ECONOMIC FUNDAMENTALS AND MACROECONOMIC SHOCKS: INSIGHT FROM ASIAN ECONOMIES

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ABSTRACT

This research presents a comprehensive analysis of the effect of various types of shocks to the macroeconomic outlook of Asian economies. Employing advanced econometric models, the first chapter dissects the multifaceted impacts of oil and natural gas price fluctuations, whereas the exchange rate regimes, and monetary policy decisions on the macroeconomic landscape and renewable energy (RE) sector across diverse Asian countries are explained in subsequent chapters The study further presents a comparative analysis of energy policies across Asia, examining the transition from conventional to renewable energy in response to energy price shocks. It identifies stark contrasts in policy implementation between high-income and low-income countries, with the former emphasizing technological innovation and the latter relying more on international aid. The research highlights Pakistan's critical need for transitioning to renewable energy due to its reliance on imported conventional energy sources and environmental commitments.

The first essay utilizes a panel Structural Vector Autoregression approach, revealing a nuanced relationship between fuel (oil and LNG) price shocks and RE consumption. It underscores how higher-income nations are more responsive to oil price changes compared to lower-income counterparts and highlights the critical role of government policy in moderating these effects, especially in oil-importing countries.

The second essay delves deeper, using non-linear ARDL and Markov-Regime Switching models to explore the effects of oil prices and exchange rates fluctuations on current account balances. It identifies long-term negative impacts and short-term variabilities, with government interventions playing a key role in mitigating oil price volatilities. This segment of the thesis highlights the necessity for tailored economic strategies that accommodate diverse market conditions, emphasizing the importance of stable exchange rate policies.

In the subsequent chapter, the focus shifts to the effect of monetary policy on asset prices within these regions. Through asymmetric SVAR analysis, significant and varied effects of interest rates on stock and housing prices are identified. The study finds a pronounced impact of monetary policy in developed economies, contrasting with the minimal influence observed in South Asian housing markets due to unique market dynamics and lesser monetary integration.

Hence, this thesis provides valuable insights into the complex dynamics of energy prices, monetary policy, and renewable energy policies in Asian economies. It offers a holistic view of how these elements interact within different economic contexts, providing essential guidance for policymakers in developing effective strategies for economic stability, growth, and sustainable energy transition.

Keywords: Oil Price, Liquified Natural Gas, Renewable Energy, Monetary Policy, Asset Price,

House Price, Stock Price, Current Account Balance, Exchange Rate, Interest Rate

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OP	Oil Price
FP	Fuel Price
CA	Current Account
CAB	Current Account Balance
IR	Interest rate
ER	Exchange Rate
INF	Inflation
RLNG	Real Liquified Natural Gas
RE	Renewable Energy
GDP	Gross Domestic Product
IP	Inflation Premium
IRF	Impulse Response Function
MP	Monetary policy
FP	Fuel price
IRF	Impulse Response Function
LR	Long Run
AP	Asset Price
HP	House Price

INTRODUCTION

1. MOTIVATION AND BACKGROUND

1.1 Overview

This study adopts a holistic approach to examine critical interactions in energy, finance, and economic policy within Asian economies. It explores the impact of fuel price changes, particularly oil and LNG prices, on renewable energy adoption, and investigates how regime switches in fuel prices and exchange rates affect the current account balance. Furthermore, the study examines the relationship between monetary policy and asset prices, using housing and stock prices as key indicators. By addressing these interconnected areas, the research aims to provide insights into the transition toward renewable energy, the dynamics of external balances, and the transmission of monetary policy in Asian economies.

The first essay focuses on the nexus between oil and LNG price fluctuations and renewable energy adoption, employing a combination of Structural Vector Autoregression (SVAR), Fixed Effects, System GMM, and Instrumental Variables methods to capture both static and dynamic relationships and to address endogeneity concerns. This analysis highlights the direct and indirect effects of fuel price changes on the shift from traditional to renewable energy and identifies policy constraints that may limit renewable energy adoption. The second essay investigates the influence of regime shifts in exchange rates and fuel prices on the current account balance, using Nonlinear Autoregressive Distributed Lag (NARDL) and Markov regime-switching models to capture asymmetries and nonlinear dynamics. This approach allows the study to uncover channels through which external shocks and regime changes propagate across the balance of payments.

The third essay examines the relationship between monetary policy and asset prices in Asian economies using SVAR to analyze asymmetric effects of expansionary and contractionary policies on housing and stock prices. By exploring these dynamics, the study provides insights into the transmission mechanisms of monetary policy and the differential impacts on asset markets. The final chapter synthesizes findings from all three essays, offering a comprehensive understanding of the interactions between energy markets, macroeconomic balances, and financial policies, and providing guidance for policymakers in promoting sustainable energy transitions and economic stability in the region.

1.2 Background

Energy contributes to the sustainable economic growth around the globe dynamically (Moriarty et al., 2022). However, there is still ongoing debate regarding the role of economic growth in the context of energy consumption. The existing body of evidence presents a diverse range of findings, with some studies suggesting a unidirectional relationship (Ikhsan et al., 2022; Mukhtarov et al., 2022; Gyamfi et al., 2020), while others indicate the presence of bidirectional causality between energy consumption and economic growth (Luqman et al., 2019; Wang et al., 2022; Saleem et al., 2020). However, in the era of globalization, the rapidly growing energy demand and increasing reliance of both emerging and developed economies on fossil fuel reserves signal a potential global energy crisis in the near future. In order to tackle these crises, it is mandatory to explore and integrate the alternate sources of energy i.e., renewable energy (Moriarty et al., 2019).

Notably, the conventional growth theories essentially accentuate labor and capital as major factors of production, however, disregarding the imperative role of energy in aggregate growth process (Moriarty, 2022; Stern et al., 2004 and Moriarty, 2019). The world witnessed the oil dependence of global economies during 1970s-80s, marked by the sequence of socio-political incidents in middle east i.e., Iranian revolution in 1979 and Yom Kippur war 1973, consequently disrupted the oil supply to the nations relying on energy exports from Middle East making it an oil crisis around the globe.

Successively, in the aftermath of 9/11, there was a brief spike in oil prices with an upward trajectory in 2001 due to geopolitical instability, followed by the substantial drop in oil price during global financial crisis in 2008. Besides, the world experienced an unprecedented and historic decline in the oil market during the COVID-19 pandemic, world witnessed a historic decline in the realm of oil price disruption during COVID-19, marking an unprecedent negative trajectory for the first in the history (Le et al., 2021). Nonetheless, as the COVID-19 restrictions relaxed, oil prices started to ascent subsequently.

However, the response of oil market to the COVID-19 highlighted the vulnerability of oil prices to external shocks, hence there is a need of alternate sources of energy which are prone to external shocks. The transition from conventional to renewable energy is a complex process shaped by multiple factors, including the cost-efficiency of renewable technologies, their long-term sustainability and reliability, and broader economic considerations such as investment incentives and market infrastructure (Dey, 2022). Not to forget the environmental and climate concerns i.e., air pollution, further contribute to driving the momentum towards the renewable energy adoption (Sen, 2017; Rietig, 2021; Osman et al., 2023; Olabi et al., 2022; Al-Shetwi et al., 2022; & Zhao 2017). Likewise, regulatory policies and government initiatives also plays a crucial role in transition of conventional energy sources into the renewables i.e. provision of subsidies, tax incentives, regulatory structures have a potential to stimulate the adoption of renewable sources of energy. Additionally, the advancement and technological innovation in renewable energy sector also accentuate the transition such as advancement in solar power, wind energy, thermal power plants and other energy storing mechanism boost the sustainability and viability of renewable energy sources.

Beyond influencing renewable energy adoption, fluctuations in oil prices in particular, and fuel prices in general, directly affect the trade balances of Asian economies (Khan et al., 2019). Persistent trade deficits resulting from these price shocks can, in turn, exert significant pressure on the current account balance. Correspondingly, the flexible exchange rate regimes expediates the self-adjustment of trade balance through currency appreciation or depreciation, where the depreciation of currency can enhance the exports more competitive, potentially improving the current account balance by increasing the exports and decreasing the imports (Amaliawiati, 2021).

If the government imposes import restrictions to correct the trade balance, the impact of fuel price and exchange rate shocks on the current account may be mitigated, as reduced imports can partially offset the adverse effects of rising fuel costs. However, such policies may also introduce inefficiencies, distort market signals, and affect overall economic growth. Similarly, a strong inflow in the capital account, like remittances, can cushion the current account against trade deficits by providing additional foreign exchange, thereby stabilizing the balance of payments. Both scenarios highlight that current account dynamics are shaped not only by trade and fuel price fluctuations but also by policy interventions and external financial flows, which should be considered when evaluating macroeconomic resilience in Asian economies.

Chronic trade deficits due to low productivity and weak competitiveness have more persistent and structural implications, limiting long-term growth and requiring reforms to enhance economic efficiency. In contrast, deficits caused by external shocks, such as oil price spikes, are often temporary and can be mitigated through short-term policy measures. The distinction is important, as structural and shock-induced deficits affect energy policy, investment, and macroeconomic stability differently. Recognizing the source of the deficit helps tailor appropriate policy responses in Asian economies.

Conversely, the fixed exchange rate regime requires the government intervention to sustain the peg, which may affect the current account balance by manipulating competitiveness of exports and imports. The overall effect of both regime shifts on current account balance of Asian economies further depend on numerous factors i.e., geo-political position, dependency on imported energy sources, net repones of trade flow to fluctuation in fuel price and exchange rate etc. moreover, these implications may have repercussion on monetary policy, inflation, and economic stability necessitating the vigilant management by policymakers.

With any abrupt increase in fuel prices in economy, the inflationary pressure rises as the high price of oil or LNG can directly impact cost of production and transportation which burdened the consumer in the form of mounted prices of goods and services. An increase in inflation prompts the Central Bank to maintain the price stability. This action can be taken by using interest rate as a tool of monetary policy. Subsequently, by increasing the interest rate, Central Bank attempts to shrink the aggregate spending and borrowing, which may lead to diminish inflationary pressure.
Changes in interest rates can significantly influence asset prices, particularly housing. Higher interest rates increase borrowing costs, which can reduce housing demand and subsequently lower housing prices. In contrast, the relationship between monetary policy and stock prices in Asian

economies is more nuanced, as stock market responses depend on investor expectations, market structure, and macroeconomic conditions.

Historical real estate crashes, such as the 2008 Global Financial Crisis, had far-reaching effects on housing markets, financial institutions, and economies worldwide. In contrast, developing countries like Pakistan, Bangladesh, Sri Lanka, and India have not experienced similar crashes. This is largely because housing in these markets is primarily financed through private equity rather than widespread mortgage lending. Nevertheless, monetary policy still influences house prices, only to some extent, in countries like Pakistan, as investors often borrow from banks to invest in real estate, without going into mortgage directly, given that potential returns typically exceed borrowing costs (Umar et al., 2019). It is why the housing prices represent an important yet underexplored indicator of asset market dynamics.

Hence, briefly this research argue that the previous studies usually focused on the impact of oil and gas price changes on renewable energy adoption, however, there is a research gap in identifying this relationship in the context of Asian economies. Besides, there is a gap in understanding the specific channels through which the substitution from conventional sources of energy to renewable energy occurs. Existing literature often focuses on the overall relationship between oil price and renewable energy adoption but fails to delve into the specific factors and dynamics that drive this substitution process.

Furthermore, Previous studies have primarily focused on examining the relationship between oil prices and renewable energy adoption, neglecting the significance of gas prices for Asian economies where liquefied natural gas (LNG) plays a substantial role in the overall energy mix. This research attempts to address this gap by analyzing the impact of fuel prices, including both LNG and oil prices, on renewable energy adoption. By considering the influence of both LNG and oil prices, this study contributes to the existing literature by offering more in depth insight into the factors that drive the substitution from traditional energy sources to renewable energy in Asian economies.

Previous studies have separately examined the impact of oil price changes or exchange rate regime switch on current account balance, while there is a research gap when it comes to understanding the combined effects of these two factors (Baharumshah et al., 2017; Malik et al., 2019; Piard, 1999; & Kassa, 2017). Understanding how fuel price (oil as well as gas price) changes and exchange rate regime switch interact and influence the current account balance of economies is crucial for policymakers and researchers alike. Further research is required to analyze the simultaneous impact of these factors, and to identify the specific channels through which they affect the current account balance.

Although there have been studies investigating the relationship between asset prices and monetary policy, there is a research gap in understanding this relationship specifically in the context of Asian economies, using stock price and housing price as indicators of asset prices. Most existing literature focuses on developed economies, particularly the United States, and may not capture the unique characteristics and dynamics of Asian economies. Further research is needed to explore the specific channels through which monetary policy influences stock and housing prices in Asian economies, and to understand the implications of these relationships for monetary policy effectiveness and financial stability in the region.

1.3 Objectives of the Study

This study holds a holistic approach and explores the impact of fuel price (oil price and LNG prices) change on renewable energy as well as how the regime switch in fuel price as well as exchange rate affects the current account balance of an economy. This study further attempts to analyze the relationship between traditional means of energy and the renewables. The channel of impacting oil price on the ability of economies to adopt renewable energy sources is precisely presented in this study. This study further explores the relationship between monetary policy and asset prices by taking stock price and housing price as an indicator of Asset prices. In the light of aforesaid concerns research gaps, the key objectives of this study are given below. The first part of the study includes the consolidated introduction which concludes with the energy overview of Asian economies. Here we investigated the energy policies of Asian economies by comparing the policies adopted by Asian economies and further highlighted the policy gaps that limit the adoption capacity of renewables especially for the sample countries.

The *first essay* of the study focuses on investigating the nexus between oil and liquefied natural gas (LNG) price changes and renewable energy in Asian countries. The essay utilizes annual data from 1973 to 2022. One of the key objectives of this chapter is to examine whether there are asymmetric impacts of oil price shocks on renewable energy.

To address these objectives, the study employs a structural vector autoregression (SVAR) approach. This approach allows for analyzing the dynamic interactions between fuel prices (specifically oil price and LNG price) and the adoption and development of renewable energy sources in Asian economies.

This essay further attempted to shed light on the direct and indirect effects of fuel price variations on the renewable energy sector. This includes investigating how changes in oil and LNG prices can influence the transition from traditional energy sources to renewables. Analyzing these relationships is crucial for policymakers and stakeholders in promoting the adoption and integration of renewable energy in Asian economies. In order to provide robust, generalizable findings, this study supplements SVAR with three additional panel data approaches i.e, the Fixed

Effects Model estimates baseline static relationship between prices and RE and it further controls for unobserved, time-invariant country heterogeneity. Second is the System Generalized Method of Moments (System GMM) estimator which evaluates dynamic panel persistence in RE adoption. Addresses endogeneity and autocorrelation. Ensures consistency of estimates., and finally the Instrumental Variables (IV) method which corrects external endogeneity in price variables. Causal inference using exogenous instruments. Accounts for global shocks on domestic RE transitions.

Furthermore, the study identifies and discusses the policy constraints that may hinder the adaptation capacity of renewable energy in Asian countries. These policy slits can limit the growth and development of renewable energy sectors, preventing them from reaching their full potential. By highlighting these constraints, the study provides insights into areas where policy improvements and adjustments are needed to support the transition towards sustainable and renewable energy resources.

The *second essay* of the study delves into the impact of regime switches in exchange rates and fuel prices on the current account balance. To capture the potential nonlinear relationship, the study employs the Nonlinear Autoregressive Distributed Lag (NARDL) approach and . This approach allows for analyzing the complex dynamics and interactions between exchange rates, fuel prices, and the current account balance.

By employing the NARDL approach, the study is able to capture the short-term as well as long-term effects of regime switches in exchange rates and fuel prices on the current account balance. This is important as it enables a more comprehensive understanding of the dynamics involved in these relationships. The NARDL approach also accounts for potential asymmetries and nonlinearity, which are crucial in capturing the complexities of real-world economic systems.

Furthermore, the study employs the Markov regime-switching model to identify and estimate the nonlinearities across different regimes. This model allows for the identification of different states or regimes in the exchange rate and fuel price dynamics, which can have distinct effects on the current account balance. By considering regime switches, the study provides insights into how changes in exchange rate and fuel price regimes affect the current account balance in different economic environments. Furthermore, System GMM (two-equation framework) is also utilized to captures direct & indirect channels of oil/fuel price shocks via exchange rate and trade balance.

The chapter focuses specifically on investigating the particular aspect of the current account balance that is significantly influenced by regime shifts in exchange rates and/or fuel prices. This analysis helps to uncover the channels through which these regime switches impact the current account balance. Understanding these specific aspects is crucial for policymakers and researchers in formulating effective policies and strategies to manage and stabilize the current account balance in response to changes in exchange rates and fuel prices.

The third essay of this study sheds light on the relationship between monetary policy and asset prices, specifically focusing on house prices and stock prices as indicators of asset prices. The chapter examines the role of expansionary and contractionary monetary policy across Asian economies during the period from 2009 to 2021. The main objective is to explore the asymmetric relationship between monetary policy stances (expansionary or contractionary) and asset prices in Asian economies.

To investigate this relationship, the study adopts the Structural Vector Autoregression (SVAR) approach. This approach allows for analyzing the dynamic interactions between monetary policy and asset prices, considering both the short-term and long-term effects. By employing the SVAR approach, the study can capture the simultaneous feedback effects between monetary policy actions and changes in asset prices.

The study focuses on exploring potential asymmetries in the relationship amid monetary policy and asset prices. Hence it examines whether expansionary or contractionary monetary policy has different impacts on housing and stock prices in Asian economies. An investigation of these asymmetries is crucial as it helps in understanding the nuanced effects of different monetary policy stances on asset prices in different economic conditions.

By analyzing the nexus between monetary policy and asset prices, the chapter provides understandings of the transmission mechanism of monetary policy in Asian economies. It highlights how changes in monetary policy i.e., interest rate adjustments, can influence the behaviour and dynamics of house prices and stock prices. Understanding these transmission channels is important for policymakers and central banks in formulating effective monetary policy strategies and managing asset price fluctuations.

Furthermore, the chapter enriches and contributes to the literature by focusing specifically on Asian economies and their unique characteristics. It recognizes the diversity and heterogeneity among Asian economies and investigates how monetary policy affects asset prices in this context. This analysis can provide valuable insights for policymakers in Asian economies, assisting them to make insightful decisions regarding monetary policy measures and their potential impacts on asset prices.

Together, the three essays of this study form an integrated analysis of how energy markets, macroeconomic dynamics, and financial policies interact in Asian economies. Essay 1 examines the impact of oil and LNG price fluctuations on renewable energy adoption, highlighting how energy price shocks and policy constraints shape the transition from conventional to renewable energy sources. Essay 2 extends this analysis by exploring how regime switches in fuel prices and exchange rates influence the current account balance, revealing the channels through which external shocks propagate across trade and payments, and underscoring the broader macroeconomic implications of energy price volatility. Both essays emphasize the role of asymmetric and nonlinear responses, demonstrating that the effects of energy price changes are neither uniform across economies nor across time, thereby providing a nuanced understanding of the economic and policy environment in Asia.

