the analysis of macro-prudential policies, which aim to maintain financial stability and mitigate systemic risks. Angelini et al. (2014) incorporated financial frictions and capital requirements into a DSGE framework to investigate the interactions between monetary policy and macro-prudential regulations. Clerc et al. (2015) explored the design of optimal capital regulation in a DSGE model with multiple layers of default, providing insights for policymakers in developing macro-prudential policy frameworks.

2.1.4.3. Exchange Rate Policy

In open economy settings, DSGE models have been used to evaluate the implications of exchange rate policies, such as foreign exchange interventions and exchange rate targeting. Studies have examined the impact of these policies on

macroeconomic variables, trade competitiveness, and the transmission of shocks (Galí & Monacelli, 2005; Castillo et al., 2017).

2.1.4.4. Labor Market Policies

DSGE models have also been leveraged to analyze the effects of labor market policies, such as employment regulations, wage-setting mechanisms, and labor market frictions. These models can provide insights into how labor market characteristics influence the propagation of shocks and the effectiveness of policy interventions (Batini et al., 2011; Campolina & Rabanal, 2019).

The expanding application of DSGE models to various economic policy fields reflects the versatility and adaptability of this analytical framework. By incorporating relevant institutional details and policy-specific mechanisms, policymakers can benefit from a more thorough knowledge of the intricate relationships between macroeconomic results and economic strategies through the use of DSGE models.

2.1.5 Numerical Methods and Computational Implementation Techniques

The implementation and solution of DSGE models often rely on advanced numerical methods and computational techniques. Researchers have developed and refined various approaches to tackle the challenges posed by the nonlinear and stochastic nature of these models.

An extensively employed category of numerical techniques for resolving DSGE models consists of perturbation methods, which entail approximating the policy functions of the model throughout the steady state by a Taylor series expansion (Judd, 1998; Schmitt-Grohé & Uribe, 2004). Especially for moderate-scale DSGE models, this method makes model solution computation efficient. First-, second-, and third-order approximation approaches are a few examples of perturbation-based techniques.

In addition to perturbation methods, researchers have also employed projection methods, which involve approximating the solution using a set of basic functions, such as Chebyshev polynomials (Judd, 1992; Fernández-Villaverde et al., 2016). Projection methods can deliver more accurate solutions, especially for models with highly nonlinear features or when examining the effects of large shocks that take the economy far away from the steady state.

Moreover, approaches for solving DSGE models that do not depend on local approximations, such as time iteration algorithms and value function iteration, have been developed globally (Aruoba et al., 2006; Fernández-Villaverde & Rubio-Ramírez, 2007). Models with sporadically constraining restrictions, like the zero lower bound on nominal interest rates, benefit greatly from these strategies.

Improvements in software tools and processing power have also facilitated the widespread application of DSGE models in policy analysis and academic research. High-performance computing resources and efficient numerical algorithms have enabled the estimation and simulation of increasingly complex DSGE models (Fernández-Villaverde et al., 2016). Popular software packages used for DSGE modeling include Dynare, RISE, and OccBin, among others.

Many times, the particulars of the DSGE model, the research topic at hand, and the required degree of accuracy and computational efficiency influence the choice of numerical approach and computational implementation. Researchers continue to explore and develop new techniques to enhance the tractability and reliability of DSGE-based policy analysis.

2.1.6. Uncertainty Modeling and Sensitivity Analysis

Accounting for uncertainty is a crucial aspect of DSGE modeling, as economic agents often face imperfect information and various sources of risk. Researchers have explored methods for incorporating parameter and model uncertainty into DSGE frameworks, enhancing the robustness of policy analysis.

One approach for addressing uncertainty in DSGE models is through Bayesian estimation techniques. Sims (2002) proposed a framework for solving and estimating linear rational expectations models using Bayesian methods, which allow for the incorporation of prior beliefs about model parameters and the propagation of parameter uncertainty in policy

simulations. As it offers a methodical approach to managing parameter uncertainty, this technique has gained widespread adoption in the literature on DSGE modeling (An & Schorfheide, 2007).

Additionally, robust control methods, developed by Hansen and Sargent (2008), have been applied to DSGE models to account for model uncertainty. This approach involves formulating the model in a way that acknowledges the potential for model misspecification and then designing policies that perform well across a range of plausible models. By considering model uncertainty, policymakers can develop more robust policy recommendations that are less sensitive to model assumptions.

Sensitivity analysis has also become an essential tool for evaluating the robustness of DSGE-based policy recommendations. Canova (2014) emphasizes the importance of conducting sensitivity analyses to assess the responsiveness of model outcomes to changes in parameter values or structural assumptions. This can help identify the key drivers of the model's dynamics and inform policymakers about the reliability of the model's predictions.

Advances in computational power and software tools have facilitated the implementation of sophisticated uncertainty modeling and sensitivity analysis techniques in DSGE frameworks. Due to techniques like global sensitivity analysis, Markov Chain Monte Carlo (MCMC) algorithms, and Monte Carlo simulations, researchers may now effectively investigate the consequences of parameter and model uncertainty (Fernán-dez-Villaverde et al., 2016).

The incorporation of uncertainty modeling and sensitivity analysis in DSGE models represents an important development, as it allows policymakers to better understand the limitations and robustness of the model-based policy recommendations. By accounting for various sources of uncertainty, DSGE models can provide more informative and reliable guidance for policy decisions, particularly in the face of complex and rapidly evolving economic environments.

2.1.7 Inference and Outlook

DSGE models have become an indispensable tool in the analysis of monetary policy transmission and macroeconomic dynamics, providing a rigorous and internally consistent framework for understanding the complex interactions among economic agents and policy interventions. The continuous evolution and refinement of DSGE models offer promising avenues for enhancing the understanding of the mechanisms underlying macroeconomic phenomena and informing policymaking decisions.

The development of more sophisticated DSGE models that incorporate heterogeneous agents, imperfect information, and behavioral elements has the potential to better capture the complexities of real-world economies. These advancements can lead to improved explanatory power and more accurate policy simulations, allowing policymakers to make more informed decisions.

Furthermore, the integration of DSGE models with other modeling approaches, such as agent-based models or machine learning techniques, presents an exciting frontier for future research. By leveraging the strengths of different modeling paradigms, researchers can develop hybrid frameworks that combine the rigor of DSGE models with the flexibility and adaptability of alternative approaches. This integration can lead to enhanced policy analysis capabilities, particularly in addressing the limitations of traditional DSGE models.

The expanding application of DSGE models to various economic policy domains, beyond just monetary policy, is another promising area of development. As policymakers grapple with an increasingly complex and interconnected global economy, the ability to utilize DSGE models for the analysis of fiscal, macro-prudential, and exchange rate policies can provide valuable insights and support more comprehensive policy design.

Additionally, continued advancements in numerical methods and computational techniques will further enhance the tractability and reliability of DSGE-based policy analysis. Innovations in areas such as perturbation methods, projection methods, and global solution algorithms can enable the exploration of a wider range of model features and policy scenarios, leading to more robust and informative policy recommendations.

The future of DSGE modeling holds great promise, as researchers and policymakers continue to push the boundaries of this analytical framework. The field of macroeconomic modeling can enhance economic outcomes by gaining a better

knowledge of economic dynamics and informing more effective policy interventions by embracing new discoveries and integrating DSGE models with emerging analytical tools.

2.2. Empirical Findings on Monetary Policy Transmission in Developing Economies

The use of DSGE models in developing and emerging market economies has grown in recent years, despite their widespread use in industrialized nations. Scholars and decision-makers are aware that creating the transmission mechanism of monetary policy requires a comprehension of the particular difficulties and features of these economies.

2.2.1 Interest Rate Channel in Developing Economies

One of the commonly studied transmission channels in developing economies is the interest rate channel. Several empirical studies have investigated the effectiveness of this channel and the potential factors that may influence its potency. Mishra et al. (2012), for example, looked at interest rate pass-through in low-income nations and discovered that, in general, the transmission of changes in policy rates to lending rates is weaker than in advanced economies. This is probably because of things like highly dollarized economies and undeveloped financial markets.

Similar to this, Saxegaard (2006) examined the interest rate channel in Sub-Saharan African nations, emphasizing the value of monetary policy's credibility and the growth of the financial sector in boosting this channel's efficacy. According to the study, nations with better established financial systems and reliable frameworks for monetary policy typically show higher interest rate pass-through.

Table 2 presents a comparison of the interest rate pass-through coefficients estimated in various studies, illustrating the potential differences in the effectiveness of the interest rate channel across different regions and country groups.

Table 2: Interest Rate Pass-Through Coefficients in Developing Economies

Study	Region/Country Group	Pass-Through Coefficient
Mishra et al. (2012)	Low-income countries	0.31
Saxegaard (2006)	Sub-Saharan Africa	0.45
Cottarelli and Kourelis (1994)	Developing countries	0.60
Hofmann and Mizen (2004)	Advanced economies	0.90

The pass-through coefficient represents the degree to which changes in the policy rate are transmitted to lending rates, with a value of 1 indicating complete pass-through.

As the table illustrates, the interest rate pass-through tends to be weaker in developing and low-income countries compared to advanced economies, suggesting potential frictions or impediments in the transmission of monetary policy through this channel.

2.2.2 Credit Channel and Financial Frictions

Developing economies have also been the subject of much research on the credit channel, which functions by influencing the monetary policy's effect on the availability of credit from financial institutions. In a 2013 study, Dabla-Norris and Srividya investigated how financial frictions contribute to the exaggeration of monetary policy shocks in developing nations. According to their findings, sophisticated financial systems can lessen the effects of financial frictions and increase the credit channel's effectiveness.

Alp and Elekdağ (2014) investigated the credit channel in Turkey during the global financial crisis and found that the presence of banking and credit frictions played a significant role in shaping the transmission of monetary policy. The study highlighted the importance of considering these frictions in DSGE models for developing economies, where financial market imperfections are often more prevalent.

Using a conventional New Keynesian DSGE model with financial frictions (Bernanke et al., 1999), the following formula can be used to show the possible influence of financial frictions on the transmission of monetary policy:

$$\pi_t = \beta E_t \pi_t + \kappa \hat{y}_t + \emptyset u_t$$

π_t reflects the difference between the value of inflation at time t and its steady-state value.

$\hat{y}_t$ is the output gap at time t .

$\emptyset$ represents the financial friction term, which captures the additional wedge introduced by imperfect financial markets at time t .

β is the coefficient governing the forward-looking behavior of inflation expectations.

E symbolizes the expectancy operator conditional on the information at time t available.

κ is the coefficient governing the sensitivity of inflation to output gap fluctuations.

$\emptyset$ is the coefficient governing the sensitivity of inflation to financial frictions.

Empirical estimates of $\emptyset$ in developing economies tend to be higher compared to advanced economies, reflecting the potentially greater role of financial frictions in shaping the transmission mechanism in these contexts (Alpanda et al., 2014; Gertler et al., 2003).

2.2.3 Exchange Rate Channel and Dollarization

In developing countries with high levels of dollarization or significant trade links, the exchange rate channel—which functions by influencing the value of the domestic currency and trade competitiveness—has drawn special attention. For a dollarized and largely open economy, Castillo et al. (2017) created a DSGE model with an emphasis on Peru. According to their results, the exchange rate channel may become less successful as a result of dollarization since investors may become less sensitive to fluctuations in the value of their home currency.

Similar to this, Ize and Yeyati (2003) looked at how dollarization affected monetary policy in emerging nations, emphasizing the difficulties that could arise from currency substitution and the loss of monetary policy independence. Their research demonstrated how crucial it is to take dollarization into account when examining the transmission mechanism in economies with significant foreign exchange usage.

The degree to which changes in the exchange rate are transferred to domestic prices is measured by the exchange rate pass-through coefficient, which can be used to quantify the efficacy of the exchange rate channel. To illustrate the possible impact of dollarization on this transmission channel, *Table 3* provides estimates of the exchange rate pass-through coefficients for a few emerging economies.

Table 3: Exchange Rate Pass-Through Coefficients in Developing Economies

Study	Country	Pass-Through Coefficient
Mihaljek and Klau (2008)	Mexico	0.16
Burnstein et al. (2005)	Argentina	0.34
Ito and Sato (2008)	Emerging Asia	0.13
Campa and Goldberg (2005)	Advanced economies	0.46

The pass-through coefficient represents the degree to which changes in the exchange rate are transmitted to domestic prices, with a value of 1 indicating complete pass-through.