Essay 3 complements these insights by focusing on the financial consequences of macroeconomic policies, specifically the relationship between monetary policy and asset prices. By examining how expansionary and contractionary monetary policies influence housing and stock markets, this essay sheds light on the transmission mechanisms that link broader economic conditions—including energy and trade dynamics—to financial markets. Collectively, the three essays provide a comprehensive framework: energy price fluctuations affect renewable energy adoption and trade balances, while monetary policy responses mediate the effects on asset markets, allowing policymakers to better coordinate energy, trade, and financial strategies to promote economic stability and sustainable growth in Asian economies.

The final part of the study provides a consolidated conclusion of all the chapters of the study. This concluding chapter of this research provides a holistic overview of the study's outcomes, highlighting the key insights, implications, and potential avenues for further research or policy development. By consolidating the knowledge obtained from the preceding chapters, the concluding chapter offers a comprehensive outlook on the study's subject matter in the context of sustainable development in Asian economies.

1.4 Contribution of the study

There are numerous studies which has attempted to establish the causes, impacts and policy response of oil price change on renewable energy but most of the literature tends to revolve around the impact of oil price change while overlooking the LNG factor which is one of the significant sources of conventional energy in Asian economies. However, this study emphasized on comprehensive effect of fuel price which includes both oil price and RLNG instead of merely oil price for more thorough investigation. This study also contributes to existing literature by providing an extensive overview of energy policies of the Asian economies which includes the policies summaries, reforms and challenges and future perspective of natural gas policies of all sample economies.

This study undertakes a comprehensive insight and comparative analysis of the current energy policies across a spectrum of countries. It delves into the obscurities of these policies, shedding light on their nuances, strengths, and shortcomings. By exploring the challenges confronting these policies, the essay aims to provide a holistic understanding of the energy landscape in each country. Furthermore, it seeks to identify potential pathways forward, suggesting strategies and approaches that could enhance the effectiveness and sustainability of these policies.

The comparative analysis serves to highlight the diversity of approaches adopted by different countries in addressing their energy needs and challenges. It underscores the importance of context-specific policies tailored to the unique circumstances and resources of each country.

Through this comparative lens, the study aims to distill key insights and lessons that can inform the elaboration and implementation of energy policies in other regions.

The study comprises of three essays, each of which strives to make a significant contribution to the existing literature. In this segment, the chapters probe into various aspects and expand upon them in a sophisticated manner.

First essay is a contribution to the existing literature on energy economics. It seeks to explicate the multifaceted factors that contribute to the transition of traditional source of energy into the realm of renewable energy by using the data of Asian economies from 1973-2023. There is a scarce literature which delves into investigating the channel of fuel price changes and their impact on the renewable energy adoption capacity of Asian economies. Previous literature has predominantly centered on analyzing the volatility of oil prices, inadvertently overlooking a crucial variable in the energy equation - the composition of energy sources, specifically liquefied natural gas (LNG). Given that Asian economies heavily depend on both oil and gas to fulfill their energy requirements, disregarding the role of gas in the energy mix fails to provide an extensive comprehension of the transition from conventional energy resources to renewable alternatives. Hence this chapter seek to address this void in literature and analyze the nexus between fuel price (oil price as well as LNG price) and renewable energy for Asian economies.

Hence, this chapter is an attempt to thoroughly analyze this mechanism. The analysis will further contribute to designing the pertinent policies and deepen the understanding of whether the transition to renewable energy is market-driven, where renewables and fuel prices move in similar direction, or if it is stirred by policies aimed at stimulating increased energy generation from renewables. The estimation is executed by employing structural VAR (SVAR) technique and analyzed the asymmetric impact of fuel prices on renewable energy of sample countries by capturing positive and negative changes in oil and fuel prices. Besides, SVAR approach is further employed to analyze the transmission of idiosyncratic shocks, common shocks, and composite structural shocks because it is considered as one of the sophisticated approaches since it allows for the estimation of individual shocks unlike conservative timeseries VAR approach which merely analyse the composite shock (Canova et al., 2013). This study illustrates a pioneer attempt to investigate the relation between energy mix within the economies of Asia by using SVAR which constitutes a valued contribution to the present literature. Additionally, the research findings of the study would have potential implications for economic modelling as well as policy makers, in terms of providing insights into the impacts of fuel price shocks in Asia, specifically oil importing and developing countries as they are more prone to energy shocks. In order to provide robust, generalizable findings, this study supplements SVAR with three additional panel data approaches i.e, the Fixed Effects Model estimates baseline static relationship between prices and RE and it further controls for unobserved, time-invariant country heterogeneity. Second is the System Generalized Method of Moments (System GMM) estimator which evaluates dynamic panel persistence in RE adoption. Addresses endogeneity and autocorrelation. Ensures consistency of estimates., and finally the Instrumental Variables (IV) method which corrects external endogeneity in price variables. Causal inference using exogenous instruments. Accounts for global shocks on domestic RE transitions.

The *second essay* provides significant contribution to the literature by estimating the impact of exchange rate as well as fuel price changes on current account balance of selected Asian economies, this study stands out as a pioneer attempt in analyzing these relationships for the given sample of countries, offering valued understandings of the specific dynamics of current account balance in this context.

This nexus has been investigated previously by using multiple estimation techniques i.e., cointegration analysis, bivariate causality tests, and vector autoregressive (VAR) methods. Nonetheless, these methodologies presume a linear correlation between oil price change and exchange rate (Wang et al., 2012; and Chen et al., 2007). Undeniably, several empirical studies established the fact that these variables' dependencies can be categorized by a nonlinear and asymmetric relationship. This study attempts to complement the previous studies and make progress in acknowledging the relationship between these two variables particularly for Asian economies by using NARDL. This study enriches the present literature in multiple ways i.e., this study investigates the nexus between changes in fuel price (instead of only oil price) and the current account balance for Asian economies predominately the oil importers. Furthermore, it examines the impact of varying oil price regimes and the exchange rate besides observing the specific segment of the current account where the oil price and exchange rate regimes affect significantly. Although this area of research has been gaining momentum in the recent past, however, the empirical analysis has not used techniques that address multiple objectives altogether. Additionally, changes in oil and LNG prices and exchange rate volatility effects the current account balance of an economy and nations may decide to adjust their consumption as well as investment pattern. As a result, policymakers in Asian economies consider investment opportunities and policy possibilities in relation to periods of high or low oil and fuel prices.

Hence, this research used non-linear ARDL as well as Markov regime-switching model for analyzing the unobserved regimes shifts of energy mix and exchange rate, and their effect on current account balance. This approach enables the identification of various potential regimes and offers insights into the magnitude of regime volatilities. By capturing the nonlinearities and regime shifts in the data, this study delivers a precise understanding of the drivers of current account balance fluctuations. Finally System GMM is employed to captures direct & indirect channels of oil/fuel price shocks via ER and trade balance as well as endogeneity.

The outcomes of this research will be particularly valuable for policymakers, as they shed light on the implications of volatility in fuel prices and exchange rate regimes for the current account balance. The efficient formulation of policies to manage the current account balance relies mainly on an extensive knowledge of the volatility of regimes, their transition probabilities, as well as the duration of each regime. By providing insights into these aspects, this study offers policymakers a valuable tool to make informed decisions regarding the management of fuel price and exchange rate volatility and their impact on the current account balance.

The *third essay* explores a nexus between monetary transmission mechanism and asset prices (house prices and stock prices) by assessing the asymmetric long run and short run relationship. Since the existing research mainly focus on developed countries while ignoring the developing economies, whereas this study emphasized on the Asian economies which include both developed and developing countries. Furthermore, it is conceived from the previous literature, that this study is pioneer and most encompassing to explore the interactions amid monetary policy and asset prices in the Asian economies context by employing SVAR approach and GMM. This essay is a contribution to existing literature by taking the house price as an indicator of asset price along with the stock price. The inspiration of using house price as one of the indicators of asset prices along with the stock price, has been taken from the policy framework of monetary policy. Housing prices are influenced by monetary policy via financial stability against the backdrop of global financial crisis which was the main culprit behind the downfall and failure of real estate sector in economic history. The previous studies and theories have endorsed the repercussion of monetary policy on real estate by and large. However, interest rate, being one of the measures of monetary policy, effects the housing price significantly by raising the prices and lowering the value of real estate even with a slight upsurge in interest rate. Hence, analysing and hypothesizing the relation between asset prices i.e., housing price and stock price and the monetary policy transmission in the context of the countries of sample used by this research has a great potential to investigate.

This study further aims to provide an insight of overview of energy policies of Asian economies. However, it is noteworthy that there has been a limited effort to offer a comprehensive analysis of energy policies, specifically in terms of incorporating liquefied natural gas (LNG) as a conventional energy source alongside crude oil. As such, this study serves as a trailblazer in providing a precise overview of energy policies within Asian economies, shedding light on the significance of considering both LNG and oil within the broader energy framework.

2. METHODOLOGY AND DATA

The dataset of all chapters/essays is meticulously analyzed for thirteen Asian economies, namely India, Thailand, China, Nepal, Bangladesh, Singapore, Korea, Sri Lanka, Philippines, Japan, Malaysia, Pakistan, and Indonesia. The first essay supplements SVAR with three additional panel data approaches: the Fixed Effects (FE) model, the System Generalized Method of Moments (System GMM) estimator, and the Instrumental Variables (IV) method.

This essay employs the Structural Vector Autoregression model to analyse the data that spans a fifty year timeframe from 1973-2023. The SVAR analytical framework serves as a robust foundation for examining the complex dynamics between fuel prices and renewable energy within various Asian economies. The Fixed Effects model is employed to estimate the baseline static relationship between energy price variables (Oil Price and Fuel Price) and RE adoption, while controlling for time-invariant country-specific characteristics using interest rate, inflation, GDP, and exchange rate. Given the potential for endogeneity, autocorrelation, and dynamic feedback, the System GMM model is applied to evaluate the effects of energy prices on RE investment.

Second essay analyzes the effect of fuel price and exchange rate shocks on the current account of selected Asian economies, considering the potential for both symmetric and asymmetric relationships. The non-linear auto-regressive distributed lag model (NARDL) developed by Shin *et al.,* (2014) is deemed a suitable methodology for this analysis. To strengthen the reliability of our econometric findings, we conducted a robustness test using the -Regime Switching model. This model enables us to investigate whether distinct volatility regimes exist in fuel prices and exchange rates, and whether these patterns have varying effects on current account balances. The analysis utilizes monthly data from January 2010 to December 2022, resulting in a total of 156 observations for each country. Further GMM is employed for robustness of results.

The analysis of the third essay encompasses quarterly data spanning from 2009 to 2023, a chosen timeframe owing to constraints in accessing house price data in Asian countries and to circumvent the impact of the structural break associated with the 2007-2008 financial crisis. An additional panel has been constructed within this timeframe, with a specific focus on South Asian economies, i.e., Sri Lanka, Bangladesh, India and Nepal. Despite the limited sample size, these countries collectively represent over 88% of the South Asia region. Moreover, the sample countries are further categorized based on their regional classifications, distinguishing between the broader category of Asian economies and the subset of South Asian economies. A SVAR technique is employed for estimating the magnitude and significance of the impact of monetary policy shocks on housing prices and stock prices.

3. ORGANIZATION OF THESIS

This study consists of three essays. The first essay contains of introduction, motivation, research objectives, methodology, theoretical framework and results and conclusion of chapter titled "Analyzing the interplay between Fuel prices and the adoption of renewable energy in Asian Markets". The second essay is devoted to the introduction, motivation, research objectives, methodology, theoretical framework and results and conclusion of "The impact of exchange rate and fuel price on current account balances: a nonlinear perspective in Asian Economies". Whereas the third essay enlightens the thorough investigation of monetary policy transmissions and asset prices. Last but not least, the final chapter comprise of consolidated conclusion of the study.

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ESSAY 1

ANALYZING THE INTERPLAY BETWEEN FUEL PRICES AND THE ADOPTION OF RENEWABLE ENERGY IN ASIAN MARKETS

1. INTRODUCTION

1.1 Background

The first essay investigates the impact of fuel price fluctuations, specifically crude oil and liquefied natural gas (LNG), on renewable energy adoption in Asian economies. While prior studies have mainly focused on oil prices, this essay uniquely incorporates LNG, reflecting the region's evolving energy mix and addressing a significant gap in understanding how fossil fuel price volatility affects clean energy transitions. The study explores whether renewable energy adoption is primarily market-driven or shaped by government policies.

Methodologically, the essay employs a multi-model econometric strategy, including Structural Vector Autoregression (SVAR), Fixed Effects, System GMM, and Instrumental Variables, to capture both short- and long-run dynamics and address potential endogeneity. This allows for a detailed analysis of the direct and indirect effects of oil and LNG price shocks on renewable energy consumption, while accounting for macroeconomic stability, institutional quality, and currency fluctuations.

The findings contribute to energy economics and policy by clarifying how fossil fuel price changes influence renewable energy transitions in Asian economies. They provide insights for policymakers on leveraging market and policy mechanisms to promote sustainable energy adoption, highlighting LNG's role as a transitional fuel and informing strategies to balance energy security with long-term renewable energy targets.

While energy is a critical driver of sustainable development, long-term economic growth depends on maintaining equilibrium between energy demand and supply. If demand consistently outpaces supply, it can lead to shortages, higher costs, and vulnerability to external shocks; conversely, an oversupply without efficient utilization may result in wasted resources and inefficiencies. Thus, achieving a balanced adjustment between energy demand and supply is a fundamental condition for sustaining economic growth. Indeed, the conventional fossil fuel sources- including coal, crude oil, and natural gas- held a paramount importance within an economy in terms of providing heat and electricity, facilitating transportation, supporting various production processes and likewise (Zhong et al., 2020). However, the energy mix has shown an increasing share of natural gas while witnessing a gradual decline in share of coal (British Petroleum-BP, 2023; Energy Information Administration, 2022).

The volatility of global fuel markets, particularly oil and liquefied natural gas (LNG), has profound implications for energy-dependent economies. For Asian economies, where import dependence on fossil fuels remains high, oil price shocks not only disrupt macroeconomic stability but also create persistent external sector vulnerabilities. Previous studies have shown that oil price fluctuations directly influence inflation, fiscal balances, and trade dynamics (Hamilton, 2009; Kilian, 2014). However, while the literature is extensive on oil prices and growth, far less attention has been given to how these shocks transmit to the current account balance or incentivize shifts toward renewable energy adoption.

Building on this macroeconomic perspective, a central channel through which oil price shocks affect economies is the current account balance. Since many Asian economies are net oil importers, rising oil prices typically deteriorate trade balances and increase the likelihood of sustained current account deficits (Narayan & Narayan, 2010). Conversely, price declines may offer temporary relief but often create instability in fiscal and monetary planning. The literature also highlights the asymmetric nature of these effects, with oil price hikes exerting stronger and more persistent impacts than price declines (Kilian & Vigfusson, 2011). Despite this, relatively few studies systematically explore these dynamics in the Asian context, where exchange rate regimes, import dependence, and structural competitiveness vary widely.

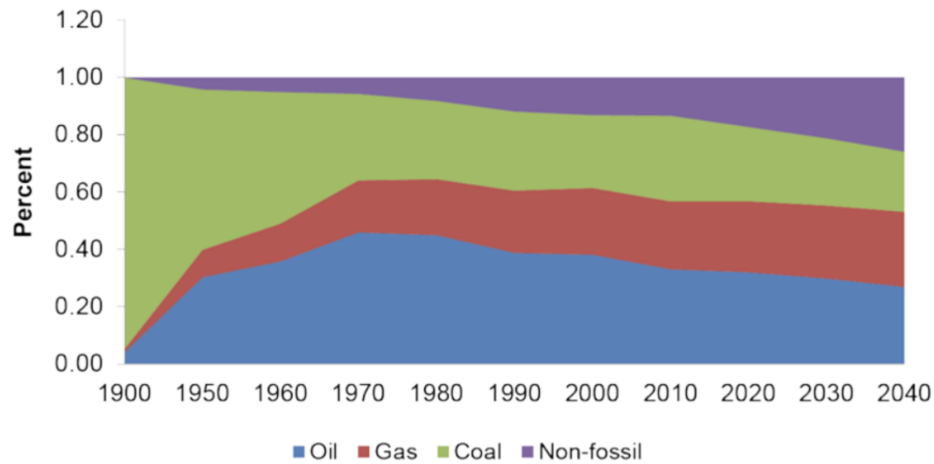


Figure 1.1: Share of Primary Energy Sources (1990-2040 %)
Source: Authors compilation from BP energy Outlook 2022

Since the increase in demand of energy and energy sources is accredited to the growth and development of an economy, hence the Table 1.1 illustrates the energy consumption of Asian economies including fossil fuels and renewable energy (BP, 2022).

Table 1.1: Primary Energy consumption by fuel in Asia and Pacific (energy unit: Exajoules)

2020							2021						
Oil	LNG	coal	Nuclear energy	Hydroelectricity	RE	Total	Oil	LNG	coal	Nuclear energy	Hydroelectricity	RE	Total
67.5	31.2	120.7	5.9	17.2	13.6	256.6	70.7	33.1	127.6	6.46	17.4	17.4	272.5

Source: Authors compilation from BP Statistical Review of World energy 2022

Table 1.2: Primary Energy consumption per year (energy unit: Exajoules)

Region	Primary Energy Consumption (Exajoules)											Growth per year		
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2011	2012	2021
Asia Pacific	207	214	220	226	230	235	243	252.7	259.5	256	272.5	6.4%	2.8%	45.8%
Total world	520	528	537	543	548	555	566	582.4	587.4	564	595.1	5.8%	1.3%	100%

Source: Authors compilation from BP Statistical Review of World Energy 2022

Here, the primary energy consists of fossil fuel as well as renewable energy. From the Table 1.2, it is evident that Asia and Pacific have been one of the major markets for energy in 2021 taking in 45.8% of the global energy supply. The energy demand is topmost in China which is 26.5% of total energy consumption around the globe followed by India which is 6.0% and Japan 3%, the energy demand of Pakistan, however, makes the 0.6% of global energy demand (BP Statistical Review of World energy 2022).

In addition to oil, LNG has emerged as a significant component of the energy mix in Asia, often regarded as a transitional fuel in the shift toward cleaner energy systems. Yet, unlike oil, LNG has received little attention in the literature as a determinant of current account imbalances or renewable energy transitions. The increasing reliance on LNG imports in countries such as Japan, South Korea, and India suggests that its price volatility can no longer be ignored in empirical analyses. The limited research on LNG creates a crucial gap that this thesis addresses by explicitly incorporating it alongside oil in examining external balance dynamics and renewable adoption.