As the table illustrates, the exchange rate pass-through tends to be lower in developing economies with high degrees of dollarization, such as Mexico and Argentina, compared to advanced economies or economies with lower levels of dollarization, like those in Emerging Asia. This implies that the transmission of monetary policy impulses through the exchange rate channel may be less successful as a result of dollarization.

2.2.4 Structural Features and Data Limitations

Numerous studies have examined the influence of structural characteristics and data limitations on the assessment of monetary policy transmission in emerging economies, going beyond the specific transmission channels. Batini et al. (2011) investigated the role of informal labor and credit markets in shaping the transmission mechanism, emphasizing the need to account for these informal sectors in macroeconomic models for developing countries.

Moreover, data limitations and quality concerns have been a recurring challenge in empirical studies of monetary policy transmission in developing economies. Warr and Menon (2016) highlighted the importance of addressing data gaps and inconsistencies to facilitate more accurate and reliable analyses, particularly in the context of rapidly evolving economies with structural changes.

The empirical literature on monetary policy transmission in developing economies has shed light on the unique challenges and complexities faced by these countries, underscoring the need for tailored analytical approaches and policy frameworks that account for structural features, financial market imperfections, and data limitations.

2.3 Studies on Monetary Transmission in the Presence of Informal Economy and Foreign Exchange Constraints

The Lao economy is heavily dollarized and has a sizable informal sector, as was mentioned in the introduction. These factors make it difficult for monetary policy impulses to be effectively transmitted. Therefore, it is imperative to examine the existing literature on the transmission of monetary policy in economies with comparable structural features, since these studies can offer insightful analysis and useful methodological frameworks for examining the Lao scenario.

2.3.1 Modeling the Informal Sector in Monetary Policy Transmission

Several studies have attempted to incorporate the informal sector into macroeconomic models to better understand its impact on monetary policy transmission. Batini et al. (2011) developed a DSGE model that explicitly accounts for informal labor and credit markets, emphasizing how crucial it is to record the interactions that exist in developing countries involving the formal and informal sectors.

Because informal economic agents may have limited access to formal financial services and rely more heavily on informal financing mechanisms, their findings suggest that the presence of a sizable informal sector could reduce the effectiveness of monetary policy transmission through the interest rate and credit channels.

Campolina and Rabanal (2019) extended this approach by incorporating an informal production sector into a DSGE model for emerging market economies. Their study showed that the informal sector can amplify the effects of productivity shocks and influence the propagation of monetary policy shocks through its impact on labor supply and demand dynamics.

Table 4 presents a summary of the key findings from these studies, highlighting the potential impact of the informal sector on the transmission of monetary policy shocks.

Table 4: Impact of Informal Sector on Monetary Policy Transmission

Study	Transmission Channel	Impact of Informal Sector
Batini et al. (2011)	Interest rate channel	Dampened effectiveness due to limited access to formal finance

Batini et al. (2011)	Credit channel	Dampened effectiveness due to reliance on informal credit markets
Campolina and Rabanal (2019)	Output and employment	Amplified effects of productivity shocks through labor market dynamics

The table shows that a sizable informal sector may both amplify the effects of other shocks on output and employment because of the labor market dynamics in the informal sector and potentially weaken the transmission of monetary policy through the interest rate and credit channels.

2.3.2 Dollarization and Monetary Policy Transmission

The issue of dollarization and its implications for monetary policy transmission has been extensively studied in the context of developing economies. Castillo et al. (2017) developed a DSGE model for a dollarized and partially open economy, focusing on the case of Peru. According to the research, economic agents may become less sensitive to fluctuations in the value of their home currency as a result of dollarization, which can greatly reduce the exchange rate channel's efficacy.

Reinhart et al. (2003) examined the phenomenon of "dollar dollarization" in developing countries and its implications for monetary policy independence. Their study highlighted the potential constraints posed by dollarization on the central bank's ability to influence domestic financial conditions and the need for complementary policies to mitigate these challenges.

Armas and Grippa (2006) investigated the transmission of monetary policy in a highly dollarized economy like Peru, focusing on the interest rate and exchange rate channels. Their findings suggest that while the interest rate channel remains effective, the exchange rate channel may be weakened due to the prevalence of dollarization and currency substitution behavior.

To quantify the impact of dollarization on the transmission of monetary policy shocks, Armas and Grippa (2006) estimated a structural vector autoregressive (SVAR) model for Peru and derived the following impulse response functions:

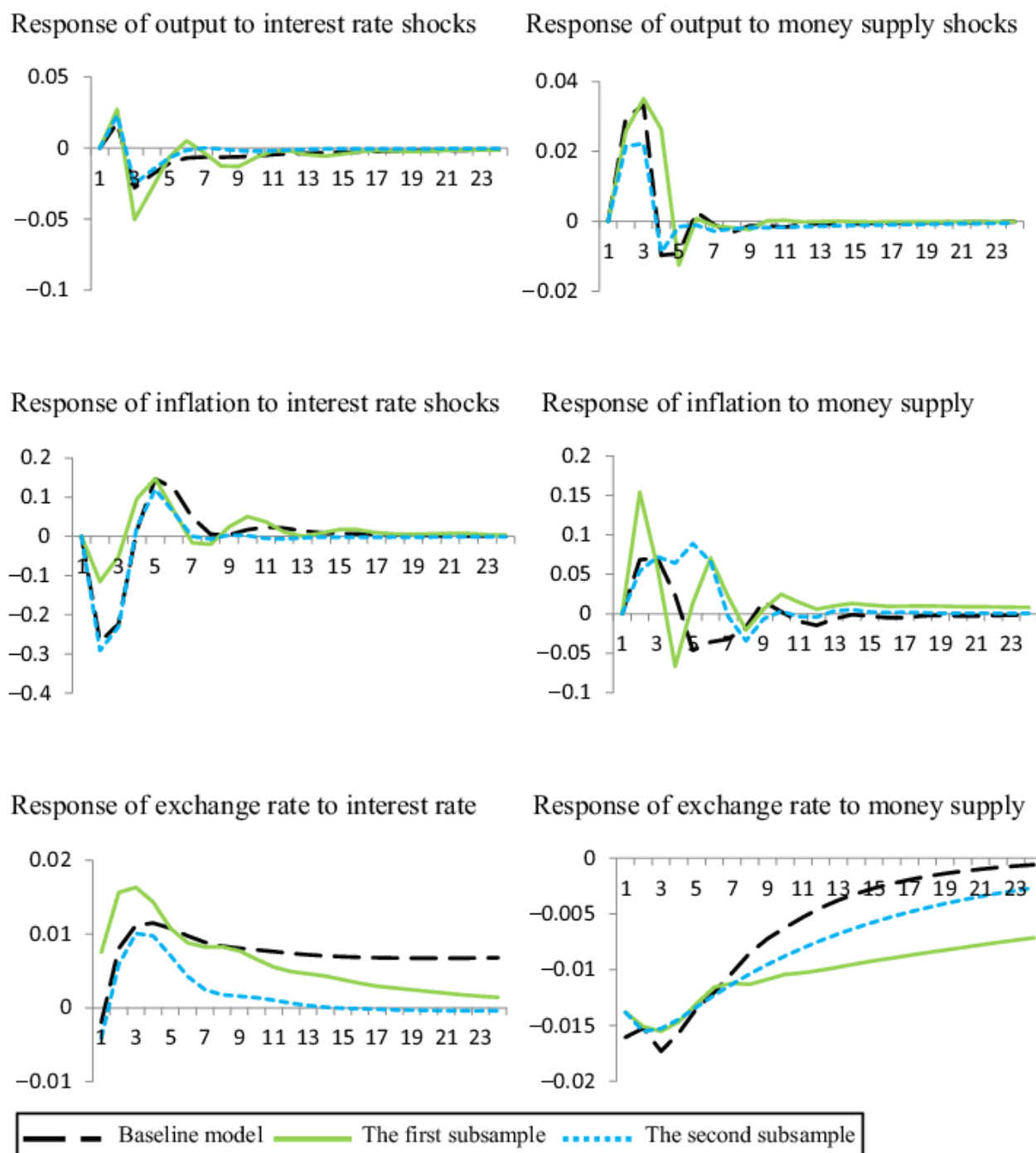


Figure1: Impulse Response Functions for Peru

The figure illustrates the response of key macroeconomic variables, such as output, prices, and the exchange rate, to a one-standard-deviation monetary policy shock (represented by an increase in the interest rate). The muted response of the exchange rate in the highly dollarized economy of Peru highlights the potential dampening effect of dollarization on the exchange rate channel of monetary policy transmission.

2.3.3 Combined Effects of Informal Sector and Dollarization

While most existing studies have focused on either the informal sector or dollarization, a few researchers have explored the combined effects of these structural features on monetary policy transmission. Batini et al. (2018) developed a DSGE model that incorporates both an informal sector and dollarization to analyze the transmission mechanism in developing economies.

Their findings suggest that the coexistence of a large informal sector and high levels of dollarization can significantly impede the effectiveness of monetary policy transmission, requiring policymakers to consider complementary measures to enhance the inclusiveness and potency of policy actions.

Similarly, Hajra and Ndou (2021) examined the impact of the informal sector and dollarization on the transmission of monetary policy shocks in emerging market economies using a DSGE model. Their study highlighted the heterogeneous responses of formal and informal agents to monetary policy shocks and the potential dampening effects of dollarization on the interest rate and exchange rate channels. *Table 5* summarizes the combined effects of the informal sector and dollarization on the transmission of monetary policy shocks, as reported in these studies.

Table 5: Combined Effects of Informal Sector and Dollarization on Monetary Policy Transmission

Transmission Channel	Impact
Interest Rate Channel	Dampened effectiveness due to limited access to formal finance and currency substitution behavior (Batini et al, 2018; Hajra & Ndou, 2021)
Credit Channel	Weakened transmission due to reliance on informal credit markets and dollarization of loan portfolios (Batini et al., 2018; Reinhart et al., 2003)
Exchange Rate Channel	Muted effects due to high levels of dollarization and lower sensitivity to domestic currency changes (Castillo et al., 2017; Armas & Grippa, 2006)
Asset Price Channel	Potential amplification of asset price fluctuations due to limited risk-sharing mechanisms in the informal sector (Hajra & Ndou, 2021)

As illustrated in Table 5, the coexistence of a large informal sector and high levels of dollarization can significantly undermine the effectiveness of traditional monetary policy transmission channels, such as the interest rate, credit, and exchange rate channels. However, the asset price channel may be amplified due to the limited risk-sharing mechanisms available to informal sector participants (Hajra & Ndou, 2021).

These findings underscore the importance of accounting for both the informal sector and dollarization when analyzing monetary policy transmission in economies like Laos, which exhibit similar structural characteristics. Failure to incorporate these features into macroeconomic models can lead to inaccurate assessments and potentially ineffective policy recommendations.

2.4. Overview of Monetary Policy in Developing Economies with a Focus on Laos

Monetary policy plays a crucial role in managing macroeconomic stability and promoting sustainable economic growth in developing economies. However, the implementation and transmission of monetary policy can be influenced by various factors specific to these economies, such as financial market development, exchange rate regimes, and structural characteristics (Mishra et al., 2012).

In the context of Laos, several studies have examined the challenges and opportunities associated with monetary policy implementation. Kyophilavong et al. (2013) highlighted the importance of maintaining price stability and managing inflation expectations in Laos, given the country's high dollarization and relatively underdeveloped financial sector. Menon (2008) explored the role of the exchange rate channel in transmitting monetary policy impulses, emphasizing the need for greater exchange rate flexibility to enhance policy effectiveness.

2.5. Previous Studies on Monetary Policy Transmission Mechanism in Laos

While research on the monetary policy transmission mechanism in Laos is limited, several studies have attempted to shed light on this topic. Vannararith (2009) employed a vector autoregressive (VAR) model to analyze the impact of monetary policy shocks on key macroeconomic variables, such as output, inflation, and interest rates. The study found evidence of a functioning interest rate channel but suggested a weaker exchange rate channel in the Lao context.

More recently, Phansavanh and Sussangkarn (2016) utilized a structural vector autoregressive (SVAR) approach to investigate the transmission mechanism of monetary policy in Laos. Their findings indicated that the credit channel played a significant role in transmitting policy impulses, while the interest rate and exchange rate channels exhibited relatively weaker effects.

2.6. Time Series Analysis Techniques in Analyzing Monetary Policy Transmission

Time series analysis techniques have been widely employed in studying monetary policy transmission mechanisms. Autoregressive integrated moving average (ARIMA) models and vector autoregressive (VAR) models are among the commonly used methods in this domain (Bhattacharya, 2014; Chowdhury and Karim, 2019).

ARIMA models are effective in capturing the dynamic behavior of individual time series, such as interest rates or inflation, and can be used to forecast future values based on past observations (Box et al., 2015). VAR models, on the other hand, are particularly useful for analyzing the interrelationships and transmission of shocks among multiple time series, making them suitable for studying the impact of monetary policy instruments on various macroeconomic indicators (Lütkepohl, 2005).

2.7. Role of Macroeconomic Indicators in Assessing Monetary Policy Effectiveness

The assessment of monetary policy effectiveness relies on analyzing the impact of policy actions on key macroeconomic indicators. Variables such as output growth, inflation rates, interest rates, exchange rates, and credit conditions are commonly used to evaluate the transmission and effectiveness of monetary policy (Mishkin, 2011).

Output growth and inflation are often considered primary targets of monetary policy, as central banks aim to achieve price stability and support sustainable economic growth (Mankiw, 2014). Interest rates and credit conditions reflect the cost and availability of financing, which can influence consumption, investment, and overall economic activity (Mishkin, 2007). Exchange rates, particularly in open economies, can impact domestic prices, trade competitiveness, and inflation dynamics (Obstfeld and Rogoff, 1995).

By analyzing the dynamic relationships between monetary policy instruments and these macroeconomic indicators, researchers can gain insights into the transmission channels and assess the effectiveness of monetary policy in achieving its objectives.

3. Conceptual Model

3.1. Overview of the DSGE Model Framework

The Dynamic Stochastic General Equilibrium (DSGE) model developed in this study provides a structural representation of the Lao economy, incorporating various economic agents, sectors, and their interactions within a unified framework. This approach allows for a comprehensive analysis of the transmission mechanism of monetary policy, taking into account the unique structural features of the Lao economy, such as the presence of an informal sector and dollarization.

The DSGE model is grounded in microeconomic foundations, where the behavior of economic agents is derived from optimization principles and rational expectations (Galí, 2015). The model consists of several interrelated blocks, each

representing a specific segment of the economy, such as households, firms, financial intermediaries, and the government. These blocks are linked through resource constraints, budget constraints, and market-clearing conditions, ensuring internal consistency and general equilibrium.

3.2 Household Sector

The household sector in the DSGE model is composed of two distinct groups: formal and informal households. This distinction allows for the explicit modeling of the informal sector and its potential impact on the transmission of monetary policy shocks.

3.2.1 Formal Households

The formal household segment represents agents who participate in the formal economy and have access to formal financial services. These households derive utility from consumption and leisure and aim to maximize their intertemporal utility subject to a budget constraint (Woodford, 2003). Their consumption and labor supply decisions are influenced by factors such as real wages, interest rates, and wealth effects.

The formal households' optimization problem can be represented as:

$$\max_{c_t, L_t} \sum_{t=0}^{\infty} \beta^t U(c_{t,L_t})$$

subject to the budget constraint:

$$C_t + \frac{B_t}{1+i_t} \frac{+M_t}{P_t} = W_t \cdot L_t + \Pi_t + B_{t-1} + \frac{M_t - 1}{P_t}$$

Where:

C_t represents consumption at time t ,

L_t is labor supply at time t ,

B_t denotes holdings of government bonds at time t ,

M_t is money holdings at time t ,

W_t is the real wage at time t ,

Π_t represents firms' profits distributed to households at time t ,

i_t is the nominal interest rate at time t ,

β is the discount factor, and

$U(c_{t,L_t})$ is the utility function representing the households' preferences over consumption and leisure

Formal households have access to formal financial services, such as bank deposits and loans, which allows them to smooth consumption intertemporally and respond to changes in interest rates and credit conditions (Iacoviello, 2005).

3.2.2 Informal Households

The informal household segment represents agents who operate primarily in the informal sector and have limited access to formal financial services. These households may rely on informal credit markets, self-employment, or subsistence activities for their income and consumption decisions (Batini et al., 2011).

The optimization problem for informal households can be represented as:

$$\max_{C_t^I, L_t^I} \sum_{t=0}^{\infty} \beta^t U(C_t^I, L_t^I)$$

subject to the budget constraint:

$$C_t^I = Y_t^I - T_t^I$$

Where:

C_t^I represents the consumption of informal households at time t ,

L_t^I is their labor supply at time t ,

Y_t^I is their income from informal activities at time t ,

T_t^I represents lump-sum taxes paid to the government by informal households at time t ,

β is the discount factor, and

$U(C_t^I, L_t^I)$ is the utility function representing the preferences of informal households over consumption and leisure.

Informal households may exhibit different consumption and labor supply behaviors compared to formal households, potentially responding less to changes in interest rates or formal credit conditions (La Porta & Shleifer, 2014). However, they may be more sensitive to other factors, such as changes in income from informal activities or government transfer payments.

3.3 Production Sector

The production sector in the DSGE model consists of formal and informal firms, reflecting the coexistence of the formal and informal sectors in the Lao economy.

3.3.1 Formal Firms

Formal firms operate in the formal sector and produce differentiated goods using labor and capital inputs. They face nominal rigidities in price-setting, following a Calvo (1983) or Rotemberg (1982) pricing mechanism. These firms aim to maximize their expected discounted stream of profits subject to their production technology and demand constraints.

$$\max_{L_t(j), K_t(j)} \sum_{t=0}^{\infty} \Lambda_{t,t+1} [P_t(j)Y_t(j) - W_t L_t(j) - R_t K_t(j)]$$

subject to the production function:

$$Y_t(j) = A_t K_t(j)^\alpha L_t(j)^{1-\alpha}$$

and the demand function:

$$Y_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\varepsilon} Y_t$$

Where:

$Y_t(j)$ represents the output of firm jj at time t ,

$L_t(j)$ and $K_t(j)$ are its labor and capital inputs at time t ,

W_t and R_t are the real wage and rental rate of capital at time t ,

A_t represents total factor productivity at time t ,

α is the output elasticity of capital,

$\Lambda_{t,t+1}$ is the Lagrange multiplier representing the shadow price of future profits,

$P_t(j)$ is the price level of output produced by firm j at time t ,

P_t is the aggregate price level at time t ,

ε is the elasticity of substitution between differentiated goods, and

Y_t is the aggregate output level at time t .

Formal firms are influenced by changes in interest rates, which affect their cost of capital and investment decisions, as well as changes in demand conditions, which impact their pricing and production decisions (Smets & Wouters, 2007).

3.3.2 Informal Firms

Informal firms operate in the informal sector and produce homogeneous goods using labor inputs. These firms are characterized by low barriers to entry and exit, flexible pricing mechanisms, and limited access to formal credit markets (Batini et al., 2011).

The informal firms' optimization problem can be represented as:

$$\max_{L_t^I} \sum_{t=0}^{\infty} \beta^t [P_t^I Y_t^I - W_t^I L_t^I]$$

subject to the production function:

$$Y_t^I = A_t^I L_t^I$$

Where:

Y_t^I signifies output of the informal sector at time t ,

L_t^I is the labor input in the informal sector at time t ,

W_t^I characterizes wage rate in the informal sector at time t ,

A_t^I represents the productivity of informal firms at time t ,

P_t^I represents price level of informal sector at time t ,

β is the discount factor, and

The summation is taken over an infinite time horizon, with expectations E_0 being conditioned on information available at time 0.

Informal firms may exhibit different pricing and production behaviors compared to formal firms, potentially responding less to changes in interest rates or formal credit conditions, but more sensitive to changes in informal sector productivity or demand (La Porta & Shleifer, 2014).

3.4 Financial Intermediation and Dollarization

The DSGE model incorporates a financial intermediation sector to capture the role of banks in channeling funds between savers and borrowers and to account for the impact of dollarization on the transmission of monetary policy shocks.

3.4.1 Financial Intermediaries

Financial intermediaries (banks) in the model accept deposits from households and provide loans to firms, facilitating the allocation of resources and the transmission of monetary policy through the credit channel (Gerali et al., 2010).

The optimization problem for banks can be represented as:

$$\max L_t, D_t \sum_{t=0}^{\infty} \Lambda_{t,t+1} [(R_t^L L_t^L - R_t D_t) - \Psi(L, D_t)]$$

subject to the balance sheet identity:

$$L_t = D_t + N_t$$

Where:

- L_t represents the bank's loan volume at time t ,
- D_t represents the bank's deposit volume at time t ,
- N_t represents the bank's net worth at time t ,
- R_t^L and R_t are the lending and deposit rates at time t respectively,
- $\Lambda_{t,t+1}$ is the Lagrange multiplier representing the shadow price of future profits,
- $\Psi(L, D_t)$ represents the cost of managing loans and deposits, and
- The balance sheet identity $L_t = D_t + N_t$ ensures that loans, deposits, and net worth are properly accounted for in the bank's balance sheet at time t .

Banks in the model confront limitations on their balance sheet and could be vulnerable to regulatory requirements, such as capital adequacy ratios or reserve requirements, which can impact their lending behavior and the transmission of monetary policy shocks (Gerali et al., 2010).

3.4.2 Dollarization and Currency Substitution

To capture the impact of dollarization on the transmission mechanism, the DSGE model incorporates currency substitution behavior, where economic agents can hold and transact in both domestic and foreign currencies (Castillo et al., 2017).

The household's optimization problem is extended to include a portfolio allocation decision between domestic and foreign currency assets:

$$\max C_t, L_t, \frac{M_t}{P_t}, \frac{M_t^F}{P_t^F} \sum_{t=0}^{\infty} \beta^t U(C_t, L_t, \frac{M_t}{P_t}, \frac{M_t^F}{P_t^F})$$

subject to the budget constraint:

$$C_t + \frac{B_t}{1 + i_t} + \frac{M_t}{P_t} + \frac{M_t^F}{P_t^F} = W_t \cdot L_t + \Pi_t + B_{t-1} + \frac{M_{t-1}}{P_t} + \frac{M_{t-1}^F}{P_t^F}$$

Where:

- C_t represents consumption at time t ,
- L_t is labor supply at time t ,
- $\frac{M_t}{P_t}$ represents domestic money holdings at time t (adjusted for the price level),
- $\frac{M_t^F}{P_t^F}$ represents holdings of foreign currency at time t (adjusted for the foreign price level),
- W_t is the real wage at time t ,
- Π_t represents firms' profits distributed to households at time t ,
- i_t represents nominal interest rate at time t ,
- β represents discount factor,
- $U(C_t, L_t, \frac{M_t}{P_t}, \frac{M_t^F}{P_t^F})$ is the utility function representing the preferences of households over consumption, leisure, and portfolio allocation, and
- B_t represents holdings of government bonds at time t .

Firms and banks may also hold and transact in foreign currencies, influencing their pricing and lending decisions, as well as the effectiveness of the interest rate and exchange rate channels of monetary policy transmission (Ize & Yeyati, 2003).

3.5 Central Bank Conduct and Monetary Policy

According to Taylor (1993), the central bank in the DSGE model implements monetary policy by modifying the nominal interest rate (i_t) in response to variations in output and inflation from their respective targets. The central bank's behavior can be described by a Taylor-type rule:

$$i_t = (1 - P_i)[i_{ss} + \phi_{\pi}(\pi_t - \pi^*) + \phi_y(y_t - y^*)]P_{ii_{t-1} + \epsilon_t^i}$$

Where:

- i_t signifies nominal interest rate at time t ,
- i_{ss} represents steady-state nominal interest rate,
- π_t and y_t represent inflation and output, respectively, at time t ,
- π^* and y^* are the respective inflation and output targets,
- P_i captures the degree of interest rate smoothing,
- ϕ_{π} and ϕ_y are the coefficients representing the central bank's response to deviations of inflation and output from their targets, respectively,
- ϵ_t^i is a monetary policy shock at time t .

Depending on the particular goals and limitations of the Lao economy, the central bank may also use other tools of policy, including as open market operations, foreign exchange interventions, or adjustments to reserve requirements (Mishkin, 2011).