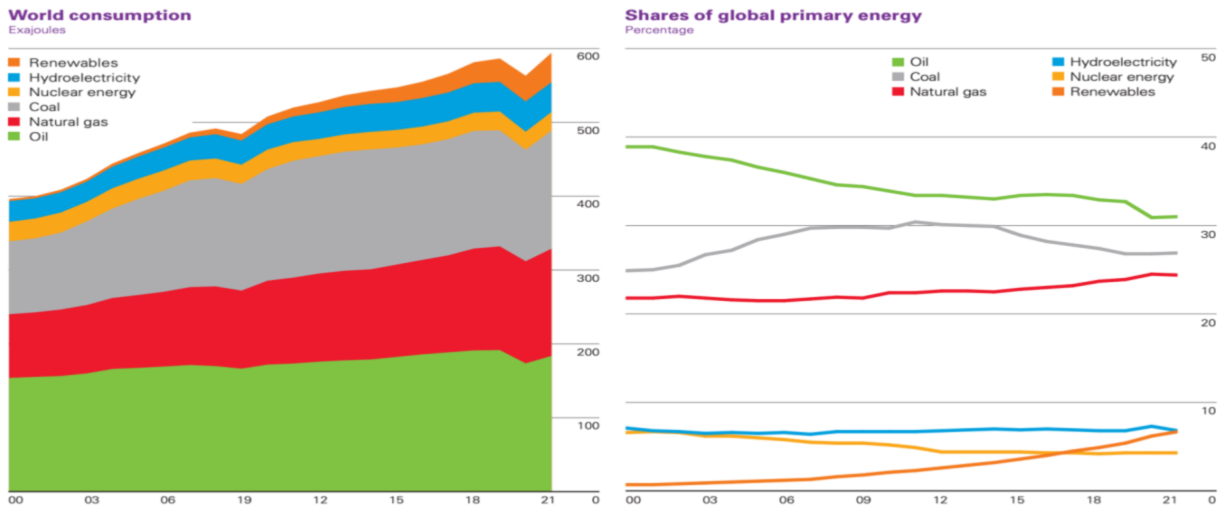


Figure 1.2: Global consumption of energy (fossil fuel + renewable energy)

The Figure 1.2 shows the global consumption of energy which shows the major portion of energy consumption is still crude oil. However, renewable energy share is small but it has been increasing since the Asian economies strive to be self-sufficient in energy demand as the dependence on energy has been largely replicated by energy insecurity in literature i.e., energy security can be judged by availability, and reliability of energy sources at affordable cost (Bielecki 2002). By taking into account thirteen Asian economies (Pakistan, India, Japan, Korea, Sri Lanka, Bangladesh, China, Nepal, Thailand, Singapore, Indonesia, Philippine, and Malaysia) we analyzed the transition of Asian economies from traditional energy sources to the renewables.

The dynamics of fossil fuel prices also have direct implications for the pace and direction of renewable energy adoption. Several studies argue that higher oil prices can make renewables more competitive, stimulating investment in solar, wind, and other alternatives (Sadorsky, 2009; Murshed, 2020). However, when oil and LNG prices remain low, the relative cost advantage of renewables diminishes, slowing the transition. This suggests an asymmetric relationship, where fuel price volatility creates both risks and opportunities for renewable energy integration. Yet, most of the existing literature has focused on oil alone, neglecting the combined role of LNG in shaping renewable energy trajectories in Asia.

Hence, against this background this study attempted to probe into the transition of economies from old energy sources to RE across Asian economies over the time. The reason behind the selection of Asian economies for this study are two dimensional. It is sensible to choose the sample where the countries share a similar pattern and second, they can be split in terms of income group or current account balances. these economies have traditionally been vastly dependent on fossil fuel for meeting their energy needs. Although current literature has explored the relationship amid oil price and RE but none of the study have taken into account the fuel price (oil price as well as LNG price) in the context of sample economies.

The global transition toward renewable energy (RE) has become a cornerstone of contemporary energy and climate policy, particularly as concerns over fossil fuel volatility, energy security, and carbon emissions intensify. Oil and gas prices—especially those of liquefied natural gas (LNG)—play a pivotal role in shaping national energy investment decisions, as they directly affect the economic competitiveness and perceived reliability of renewable alternatives. Understanding the relationship between traditional energy prices and the adoption of renewable energy sources is therefore essential to formulating effective and forward-looking energy strategies.

The adoption of renewable energy (RE) varies widely across Asian economies, which has direct implications for how fuel price shocks shape their energy transitions. China dominates the regional landscape, with over 1.4 terawatts of installed renewable capacity by 2024, nearly half of its total power generation capacity, driven primarily by solar and wind. India follows as another leader, having achieved 209 GW of RE capacity, with solar alone contributing 24.5 GW in 2024 (National Bureau of Statistics of China, 2025). In contrast, countries in South Asia such as Pakistan, Bangladesh, and Sri Lanka remain in the early stages of transition, with renewables comprising less than 10% of the energy mix (Ember, 2024). Similarly, advanced economies like South Korea and Japan continue to depend heavily on fossil fuels, with South Korea's renewable share at only ~9% as of 2023 (Energy Tracker Asia, 2023). These disparities highlight that while some countries are already experiencing substantial substitution effects between fossil fuels and renewables, others remain highly vulnerable to external fuel price shocks due to their limited adoption of clean energy alternatives.

Despite substantial work on global energy markets, there remains a limited understanding of how oil and LNG price dynamics influence renewable energy development, especially in emerging and developing Asian economies. Theoretically, this study draws on substitution and investment theories, which posit that fluctuations in fossil fuel prices can either incentivize or deter investment in alternative energy. According to the substitution effect, higher oil prices can make renewables more competitive, accelerating their deployment. However, the income effect—particularly in energy-importing economies—may lead to reduced fiscal space for renewable energy subsidies and infrastructure when fossil fuel prices rise. These competing dynamics are yet to be fully explored in the context of Asia.

Asia, as a region, presents a unique and critical case for studying this relationship. The continent accounts for a significant share of global energy demand and is home to both some of the world's largest energy consumers (e.g., China, India, Japan) and most vulnerable fossil fuel importers (e.g., Pakistan, Bangladesh, the Philippines). Moreover, many Asian countries are simultaneously pursuing aggressive renewable energy targets while facing structural dependence on oil and gas imports. This duality makes Asia a fertile ground for assessing how international price volatility affects domestic energy transitions.

Existing literature has often treated oil prices and LNG separately or focused predominantly on OECD economies. Very few studies have jointly assessed the combined impact of oil and LNG prices (as a composite fuel price measure) on renewable energy adoption. Moreover, the literature tends to overlook the asymmetric or nonlinear responses of renewable energy investment to fossil fuel price shocks, especially in policy-constrained, developing Asian economies.

Although, oil and LNG are distinct markets, serving different sectors and with potentially divergent effects on renewable energy adoption. However, in many Asian economies, oil and LNG jointly constitute the primary fossil fuel basket influencing energy costs, investment incentives, and policy decisions. Combining them as a composite fuel price measure does not imply perfect alignment of their individual effects but rather captures the overall fossil fuel price environment to which renewable energy investments respond. This approach allows us to account for situations where, for instance, high oil prices incentivize renewable energy adoption in transport (e.g., electric vehicles), while low LNG prices might reduce the cost advantage for power generation from renewables. By modeling them jointly, we can capture the net effect of fossil fuel price volatility on renewable energy adoption, including the possibility of asymmetric and offsetting influences. Methodologically, the use of Structural Vector Autoregression (SVAR) and panel econometric models further allows the separation of direct and indirect effects of each fuel type, thus mitigating concerns about analytical bias from treating them jointly. In short, the composite measure provides a holistic indicator of the fossil fuel price environment, which is particularly relevant for economies heavily dependent on both oil and LNG.

This study addresses this critical gap by analyzing the dynamic and potentially nonlinear effects of oil price (OP) and fuel price (FP = oil + LNG) on renewable energy adoption across a panel of Asian economies. By employing advanced econometric techniques, including SVAR and System GMM, the research aims to disentangle short- and long-run causal relationships and offer policy-relevant insights. In doing so, it contributes to a more nuanced understanding of how fossil fuel price volatility interacts with the renewable energy transition in one of the world's most energy-dependent and demographically dynamic regions.

1.2 Problem Statement

The problem addressed in this study is the lack of empirical research on the impact of fuel price fluctuations, particularly crude oil and liquified natural gas (LNG), on the transition to renewable energy in Asian economies. While there is existing literature on the relationship between oil prices and RE, the analysis of how LNG prices and the combined effect of both oil and LNG prices influence the adoption of RE sources has not been adequately explored specifically for Asian economies. This study seeks to address gap by examining the impact of fuel price shocks on the ability of Asian economies to embrace renewable energy and determine whether this transition is primarily driven by market forces or influenced by government policies. The outcomes of this study will enhance our understanding of the factors affecting the adoption of renewable energy sources and inform the development of relevant policies in Asian economies.

The adoption of renewable energy (RE) in Asian economies is highly sensitive to fluctuations in fossil fuel prices, yet the mechanisms through which these price changes influence investment and transition decisions remain inadequately understood. While prior studies have examined the effect of crude oil prices on RE adoption, they largely overlook liquefied natural gas (LNG) and the combined dynamics of oil and LNG prices as determinants of renewable energy uptake. This omission is significant because oil and LNG serve different sectors—oil mainly drives transport and industrial energy costs, whereas LNG primarily influences power generation—and their price movements can create conflicting incentives for RE investment. For example, high oil prices may stimulate adoption of electric vehicles, while low LNG prices could reduce the relative competitiveness of renewable electricity. Therefore, understanding the joint and asymmetric effects of oil and LNG price shocks is crucial to accurately evaluate how market signals and policy interventions shape renewable energy adoption. This study analytically examines these interactions using econometric models to isolate the direct and indirect effects of fossil fuel price volatility, providing actionable insights for policymakers to design effective strategies that accelerate the energy transition in diverse Asian economies.

1.3 Objectives of the Study

In the light of aforesaid concerns research gaps, these key objectives of the present study are:

- Examine how fluctuations in global oil and LNG prices affect investment and consumption of renewable energy, considering that these fuels serve different sectors and create distinct incentives.
- Determine whether increases and decreases in oil or LNG prices have unequal or opposing impacts on renewable energy uptake, reflecting real-world non-linearities in energy markets.
- Examine whether reliance on imported oil constrains or shapes the pace and scale of renewable energy adoption in Asian economies, considering both market incentives and policy interventions.

1.4 Contribution and Significance of the Study

This essay is an attempt to analyse the nexus between fuel price (oil and LNG) fluctuations and demand for renewable energy in Asian economies that majorly rely on oil imports beside probing into the contributors of transition from conventional source to energy renewables. In this study, renewable energy (RE) is defined as energy derived from naturally replenishing sources, including solar, wind, hydro, biomass, and geothermal power, which are capable of providing sustainable electricity and heat with minimal environmental impact. This definition is important because the responsiveness of RE adoption to oil and LNG price fluctuations may vary across different forms; for example, capital-intensive sources like solar and wind may be more sensitive to policy incentives and investment costs, while hydro or biomass may be influenced more by local resource availability. By clearly specifying the types of renewable energy considered, the analysis ensures that the estimated effects of fuel price shocks accurately reflect the dynamics of energy transition in Asian economies. Renewable energy adoption refers to the extent to which Asian economies integrate and utilize renewable energy sources into their energy mix, capturing both the capacity and consumption of these sustainable energy technologies.

The pathway of impacting oil price shocks on the ability of economies to clasp and embrace renewable energy sources has been inadequately untouched in empirical history. There is an adequate literature on oil price and renewables but analysis of impact of oil price along with other conventional energy sources (i.e., LNG) on renewable energy transition has remain untouched in literature, especially for Asian economies. The analysis of this research is expected to react in a different way to the shocks of fuel price in the context of RE, and help in formulating the related policies in order to determine whether the RE transition is predominantly market determined, i.e., renewables and fuel price move in the same direction, or it is influenced by the government policies which promote the energy generation from RE sources.

Furthermore, this study is dedicated to the analysis of impact of real LNG on renewable energy while stressing the asymmetric role of LNG and crude oil price. This is a pioneer attempt to explore the nexus between energy mix of oil and gas for Asian economies by using SVAR which is itself a contribution in empirical literature.

Conclusively the contribution of this research lies in a meticulous exploration into the relationship of fuel price -crude oil as well as real liquefied natural gas (LNG) prices- on renewable energy within the context of Asian economies. Unlike previous analyses that predominantly focused on discerning the effect of oil prices on RE our endeavour uniquely incorporates the crucial aspect of LNG, a pivotal source of energy. This distinction is paramount, as overlooking or neglecting such a fundamental energy source impedes a comprehensive understanding of how shifts in energy prices influence the adoption of renewable alternatives. This research has the potential to benefit economic modelling as well as policymaking. By examining the effects of both oil prices and LNG on renewable energy adoption in Asian economies, we aim to offer the policy makers with a more extensive knowledge of the factors influencing energy transitions. This could lead to more informed policy decisions and strategies for promoting renewable energy in the region.

This essay makes several important contributions to the literature on energy economics and policy, particularly within the context of Asia's evolving energy landscape. While existing studies have primarily focused on the relationship between oil prices and renewable energy adoption, this study broadens the scope by incorporating both oil and LNG prices as core explanatory variables. This dual focus reflects the unique energy mix of Asian economies, where LNG is increasingly positioned as a transitional fuel. By analyzing their joint and separate effects on renewable energy consumption, the study addresses a significant empirical gap in understanding how fossil fuel price volatility influences clean energy transitions in emerging markets.

Methodologically, this research contributes to the field by integrating a multi-model econometric strategy that includes SVAR, Fixed Effects, System GMM, and Instrumental Variable estimation. This approach allows for a comprehensive exploration of both short- and long-run dynamics, accounts for potential endogeneity, and captures the direct and indirect effects of fossil fuel prices. These models also control for institutional quality, macroeconomic stability, and currency fluctuations - factors often overlooked in similar studies but shown here to significantly mediate the relationship between energy prices and renewable energy consumption.

Finally, this research contributes to the ongoing policy debate about the viability of LNG as a transitional fuel in light of renewable energy targets. It shows how price shocks in both oil and LNG markets can either hinder or catalyze clean energy investment, depending on the policy environment and macroeconomic conditions. This insight is particularly valuable for policymakers seeking to balance short-term energy security with long-term sustainability goals.

2. LITERATURE REVIEW

2.1 Review of Literature

Apparently, the energy is the one of the decisive elements of any economy which shapes the economic growth. The energy mix of any country contains oil, fossil fuel, natural gas, and renewables However, in Asian economies, the primary reliance for meeting domestic energy needs lies in two key sources: crude oil and liquefied natural gas (LNG). Extensive research conducted by Adebayo et al. (2021a), Kartal (2022), Kılıç et al. (2022), Li et al. (2020), and Shen et al. (2020) highlights the bidirectional nexus between energy consumption and its prices. With increasing global concerns over environmental sustainability, as highlighted by Sahu et al. (2020) and Murshed et al. (2021), and the growing dependence on imported oil, nations are gradually shifting their focus towards renewable energy sources (Kartal, 2022).

Nonetheless, this research unequivocally explores the correlation between fuel price and renewable energy consumption in two dimensions. Firstly, it analyzes the impact, delving into the mechanism of transition of conventional energy to alternative and sustainable sources of energy. Secondly, the impact of fuel price on the RE adoption in Asian economies (Deligiannakis, 2018; Mseddi, 2016). Since the fuel price is one of the drivers of economy's growth, exerting demand induced inflationary pressure on energy prices, the fluctuation of oil prices in global economy (Yasmeen et al., 2019) and scarcity of primary energy sources (Shakeel et al., 2016). The enhancing capacity of RE consumption in the economy can be beneficial in number of ways e.g., if the renewable energy technologies are integrated in the global energy policies it would complement the energy security strategies worldwide (Valentine, 2011). This incorporation of renewable energy into world's energy mix would alleviate the fossil fuel dependence pressure and convalesce the domestic supply of energy (Jiang, 2008). Renewable energy not only regain the energy security of an economy by surpassing the oil import dependency but also downgrade the vulnerability of economies against oil price shocks (Rentschler, 2013). Consistency of the oil prices (Shen et al. 2010), beside improving the efficiency of energy (Murshed, 2020), increase the availability rate of energy supply (Oseni, 2012), expediate off-grid electrification with renewable energy sources (Sen et al., 2014), as well as increase the employability at the domestic level (Sari et al., 2008; Llera et al., 2013).

Besides oil the liquified natural gas is another important gear of energy. There is an enormous number of research which shows the direct and significant relationship between natural gas and macroeconomic variables e.g. GDP and economic growth (Das et al., 2013). Bangladesh is one of those countries where the economic growth has been casually influenced by natural gas from year 1980 to year 2010 and this positive yet forward-facing causality directing from the economic growth to the usage of natural gas. Besides the correlation between natural gas and macro-economic variables, there are amount of researches in the literature which support the cointegration of oil price and LNG. For instance, Villar and Joutz (2006) are one of the pioneers to highlight the apparent decoupling of crude oil of west Texans US and LNG of Henry Hub. Their research illustrated a positive and significant correlation among the prices of oil and natural gas, which exhibit an emerging and developing long term relation between the two.

There is a negligible literature found in empirical history for the gas and oil relationship with renewable energy for Asian economies. Hence, this study aims to analyze the oil and gas impact in the context of Asian economies. It is the common phenomena in energy market that the higher the prices of crude oil and LNG, the higher would be the dependency of economy on imports (Elder et al., 2010, Ali et al., 2018). Economies which are net oil importer are greatly impacted by the rise of fuel prices as compared to the economies which export the oil, hence gets the benefit of elevated fuel prices (William 2013, Aydin et al., 2011, Al Maamary et al 2009). The trivial changes and variations in fuel price are explainable when it comes to the typical market structures and fundamentals, unlike environmental variable (Omri, 2014). This notion is further elaborated by Hartley (2008) and his contemporary fellows who analyzed these empirical findings for the US economy. They used vector error correction model like the previous researchers to gain insight on the variation of relationship between both variables from 1990-2006 and observed a steady relation by taking into account the technical changes. However, this relationship turned out to be unstable by the latest analysis of Ramberg et al., (2012) who also used error correction method once again to incorporate the short-term modification in both variables by taking the factors alike to Brown and Yücel (2008). Specifically, they observed that prices of oil and natural gas are interlinked, and any movement would lead to the large confidence interval. Moreover, this unusual yet crucial relationship was measured with the help of error correction model for estimation of weekly prices of oil and LNG and came out with the results that a steady relationship exists only for long run and it failed to survive in short period of time of sample i.e. 1997 -2006. However, the short-term variations are explicable under basic market fundamentals. Since, crude oil and LNG are the most crucial sources of energy in any economy. Hence this study attempted to analyze the importance of energy mix of Asian economies sector and how they influence the consumption of renewable energy.

While the preceding literature outlines the role of fossil fuel prices in shaping economic dynamics, a more structured synthesis is needed to critically evaluate how oil and liquefied natural gas (LNG) prices interact with the adoption of renewable energy (RE), especially within Asian economies. Much of the earlier literature either examines energy price impacts on macroeconomic indicators like GDP, inflation, or industrial productivity (Das et al., 2013; Aydin et al., 2011), or isolates renewable energy determinants such as technological progress, foreign direct investment, or environmental policy stringency (Murshed et al., 2021; Sahu et al., 2020). However, the fuel–renewables interplay remains underexplored, particularly in the context of LNG, which has become an increasingly important component of the global energy mix.

Empirical studies such as Villar and Joutz (2006) and Ramberg et al. (2012) established long-run cointegration between oil and LNG prices, emphasizing how their comovement affects global energy market volatility. Similarly, Brown and Yücel (2008) showed that oil and gas prices tend to move together due to fuel substitution in power generation and heating, but these analyses rarely consider the downstream effect on RE investment. Notably, Omri (2014) and Rentschler (2013) focus on how oil price volatility can trigger energy diversification, yet they do not examine LNG's moderating or reinforcing role in that relationship.

In addition, Al Mamary et al. (2009) and Ali et al. (2018) demonstrate how price shocks in energy-importing countries exacerbate current account imbalances and fiscal burdens, which can either delay or force a shift toward alternative energy strategies. These macroeconomic constraints have direct implications for RE deployment, especially in Asian economies where public subsidies and foreign capital play vital roles in financing renewable infrastructure (Kartal, 2022; Li et al., 2020).

Despite increasing attention to renewable energy investment in Asia, the literature is fragmented. For example, Deligiannakis (2018) investigates the impact of oil prices on renewable energy policy but offers no insight into LNG dynamics. Meanwhile, Mseddi (2016) considers fuel prices in RE transitions, but only in North African contexts. These gaps are particularly evident in studies involving Asian countries that are both major energy consumers and high RE growth markets, such as India, China, and Southeast Asian nations.

Moreover, while a few studies employ panel cointegration or causality tests (e.g., Sari et al., 2008; Yasmeen et al., 2019), there is limited use of dynamic or nonlinear modeling techniques to capture asymmetric effects of price fluctuations on RE deployment. The NARDL model, for instance, remains underutilized in this context, despite its ability to differentiate between the impact of rising and falling fuel prices over short and long horizons. Likewise, dynamic panel data models such as System GMM are rarely applied in this area, though they are well-suited to control for endogeneity and unobserved heterogeneity - key concerns when analysing macroeconomic determinants of renewable energy adoption.

By addressing these gaps, the study advances the literature on energy economics and environmental policy and provides a robust framework for evaluating how traditional energy price dynamics influence the pace and direction of renewable energy transitions in one of the world's most energy-sensitive regions.

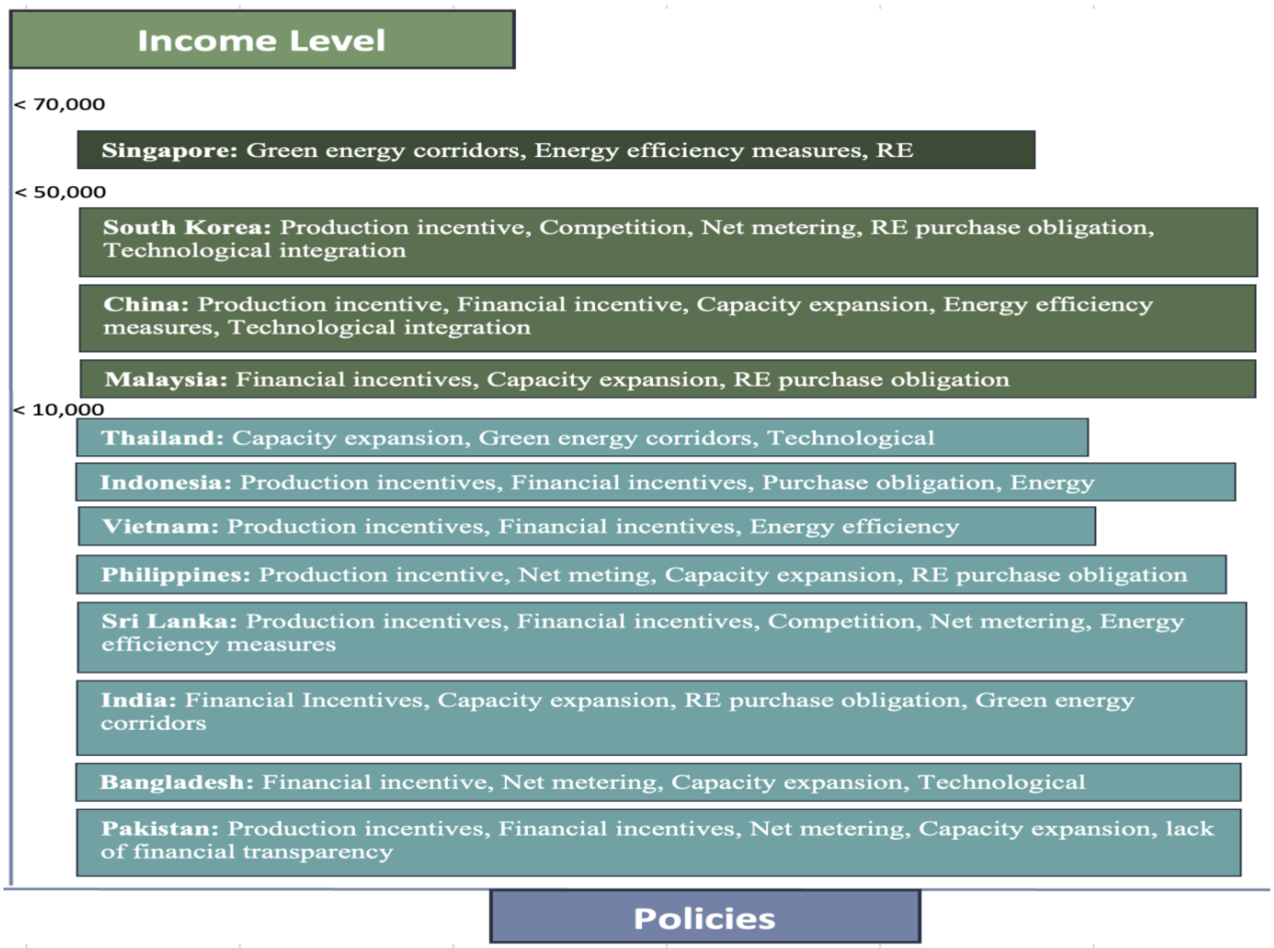
2.2. Policy Overview of RE in Asian Economies

This section aims to compare the policies enforced by selected countries Asia to boost their renewable energy production capacity. This policy comparison is imperative to highlight the policies being adopted and which of them have been more successful in terms of providing energy efficiency and increased proportion of renewable energy percentage in total energy mix. The main policies executed across the countries are to provide RE production incentives, financial incentives in terms of tax relaxation, increased competition in the energy market supply, allowing RE producers to sell energy to national grids, capacity expansion, RE purchase obligations, green energy initiatives, measures taken to improve energy efficiency, technological integration through smart grids, and RE imports.

Along with evaluating the renewable energy policies, we also brought up the leading challenges being faced by the countries (as shown in the figure below). The leading challenges faced by the countries are to incorporate advanced technology in the system, high investment requirements, lack of incentives and no clear incentive structure, need of improved infrastructure, vulnerability in RE production, high of production, transition from fossil fuel due to high opportunity cost, lack of financial transparency, high energy demand, and limited RE resources available with the countries.

2.2.1. An Overview of RE Policies Comparison

The RE policies and challenges being faced by the countries are categorized in terms of income level across the countries (figure below). The figure shows that the nature of policies and the challenges differ across the countries based on their income level and other geographical dynamics.



[Source: Author's Own]

Figure 1.3: Policies implemented to boost RE across income groups.

Sri Lanka, India, Malaysia, and Indonesia have implemented a range of policies to enhance renewable energy production. Sri Lanka focuses on feed-in tariffs, financial incentives, competitive auctions, and net metering. India's approach includes subsidies, tax exemptions, a significant renewable capacity expansion, and green energy corridors. Malaysia aims for a mix of natural gas and renewables by 2040, with increased public investment and a focus on energy supply. Indonesia's strategy involves subsidy reallocation, moratoriums on new coal-fired power plants, and incentives for renewable energy and energy efficiency measures.

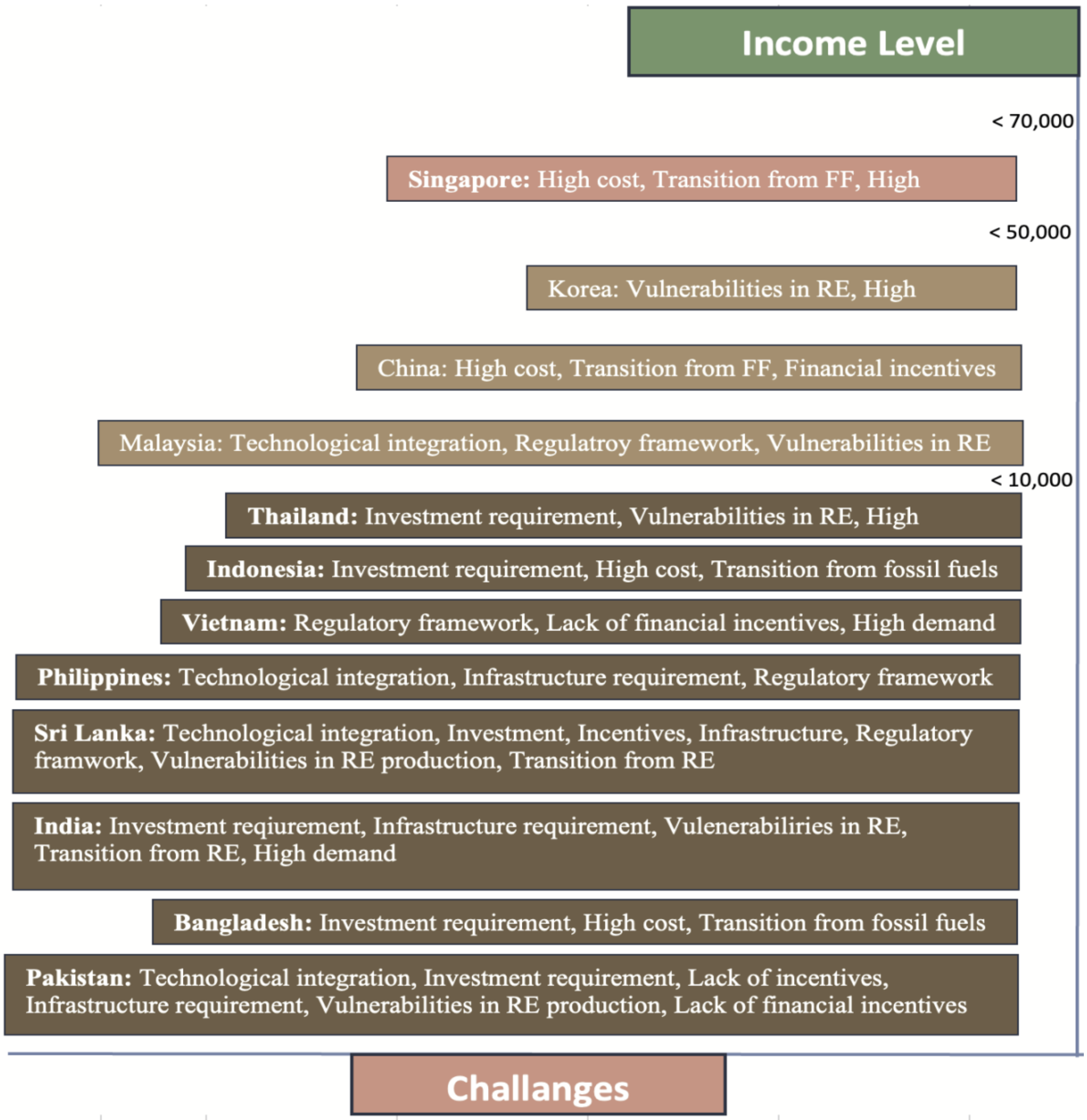
Vietnam, Bangladesh, China, Japan, and South Korea have also adopted various renewable energy policies. Vietnam is updating its incentive structures and implementing tax reductions, while

Bangladesh is integrating technology and offering tax and duty exemptions. China is transitioning to a service-based economy, emphasizing renewable capacity expansion and feed-in tariffs. Japan focuses on reducing reliance on imports and improving energy efficiency, while South Korea is committed to increasing its renewable energy share and addressing regulatory hurdles.

The Philippines, Singapore, Thailand, and Pakistan have their own unique policies. The Philippines established a feed-in tariff system and net metering program. Singapore is importing renewable energy and supporting R&D, while Thailand focuses on green financing and increasing power generation from renewables. Pakistan's policies include an alternative energy development board, renewable energy purchase obligation, and net metering regulations.

2.2.2. Challenges

In terms of challenges, countries like Sri Lanka, Malaysia, Indonesia, and Vietnam face issues such their struggle with balancing clean energy access, transitioning from coal, and uncertainty in incentive policies. Japan, South Korea, and Thailand confront challenges like limited local renewable resources, grid integration, and increased energy demand.



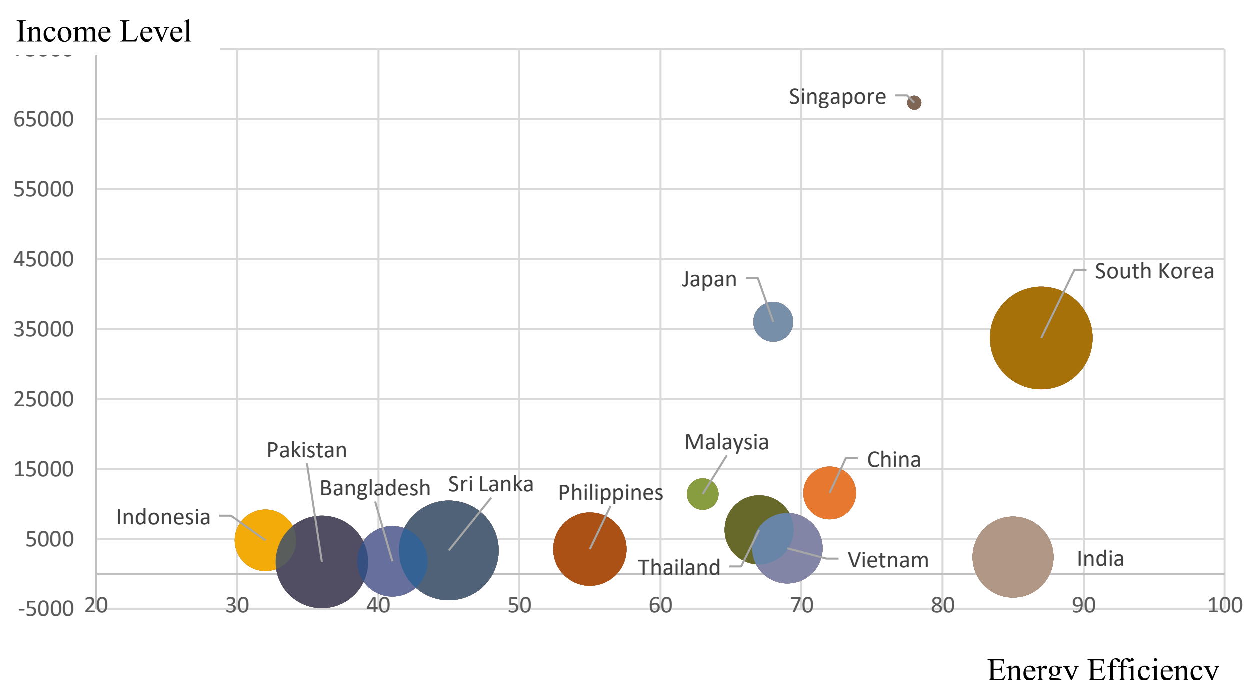
[Source: Author's Own]

***Figure 1.4**:* Challenges faced in adopt RE across income groups.

The Philippines and Pakistan deal with land-use and permitting issues, technology and infrastructure development, and grid stability. Singapore's challenges revolve around limited renewable resources and storage issues. Overall, these countries face a mix of investment requirements, technical challenges, regulatory and institutional capacity gaps, and the need to transition from fossil fuel dependency while balancing energy security and environmental sustainability.

2.2.3. Renewable Energy Adoption

Next, an effort is made to bring up the comparison of renewable energy adoption across the Asian economies. This purpose is served while exploring the association between income level of countries and their energy efficiency in terms of renewable energy adoption. Here the income level is measured in terms of GDP per capita for the country, energy efficiency is an index value out of 100 based on the indicators: energy efficiency planning, entities dedicated to energy efficiency, industrial and commercial based incentives, public sector incentives, energy utility planning, financial mechanism to boost energy efficiency, energy efficiency standards, and energy labelling systems. The RE adoption is the renewable energy percentage of total energy consumption in the country. All these measures are helpful in tracking the Sustainable Development Goal 7 i.e., affordable, and clean energy.



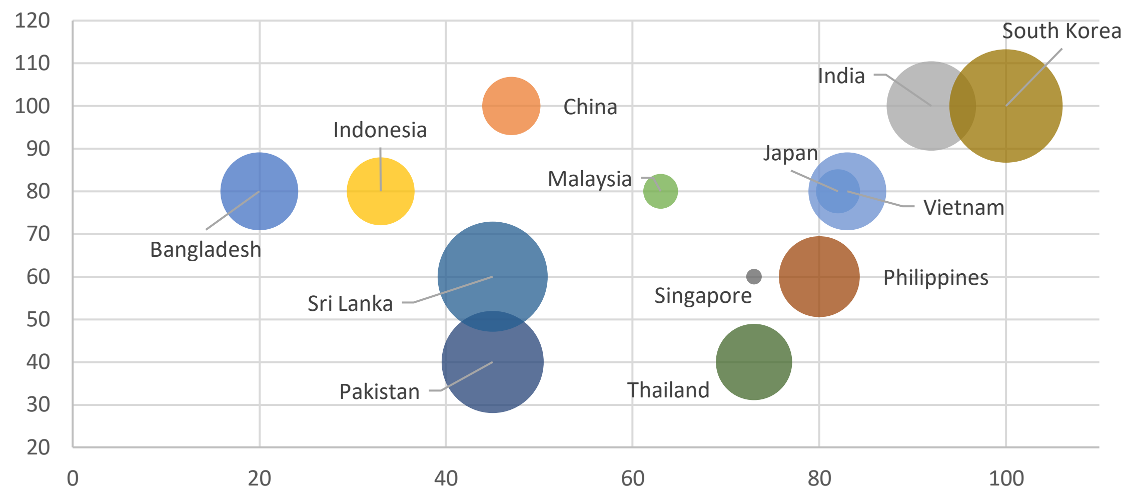
[Source: Author's Own]

Figure 1.5: RE adoption and energy efficiency across income level

The analysis is done in the figure below for all the selected countries. Where the income level is shown on vertical and energy efficiency is represented on the horizontal axis. The size of each country shows the RE as percentage of total energy consumption i.e., higher the size of bubble for the country higher is the RE adoption. South Korea has the highest RE adoption and Bangladesh and Pakistan follows it. The figure shows that the higher income countries like Singapore, South Korea, China, and Malaysia has higher energy efficiency as compared to lower income countries. Relatively lower income countries have very low energy efficiency i.e., Indonesia, Pakistan, Bangladesh, and Sri Lanka. These countries have efficiency even less than 50 percent. For most of the countries, higher the income level higher is the energy efficiency and more proportion of RE in this energy mix. However, there are some exceptions there. For instance, India has been able to achieve very high energy efficiency (85 percent) even with lower income level (GDP of 2389 thousand USD per capita). It is because of the policy reform adopted to increase the energy efficiency while embracing more RE resources.