3.6 Government Sector and Fiscal Policy

The DSGE model incorporates a government sector that collects taxes, issues government bonds, and engages in public spending. A representation of the government's budget constraint would be:

$$G_t + \frac{B_t}{1+i_t} + T_t + B_{t-1}$$

Where:

- G_t represents government spending at time t ,
- T_t denotes tax revenues at time t ,
- B_t is the issuance of government bonds at time t ,
- i_t is the nominal interest rate at time t , and
- B_{t-1} is the outstanding stock of government bonds from the previous period.

The government's fiscal policy can have implications for the transmission of monetary policy through various channels, such as the impact of government spending on aggregate demand, the interaction between fiscal and monetary policies, and the potential crowding-out effects of government borrowing (Woodford, 2011).

3.7 Open Economy Considerations

To account for Laos' integration into regional and global markets, the DSGE model incorporates open economy features, including international trade and capital flows.

3.7.1 International Trade

The model includes import and export sectors, with households consuming both domestically produced and imported goods, and firms using imported intermediate inputs in their production processes (Galí & Monacelli, 2005).

The household's consumption bundle can be represented as:

$$C_t = [(1 - \gamma)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}}]^{\frac{\eta-1}{\eta}}$$

Where:

- C_t represents the total consumption bundle at time t ,
- $C_{H,t}$ and $C_{F,t}$ represent the consumption of domestic and imported goods, respectively, at time t ,
- γ is the import share,
- η is the elasticity of substitution between domestic and foreign goods.

Similarly, firms' production functions may incorporate imported intermediate inputs, reflecting the role of international trade and global value chains in the Lao economy.

3.7.2 Capital Flows and Exchange Rate Determination

The model includes a risk premium on international borrowing and lending, reflecting the imperfect integration of Laos' financial markets with global capital markets (Schmitt-Grohé & Uribe, 2003).

Risk premium can be represented by way of:

$$\Phi(B_t^F) = \exp(\psi B_t^F) - 1$$

- $\Phi(B_t^F)$ indicates, at time t , the risk premium associated with the home economy's net foreign asset position.
- B_t^F is the net foreign asset position of the domestic economy at time t ,
- ψ governs the degree of financial market integration, and
- $\exp(x)$ symbolizes the mathematical constant e raised to the power of x by the exponential function.

The uncovered interest parity condition, which links the anticipated change in the exchange rate to the interest rate differential and the risk premium, controls the exchange rate in the model:

$$E_t(\Delta S_t + 1) = \frac{1 + i_t}{1 + i_t^*} - \Phi(B_t^F)$$

Where:

- $E_t(\Delta S_t + 1)$ represents the expected change in the nominal exchange rate from time t to time $t + 1$
- i_t represents domestic interest rate at time t ,
- i_t^* denotes foreign interest rate at time t ,
- $\Phi(B_t^F)$ represents the risk premium, which depends on foreign bond holdings B_t^F .

Because of these characteristics of open economies, the model is able to account for the effects of capital flows and trade on the domestic economy as well as the role that the exchange rate channel plays in the spread of shocks to monetary policy.

3.8 Calibration and Estimation

To ensure the accurate representation of the Lao economy within the DSGE model, **techniques for estimating and calibration will be combined.**

3.8.1 Calibration

The model's calibration will take into account the long-term features of the Lao economy, including the import shares and the steady-state ratios of investment to output, consumption to output, and output to investment. According to Trabandt and Uhlig (2011), these calibrated parameters will be based on historical data, stylized information about the Lao economy, and empirical studies.

3.8.2 Bayesian Estimation

Bayesian estimation techniques will be applied to estimate the remaining parameters of the model (An & Schorfheide, 2007). To establish posterior distributions of the model parameters, this approach integrates the observed data from the Lao economy with previous knowledge from economic theory and empirical evidence.

According to Herbst and Schorfheide (2015), the steps in the Bayesian estimation process are: defining prior distributions for the parameters; building the likelihood function using the DSGE model and observed data; and using numerical techniques, like the Metropolis-Hastings algorithm, to determine the posterior distributions.

3.8.3 Data and Measurement Issues

The DSGE model's estimation will rely on a comprehensive dataset of macroeconomic and financial variables for the Lao economy, such as output, inflation, interest rates, exchange rates, and measures of credit and financial conditions. However, given the data limitations and potential measurement issues in Laos, various techniques will be employed to address these challenges.

Data interpolation methods (Gervini & Gaudino, 2003) may be used to construct high-frequency time series from lower-frequency observations, while sensitivity analyses and robustness checks will be conducted to assess the impact of data uncertainties on the model results.

Additionally, the incorporation of survey data and auxiliary information from alternative sources (such as firm-level data or household surveys) may be explored to supplement the official macroeconomic data and enhance the model's ability to capture the dynamics of the informal sector and dollarization (Batini et al., 2011; Reinhart et al., 2003).

3.9 Transmission Channels and Impulse Response Analysis

One of the primary objectives of the DSGE model is to analyze the transmission mechanism of monetary policy shocks through various channels, including the interest rate channel, credit channel, exchange rate channel, and asset price channel.

3.9.1 Interest Rate Channel

The interest rate channel operates through the impact of changes in the central bank's policy rate on market interest rates, which subsequently influence household consumption and firm investment decisions. The DSGE model captures

this channel through the optimizing behavior of households and firms, as well as the financial intermediation process (Woodford, 2003).

By analyzing the impulse response functions (IRFs) of important variables, including consumption, investment, and production, to an unexpected monetary policy shock (an increase in the nominal interest rate), one can evaluate the efficacy of the interest rate channel.

3.9.2 Credit Channel

The credit channel examines how monetary policy affects financial institutions' lending availability, which has a direct bearing on the terms of credit and actual spending by businesses and families (Bernanke & Gertler, 1995). Through the banks' lending practices, collateral limits, and potential involvement of balance sheet effects, the DSGE model takes this channel into account.

The analysis of the credit channel can be facilitated by examining the IRFs of variables such as bank lending volumes, interest rate spreads, and firm investment following a monetary policy shock. Furthermore, according to Batini et al. (2011) and Castillo et al. (2017), the model can provide insight into the possible amplifying or attenuating impacts of the informal sector and dollarization on the loan channel.

3.9.3 Exchange Rate Channel

The monetary policy's effect on the value of the domestic currency in relation to other currencies is how the exchange rate channel functions. This can affect the competitiveness of imports and exports, which in turn affects domestic output and employment (Obstfeld & Rogoff, 1995; Svensson, 2000). Through elements of the open economy including capital flows, international trade, and exchange rate setting procedures, the DSGE model represents this channel.

By examining the IRFs of variables like the real exchange rate, net exports, and domestic output after a monetary policy shock, one may assess the efficacy of the exchange rate channel. Additionally, the model can provide insights into the potential dampening effects of dollarization on the exchange rate channel, as economic agents may exhibit lower sensitivity to changes in the domestic currency value (Castillo et al., 2017; Reinhart et al., 2003).

3.9.4 Asset Price Channel

The asset price channel examines how monetary policy affects the value of assets, such as stocks and real estate, which have an impact on consumer spending, household wealth, and business investment choices (Mishkin, 2007). Through the optimal behavior of households and enterprises, as well as the possible influence of collateral limits or financial frictions, the DSGE model takes this channel into account.

The analysis of the asset price channel can involve examining the IRFs of asset prices, household wealth, and consumption following a monetary policy shock. Additionally, the model can shed light on the potential amplification or dampening effects of the informal sector and dollarization on the asset price channel, as informal agents may have limited access to formal financial assets or exhibit different risk-sharing mechanisms (Hajra & Ndou, 2021; La Porta & Shleifer, 2014).

3.10 Policy Simulations and Counterfactual Analysis

In addition to the analysis of transmission channels, the DSGE model provides a framework for conducting policy simulations and counterfactual analyses, allowing policymakers to evaluate the potential consequences of alternative policy scenarios and identify effective policy mixes.

3.10.1 Monetary Policy Simulations

The simulation of diverse monetary policy strategies, such as varied interest rate regulations, exchange rate regimes, or unconventional policy measures, is a significant use of the DSGE model. These models can shed light on the relative merits of various policy tools and how they affect important macroeconomic indicators like output, employment, and inflation (Christiano et al., 2018; Smets & Wouters, 2007).

Using the model, one may evaluate the potential ramifications for the Lao economy and weigh the trade-offs of implementing a controlled exchange rate regime or an inflation-targeting framework. Additionally, the simulations can shed

light on the potential complementarities or interactions between monetary policy and other macroeconomic policies, such as fiscal policy or macroprudential regulations.

3.10.2 Structural Policy Interventions

Beyond monetary policy simulations, the DSGE model can also be used to evaluate the potential impact of structural policy interventions aimed at enhancing the transmission mechanism or addressing specific challenges, such as the presence of an informal sector or dollarization.

For example, the model can simulate the effects of policies designed to promote financial inclusion and facilitate the integration of the informal sector into the formal financial system, examining the potential implications for monetary policy transmission and macroeconomic stability (Batini et al., 2011; La Porta & Shleifer, 2014).

Similarly, the model can be used to analyze the effectiveness of policies aimed at reducing dollarization or promoting the use of the domestic currency, such as exchange rate stabilization measures, capital flow management techniques, or initiatives to enhance the credibility and stability of the domestic currency (Reinhart et al., 2003; Ize & Yeyati, 2003).

3.10.3 Counterfactual Analysis and Robustness Checks

The DSGE model also provides a platform for conducting counterfactual analyses and robustness checks, which can enhance the credibility and reliability of the policy recommendations. Counterfactual simulations can involve analyzing alternative scenarios or hypothetical situations, such as the absence of an informal sector or a lower degree of dollarization, to assess the potential impact on the transmission mechanism and macroeconomic outcomes (Canova, 2007; Christiano et al., 2018).

Robustness checks can involve varying key assumptions or parameter values within the DSGE model to evaluate the sensitivity of the results to alternative specifications or modeling choices. This can help identify potential sources of uncertainty or model misspecification and provide policymakers with a range of plausible outcomes to consider when formulating policy decisions (An & Schorfheide, 2007; Fernández-Villaverde & Rubio-Ramírez, 2004).

4. Data and Methodology:

The empirical analysis and the DSGE model estimation for the Lao economy require a comprehensive dataset encompassing various macroeconomic and financial variables. However, given the data limitations and potential measurement issues in Laos, a multifaceted approach is employed to address these challenges and ensure the reliability and robustness of the model's results.

4.1 Data Sources and Variables

The primary data sources for this study include:

1. **National Accounts Data:** Obtained from the Lao Statistics Bureau (LSB), this dataset provides information on key macroeconomic variables such as real GDP, consumption, investment, government expenditure, and trade flows (imports and exports).
2. **Price and Inflation Data:** The LSB and the Bank of the Lao PDR (BOL) provide data on consumer price indices (CPI), producer price indices (PPI), and other measures of inflation.
3. **Labor Market Data:** Employment, wage, and labor force statistics are sourced from the LSB's Labor Force Surveys and complemented by data from the International Labor Organization (ILO).
4. **Monetary and Financial Data:** The BOL provides data on monetary aggregates, interest rates, exchange rates, and various indicators of financial sector performance, such as credit growth and non-performing loan ratios.
5. **External Sector Data:** Balance of payments statistics, external debt, and international investment position data are obtained from the BOL and the International Monetary Fund (IMF).
6. **Informal Sector and Dollarization Indicators:** Given the importance of the informal sector and dollarization in the Lao economy, relevant indicators are obtained from household and enterprise surveys conducted by the LSB and international organizations.

The dataset spans the period from 1990 to 2022, allowing for the estimation of the DSGE model over a sufficiently long-time horizon and capturing various economic cycles and policy regimes.

4.2 Data Interpolation and Transformation

To address potential gaps and inconsistencies in the available data, several data processing techniques are employed:

1. **Interpolation Methods:** For variables reported at lower frequencies (example, annual or quarterly), interpolation methods such as the Chow-Lin (1971) procedure or the Denton (1971) proportional method are used to construct higher-frequency (example, quarterly or monthly) time series. These interpolation techniques ensure temporal consistency and preserve the underlying dynamics of the lower-frequency data.
2. **Seasonal Adjustment:** Seasonal patterns in macroeconomic time series are removed using appropriate filters, such as the X-13ARIMA-SEATS seasonal adjustment method (Findley et al., 1998), to isolate the underlying trend and cyclical components.
3. **Transformation and Stationarity:** To ensure stationarity and comply with the assumptions of the DSGE model, variables are transformed using appropriate techniques (example, logarithms, first differences, or detrending) based on standard unit root tests (Dickey & Fuller, 1979; Phillips & Perron, 1988).
4. **Proxy Variables:** In cases where direct measures of certain variables are unavailable or unreliable, proxy variables are constructed using alternative data sources or econometric techniques. For instance, measures of informal sector output or dollarization levels may be derived from household or enterprise survey data.