Even deeper analysis is caried out to highlight the countries that outperform the higher income countries in terms of RE adoption even with lower resources. In addition to availability and access to exploit renewable resources, it is imperative for the countries to be capable of leveraging such opportunities through helpful legal framework and attractive financial incentives. For this reason, a comparison is made between the countries for legal framework adopted and the financial incentives provided to adopt more renewables. The figure below shows the association of RE adoption with respect to legal framework and financial incentives provided by the country to increase renewable capacity.

Mostly the developed countries have provided more friendly legal environment and financial incentives to support RE adoption. It is the reason that some countries even with low GDP per capita have been able to achieve high RE adoption by implying concrete legal framework and by ensuring attractive financial incentives. India and Vietnam are good example of it.



[Source: Author's Own]

Figure 1.6*:* Legal and financial attributes in RE adoption

For other countries, RE adoption has been an issue either due to the legal and financial framework or because of their low income to support the sector. Main sources of these low-income countries like Pakistan and Sri Lanka having high RE adoption is because of inclusion of non-combustible hydropower energy. If we only rely on the modern RE resources, then even these countries remain with very low share of renewable energy in the total energy consumption. The recent change in climate reveals the vulnerability of RE production especially based on hydropower. It is the reason that more resources are required to more away towards modern renewables while ensuring the energy efficiency. Countries in South Asia, i.e., Bangladesh, Pakistan and Sri Lanka, shall ensure smooth yet timely transition to renewables while aiming for energy efficiency.

2.3 Conceptual Framework

It is commonly perceived that there is a trade-off between fuel price and RE consumption. With an upsurge in the oil or gas price, the energy consumption becomes more expensive which motivates the oil importing economies to find and adopt alternatives to conventional energy sources in order to alleviate the burden of imports on economy. It can be depicted as the substitution effect and income effect between the oil/gas price and renewable energy. As the RE is an alternative source of energy for oil and other fossil fuels like LNG and coal so, its impact can be represented through SE, considering RE as perfect substitute of fossil fuels (Kruger, 2006).

The substitution effect between oil and RE consumption is illustrated in the figure below. For fuel consumption at any level of oil price in the international market, the efficient level of RE consumption happens to be at point A at which point the indifference curve (IC) is tangent to budget constraint (BC_0). The slope of the BC_0 is equal to the relative price ratio of RE and crude oil (Price (RE_0)/ Price (OIL_0)). At this optimal point where the IC is tangent to BC_0, the optimum levels of consumptions of RE and oil care represented as RE_0 and OIL_0.

With a rise in oil price in the international market (from $POIL_0$ to $POIL_1$), whilst the price of renewables which is determined locally, is presumed to hold still (at RE_0), the relative price ratio drops leading to the relatively flat slope of the budget constraint. Due to this change in oil price, the new budget constraint is exhibited as BC_1, and the new level of relative price ratio is given by $PRE_0/POIL_1$. These changes lead to movement in IC, from point A to point B, whereby the RE consumption is anticipated to upsurge whereas the oil consumption is expected to fall.

The substitution effect of the increase in international oil prices can be exhibited as a rise in RE consumption from RE_0 to RE_1 and the decline in oil consumption levels from OIL_0 to OIL_1. However, this phenomenon is strongly based on the assumption that RE and conventional energy sources are perfect substitutes. Otherwise, if they are not perfect substitutes, then SE would be trivial which leads to an insignificant impact of oil price increase on the level of RE consumption. Hence, the RE consumption and crude oil price nexus is related to the possibility of the substitution amid the conventional and renewable resources, along with the magnitude of dependency of oil-importing countries.

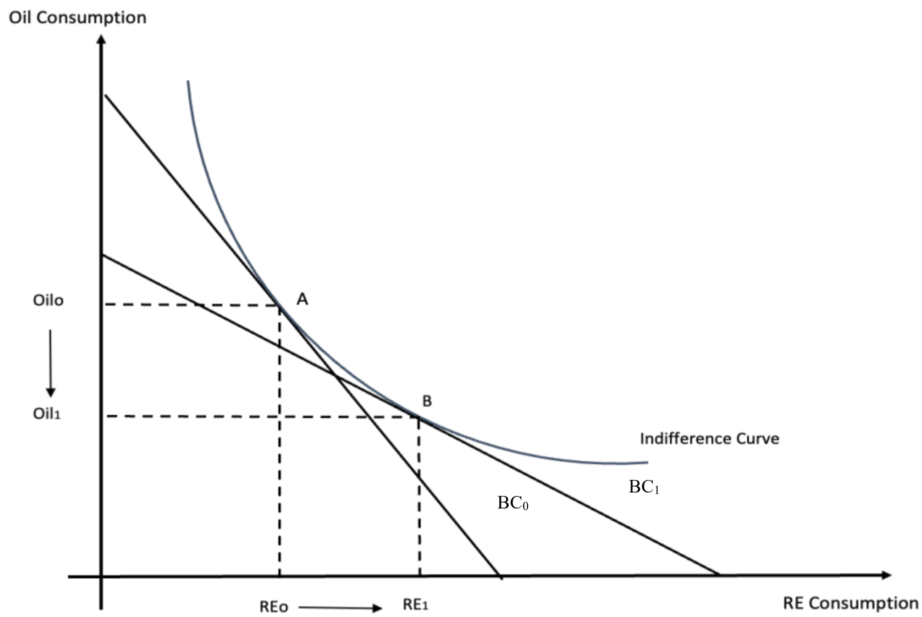


Figure 1.7: Substitution effect between oil and renewable energy consumption

Source: Author's own

Apparently, after elaboration of substitution effect between the oil price and RE consumption, the next attempt is to explain the channels through which the impact of oil price change is translated into RE. In the periods of international oil price shocks, a large sum of literature can be found on empirical research for investigative the relations between oil prices, renewable energy, and other macroeconomic fundamentals.

The change in OP affects RE consumption through various direct or indirect channels, as depicted by economic theory. There are numerous channels that explicitly shows the relationship between

RE and OP i.e., supply-side channel, monetary policy channel, and wealth channel etc. The illustration of these channels is provided in the figure below.

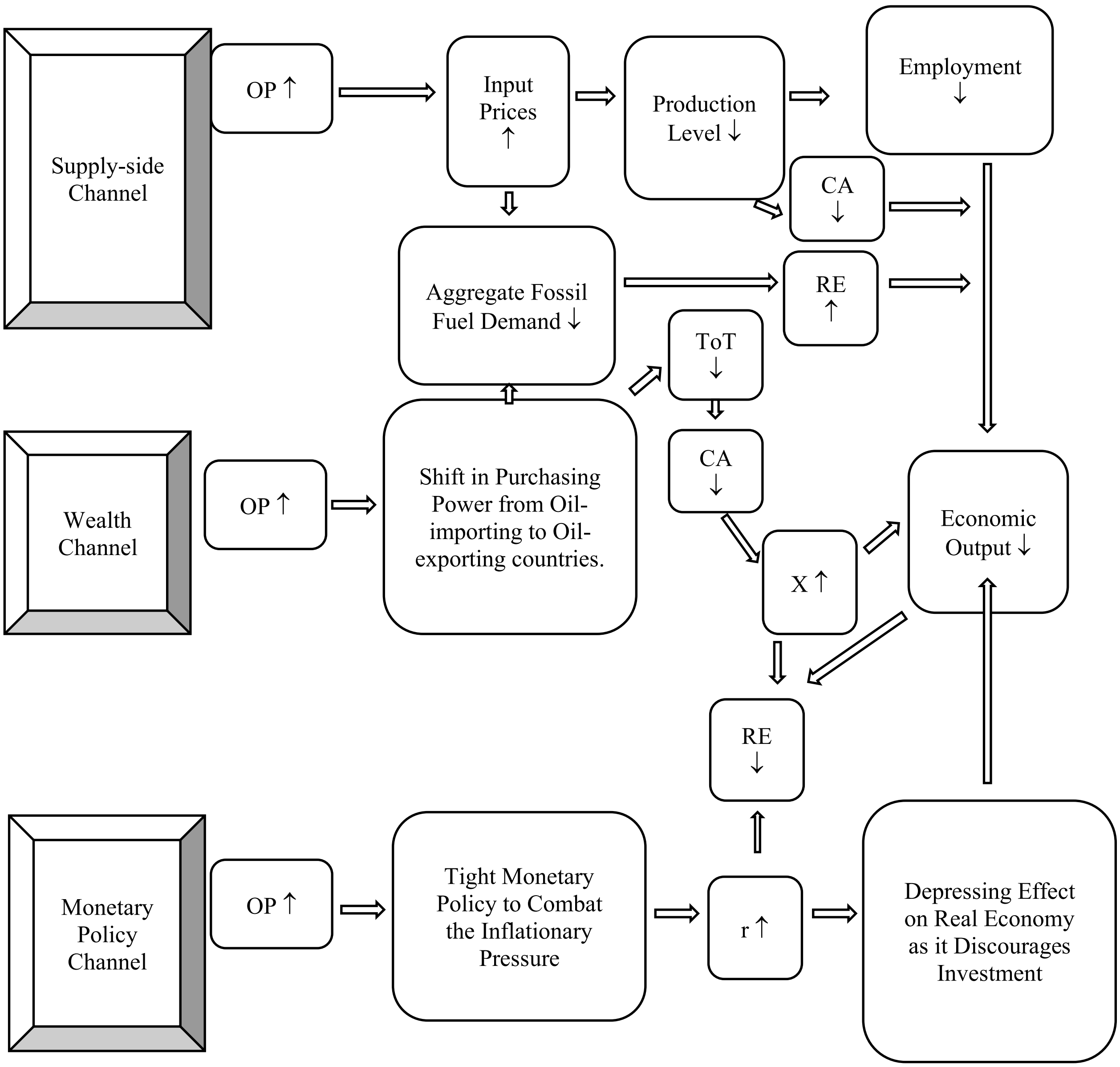


Figure 1.8. A Theoretical Framework of OP Shock on RE

Source: Author's own

The channels through which the OP changes impact RE consumption are described below.

Supply-Side Channel: The impact of changes in OP on the supply side is manifested through alterations in input costs for production. Since oil is a predominant resource for generating electricity utilized in both households and industries, an escalation in oil prices directly corresponds to elevated input costs. This gives rise to a tradeoff between oil usage and the espousal of renewable energy sources at both private and public levels (Fattouh et al., 2019). Conversely, the upsurge in input costs escalates production expenses, potentially resulting in reduced company sales. This, in turn, contributes to a decline in employment and a deterioration in GDP. The marginal cost of production and the growth in output levels experience a decrease (Amjad et al., 2016). Conversely, positive shocks in oil prices enhance the marginal benefit of renewable energy, attracting increased demand and future investments.

Wealth Channel: The wealth transfer channel, as suggested by Kilian (2010), explains the influence of OP on RE consumption in oil-dependent nations. This channel shows that an exogenously positive OP shock benefits oil-exporting countries but has adverse effects on oil-importing nations. Such shock diminishes the purchasing power of oil-dependent countries while transferring purchasing power to oil-exporting economies (Galesi and Lambardi, 2009). A shift in purchasing power causes a deterioration of the terms of trade (ToT) for oil-importing economies, while adversely impacting the current account and exchange rate. On the contrary, the higher costs of importing RE production equipment, necessary to expand capacity and reduce reliance on oil, hinder the adoption of RE in oil-importing economies.

Correspondingly, a reduction in ToT, coming from the shift in purchasing power, results in the deterioration of economic output of the economy, further impeding the ability to embrace RE. The shift in purchasing power may have an opposite impact as well. For instance, a decline in the purchasing power of oil-importing economies contributes to an overall reduction in RE demand but simultaneously encourages the utilization of RE (Murshed et al., 2020). It is why, the causal direction here is critical to consider within the wealth channel while explaining the repercussions of OP changes (Zhao et al., 2017).

Monetary Policy Channel: Finally, this relationship can be apprehended by the monetary policy transmission channel. The positive shock in oil prices directly affects the input prices in oil importing countries which results in inflationary pressure in the economy. To subsidize this inflation, monetary policy measures would be implemented. Typically, a tight monetary policy is implemented to deal with the inflationary pressures (Tang *et al.,* 2010; Khan et al., 2016) which involves increasing interest rates in the economy. This, in turn, encourages investors to prioritize savings over investment. Consequently, investment in renewable energy is discouraged, and this discouragement negatively impacts the real economy, leading to a decline in overall economic output.

Theoretical rationale coming from the economic theory is explained as below. When there's an oil price shock (e.g., an impulsive rise in oil prices), it affects the trade balance of oil-importing countries. Increased oil prices lead to higher import costs, which can deteriorate the trade balance. This deterioration in the trade balance may put downward pressure on the exchange rate. Since exchange rates regulate to balance the prices of identical goods in different countries as per purchasing power parity theory. Therefore, a negative trade balance due to higher oil prices may lead to a devaluation of the currency.

A depreciation of the domestic currency can have mixed effects on GDP. On one hand, it can stimulate the exports by lowering the cost of domestic goods for foreign consumers, thus rising aggregate demand and potentially leading to higher GDP. On contrary, a depreciation can also lead to higher import costs, which may reduce consumer purchasing power and negatively impact GDP growth. The J-curve theory advocates that in short run the trade balance may worsen further after a currency depreciation before improving. This means that the impact of the exchange rate on GDP may be more evident in long run.

GDP growth affects interest rates through its influence on inflation and monetary policy. Higher GDP growth rates may lead to increased inflationary pressures as demand for goods and services outstrips supply. According to the Taylor rule, an extensively used guideline for monetary policy, the central banks modify interest rates in reaction to variations in inflation and the output gap. Lower interest rates decrease the borrowing cost for renewable energy projects, causing these to be more appealing to investors.

The adoption of renewable energy (RE) in Asian economies is shaped by a combination of market dynamics, policy interventions, and technological progress. Within this multidimensional setting, fuel prices—particularly crude oil and liquefied natural gas (LNG)—play a significant but not exclusive role. Oil and LNG prices act as benchmarks for the cost competitiveness of renewables, especially in sectors such as transport (oil) and power generation (LNG). Volatility in these prices can alter investment incentives, influence demand patterns, and reshape the relative attractiveness of renewable alternatives.

However, renewable energy adoption is not merely a one-to-one function of fossil fuel prices. It is also driven by government policies and subsidies, technological innovation and cost declines in renewables, institutional capacity, and sustainability commitments under international agreements. For instance, feed-in tariffs, carbon pricing, or renewable portfolio standards can significantly accelerate RE uptake, sometimes independently of fossil fuel price movements.

This study therefore situates oil and LNG prices as external economic drivers within a broader framework that recognizes the complex interaction between market forces and policy environments. By doing so, the analysis not only evaluates the asymmetric effects of fossil fuel price shocks but also acknowledges the wider set of structural factors that influence renewable energy transitions in Asian economies.

Based on these theoretical relations the following impact channels are tested in the next section. Oil and LNG prices are assumed to exert a significant long-run influence on renewable energy consumption in Asian economies, recognizing that these effects may operate through different sectoral channels and could be moderated over time by technological change, policy interventions, and shifts in relative energy costs.

Restriction 1: Oil (and LNG) prices have significant positive impact on the renewable energy consumption in the long run.

Restriction 2: GDP has significant positive impact on the renewable energy consumption in long run (Wealth channel).

Restriction 3: Interest rate has significant negative impact on the renewable energy in long run.

Restriction 4: Oil and LNG prices have significant positive impact on the exchange rate in short run.

Subsequently, the methodological approach is explained to testify if these above-mentioned theoretical relations exist for the Asian countries.

3. MODEL & METHODOLOGY

3.1 Econometrics Approach

In order to investigate the forecasting and dynamic behaviour of time series, VAR approach has been widely used in the literature (Sims, 1980). The VAR approach keeps the account of an economy's natural reaction to the macroeconomic (internal or external) shocks as well as the role of these shocks in macroeconomic framework development. This study moves forward in line with the previous empirical studies. Given the characteristics of the macroeconomic variable, this research opts for structural VAR (SVAR) model. The benefit of using SVAR model, is the flexibility to impose restrictions on the contemporaneous relationships between variables, making the model more interpretable in economic terms. In general, the VAR approach is a multivariable time series methodology where all variables are treated endogenously. Estimation in VAR uses the lag values of both dependent and independent variables. Hence, we considered the VAR model of order p as follows:

$$x_t = c + \sum_{i=1}^{p} w_i \, y_t + u_t \qquad (2.1)$$

Where y_t is $(n \times 1)$ vector of endogenous variables, where as $c = (c_1, c_2, \dots, c_n)$is taken as the vector of intercept of VAR, ω_i is the $i^{th}(n \times 1)$ matrix of autoregressive coefficients for $i = 1,2, \dots, p$, and $u_t = (u_{1t}, \dots, u_{2t})$ is taken as the $(n \times 1)$ white noise process generalization.

After the estimation of VAR model, the pertinent shocks are documented and respond to these shocks by the system is designated by IRF and variance decomposition analysis. Here, the generalized IRF is employed which is established by Koop et al. (1996) and Pesaran et al., (1998).

Unlike typical IRF, the generalized IRF provides robust results because the impulse responses are independent of the order of variables in SVAR.

Further we attempted to probe the asymmetric impacts of oil price and natural gas price on renewable energy. The asymmetric specification is characterized by the positive and negative changes of oil price and fuel price i.e., OP_{it}^{+}, FP_{it}^{+} OP_{it}^{-}, FP_{it}^{-} respectively. We pursue the Lee et al. (1995), and Hamilton (1996) proposed approach in order to justify the statement that any increase in oil and fuel prices affect macroeconomic variables more intensely as compared to the drop in fuel and oil prices during the period quarter. For the construction of Structural VAR models, we used the given variables in the following order following Kim et al., (2008).

$$X_t = (OP, IR, ER, GDP, RE) \quad (2.2)$$

$$Y_t = (FP, IR, ER, GDP, RE) \quad (2.3)$$

Here, OP symbolizes the oil price which is US dollar per barrel, FP contains LNG and oil price to together as a fuel price, GDP is real Gross Domestic Price/capita for the sake of estimation of impact of output shock on the business cycle, IR is real rate of interest, ER is real effective exchange rate and RE is renewable energy and taken as percentage of total primary energy consumption.

In typical VAR approach the variables do not share any contemporaneous relationship with each other whereas the SVAR approach usually incorporates the contemporary relationship between the variables, it can be illustrated by the matrix A which has the coefficients of variables with current time "t". Structural VAR in vector form can be written as follows:

$$AX_t = BX_{t-1} + \varepsilon_{it} \qquad \varepsilon_{it} \sim iid\,(0, \textstyle\sum_\varepsilon) \text{ for each 'i'}$$

(2.14)

Here,

X_t = *(OP, IR, ER, GDP, RE)* symbolizes the vector of endogenous variables for every cross-sectional unit 'i'. the contemporary relationship between the variables is shown by the Matrix A. ε_{it} is the error terms which in fact indicates the structural shocks to their corresponding variables. in order to explain the SVAR we formulated of equations while applying the following short and long run restriction in the structural VAR model.

Besides, the correct number of lagged value is very important in SVAR, for this purpose we run the AIC test. This system is shown in matrix form SVAR as below:

$$BX_t = \Gamma_0 + \Gamma_1 X_{t-1} + \cdots + \Gamma_k X_{t-k} + \varepsilon_t \tag{2.25}$$

$$B^{-1}BX_t = B^{-1}\Gamma_0 + B^{-1}\Gamma_1 X_{t-1} + \cdots + B^{-1}\Gamma_k X_{t-k} + B^{-1}\,\varepsilon_t \tag{2.26}$$

$$X_t = A_0 + A_1 X_{t-1} + \cdots + A_k X_{t-k} + e_t \tag{2.27}$$

Here $Xt = (OP, IR, ER, GDP, RE)$ and

$$A_0 = B^{-1}\Gamma_0 \; A_1 X_{t-1} = B^{-1}\Gamma_1 X_{t-1} \; e_t = B^{-1}\varepsilon_t$$

(2.28)

The typical VAR model is illustrated by eq (15) which have lag values of the variables on right hand side of equation. Where the contemporary effect of variables on either side is shown by coefficients of 'B' matrix and, 'Γ_0' symbolizes the vector whereas 'Γ_1 and Γ_k' are shown as a matric of coefficients estimating the lagged effect of variables on each other.

Furthermore, e_t is not correlated though it has zero means and constant variance however the errors can correlate simultaneously. Therefore,

$$\{E(e_{jt}) = 0 \; var(e_{jt}) = \delta_j^2 \; cov(e_{jt}, e_{jt-1}) = 0 | \tag{2.29}$$

'ε_t' denotes the vector comprising structural innovations which have constant variance and zero mean. Moreover, these innovations are not correlated with serial or cross correlation as per the assumptions but displays net structural shocks. Hence the error terms in their reduced form are as follows.

Here e_{RGDPt}, e_{GOVt}, e_{CAt} and e_{OPt} are composite of these shocks ε_{RGDPt}, ε_{GOVXt}, ε_{CAt} and ε_{OPt}. In order to achieve the identification, we normalize 'n' diagonal elements of B to 1s, additionally we impose at least n (n +1)/2 contemporaneous restrictions on B.

Hence, for the identification of transmission of idiosyncratic shocks, common structural shocks and composite structural shocks, the SVAR is one of the sophisticated approaches fairly used by the researcher and economist (Pedroni, 2013; Skare, 2012). because the conventional time series VAR diagnose only composite shocks.

While the Structural Vector Autoregression (SVAR) model offers valuable insights into country-specific dynamic interactions between energy prices and renewable energy (RE) investment, it has notable limitations when used in a multi-country panel setting. In particular, SVAR is ill-suited for estimating pooled effects or accounting for unobserved heterogeneity and common policy dynamics across countries. To overcome these limitations and provide robust, generalizable findings, this study supplements SVAR with three additional panel data approaches: the Fixed Effects (FE) model, the System Generalized Method of Moments (System GMM) estimator, and the Instrumental Variables (IV) method.

These approaches have been widely adopted in empirical literature on energy economics (e.g., Sadorsky, 2009; Apergis & Payne, 2010; Murshed, 2021) and are particularly well-suited for analyzing the interplay between oil and fuel prices and RE deployment in the presence of endogeneity, unobserved heterogeneity, and dynamic feedback.

The Fixed Effects model is employed to estimate the baseline static relationship between energy price variables (Oil Price [OP] and Fuel Price [FP]) and RE adoption, while controlling for time-invariant country-specific characteristics. These may include regulatory frameworks, climatic conditions, and historical infrastructure development, which could confound the observed relationship.

Fixed Effect: Model Specification:

$$RE_{it} = \alpha_i + \beta_1 OP_{it} + \beta_2 FP_{it} + \beta_3 IR_{it} + \beta_4 INF_{it} + \beta_5 GDP_{it} + \beta_6 ER_{it} + \varepsilon_{it} \quad (2.30)$$

Where:

- αi is the unobserved, country-specific fixed effect
- RE_{it}: renewable energy capacity or consumption
- OP_{it}, FP_{it}: oil and fuel prices
- IR_{it}, INF_{it}: interest and inflation rates
- GDP_{it}: economic growth
- ER_{it}: exchange rate

This approach isolates the within-country variation over time, thus reducing omitted variable bias (Baltagi, 2005). The Hausman test is used to verify that FE is preferred over random effects by checking the correlation of regressors with the unobserved heterogeneity. Studies such as Sadorsky (2009) and Jebli et al. (2016) apply FE models to isolate how economic variables influence RE investment across countries, concluding that static estimators provide important initial insights but may miss dynamics and feedback.

Given the potential for endogeneity, autocorrelation, and dynamic feedback, the System GMM model is applied to evaluate the short- and long-term effects of energy prices on RE investment. This model is especially appropriate for datasets with large cross-sections (N) and shorter time periods (T) and where past values of RE influence current investment decisions.

System GMM: Model Specification:

$$RE_{it} = \gamma\, RE_{it-1} + \beta_1\, OP_{it} + \beta_2\, FP_{it} + \beta_3\, IR_{it} + \beta_4\, INF_{it} + \beta_5\, GDP_{it} + \beta_6\, ER_{it} + \varepsilon_{it} \quad (2.31)$$

- RE_{it-1}: Lagged RE captures persistence
- Endogenous regressors (OP, FP, IR) are instrumented using their own lags
- GMM - style instruments address reverse causality and omitted variable bias

System GMM improves upon difference GMM by reducing finite sample bias and instrument proliferation. Diagnostic checks includes Arellano-Bond test for second-order serial correlation (AR(2)) and Hansen J-test for overidentifying restrictions.

Blundell and Bond (1998) developed the System GMM estimator to overcome weak instrument problems in dynamic panel settings. Energy studies by Apergis and Payne (2010) and Murshed (2021) show that System GMM is ideal for modeling the interaction between energy consumption, macroeconomic variables, and RE in the presence of endogenous relationships.

To account for external sources of endogeneity, particularly in oil and fuel prices that are influenced by global market forces and domestic energy policies, a Two-Stage Least Squares (2SLS) IV approach is adopted.

Instrumental Variable Approach: Model Specification:

First stage:

$$OP_{it} = \pi_0 + \pi_1 ER_{it} + \pi_2 GDP_{it} + \pi_3 X_{it} + u_{it} \quad (2.32)$$

Second stage:

$$RE_{it} = \alpha + \beta_1 OP\hat{}_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (2.33)$$

Where:

- GDP_{it}: GDP per capita
- X_{it}: Exogenous controls (IR, INF, ER)

Relevance of instruments is verified via first-stage F-statistics (rule of thumb: $F > 10$), while validity is checked using the Hansen J-test.

Lee and Chang (2007) and Balcilar et al. (2016) emphasize the importance of using external instruments to address price endogeneity in energy economics. IV methods are especially useful in evaluating exogenous shocks to oil prices that may affect investment behaviour in energy infrastructure.

3.2 Data and Sample

To investigate the nexus between oil price and RE, the data of variable encompassing oil prices (OP), real liquefied natural gas prices (LNG), real interest rates (IR), real effective exchange rates (ER), and gross domestic product (GDP) has been obtained from International Financial, Organization for Economic Co-operation (OECD) and World Bank (WDI) whereas the data of renewable energy consumption is acquired from IRENA (International Renewable Energy Agency). Here the renewable energy consists of hydro, solar, wind, biothermal, geothermal, and marine energy. For estimation, the data covering fifty-years timeframe spanning 1973-2023 has been employed. The selection of year 1973 as the starting point is motivated by two major considerations. First, this period follows the resolution of the oil price shock of 1970, eliminating its contemporaneous effects on the data. Second the political conflict of 1971 has settled for two specific sample countries namely Pakistan and Bangladesh.

The dataset is meticulously analysed for thirteen Asian economies, namely India, Thailand, China, Nepal, Bangladesh, Singapore, Korea, Sri Lanka, Philippines, Japan, Malaysia, Pakistan, and Indonesia. This analytical framework provides a robust foundation for exploring the complex dynamics amid oil plus LNG prices and renewable energy across diverse Asian economies. Our sample countries including both high-income and low-income nations. Furthermore, it encompasses a mix of oil-importing and oil-exporting countries, exemplified by economies such as Indonesia and Malaysia, respectively. Notably, nearly all countries within our sample have experienced the shocks of oil and gas price shocks. This comprehensive approach enriches the depth and scope of our analysis, contributing significantly to the existing body of literature on the subject.

The selection of variables in this study is informed by both established economic theory and empirical literature on the determinants of renewable energy (RE) consumption, particularly within the context of fossil fuel price dynamics and macroeconomic adjustment processes in Asian developing economies. Each variable has been deliberately chosen to reflect its theoretical relevance and practical significance in capturing either the direct or indirect pathways through which oil prices (OP) and fuel prices (FP), inclusive of oil and liquefied natural gas (LNG), affect the pace and scale of renewable energy adoption. This approach is rooted in theoretical frameworks such as the energy transition theory, the resource substitution model, and the macroeconomic price-channel transmission mechanism.

Oil price (OP) and fuel price (FP) function as the core explanatory variables of the study, representing the global cost dynamics of conventional energy inputs. According to the substitution effect posited by energy transition theory, higher fossil fuel prices should incentivize a shift toward renewable energy sources (Sadorsky, 2009). However, in fossil fuel-importing economies, high and volatile prices can also generate adverse fiscal pressures and inflationary shocks, which may ultimately crowd out renewable energy investments (Murshed, 2021).

Renewable energy consumption (RE), the primary dependent variable, captures the extent of clean energy utilization and transition progress within each country. This variable is particularly responsive to changes in fossil fuel pricing, policy shifts, and macroeconomic stability, making it a suitable and sensitive outcome indicator. Interest rate (IR) is introduced to capture the cost of financing—critical for capital-intensive RE projects. Higher interest rates increase borrowing costs, potentially deterring RE investment, while lower rates facilitate expansion (Polzin et al., 2019).

The inclusion of the inflation rate (INF) controls for broader macroeconomic volatility that could distort the transmission of energy prices to RE outcomes. Similarly, gross domestic product (GDP) serves as a proxy for income levels and stage of development, aligning with the Environmental Kuznets Curve (EKC) hypothesis that posits energy consumption structures evolve with economic growth (Grossman & Krueger, 1995). Exchange rate (ER) volatility is also accounted for, as it affects the affordability of imported RE technologies and capital goods, which are critical to energy transition efforts in many Asian economies (Taghizadeh-Hesary et al., 2022).

This study has further included institutional and policy variables, specifically drawn from the World Governance Indicators. Variables such as regulatory quality and political stability are integrated to control for the enabling environment within which energy policy decisions are made and implemented. These factors may either amplify or dampen the responsiveness of RE adoption to market and policy signals.

Building on this theoretical foundation, several testable hypotheses are derived. H1 posits that increases in oil and fuel prices lead to higher RE consumption in the long run due to the substitution effect. H2 anticipates that higher interest rates and inflation will suppress RE investment. H3 aligns with the EKC hypothesis by proposing that higher levels of GDP are positively correlated with RE uptake. H4 hypothesizes that exchange rate depreciation negatively affects RE consumption due to the increased cost of imported technology. Finally, H5 suggests that institutional quality moderates these relationships, strengthening the positive effects of high fossil fuel prices on RE adoption where governance is strong.

To ensure the robustness of findings, the empirical strategy has been expanded in several keyways. The model incorporates multiple estimation techniques, including Fixed Effects, System GMM, and Instrumental Variable regressions, to account for time-invariant heterogeneity, endogeneity, and dynamic adjustments. These extensions not only enhance the credibility of the findings but also offer a more nuanced understanding of how energy prices interact with macroeconomic, institutional, and policy dimensions to influence renewable energy transitions across diverse Asian economies.

Table 1.3. Descriptive Statistics

	ER	OP	FP	RE	GDP	IR
Mean	102.1	42.5	33.2	3.8	9956.9	4.3
Standard Error	3.2	2.1	1.7	0.1	488.4	0.2
Median	104.6	55.1	30.6	2.7	4457.2	4.2
Standard Deviation	33.9	17.9	18.9	3.3	12448.0	5.0
Sample Variance	183.2	88.0	44.5	1.1	577698	4.1
Minimum	-12.2	10.8	17.3	0.0	802.5	-12.7
Maximum	279.7	114.6	55.3	17.0	69803.7	33.8

Besides oil price change, the RE is also influenced by natural gas LNG, particularly in oil-importing economies. Subsequently the import of oil and natural gas is the reason behind determining the changes in fuel price as a whole instead of oil price individually. Here in descriptive analysis, the most vulnerable and depreciated currency in terms of ER is Sri Lankan Rupee since during early 2022 it was devalued for 365 LKR. against US$ due to the economic crunch in Sri Lanka as a consequence of COVID-19. Alternatively, the India Rupee turns out to be the most appreciated currency as it stands for 78 INR against 1US$.

Renewable energy consumption is highest in high-income countries like China, Japan, and Korea respectively. It is because of higher financial cushion these countries must embrace alternative energy sources. Whereas the lower-income countries like Bangladesh, Pakistan, and Sri Lanka have fewer financial resources available to move away from the conventional energy sources and adopt the renewables. The next section represents the econometric results for these selected Asian economies to explore the effect of fuel price shocks on renewable adoption.

4. EMPIRICAL FINDINGS

In accordance with the research objectives, this study purposes to examine the influence of oil prices on the adoption of RE in Asian economies. The empirical analysis commences with conducting a test for unit root on the time series data of Asian economies spanning from 1973 to 2023. The results of the AIC test signify the existence of a unit root in all the thirteen countries. The Table below illustrates the results, clearly indicating that the model is not stationary at the level. It is crucial to verify the stationarity of data, as unreliable results may arise in the VAR model. For this purpose, the difference of all the variables is used to run the structural VAR model. This issue becomes particularly relevant in the case of impulse response functions, as the presence of a unit root may result in divergence from the actual path.

Table 1.4: Lag Length Criterion

Country	OP - Stationary (AIC value)	FP - Stationary (AIC value)
Bangladesh	2 (15.64*)	1 (12.64*)
China	1 (14.69*)	2 (11.62*)
India	1 (14.00*)	2 (11.47*)
Indonesia	2 (18.37*)	1 (15.32*)
Japan	1 (15.57*)	1 (13.00*)
South Korea	1 (16.32*)	2 (13.49*)
Pakistan	1 (17.09*)	2 (14.14*)
Philippines	1 (17.32*)	1 (16.48*)
Singapore	1 (19.92*)	2 (16.48*)
Sri Lanka	2 (11.25*)	1 (8.66*)
Thailand	1 (22.52*)	2 (18.43*)

Vietnam	1 (18.46*)	1 (15.89*)
Malaysia	1 (18. 97*)	3 (14.02*)

A crucial step in the estimation process involves determining the appropriate number of lags. Therefore, following the stationarity test, we proceeded to estimate the lag length. Various criteria are employed in empirical literature to select the lag length. However, in this study, we have chosen the Akaike Information Criterion (AIC), which has shown significance at lag length 1 for most of the countries for model 1 (with oil price) and mixed lags for model 2 (with LNG).

Once the lag-length criterion has been examined, the diagnostic test is conducted for both models. The subsequent step is to evaluate if there exists any co-integration in the proposed models. The purpose is to analyze the long-run relationship amid oil and LNG prices, and renewable energy (Troster, et al., 2018). As per previous literature, the oil price changes occur more frequently compared with the changes in renewable energy adoption and other macroeconomic variables. Accordingly, the impact of oil prices on the economy is predominantly translated in the short-term while its impact on the adoption of renewable is seen in a relatively longer period (Sadorsky, 2012a; Reboredo et al., 2017). Moreover, the direction of oil and LNG price fluctuations also contributes to the intensity of short-term effects of changes in these variables.

However, in the long run, the overall effect of oil price fluctuations tends to decline which leads to a less significant long-term impact on renewable adoption making it challenging to capture any impact (Sadorsky, P. 2009). There exists no co-integration in the models. The results of the co-integration Kao-Residual test are shown in appendix 1.2. To examine the long-term impact of oil and fuel prices on RE and other macroeconomic variables, the structural Vector Autoregression (VAR) is applied (Andini et al., 20189; & Shah et al., 2018). Considering the presence of a long-term impact of oil and fuel prices on RE is uncertain, a structural VAR (SVAR) approach is used to detect the structural impact, if any, which helps to estimate the response of RE to the oil and fuel price shocks.

4.1 Nexus of oil price shock on renewable energy

In this section, we illustrate a detailed analysis of transition from oil price consumption to RE consumption. The results are derived by employing structural VAR (SVAR) which not only sheds light on the response of RE to oil price shocks but also provides an insight into the impact on other macroeconomic variables taken in the model i.e., economic growth, exchange rate as well and interest rate (Economou et al., 2016). One of the major benefits of applying the SVAR approach is its ability to divide the impact of shock across countries into two distinct subcategories (Roy et al., 2022; & Jin et al., 2023). It is imperative to consider both types of shocks across the countries with different income groups as it plays a significant role for capturing different variations of external shocks on renewables.