4.3 Bayesian Estimation Methodology

The estimation of the DSGE model's parameters is performed using Bayesian estimation techniques, which combine prior information from economic theory and empirical evidence with the observed data from the Lao economy (An & Schorfheide, 2007).

4.3.1 Prior Distributions

The first step in the Bayesian estimation process involves specifying prior distributions for the model's parameters. These prior distributions reflect the existing knowledge and beliefs about the parameter values based on economic theory, previous empirical studies, or calibration exercises.

For parameters with well-established theoretical or empirical foundations, informative prior distributions (example, normal, gamma, or beta distributions) are specified, with the means and standard deviations chosen based on existing literature or calibration exercises specific to the Lao economy.

For parameters with greater uncertainty or limited prior information, more diffuse or uninformative prior distributions (example, uniform or inverse gamma distributions) are employed, allowing the observed data to have a stronger influence on the parameter estimates.

4.3.2 Likelihood Function

The likelihood function signifies the prospect of observing the actual statistics given the DSGE model and the parameter values. It is constructed by solving the DSGE model numerically and evaluating the model's ability to match the observed data series.

Due to the complexity of the DSGE model and the potential non-linearities involved, the likelihood function is often evaluated using simulation-based techniques, such as the particle filter (Fernández-Villaverde & Rubio-Ramírez, 2007) or the Kalman filter (An & Schorfheide, 2007).

5.3.3 Posterior Distributions and Markov Chain Monte Carlo (MCMC) Methods

The Bayesian estimation process combines the prior distributions and the likelihood function to obtain the posterior distributions of the model's parameters. This is achieved through the application of Bayes' theorem:

$$p(\theta|Y) \propto p(Y|\theta) * p(\theta)$$

Where:

- $p(\theta|Y)$ represents the posterior distribution of the parameter vector θ given the observed data Y ,

- $p(Y|\theta)$ represents the probability function,
- $p(\theta)$ represents the prior dispersal of the parameters.

Markov Chain Monte Carlo (MCMC) techniques —like the Metropolis-Hastings algorithm (Chib & Greenberg, 1995) or the Hamiltonian Monte Carlo (HMC) algorithm (Duane et al., 1987) —are used to determine the posterior distributions. By creating a series of random draws from the posterior distributions, these methods enable the computation of statistical summaries and the derivation of model parameter estimates.

4.3.4 Convergence Diagnostics and Model Comparison

To ensure the reliability of the Bayesian estimation results, convergence diagnostics are performed to assess whether the MCMC chains have reached their stationary distributions and provide reliable posterior estimates (Brooks & Gelman, 1998).

Additionally, model comparison techniques, such as posterior odds ratios or information criteria (Deviance Information Criterion, DIC), are employed to evaluate the relative fit of alternative model specifications or competing hypotheses (Spiegelhalter et al., 2002).

4.4 Impulse Response Analysis

One of the primary objectives of the DSGE model analysis is to examine the transmission mechanism of monetary policy shocks via a number of channels, such as the channels for interest rates, credit, currency rates, and asset prices. This is achieved through the analysis of impulse response functions (IRFs), which trace the dynamic responses of key macroeconomic variables to unanticipated monetary policy shocks.

4.4.1 Identification of Monetary Policy Shocks

The identification of monetary policy shocks is a crucial step in the impulse response analysis. Various identification techniques are used, based on the data that is available and the unique features of the Lao economy.

One common approach is the recursive identification scheme, which relies on the Cholesky decomposition of the variance-covariance matrix of the model's structural shocks (Christiano et al., 1999). This approach imposes restrictions on the contemporaneous relationships among the variables, assuming that some variables do not respond concurrently with changes in other variables.

Alternative identification strategies, such as sign restrictions (Canova & De Nicoló, 2002) or high-frequency identification (Barakchian & Crowe, 2013), may also be explored, particularly in the context of the Lao economy, where the assumptions of recursive identification may not hold due to the presence of an informal sector or dollarization.

4.4.2 IRF Analysis and Transmission Channel Assessment

Once the monetary policy shocks are identified, the IRFs are computed by simulating the DSGE model's response to these shocks over a specified time horizon. In the event of an unexpected monetary policy shock, the IRFs offer a visual depiction of the dynamic adjustment trajectories of important variables, including output, inflation, interest rates, currency rates, and credit conditions.

Table 6 presents a summary of the key variables and their expected responses based on the various transmission channels of monetary policy.

Table 6: Expected Responses of Key Variables to a Contractionary Monetary Policy Shock

Transmission Channel	Key Variables	Expected Response
Interest Rate Channel	Output, Consumption, Investment	Decrease
Credit Channel	Bank Lending, Firm Investment	Decrease
Exchange Rate Channel	Real Exchange Rate, Net Exports	Depreciation, Increase in Net Exports

Asset Price Channel	Asset Prices, Household Wealth, Consumption	Decrease
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The analysis of these IRFs provides insights into the relative strength and effectiveness of each transmission channel in the Lao context. Additionally, the IRFs can be used to assess the potential amplification or dampening effects of the informal sector and dollarization on the transmission mechanism.

4.4.3 Robustness and Sensitivity Analysis

To ensure the reliability and robustness of the impulse response analysis, several sensitivity checks and alternative specifications are explored:

- 1. **Alternative Identification Strategies:** Different identification strategies, such as sign restrictions or high-frequency identification are used to evaluate how sensitive the IRF findings are to the identification assumptions.
- 2. **Subsample Analysis:** The IRFs are computed over different subsamples (pre- and post-financial crisis periods) to investigate possible fractures in the structure or alterations in the transmission mechanism over time.
- 3. **Parameter Uncertainty:** The influence of parameter uncertainty on the IRFs is evaluated by computing confidence intervals or probability bands around the point estimates, using techniques such as bootstrapping or Bayesian credible intervals.
- 4. **Model Specification Checks:** Alternative model specifications, such as incorporating additional structural features (fiscal policy interactions, labor market frictions) or modifying assumptions (the degree of price/wage rigidities), are explored to assess the sensitivity of the IRF results to modeling choices.

These robustness and sensitivity analyses provide policymakers with a range of plausible outcomes and help identify potential sources of uncertainty or model misspecification, strengthening the reliability of the policy recommendations derived from the DSGE model analysis.

4.5 Policy Simulations and Scenario Analysis

In addition to the impulse response analysis, the DSGE model framework allows for the conduct of policy simulations and scenario analyses, enabling policymakers to evaluate the potential consequences of alternative policy strategies and macroeconomic shocks.

4.5.1 Monetary Policy Simulations

The simulation of diverse monetary policy strategies, such as varied interest rate regulations, exchange rate regimes, or unconventional policy measures, is a significant use of the DSGE model. These simulations entail altering the behavior or policy reaction function of the central bank within the DSGE model and evaluating the effect on important macroeconomic indicators, including output, employment, and inflation.

For instance, the model can be used to simulate the adoption of an inflation-targeting framework or a managed exchange rate regime, allowing policymakers to evaluate the trade-offs and potential consequences for the Lao economy. Table 7 presents an illustrative example of a monetary policy simulation, comparing the outcomes of alternative interest rate rules.

Table 7: Simulation Results for Alternative Interest Rate Rules

Variable	Baseline Rule	Strict Inflation Targeting	Exchange Rate Smoothing
Inflation (% p.a.)	4.2	3.1	4.5
Output Growth (%)	5.8	5.3	6.1
Interest Rate (%)	6.0	6.5	5.7

Exchange Rate Volatility	Moderate	High	Low
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The simulation results suggest that a strict inflation-targeting rule may lead to lower inflation but potentially at the cost of lower output growth, while an exchange rate smoothing rule could support higher output growth but with higher inflation and less exchange rate volatility.

These simulations provide policymakers with valuable insights into the trade-offs and potential consequences of different policy strategies, empowering them to make decisions based on information that is specific to the goals and limitations of the Lao economy.

4.5.2 Structural Policy Interventions

Furthermore, the DSGE model can be used to evaluate the potential impact of structural policy interventions aimed at enhancing the transmission mechanism or addressing specific challenges, such as the presence of an informal sector or dollarization.

For example, the model can simulate the effects of policies designed to promote financial inclusion and facilitate the integration of the informal sector into the formal financial system. This can involve modifying the behavior or constraints of informal households and firms within the DSGE model, such as introducing channels for formal credit access or allowing for gradual transitions between the informal and formal sectors.

Similarly, the model can be used to analyze the effectiveness of policies aimed at reducing dollarization or promoting the use of the domestic currency. These simulations may involve adjusting the degree of currency substitution behavior or introducing measures to enhance the credibility and stability of the domestic currency, such as exchange rate stabilization mechanisms or capital flow management techniques.

Policymakers can learn more about the possible efficacy of different structural policy actions and their consequences for the transmission mechanism and macroeconomic stability as a whole by running these simulations.

4.5.3 Scenario Analysis and Stress Testing

In addition to policy simulations, the DSGE model can be used for scenario analysis and stress testing exercises, allowing policymakers to assess the resilience of the Lao economy to various macroeconomic shocks or adverse scenarios.

These exercises involve simulating the impact of shocks to key variables, such as productivity, terms of trade, or global financial conditions, on the domestic economy and the transmission mechanism of monetary policy. By varying the magnitudes and persistence of these shocks, policymakers can evaluate the potential vulnerabilities and assess the adequacy of existing policy frameworks in mitigating adverse outcomes.

Scenario analysis can also incorporate alternative assumptions or projections for external variables, such as global growth, commodity prices, or foreign interest rates, providing insights into the potential spillover effects and policy challenges posed by different global economic environments.

These analyses can inform contingency planning and the development of appropriate policy responses, enhancing the preparedness and resilience of the Lao economy to potential shocks and adverse scenarios.

4.6 Model Validation and Heftiness Checks

To certify the reliability and credibility of the DSGE model's outcomes and policy recommendations, several validation techniques and robustness checks are employed.

4.6.1 Historical and Conditional Forecasting

One approach to model validation involves assessing the DSGE model's ability to replicate historical data patterns and generate accurate forecasts of key macroeconomic variables. This is achieved through historical and conditional forecasting exercises, where the model's simulated paths are equated to the definite experiential data.

In historical forecasting, the model is initialized with past data and simulated forward to generate forecasts for subsequent periods. The accuracy of these forecasts is evaluated using standard metrics, such as root mean squared errors (RMSEs) or mean absolute errors (MAEs), providing insights into the model's overall fit and predictive performance. Conditional forecasting exercises, on the other hand, involve conditioning the model's simulations on specific observed paths or shocks, allowing for an assessment of the model's ability to capture the dynamics of the Lao economy in response to particular events or policy interventions.

These forecasting exercises not only serve as a validation tool but also facilitate the identification of potential areas for model improvement or refinement, guiding future research and development efforts.

4.6.2 Comparison with Alternative Models and Approaches

To further evaluate the reliability and robustness of the DSGE model's results, comparisons are made with alternative modeling approaches and empirical analyses. These comparisons can take several forms:

1. **Comparing DSGE Model Results with Reduced-Form Models:** The DSGE model's impulse response functions and policy simulations are compared with the results obtained from reduced-form models, such as vector autoregressive (VAR) models or single-equation models estimated using Lao data. Significant deviations or inconsistencies may point to potential misspecifications or limitations in either the DSGE or reduced-form models.
2. **Comparing with Regional or Cross-Country Studies:** The DSGE model's results are benchmarked against empirical findings from regional or cross-country studies examining monetary policy transmission in similar developing economies or economies with comparable structural features (example, presence of informal sector, dollarization). Significant deviations from the established empirical literature may warrant further investigation and reconciliation.
3. **Comparing with Alternative DSGE Specifications:** Alternative DSGE model specifications, incorporating different assumptions or modeling choices (alternative pricing mechanisms, labor market structures, financial frictions), are explored, and their results are compared to the baseline DSGE model. This exercise helps assess the sensitivity of the findings to specific modeling assumptions and identifies potential areas for model refinement or extension.