Consequently, the results of SVAR are presented through two variants of measures (IRF and variance decomposition). The IRF of SVAR demonstrates how the adoption of renewable energy is affected due to oil price shocks and other macroeconomic variables. Whereas the variance decomposition analysis serves two purposes. Firstly, it helps to explain the proportion of volatility in the dependent variable (renewable energy) which could be described by the independent variable (oil price). Secondly, it enables an understanding of the proportion of volatility in the dependent variable (renewable energy) which could be attributed to fluctuations in the independent variable (LNG +oil price). Essentially, the variance decomposition allows us to quantify the extent to which changes in fuel/oil prices influence the variation in renewable energy, as well as the extent to which other macroeconomic factors contribute to this variation. Both of these measures are integral in presenting the impact of shocks on renewable energy. The findings of the SVAR analysis are subsequently discussed below.

The first section of the results focuses on the effects of oil and LNG price shocks on RE production. To illustrate the impact of these shocks, the Structural Vector Autoregression (SVAR) model generates three types of impulse response functions (IRFs). These IRFs encompass the entire panel of thirteen countries. Furthermore, the SVAR model categorizes the IRFs as composite, common, and idiosyncratic shocks. The subsequent section presents the outcomes of these shock impacts in detail.

a) IRF of Oil Price and LNG to Renewable Energy

The results of IRF exhibit a significant impact of oil price shock on renewable energy. The theoretical relationship between OP shocks and renewable energy shows an increase in OP results in an upsurge in adoption of RE consumption due to an increase in the cost of inputs for the oil-importer countries (Sahu et al. 2020; and Murshed et al. 2021). It motivates the countries to find and invest in alternative energy sources (Elder et al., 2010, Ali et al., 2018). This channel supports the rationale that an upsurge in the OP leads to a hike in the opportunity cost of using oil and gas when compared with other energy sources and it attracts more investment and more use of renewables. However, it is important to note that the correlation amid fuel prices and renewable energy can be negative in certain cases, particularly when countries are experiencing severe economic crunch for instance Marques et al., 2011; Guo et al. 2021; & Murshed et al., 2021 used panel data model and upheld that oil price has a negative impact on the level of renewable energy consumption.

In such situations, an increase in fuel prices can exacerbate the economic difficulties already faced by the country. Consequently, potential investments in renewables may be redirected toward economic management instead of expanding alternative energy sources.

On the other hand, the lack of significance in the impact of fuel prices on renewable energy adoption can be attributed to two factors. Firstly, it is possible that the impact of oil and gas prices is not effectively transmitted to the adoption of renewable energy sources. Secondly, policies regarding renewable energy are typically formulated with long-term objectives in mind, disregarding short-term fluctuations in oil prices.

Similarly, the composite shock, which presents an overall impact of shock in the independent variable on the dependent, shows a negative impact of interest rate on renewable energy. This sign of relationship is again in line with the theory. Apparently, an increase in the interest rate causes a crowding out of investment from renewable and moves it to saving accounts hence causing a drop in investment in renewables. A negative shock to the interest rate motivates investors to invest in other investment opportunities and renewables are considered as one of the potential investment choices (Mukhtarov *et al.,* 2023).

According to the analysis, it is observed that shocks to the exchange rate (ER) do not significantly affect renewable energy (Deka et al., 2021; & Deka et al., 2023). This suggests that countries develop renewable energy policies independently of the macroeconomic outlook. However, it is noteworthy that these policies are viable only when a country has a strong financial position, as adverse macroeconomic indicators could potentially compromise renewable energy projects. On the other hand, the analysis reveals that economic shocks have a positive effect on the development of renewables.

The results for impulse response functions for all the thirteen Asian economies are presented in the Figure 1.9 for both type of shocks i.e., oil price and the LNG price shocks.

The IRF results for the long-run restriction of oil prices on the RE adoption in Bangladesh suggest a dynamic relationship among oil prices and RE adoption. The initial negative impact of oil prices on renewable energy adoption aligns with economic theory, where higher oil prices typically cause an increase the cost of energy production and can discourage the adoption and implementation of the RE sources, which may be perceived as more expensive in the short term.

However, the diminishing impact of oil prices on RE adoption over time, eventually reaching zero, indicates a changing landscape influenced by several factors specific to Bangladesh. One important factor is the country's commitment to RE development, compelled by the requirement to downgrade the reliance on imported fossil fuels and improve energy security. Bangladesh has established the ambitious goals for renewable energy adoption, such as producing 20% of its net electricity from renewable sources by the year 2030.

Government policies and incentives have been playing a decisive role in endorsing renewable energy adoption. For example, the government has executed net metering policies to encourage the use of solar panels in households and businesses. Additionally, the Bangladesh Climate Change Strategy and Action Plan prioritizes the development of RE as a means to mitigate the climate change impacts.

As renewable energy technologies become more mature and costs continue to decrease, they are becoming increasingly competitive with traditional fossil fuel sources. This trend is likely contributing to the diminishing effect of oil prices on RE adoption over time. Additionally, investments in renewable energy infrastructure and capacity building are enhancing the resilience of Bangladesh's energy sector to external shocks, including fluctuations in oil prices.

Overall, the IRF results reflect Bangladesh's transition towards a more sustainable and diversified energy mix, where renewable energy adoption is becoming less sensitive to the variations in oil OP. This transition is supported by a combination of government policies, technological progressions, along with the budding recognition of the importance of RE for attaining long-term energy security.

The initial positive impact of LNG prices on RE adoption can be explained by economic theory and specific characteristics of Bangladesh's energy sector.

In the short term, an increase in LNG prices can make RE sources relatively more appealing as an alternative energy source. Bangladesh has been vigorously endorsing RE adoption to downgrade its reliance on imported fossil fuels, including LNG. As LNG prices rise, the cost competitiveness of renewable energy sources improves, which leads to an initial upsurge in their adoption. The diminishing impact of LNG prices on renewable energy adoption over time, eventually reaching zero, indicates that other factors are at play. Bangladesh's renewable energy sector is still in the preliminary phases of development, and significant investments and policy support are needed to scale up renewable energy infrastructure. As renewable energy capacity increases and technologies mature, the impact of LNG prices on RE adoption is anticipated to diminish.

While higher LNG prices initially stimulate renewable energy adoption, the long-term impact is expected to diminish as the renewable energy sector matures and becomes more competitive.

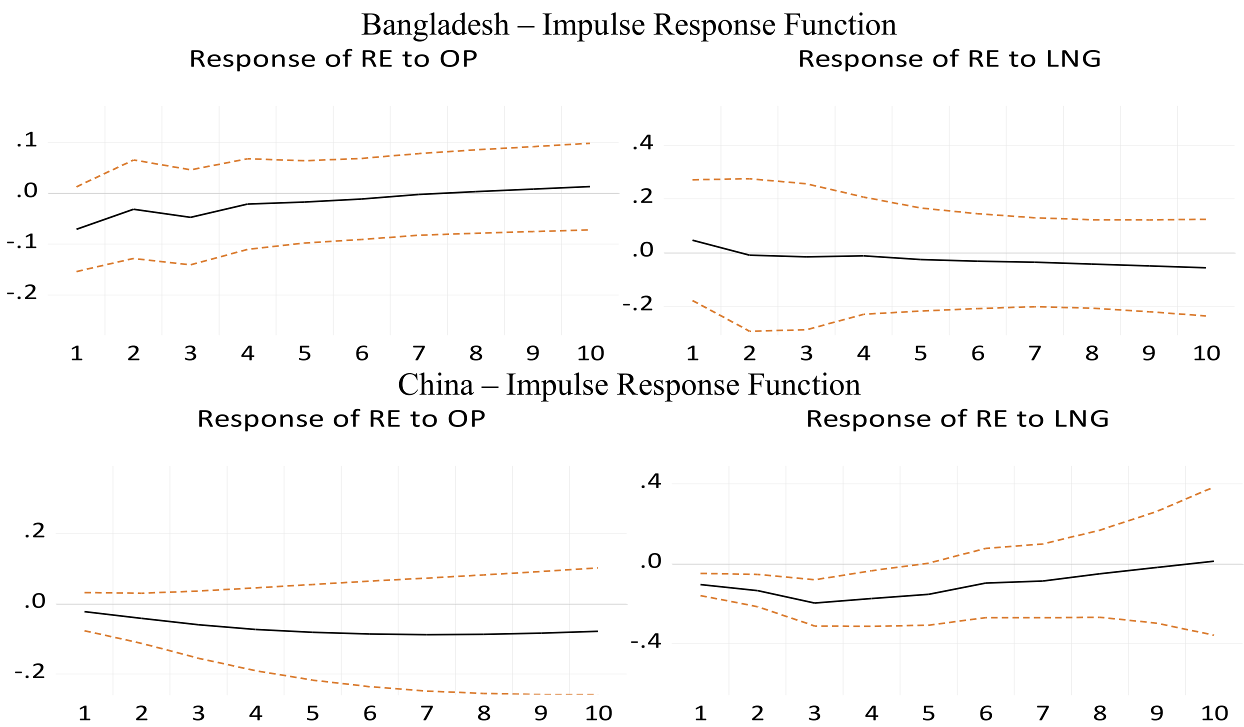


Figure 1.9.1. IRF of RE on Bangladesh and China

For China, the persistent negative effect of oil prices on RE adoption in China accentuates the significance of government policies in compelling the transition to a more sustainable energy mix. China has set ambitious renewable energy targets, including rising the share of non-fossil fuels in primary energy consumption to 20% by 2030. The strong commitment of the government towards RE development, combined with technological progresses and cost efficiency in the sector, is likely to continue driving the adoption of RE in China despite fluctuations in oil prices.

The energy mix of China has coal as the dominant place succeeded by oil and LNG. While renewable energy adoption is growing, it still makes a comparatively small share of China's net energy consumption. This dependence on fossil fuels, including oil and LNG, can limit the immediate impact of oil and LNG price shocks on RE adoption, as the infrastructure and policies needed for a rapid transition are still being developed.

India has also set an ambitious goal for renewable energy, including achieving 450 GW of RE capacity by the year 2030. The government has executed various policies and spurs to endorse RE adoption, for instance the Renewable Purchase Obligation (RPO) and the National Solar Mission. These efforts have helped drive the development of RE in India, despite a negative impact of oil and LNG prices.

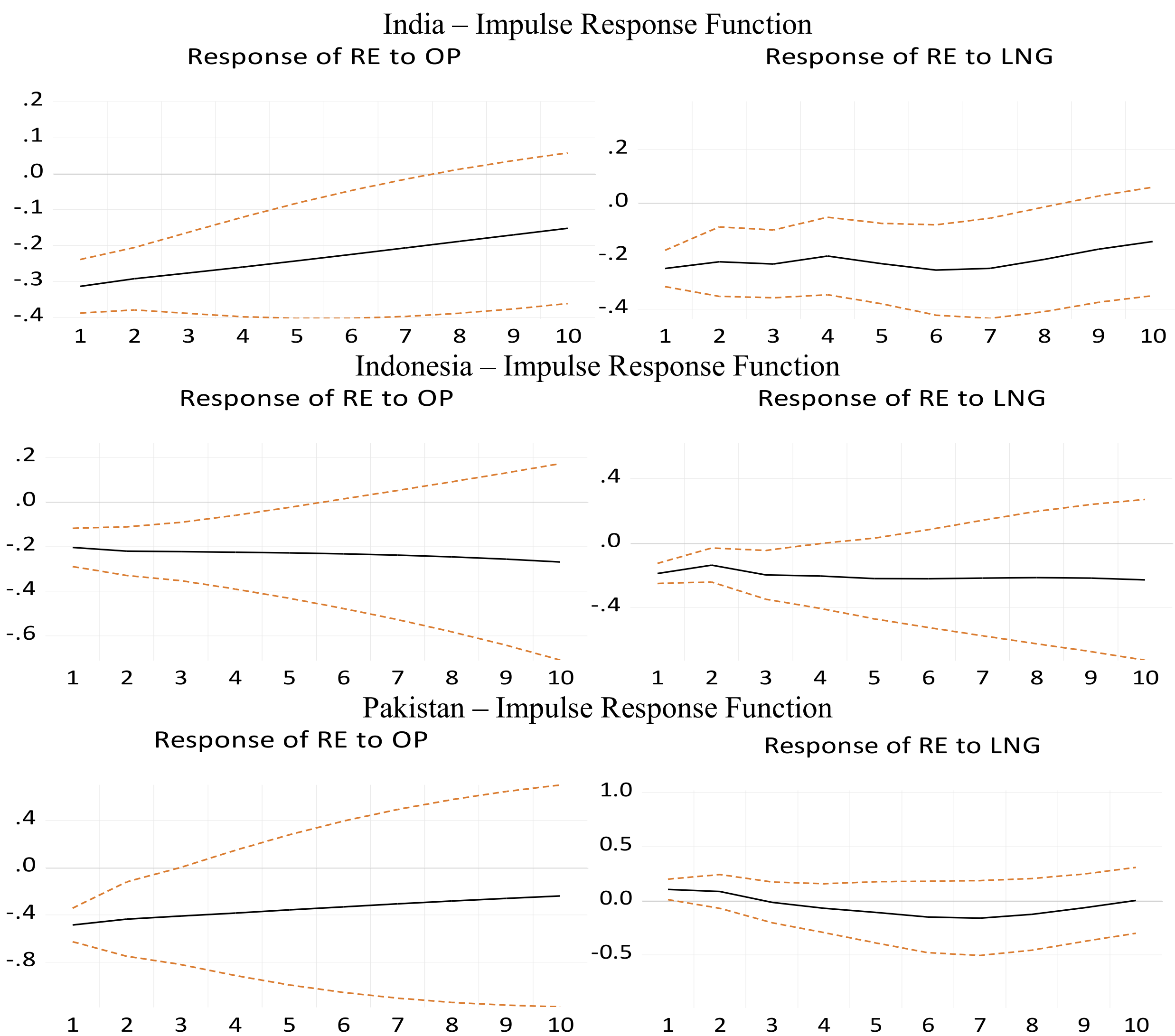


Figure 1.9.2. IRF of RE on India, Pakistan and Indonesia

Pakistan has also made efforts to promote RE adoption, with the more emphasis given to solar and wind power. The government of Pakistan has executed various policies such as net metering and feed-in tariffs to boost the investment in renewable energy projects. These policies have helped increase renewable energy capacity in Pakistan, though the challenges still stay in terms of grid integration and financing.

Pakistan's economy faces financial challenges, including budget deficits and high levels of debt. This limits the government's facility to invest in renewable energy infrastructure and provide subsidies or incentives to promote renewable energy adoption. According to the World Bank, Pakistan's renewable energy investments were around 0.2% of GDP in 2019, significantly lower than the global average of 0.8%. The lack of clear and stable policies, including tariffs and grid access rules, hampers the development of RE projects. According to the International Renewable Energy Agency (IRENA), Pakistan ranked 91st out of 115 economies in relation to RE policy and regulations in 2020. Similarly, the country's energy infrastructure is not well-developed, especially in rural areas where renewable energy sources could have the most significant impact. The lack of grid connectivity and energy storage infrastructure limits the implementation of RE technologies. According to the Pakistan Economic Survey 2020-21, only about 2.5% of Pakistan's total electricity production comes from renewable sources.

Pakistan has made notable efforts to promote renewable energy adoption, particularly in solar and wind power, through policies such as net metering, feed-in tariffs, and the Alternative Energy Policy 2019. These initiatives have stimulated private investment in renewable energy projects and contributed to incremental increases in installed RE capacity. However, despite these policy measures, Pakistan's renewable energy sector remains small relative to overall energy demand, with only about 2.5% of electricity generation coming from renewables (Pakistan Economic Survey, 2020–21).

The limited penetration of renewable energy affects Pakistan's ability to moderate the impact of global fuel price fluctuations. Since a significant portion of the country's electricity and industrial energy supply depends on imported oil and gas, changes in global fuel prices directly influence electricity tariffs, production costs, and inflation. A higher reliance on fossil fuels increases the economy's vulnerability to international oil and LNG price shocks, while the relatively low RE share reduces the buffering effect that renewables could provide against such shocks.

Financial constraints further hinder the expansion of renewable energy. Pakistan's high budget deficits and debt levels limit public investment capacity and reduce the feasibility of offering substantial subsidies or incentives for RE adoption. In addition, grid integration challenges, lack of storage infrastructure, and inconsistent policy implementationimpede the scaling-up of renewable projects. For example, rural areas, which could benefit the most from decentralized solar and wind systems, remain largely disconnected from the main grid, constraining both electricity access and the economic benefits of renewables.

To strengthen the role of RE in mitigating fuel price volatility, Pakistan would need a comprehensive approach that includes improving grid infrastructure, ensuring policy stability, and facilitating financing mechanisms for private and community-level renewable projects. Investments in energy storage and smart-grid technology could enhance the reliability of RE supply, enabling the country to gradually reduce dependence on imported fossil fuels. In the long run, a higher share of renewables would dampen the sensitivity of the economy to oil and LNG price fluctuations, support energy security, and contribute to sustainable development goals.

Indonesia has the ample resources of RE which includes geothermal, hydro, and solar power. Their government has also executed the strategies to stimulate renewable energy adoption, for instance Renewable Energy Development Program and the National Energy Policy. These efforts have helped upsurge the share of RE in the energy mix of Indonesia, although progress has been slower compared to other countries in the region.

For these countries, the existing energy infrastructure is often built around fossil fuel sources, particularly coal and oil. Transitioning to RE sources involves a substantial investment in new infrastructure, which may not happen quickly enough to offset the immediate impacts of oil and LNG price shocks. While renewable energy costs have been declining, fossil fuels remain relatively cheaper in many cases. Oil and LNG price shocks can lead to short-term fluctuations in energy prices, but the long-term cost competitiveness of RE sources depends on factors such as technology advancements, scale of deployment, and policy support.

India, Pakistan, and Indonesia have diverse energy mixes, with a mix of fossil fuels, renewables, and nuclear power. Achieving a balanced energy mix requires careful planning and coordination to ensure energy security and reliability, which can be challenging in the face of oil and LNG price shocks. The price elasticity of demand for oil and renewable energy influences the extent of the impact of oil price increases on RE adoption (Schmidt, et al.,2019; Kyritsis et al., 2019). The oil demand is relatively inelastic (i.e., not very responsive to price changes), so even a small increase in oil prices may not lead to a significant shift towards RE sources but a drop in the purchasing power to adopt renewables, especially in low-income countries.