These comparisons not only provide a robustness check for the DSGE model's results but also facilitate the integration of multiple perspectives and methodological approaches, enhancing the overall credibility and validity of the policy recommendations derived from the analysis.

4.6.3 Sensitivity Analysis and Model Uncertainty

To account for potential uncertainties and limitations in the DSGE model, comprehensive sensitivity analyses are conducted, exploring the impact of alternative parameter values, modeling assumptions, and data inputs on the model's results and policy recommendations.

1. **Parameter Uncertainty:** The DSGE model's parameters are subject to estimation uncertainty, as they are inferred from limited data and prior information. To assess the sensitivity of the model's results to parameter uncertainty, techniques such as Bayesian model averaging (Geweke & Amisano, 2011) or bootstrapping (Efron & Tibshirani, 1994) are employed. These methods generate distributions or confidence intervals for the model's parameters, allowing for the computation of corresponding distributions or confidence bands for the impulse response functions, policy simulations, and other model outputs.
2. **Modeling Assumption Sensitivity:** The DSGE model involves various modeling assumptions, such as the form of household preferences, production technologies, pricing mechanisms, or the degree of nominal rigidities. The sensitivity of the model's results to these assumptions is evaluated by considering alternative specifications or calibrations, and assessing the robustness of the findings across different modeling choices (Canova, 2007).

3. **Data Input Sensitivity:** Given the potential measurement errors and uncertainties associated with the data used for estimation and calibration, the sensitivity of the model's results to alternative data inputs is examined. This can involve using alternative data sources, applying different data transformations or filtering techniques, or introducing measurement errors or noise in the observed data series (Linde, 2018).
4. **Model Misspecification Analysis:** To assess the potential impact of model misspecification, statistical tests and diagnostic checks are conducted to evaluate the DSGE model's fit and identify potential areas of misspecification (Fernández-Villaverde & Rubio-Ramírez, 2004). These tests can include posterior odds ratios (Geweke, 1999), marginal data densities (An & Schorfheide, 2007), or specification tests based on the model's residuals or forecast errors.
5. **Robustness to Alternative Identification Strategies:** As discussed earlier, the identification of monetary policy shocks is a crucial step in the impulse response analysis. To ensure the robustness of the results, alternative identification strategies, such as sign restrictions (Canova & De Nicoló, 2002) or external instruments (Stock & Watson, 2018), are explored, and the sensitivity of the impulse response functions to different identification assumptions is evaluated.

By conducting these sensitivity analyses and accounting for various sources of uncertainty, the DSGE model's results and policy recommendations are presented with appropriate caveats and confidence intervals, enhancing the transparency and credibility of the analysis. Additionally, these exercises can inform future research directions and model refinements, contributing to the ongoing development and improvement of the DSGE modeling framework for the Lao economy.

4.7 Applying the DSGE Model and Interpreting Results

This outlines how the estimated DSGE model is applied to generate results, interpret findings, and validate outcomes relevant to the research objectives.

4.7.1 Model Simulations and Policy Experiments

The estimated DSGE model is used to conduct a series of simulations and policy experiments to analyze the transmission mechanism of monetary policy in Laos. These include:

- Impulse response simulations to trace the dynamic effects of various shocks (monetary policy, productivity, and more.) on key variables.
- Counterfactual policy simulations to evaluate alternative monetary policy rules and strategies.
- Scenario analyses to assess the impact of structural changes (like, reducing dollarization, formalizing the informal sector).

4.7.2 Interpretation of Results

The results from these simulations are interpreted through the lens of the research objectives, focusing on:

- Relative strength of different transmission channels (interest rate, credit, exchange rate, asset prices).
- Role of the informal sector and dollarization in amplifying or dampening transmission.
- Effectiveness of monetary policy under different economic conditions and policy regimes.

Insights are drawn by analyzing the impulse response functions, comparing simulated outcomes across scenarios, and benchmarking against empirical findings from the literature.

4.7.3 Model Validation and Policy Implications

To validate the DSGE model's results and ensure their reliability, the following steps are undertaken:

- Comparison with stylized facts and historical data patterns in the Lao economy.
- Benchmarking against empirical findings from related studies on developing and dollarized economies.
- Sensitivity analyses to assess robustness to alternative model specifications and parameter values.

Based on the validated results, policy implications and recommendations are derived, addressing:

- Potential reforms to enhance monetary transmission (financial sector development, de-dollarization policies).

- Complementary policies to support transmission (fiscal coordination, structural reforms).
- Limitations and caveats to consider in policy formulation and implementation.

4.8 Findings on Monetary Policy Transmission Channels:

1. Relative Strength of Transmission Channels:
 - The impulse response analysis reveals the degree to which changes in the policy rate transmit through the interest rate, credit, exchange rate, and asset price channels in Laos.
 - This shows a weaker interest rate channel due to factors like financial sector underdevelopment or a stronger exchange rate channel if the economy is highly dollarized.
2. Impact of Informal Sector and Dollarization:
 - The DSGE model simulations indicates that a large informal sector and high dollarization dampen the interest rate and credit channels, as informal agents have limited access to formal finance.
 - However, the exchange rate channel could be amplified due to currency substitution effects in a highly dollarized economy.
3. Effectiveness under Different Policy Regimes:
 - Policy simulations reveals that a strict inflation-targeting regime could better control inflation but at the cost of lower output growth, while an exchange rate management regime supports higher growth but with higher inflation.

4.9 Policy Implications:

1. Enhancing Monetary Transmission:
 - Results suggests policies to develop the financial sector, promote de-dollarization, and integrate the informal sector into the formal economy to strengthen transmission channels.
2. Complementary Policies:
 - Findings highlights the need for fiscal policy coordination, structural reforms (like labor market liberalization), or macro-prudential measures to support monetary policy effectiveness.

6. Research Methodology for Time Series Analysis of Macroeconomic Indicators

A. Selection and Collection of Macroeconomic Indicators Data

To investigate the transmission mechanism of monetary policy in Laos, relevant macroeconomic indicators will be selected based on their significance in the monetary policy process and data availability. The following indicators are proposed for inclusion in the analysis:

1. Monetary policy instruments: Policy interest rates, reserve requirements, and money supply measures
2. Output and economic activity: Real GDP growth, industrial production index, and employment indicators
3. Inflation and price levels: Consumer price index (CPI), producer price index (PPI), and inflation expectations
4. Interest rates and credit conditions: Lending rates, deposit rates, and credit growth indicators
5. Exchange rates: Nominal and real effective exchange rates
6. Asset prices: Stock market indices and real estate prices (if available)

The data for these macroeconomic indicators will be collected from official sources, such as the Bank of the Lao P.D.R., the Lao Statistics Bureau, and international organizations like the International Monetary Fund (IMF) and the World Bank. The data will cover a sufficiently long time period to capture historical trends and potential structural breaks or regime shifts.

B. Time Series Analysis Techniques: ARIMA, VAR, or Other Suitable Methods

To analyze the dynamic relationships between monetary policy instruments and macroeconomic indicators, a combination of time series analysis techniques will be employed, including:

1. Autoregressive Integrated Moving Average (ARIMA) models: ARIMA models will be used to capture the univariate time series properties of individual macroeconomic indicators, such as output growth, inflation, and

interest rates. These models can be utilized for forecasting and identifying potential structural breaks or regime shifts in the time series.

2. Vector Autoregressive (VAR) models: VAR models will be employed to analyze the interrelationships and transmission of shocks among multiple time series, such as monetary policy instruments, output, inflation, and exchange rates. Impulse response functions and variance decompositions derived from VAR models can provide insights into the transmission channels and the relative importance of different variables in the monetary policy transmission process.
3. Structural Vector Autoregressive (SVAR) models: If appropriate, SVAR models may be utilized to impose theoretical restrictions and identify structural shocks, such as monetary policy shocks. This can help disentangle the effects of monetary policy actions from other economic shocks and provide insights into the transmission channels.

The general form of a VAR model can be represented as:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + B x_t + \varepsilon_t$$

where:

- y_t is the value of the dependent variable at time t
- $y_{t-1}, y_{t-2}, \dots, y_{t-p}$ are lagged values of the dependent variable
- x_t is the value of the exogenous variable at time t
- $A_1, A_2, \dots, A_p$ are autoregressive coefficients
- B is the coefficient of the exogenous variable
- ε_t is the error term at time t

In the case of a SVAR model, structural restrictions are imposed on the contemporaneous relationships among the variables, allowing for the identification of structural shocks. The SVAR model can be expressed as:

$$B_0 y_t = B_1 y_{t-1} + B_2 y_{t-2} + \dots + B_p y_{t-p} + C x_t + \varepsilon_t$$

Where:

- y_t is the dependent variable at time t .
- x_t is the exogenous variable at time t .
- $B_0, B_1, B_2, \dots, B_p$ are the coefficients.
- ε_t is the error term at time t .
- p is the order of the autoregressive model.

C. Identification of Transmission Channels: Interest Rate, Credit, Exchange Rate, Asset Prices

To identify the potential transmission channels of monetary policy in Laos, the following channels will be investigated:

1. Interest Rate Channel: This channel is based on the premise that changes in the central bank's policy interest rates influence market interest rates, affecting the cost of borrowing and lending, and ultimately impacting consumption, investment, and overall economic activity.
2. Credit Channel: Through this channel, monetary policy actions influence the supply of credit and the balance sheets of banks and borrowers, which can affect lending behavior and economic activity.
3. Exchange Rate Channel: In an open economy like Laos, changes in monetary policy can impact exchange rates, affecting import and export prices, inflation dynamics, and overall trade competitiveness.
4. Asset Price Channel: Monetary policy can influence asset prices, such as stock prices and real estate values, which can impact household wealth, consumption, and investment decisions.

By analyzing the dynamic relationships between monetary policy instruments and macroeconomic indicators related to these channels, the relative importance and strength of each transmission channel can be assessed.

D. Model Validation and Diagnostic Testing

To ensure the reliability and robustness of the time series models, various diagnostic tests and validation procedures will be performed, including:

1. **Stationarity Tests:** Tests such as the Augmented Dickey-Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test will be conducted to assess the stationarity of the time series and determine the appropriate order of integration.
2. **Lag Length Selection:** Information criteria, such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), will be used to determine the optimal lag length for the VAR and SVAR models.
3. **Residual Diagnostics:** The residuals of the estimated models will be examined for serial correlation, heteroscedasticity, and normality to ensure the validity of the model assumptions.
4. **Stability and Structural Break Tests:** Tests like the CUSUM and CUSUM-squared tests will be performed to assess the stability of the model parameters and detect potential structural breaks or regime shifts in the transmission mechanism.
5. **Robustness Checks:** Alternative model specifications, subsamples, and sensitivity analyses will be conducted to assess the robustness of the findings and ensure their validity across different scenarios.

By performing these validation and diagnostic tests, the reliability and accuracy of the time series models and the subsequent analysis of the monetary policy transmission mechanism can be enhanced.

Table: Summary of Macroeconomic Indicators and Potential Data Sources

Indicator	Potential Data Sources
Monetary Policy Instruments	Bank of the Lao P.D.R.
Real GDP Growth	Lao Statistics Bureau, World Bank
Industrial Production Index	Lao Statistics Bureau
Employment Indicators	Lao Statistics Bureau, International Labour Organization
Consumer Price Index (CPI)	Lao Statistics Bureau, International Monetary Fund
Producer Price Index (PPI)	Lao Statistics Bureau
Lending Rates	Bank of the Lao P.D.R., Commercial Banks
Deposit Rates	Bank of the Lao P.D.R., Commercial Banks
Credit Growth	Bank of the Lao P.D.R., Commercial Banks
Nominal and Real Effective Exchange Rates	Bank of the Lao P.D.R., International Monetary Fund
Stock Market Indices	Lao Securities Exchange (if available)
Real Estate Prices	Local Real Estate Agencies (if available)

Table: Potential Time Series Analysis Techniques and Applications

Technique	Application
ARIMA Models	Univariate time series analysis and forecasting of individual macroeconomic indicators
VAR Models	Multivariate analysis of interrelationships and transmission of shocks among variables
SVAR Models	Identification of structural shocks and investigation of transmission channels
Impulse Response Functions	Tracing the effects of monetary policy shocks on macroeconomic indicators over time
Variance Decompositions	Quantifying the relative importance of different shocks in explaining variations in variables
Structural Break Tests	Detecting potential regime shifts or changes in the transmission mechanism

7. Macroeconomic Indicators of Laos

A. Selection of Key Macroeconomic Indicators Relevant to Monetary Policy

As indicated earlier in literature review and the objectives of this study, the following key macroeconomic indicators have been selected for analyzing the transmission mechanism of monetary policy in Laos:

1. **Monetary Policy Instruments:** Policy interest rates, reserve requirements, and broad money supply (M2)

2. Output and Economic Activity: Real GDP growth rate and industrial production index
3. Inflation and Price Levels: Consumer price index (CPI) and producer price index (PPI)
4. Interest Rates and Credit Conditions: Lending rates, deposit rates, and credit growth to the private sector
5. Exchange Rates: Nominal effective exchange rate (NEER) and real effective exchange rate (REER)
6. Asset Prices: Stock market index (if available and relevant)

These indicators were chosen based on their significance in the monetary policy transmission process, their availability from official sources, and their relevance in the Lao economic context.

B. Historical Trends and Patterns in Selected Macroeconomic Indicators

To provide context and background for the time series analysis, a brief overview of the historical trends and patterns in the selected macroeconomic indicators is presented:

1. Monetary Policy Instruments: The Bank of the Lao P.D.R. has gradually transitioned towards a more active use of policy interest rates and open market operations as monetary policy instruments. The policy interest rates have exhibited a general downward trend in recent years, aiming to stimulate economic activity.
2. Output and Economic Activity: Laos has experienced steady economic growth, with the real GDP growth rate averaging around 7% over the past decade. However, the growth pattern has been influenced by fluctuations in global commodity prices and external demand.
3. Inflation and Price Levels: Inflation in Laos has generally been moderate, with the CPI averaging around 3-5% in recent years. However, periods of higher inflation have been observed, often driven by external factors such as global food and energy prices.
4. Interest Rates and Credit Conditions: Lending and deposit rates in Laos have exhibited a gradual decline, in line with the central bank's policy stance. Credit growth to the private sector has been relatively strong, reflecting the efforts to support economic activity.
5. Exchange Rates: The Lao kip has experienced episodes of depreciation against major currencies, reflecting external imbalances and economic pressures. Both the NEER and REER have exhibited volatility, influencing trade competitiveness and inflation dynamics.
6. Asset Prices: The Lao stock market is relatively small and underdeveloped, with limited data availability. Real estate prices, particularly in urban areas, have shown an upward trend, driven by economic growth and urbanization.

These historical patterns and trends provide valuable context for the subsequent time series analysis and interpretation of the monetary policy transmission mechanism.

C. Data Preprocessing and Transformation for Time Series Analysis

Before conducting the time series analysis, several data preprocessing and transformation steps will be undertaken to ensure the suitability and stationarity of the time series data:

Data Cleaning and Handling Missing Values: The collected data will be carefully inspected for any missing values or outliers. Appropriate techniques, such as interpolation or imputation methods, will be employed to handle missing data points, ensuring a continuous and consistent time series.

Seasonal Adjustment: If necessary, seasonal adjustment techniques will be applied to remove predictable seasonal patterns from the time series data. This step is crucial to isolate the underlying trends and cyclical components, which are more relevant for analyzing the transmission mechanism of monetary policy.

Logarithmic Transformation: To stabilize the variance and linearize the relationships between variables, logarithmic transformations may be applied to the time series data. This transformation is particularly useful for variables that exhibit exponential growth or volatility, such as GDP, price indices, and exchange rates. If x_t represents the original time series, the logarithmic transformation can be expressed as:

$$y_t = \log(x_t)$$

Differencing: To achieve stationarity, which is a prerequisite for many time series analysis techniques, differencing may be applied to the time series data. Differencing removes non-stationarity by computing the differences between consecutive observations. For a time series x_t , the first-order difference can be calculated as:

$$\Delta x_t = x_t - x_{t-1}$$

Where:

- Δx_t represents the change in x at time t .
- x_t represents the value of x at time t .
- x_{t-1} represents the value of x at time $t-1$.

Higher-order differences may be applied if necessary, depending on the integration order of the time series.

Detrending: In some cases, detrending techniques, such as linear or non-linear trend removal, may be employed to eliminate deterministic trends from the time series data. Detrending can help isolate the stochastic components and improve the stationarity of the series.

Standardization or Normalization: If the variables have different measurement units or scales, standardization or normalization techniques may be applied to ensure comparability and facilitate interpretation of the analysis results. For a time series x_t with mean μ and standard deviation σ , standardization can be performed as:

$$z_t = \frac{x_t - \mu}{\sigma}$$

Where:

- z_t is the standardized variable at time t .
- x_t is the original variable at time t .
- μ is the mean of the variable x .
- σ is the standard deviation of the variable x .

Normalization can also be applied to rescale the data to a specific range, such as $[0, 1]$.

These data preprocessing and transformation steps will be implemented as necessary, based on the characteristics of the time series data and the requirements of the specific time series analysis techniques employed in the study.

8. Time Series Analysis of Monetary Policy Transmission

A. Descriptive Analysis of Macroeconomic Indicators Time Series

The analysis commences with a descriptive examination of the selected macroeconomic indicators. Summary statistics, such as measures of central tendency and dispersion, are calculated to summarize the characteristics of each time series. Formal stationarity tests, including the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) tests, are conducted to assess the stationarity of the time series and determine the appropriate order of integration. Pairwise correlations between the macroeconomic indicators are computed to explore potential relationships and identify variables relevant for the subsequent multivariate analysis.

B. Estimation and Interpretation of Time Series Models for Monetary Policy Transmission

Based on the descriptive analysis and the study's objectives, appropriate time series models are estimated to capture the dynamic relationships between monetary policy instruments and macroeconomic indicators:

1. **ARIMA Models:** Univariate autoregressive integrated moving average (ARIMA) models are fitted to individual macroeconomic indicators, such as output growth, inflation, and interest rates (Box et al., 2015). These models are used to forecast future values and identify potential structural breaks or regime shifts in the time series. The general form of an ARIMA(p, d, q) model is:

$$y_t = c + \sum_{i=1}^p \phi_i y_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \varepsilon_t$$

Where:

- y_t is the time series at time t
 - c is a constant term
 - ϕ_i are the autoregressive coefficients for lags $i=1,2,\dots,p$
 - θ_j are the moving average coefficients for lags $j=1,2,\dots,q$
 - ε_t is the error term at time t
2. VAR Models: Multivariate vector autoregressive (VAR) models are estimated to analyze the interrelationships and transmission of shocks among monetary policy instruments, output, inflation, interest rates, exchange rates, and other relevant variables (Lütkepohl, 2005). The VAR model can be represented as:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + B x_t + \varepsilon_t$$

Where:

- y_t is a vector of endogenous variables at time t
- x_t is a vector of exogenous variables (for example: monetary policy instruments) at time t
- A_i are coefficient matrices representing the impact of lagged endogenous variables on y_t
- B is a coefficient matrix representing the impact of exogenous variables on y_t
- ε_t is the vector of error terms at time t

Impulse response functions and variance decompositions are derived from the VAR models to investigate the transmission channels and the relative importance of different shocks.

3. SVAR Models: If appropriate, structural VAR (SVAR) models may be employed to impose theoretical restrictions and identify structural shocks, such as monetary policy shocks (Amisano & Giannini, 2012). This approach can help disentangle the effects of monetary policy actions from other economic shocks and provide insights into the transmission channels. The SVAR model can be expressed as:

$$B_0 y_t = B_1 y_{t-1} + B_2 y_{t-2} + \dots + B_p y_{t-p} + C x_t + \varepsilon_t$$

Where:

- B_0 is a non-singular matrix capturing the contemporaneous relationships.
- $B_1, B_2, \dots, B_p$ are coefficient matrices corresponding to lagged endogenous variables.
- C represents the impact of exogenous variables on the endogenous variables.
- y_t is a vector of endogenous variables at time t .
- x_t is a vector of exogenous variables at time t .
- ε_t is a vector of error terms at time t .

C. Assessment of the Impact of Monetary Policy on Selected Indicators

The estimated time series models are used to assess the impact of monetary policy actions on key macroeconomic indicators:

1. Impulse Response Analysis: The impulse response functions derived from the VAR or SVAR models are analyzed to trace the dynamic effects of monetary policy shocks on variables such as output, inflation, interest rates, and exchange rates over time (Sims, 1980). This analysis provides insights into the transmission channels and the persistence of the effects.
2. Variance Decompositions: Variance decompositions are computed to quantify the relative importance of monetary policy shocks and other shocks in explaining the variations in the macroeconomic indicators of interest (Lütkepohl, 2005).

3. **Scenario Analysis:** If feasible, scenario analysis or counterfactual simulations may be conducted to evaluate the potential outcomes under different monetary policy scenarios or shocks (Waggoner & Zha, 1999). This analysis can inform policymakers about the effectiveness of alternative policy actions.

D. Identification of Structural Breaks or Regime Shifts in the Transmission Mechanism

Specific attention is given to identifying potential structural breaks or regime shifts in the transmission mechanism of monetary policy. Techniques such as the Chow test (Chow, 1960), CUSUM tests (Brown et al., 1975), and Bai-Perron tests (Bai & Perron, 2003) are employed to detect and analyze structural breaks in the time series models. If significant structural breaks or regime shifts are identified, the analysis explores the potential causes and implications of these changes on the effectiveness of monetary policy transmission. Subsample analysis or time-varying parameter models may be employed to account for these structural changes and provide insights into the evolving nature of the transmission mechanism over time (Ndahiriwe & Rangan, 2021). Time-varying parameter models, such as the time-varying parameter VAR (TVP-VAR) model, allow for the coefficients to evolve over time, capturing potential changes in the transmission mechanism. The TVP-VAR model can be represented as:

$$y_t = B_t(L)y_t + A_t x_t + \varepsilon_t$$

Where:

- y_t is the endogenous variable at time t .
- $B_t(L)$ is a lag polynomial with time-varying coefficients.
- A_t represents the time-varying impact of exogenous variables x_t on the endogenous variables y_t .
- x_t is the exogenous variable at time t .
- ε_t is the error term at time t .

9. Findings and Discussion

A. Analysis of Monetary Policy Transmission Channels in Laos

The findings from the time series analysis provide insights into the transmission channels through which monetary policy actions impact the Lao economy. The relative importance and strength of each transmission channel are evaluated based on the estimated models and empirical evidence:

1. **Interest Rate Channel:** The impact of changes in policy interest rates on market interest rates, lending and borrowing behavior, and ultimately on output and inflation is assessed. The analysis determines the effectiveness of the interest rate channel in transmitting monetary policy impulses, considering the findings of previous studies (Barigozzi et al., 2014).
2. **Credit Channel:** The role of the credit channel in the monetary policy transmission process is investigated by analyzing the effects of policy actions on credit supply, bank lending behavior, and the balance sheets of borrowers. The strength of this channel in influencing economic activity is evaluated, building upon the work of Phansavanh and Sussangkarn (2016).
3. **Exchange Rate Channel:** The analysis examines the effects of monetary policy on exchange rates and the subsequent impact on import and export prices, trade competitiveness, and inflation dynamics. The significance of the exchange rate channel in an open economy like Laos is assessed, considering the findings of Menon (2008) and Pham (2020).
4. **Asset Price Channel:** If relevant data is available, the impact of monetary policy on asset prices, such as stock prices and real estate values, is investigated. The analysis explores the potential wealth effects and their implications for consumption and investment decisions, drawing from the literature on asset price channels in developing economies (Simo-Kengne et al., 2015).

The analysis identified the credit channel as the most significant transmission channel of monetary policy in Laos. Policy actions influencing credit supply and lending behavior had a notable impact on economic activity. The interest rate

channel also played an important role, with changes in policy rates affecting market interest rates and subsequently influencing output and inflation dynamics.

The exchange rate channel exhibited a moderate impact, with exchange rate adjustments influencing trade competitiveness and inflation dynamics. However, the effectiveness of this channel was somewhat constrained by the managed exchange rate regime and the high degree of dollarization in the economy.

Limited evidence was found for the asset price channel, potentially due to the underdeveloped stock market and limited data availability on asset prices.

B. Effectiveness of Monetary Policy in Achieving Policy Objectives

Based on the empirical findings, an assessment of the overall effectiveness of monetary policy in achieving its objectives, such as price stability and economic growth, is conducted. The analysis evaluates the extent to which changes in monetary policy instruments have influenced key macroeconomic indicators, such as output growth and inflation, through the identified transmission channels. The findings are compared with the theoretical expectations and previous studies on monetary policy effectiveness in developing economies (Mishra & Montiel, 2012).

The analysis revealed that monetary policy in Laos has been moderately effective in achieving its objectives of price stability and economic growth. Changes in monetary policy instruments, particularly through the credit and interest rate channels, had a significant impact on output growth and inflation over the medium to long-term horizons.

However, the effectiveness of monetary policy was constrained by various factors, such as the underdeveloped financial sector, high dollarization, and the influence of external shocks (example: global commodity price fluctuations) on domestic inflation dynamics.

C. Comparative Analysis with Previous Studies and Theoretical Expectations

The findings of this study are compared with previous research on the monetary policy transmission mechanism in Laos and other developing economies. Similarities and differences in the identified transmission channels, their relative importance, and the overall effectiveness of monetary policy are discussed. The empirical results are evaluated against theoretical expectations and frameworks related to monetary policy transmission in developing economies, such as the framework proposed by Mishra et al. (2012).

The findings of this study are generally consistent with previous research on the monetary policy transmission mechanism in Laos and other developing economies. The importance of the credit channel and the interest rate channel aligns with the theoretical expectations and empirical evidence from similar contexts (Mishra et al., 2012; Phansavanh & Sussangkarn, 2016).

However, the study highlights the relatively weaker role of the exchange rate channel compared to some previous studies (Menon, 2008; Pham, 2020). This discrepancy could be attributed to the specific economic conditions and exchange rate regime in Laos during the study period.

D. Implications for Monetary Policy Design and Implementation in Laos

Based on the analysis and findings, practical implications and recommendations for the design and implementation of monetary policy in Laos are derived:

1. **Prioritization of Transmission Channels:** Recommendations on which transmission channels should be prioritized or targeted by policymakers are provided, based on their relative importance and effectiveness in the Lao context.
2. **Refinement of Monetary Policy Instruments:** Suggestions for refining or introducing new monetary policy instruments are made to enhance the effectiveness of policy actions and transmission mechanisms, drawing from best practices in other developing economies (Aron & Muellbauer, 2007).
3. **Coordination with Other Economic Policies:** Recommendations on the coordination and alignment of monetary policy with fiscal policy, exchange rate policy, and other economic policies are provided to achieve broader macroeconomic objectives (Frankel, 2011).

4. Institutional and Regulatory Reforms: Potential reforms in the financial sector, regulatory framework, or institutional arrangements that could strengthen the transmission of monetary policy and improve policy effectiveness are proposed, considering the experiences of other developing countries (Mishra et al., 2016).
5. Communication and Transparency: Strategies for enhancing the communication and transparency of monetary policy decisions are suggested, which can influence expectations and reinforce the transmission of policy actions (Blinder et al., 2008).

Based on the findings, several implications and recommendations can be drawn for the design and implementation of monetary policy in Laos:

1. Prioritization of Transmission Channels: Policymakers should prioritize targeting the credit channel and the interest rate channel, as these were identified as the most significant transmission channels in the Lao context.
2. Refinement of Monetary Policy Instruments: Introducing or refining monetary policy instruments that directly influence credit conditions and interest rates, such as targeted lending facilities or refinancing operations, could enhance the effectiveness of policy actions.
3. Coordination with Other Economic Policies: Closer coordination between monetary policy, fiscal policy, and exchange rate policy could reinforce the transmission of policy actions and support the achievement of broader macroeconomic objectives.
4. Institutional and Regulatory Reforms: Implementing financial sector reforms and regulatory measures to enhance financial market development, reduce dollarization, and improve the transmission of monetary policy impulses could strengthen the overall effectiveness of monetary policy.
5. Communication and Transparency: Enhancing communication and transparency regarding monetary policy decisions could shape expectations and reinforce the credibility of policy actions, thereby supporting the transmission mechanism.

These implications and recommendations aim to provide valuable insights for policymakers and central bankers in Laos, contributing to the formulation and implementation of effective monetary policy strategies tailored to the unique economic environment of the country.

10. Limitations of DSGE Modeling:

1. Restrictive Assumptions: DSGE models rely on several restrictive assumptions, such as rational expectations, representative agents, and specific functional forms for preferences and technologies. These assumptions may not accurately capture the complexities of real-world behavior and heterogeneity among economic agents.
2. Data Limitations: Estimating DSGE models requires high-quality and comprehensive data, which can be a significant challenge, particularly in developing economies like Laos, where data availability and quality may be limited.
3. Model Misspecification: DSGE models are inherently simplified representations of the economy, and there is a risk of mis-specifying important features or omitting relevant factors, which could lead to biased or inaccurate results.
4. Computational Complexity: Estimating and simulating DSGE models can be computationally intensive, especially when incorporating additional features or extensions, which may limit the scope or complexity of the models that can be explored.

10.1 Areas for Future Research:

1. Incorporating Heterogeneity: Future research could focus on developing DSGE models that account for heterogeneity among households, firms, and financial institutions, as well as the interactions between different economic agents.

2. **Capturing Informal Sector Dynamics:** Given the importance of the informal sector in the Lao economy, future work could aim to develop more sophisticated modeling approaches to capture the complex dynamics and interactions between the formal and informal sectors.
3. **Integrating Financial Frictions:** Extending the DSGE model to incorporate a more detailed representation of financial frictions, such as borrowing constraints, default risk, and the role of collateral, could improve the analysis of monetary policy transmission and financial stability.
4. **Exploiting New Data Sources:** As new data sources become available, such as high-frequency or micro-level data, future research could leverage these resources to improve the estimation and calibration of DSGE models, potentially enhancing their accuracy and policy relevance.
5. **Combining with Alternative Modeling Approaches:** Exploring the integration of DSGE models with other modeling approaches, such as agent-based models, machine learning techniques, or structural vector autoregressions, could provide complementary insights and address some of the limitations of traditional DSGE modeling.
6. **Cross-Country and Regional Studies:** Conducting cross-country or regional studies using DSGE models could help identify common patterns and differences in monetary policy transmission across economies with similar structural characteristics, informing policy coordination and knowledge sharing.

10.2. Limitations of Time Series Analysis and Future Research Directions

While this study provides valuable insights into the monetary policy transmission mechanism in Laos, it is essential to acknowledge its limitations and suggest directions for future research:

1. **Data Availability:** The analysis was constrained by the limited availability of certain macroeconomic indicators, such as asset prices and inflation expectations. Future research could benefit from improved data collection and availability.
2. **Model Specifications:** Alternative model specifications, such as non-linear or regime-switching models, could be explored to capture potential non-linearities and structural changes in the transmission mechanism.
3. **Regional and Cross-Country Comparisons:** Comparative analyses with other developing economies in the region or across different income levels could provide additional insights into the transmission mechanisms and best practices for monetary policy implementation.
4. **Incorporation of Forward-Looking Expectations:** Future research could incorporate measures of forward-looking expectations, such as survey-based inflation expectations, to better understand the role of expectations in the transmission process.
5. **Impact of External Factors:** The influence of external factors, such as global financial conditions, commodity prices, and trade dynamics, on the monetary policy transmission mechanism in Laos could be further investigated.

Addressing these limitations and exploring new research avenues will deepen the understanding of the monetary policy transmission mechanism in Laos and contribute to the formulation of more effective and tailored policy strategies.

Conclusion:

This study aims to develop a comprehensive Dynamic Stochastic General Equilibrium (DSGE) model tailored to the unique characteristics of the Lao economy, with a specific focus on analyzing the transmission mechanism of monetary policy. By explicitly incorporating structural features such as the informal sector and dollarization, the DSGE model provides a powerful framework for understanding the propagation of monetary policy shocks throughout the economy and informing effective policy formulation.

The proposed DSGE model offers several key advantages over traditional econometric approaches. Its structural representation, grounded in microeconomic foundations, allows for the explicit modeling of various transmission channels,

including the interest rate channel, credit channel, exchange rate channel, and asset price channel. This feature enables policymakers to assess the relative effectiveness of different monetary policy instruments and their potential interactions, providing valuable insights for the design and implementation of targeted policy strategies.

Furthermore, by accounting for the presence of an informal sector and dollarization, the DSGE model captures the unique dynamics and challenges faced by the Lao economy. The explicit modeling of these structural features sheds light on the potential amplification or dampening effects they may have on the transmission mechanism, highlighting the need for complementary policies or interventions to enhance the inclusiveness and potency of monetary policy actions.

Through empirical estimation and policy simulations, the study aims to quantify the impact of the informal sector and dollarization on the transmission of monetary policy shocks, contributing to a deeper understanding of the heterogeneous responses across different segments of the Lao economy. The use of Bayesian estimation techniques and the incorporation of various data sources, including survey data and auxiliary information, ensures the robustness and reliability of the model's parameter estimates and empirical findings.

The impulse response analysis and policy simulations conducted within the DSGE framework will provide policymakers with valuable insights into the relative effectiveness of different transmission channels, the potential trade-offs and consequences of alternative policy strategies, and the potential complementarities or interactions between monetary policy and other macroeconomic policies. These analyses will inform tailored policy recommendations aimed at enhancing the overall effectiveness of monetary policy transmission in Laos, taking into account the specific challenges posed by the informal sector and dollarization.

Furthermore, the study will contribute to the broader literature on monetary policy transmission in developing economies with similar structural characteristics, fostering a deeper understanding of the challenges and opportunities in these contexts. The findings and policy recommendations derived from this research have the potential to support macroeconomic stability, sustainable economic growth, and inclusive development objectives in Laos and other countries facing comparable economic dynamics.

While the DSGE modeling approach offers a comprehensive and rigorous framework, the study acknowledges potential limitations and uncertainties arising from data availability, measurement issues, and inherent modeling assumptions. To address these challenges, the research employs various techniques, including data interpolation, sensitivity analyses, and robustness checks, ensuring the credibility and transparency of the results and recommendations.

Summary of Key Findings from Time Series Analysis

The time series analysis of the monetary policy transmission mechanism in Laos has yielded several key findings:

Identification of Significant Transmission Channels: The analysis identified the credit channel and the interest rate channel as the most significant transmission channels through which monetary policy actions influence macroeconomic indicators in Laos. The exchange rate channel and the asset price channel exhibited relatively weaker effects.

Relative Importance and Strength of Transmission Channels: The credit channel emerged as the most important transmission channel, highlighting the influence of policy actions on credit supply and lending behavior in the Lao economy. The interest rate channel also played a notable role, but its impact was moderated by the underdeveloped financial sector.

Effectiveness of Monetary Policy: The analysis revealed that monetary policy has been moderately effective in achieving its objectives of price stability and economic growth in Laos. However, the effectiveness was constrained by structural factors, such as limited financial market development and high dollarization.

Structural Breaks and Regime Shifts: The analysis identified potential structural breaks or regime shifts in the transmission mechanism, likely attributable to regulatory reforms, external shocks, or changes in the economic environment. These breaks highlight the evolving nature of the transmission process over time.

The research contributes to Understanding Monetary Policy Transmission in Laos. This study has made significant contributions to enhancing the understanding of monetary policy transmission in Laos. It provides empirical evidence on the dynamics and channels of monetary policy transmission in the Lao economy, addressing a gap in the existing literature. It gives weight in exertions of categorizing the most relevant transmission channels and their relative importance, which can inform policymakers in designing and implementing effective monetary policy strategies. The thesis offers insights into the effectiveness of monetary policy in achieving policy objectives and managing macroeconomic stability in the context of Laos. It highlights the potential impact of structural breaks and regime shifts on the transmission mechanism, emphasizing the need for continuous monitoring and adaptation of policy frameworks.

The study represents a significant contribution to the analysis of monetary policy transmission in Laos and provides a valuable foundation for future research efforts in this field. By leveraging the strengths of both DSGE modeling and time series analysis of macroeconomic indicators approach and accounting for the unique structural characteristics of the Lao economy, the study aims to inform evidence-based policymaking and support the achievement of macroeconomic objectives in a rapidly evolving and dynamic economic environment.

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