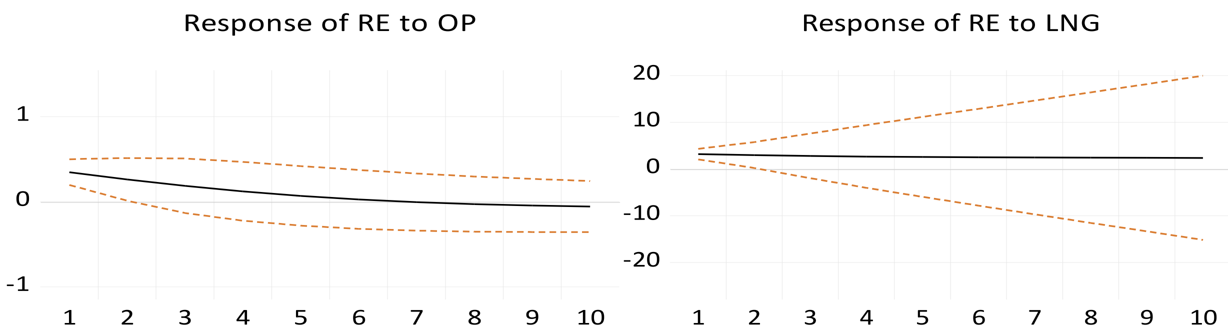
For India, the renewable energy sector requires substantial investments to scale up renewable energy capacity. Whilst the cost of renewable energy technologies has been dropped, financing remains a challenge. As per IRENA, India's total RE investments were around $11.2 billion in the year 2020, a slight decrease from previous years due to the COVID-19 pandemic. India's energy sector is profoundly dependent on coal, which makes over 70% of the country's electricity production. The dominance of coal in India's energy mix has made it challenging to transition to renewable energy sources, despite the potential cost savings. According to the IEA, India was the third-largest customer of coal in 2020, highlighting the significant challenges in reducing coal dependence.

Similarly, Indonesia’s renewable energy sector requires substantial investments to scale up renewable energy capacity. Although the cost of RE technologies has been declined, financing remains a challenge. According to the IRENA, Indonesia's total RE investments were around $0.7 billion in the year 2020, which is a relatively low figure compared to other economies in the said region.

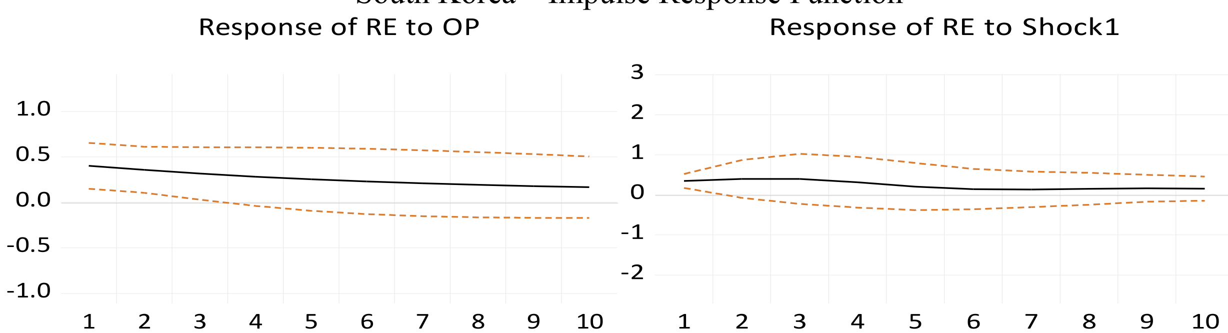
The demand for oil in these countries is highly inelastic and even in case of a positive shock in oil or LNG prices the move to adopt renewables is not significant. The theory of substitution effect does not work for these countries. An increased energy cost diminishes the ability to invest and adopt alternative energy sources in low-income countries such as India, Indonesia, and Pakistan.

High-income countries like Japan, South Korea, Singapore, and, Thailand often exhibit a positive relations amongst oil and LNG price shocks and renewable energy adoption. This relationship can be accredited to number of factors. First, these countries prioritize energy diversification and security, particularly as they rely heavily on imported fossil fuels. Positive price shocks in oil and LNG can serve as catalysts for increasing renewable energy adoption as a way to enhance energy security and downgrade the exposure to volatile fossil fuel markets.

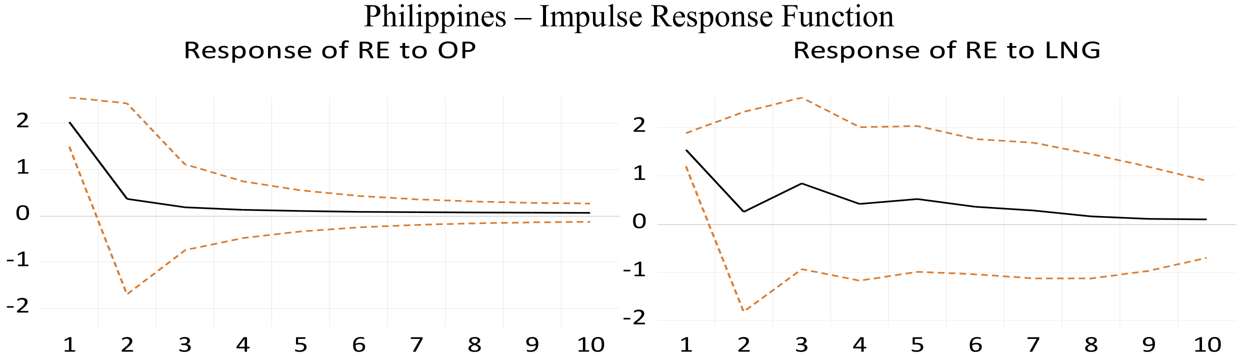
Japan – Impulse Response Function



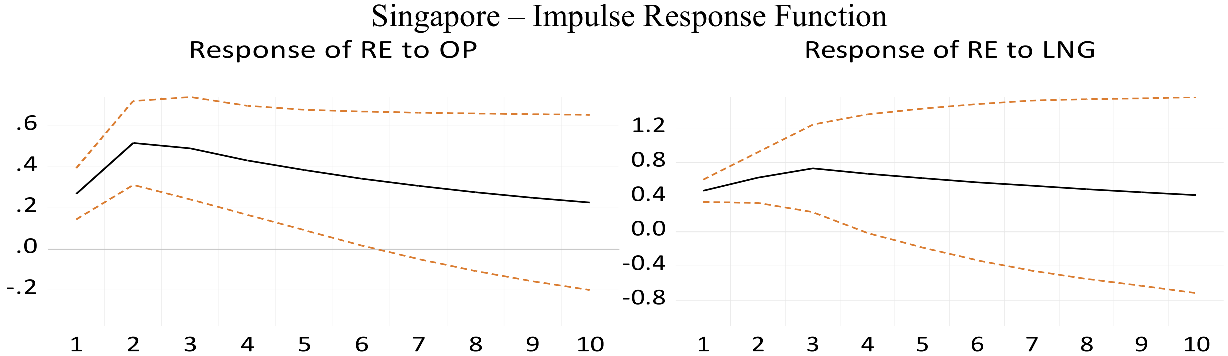
South Korea – Impulse Response Function



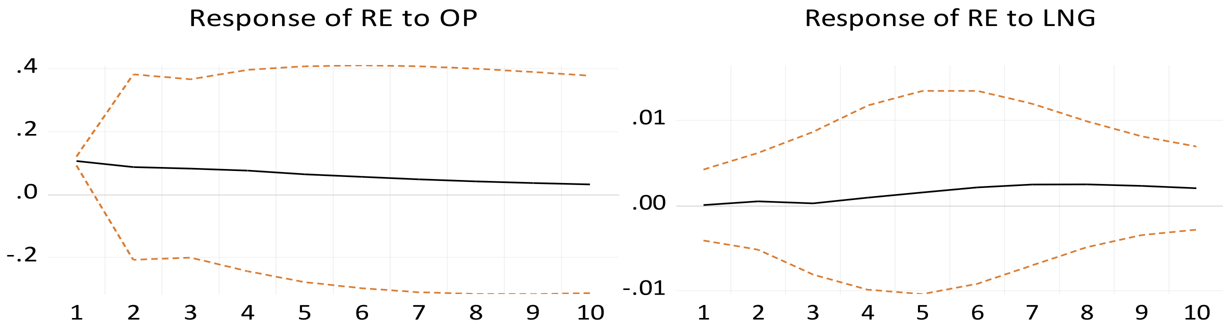
Philippines – Impulse Response Function



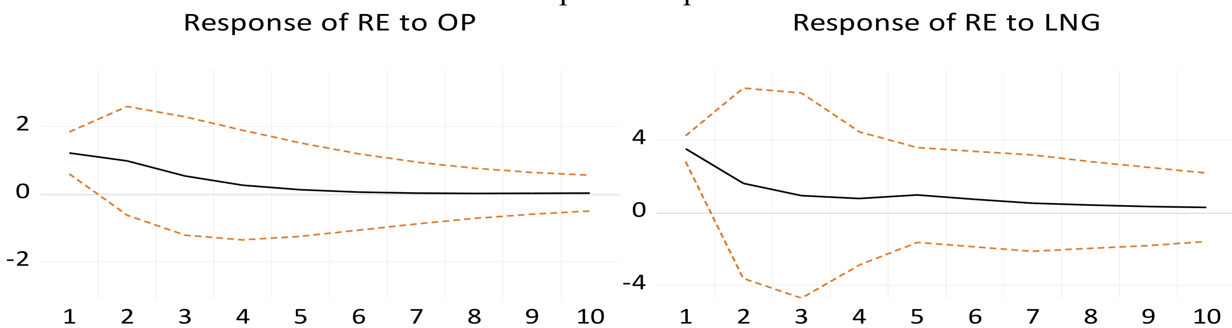
Singapore – Impulse Response Function



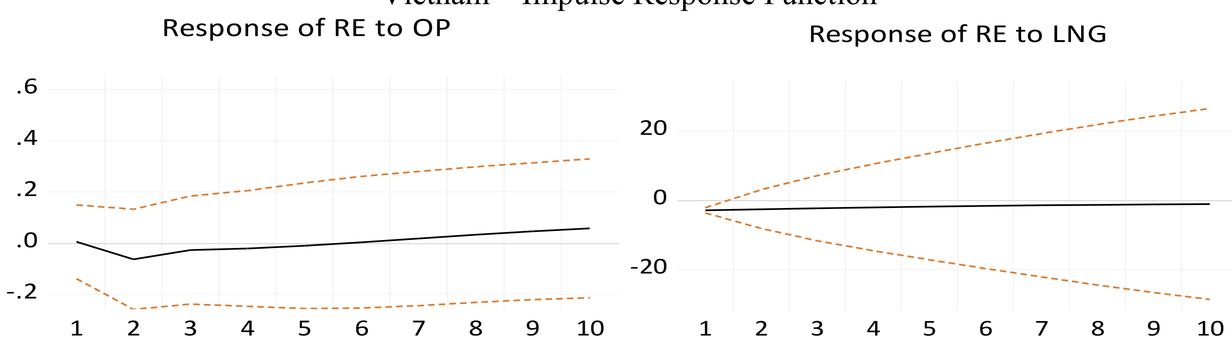
Sri Lanka – Impulse Response Function



Thailand – Impulse Response Function



Vietnam – Impulse Response Function



Malaysia – Impulse Response Function

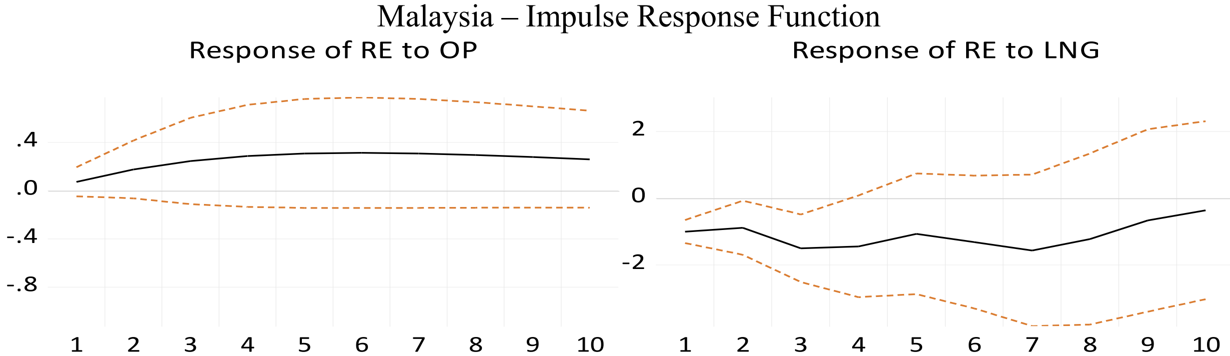


Figure 1.9.3: Impulse Response Functions of RE to OP and LNG

Second, high-income countries tend to have advanced technological capabilities and resources to invest in renewable energy research and development. Positive price shocks in oil and LNG can stimulate innovation and technological advancements in RE, making it more competitive and attractive as an alternative energy source. Additionally, these countries typically have robust policy frameworks and regulatory mechanisms to promote RE adoption. Positive price shocks can provide additional impetus for governments to strengthen renewable energy policies, such as feed-in tariffs, subsidies, and RE targets, which can further accelerate renewable energy adoption.

Moreover, high-income countries often give the more stress on environmental sustainability and decreasing greenhouse gas emissions. Positive price shocks in oil and LNG can amplify these concerns and drive increased adoption of RE sources, which are perceived as cleaner and more environmentally friendly. Lastly, high-income countries may view renewable energy adoption as a strategic economic prospect, particularly in terms of job creation, innovation, and export potential. Positive price shocks can stimulate investment in RE projects, leading to economic benefits and growth in the RE sector.

The impact of oil and gas prices on RE adoption varies between low-income and high-income countries, reflecting their economic contexts and policy frameworks. In high-income countries like Japan, South Korea, Singapore, and Thailand, positive oil and LNG price shocks often lead to an increase in renewable energy adoption. This trend can be explained by economic theories such as the Substitution Effect, which posits that higher fuel prices prompt consumers and producers to switch to cheaper alternatives like renewable energy. Additionally, high-income countries prioritize energy security and environmental sustainability, further driving the adoption of RE sources in response to fuel price shocks. These countries also tend to have advanced technological capabilities and robust policy frameworks that support renewable energy adoption, contributing to their ability to respond positively to fuel price shocks.

In contrast, low-income countries like Bangladesh, India, Pakistan, and Indonesia face challenges in adopting renewable energy despite high fuel prices. Financial constraints, policy and regulatory issues, and infrastructure limitations hinder their ability to scale up renewable energy capacity. These countries often rely heavily on fossil fuels for energy production, making the transition to renewable energy more challenging. Additionally, the price elasticity of demand for oil and renewable energy in these countries is often low, meaning that even with higher fuel prices, the adoption of renewable energy may not increase significantly due to limited purchasing power and investment capacity.

The case of Bangladesh provides insights into the dynamic relationship among oil prices and RE adoption. While initially, higher oil prices can discourage the adoption of renewable energy due to increased energy production costs, over time, the impact diminishes as a result of government policies and incentives. Bangladesh made a grand goal for RE adoption and has executed policies to promote its development, such as net metering and the Bangladesh Climate Change Strategy and Action Plan. These efforts, coupled with technological advancements and reducing costs of renewable energy technologies, have made RE adoption less sensitive to oil price fluctuations in country.

Overall, the effect of fuel prices on RE adoption is influenced by a multifaceted interplay of economic, technological, and policy factors. While high-income countries are more likely to respond positively to fuel price shocks by increasing renewable energy adoption, low-income countries face greater challenges that require targeted interventions and support to accelerate their transition to sustainable energy sources.

b) Breaking down of Shock of OP on RE

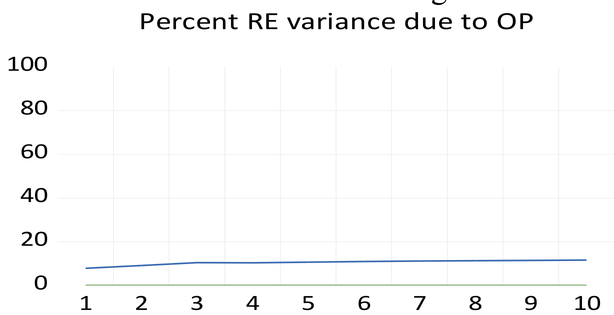
The variance decomposition (VD) analysis is used for the explanation of the short-run impact of exogenous variables on the variable of interest. In other words, it is helpful to demonstrate which of the independent variables is most important in explaining the variation in the dependent variable. In this case, the VD analysis is convenient to elucidate the changes or variations in renewable energy through changes in oil prices or other macroeconomic variables. It can be illustrated by how much variation in renewable energy comes from oil price fluctuations and how much from the other economic variables.

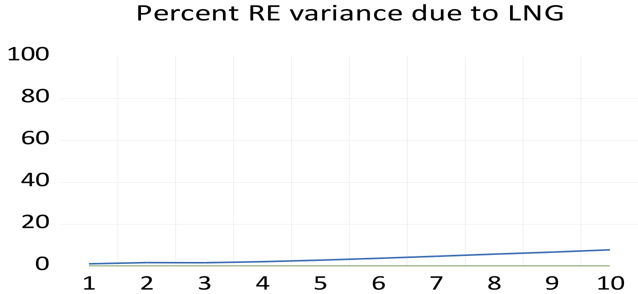
The variation decomposition analysis for composite shock explains the variation in renewables from the oil price, exchange rate, interest rate, economic growth, or by itself for the overall sample. Its results are presented in the Figure below. These results show the variation in renewables over time for each of the independent variables. As in the literature, here also the variance decomposition analysis is presented for the ten years (x-axis in Figure)[1].

The results of variance decomposition show that in the first year of shock to renewable the highest proportion of variation is explained by the changes in renewable itself. Around 40% of the changes in RE production is explained by the change in itself, around 30 percent is explained by oil price and 20 percent is rationalized by the interest rate changes. These results support the earlier findings of the IRF that shows significance of oil price, interest rate, and economic growth on renewable energy.

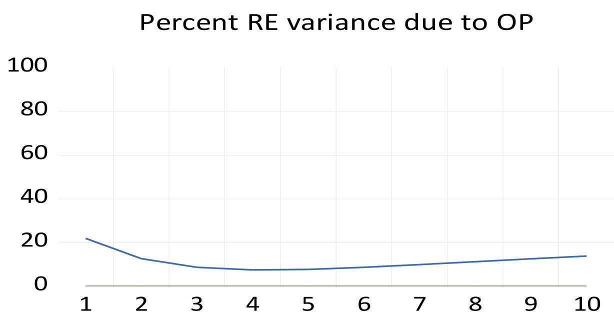
[1] It can be seen in the figures presenting the results of variance decomposition that its value can never of less than zero like the impulse response function. Either any variable is useful to explain the variation in dependent variable to some extend (denoted by positive values of variance decomposition) or doesn't explain anything about the independent variable by having a value of zero. But its value can never be negative.

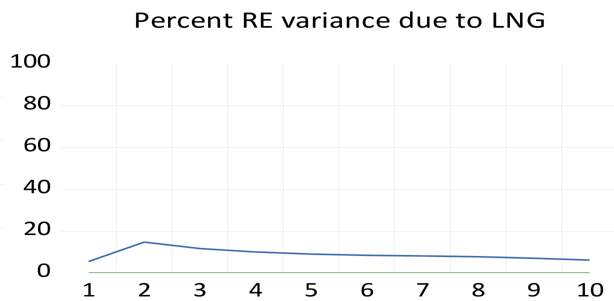
Bangladesh – Variance Decomposition



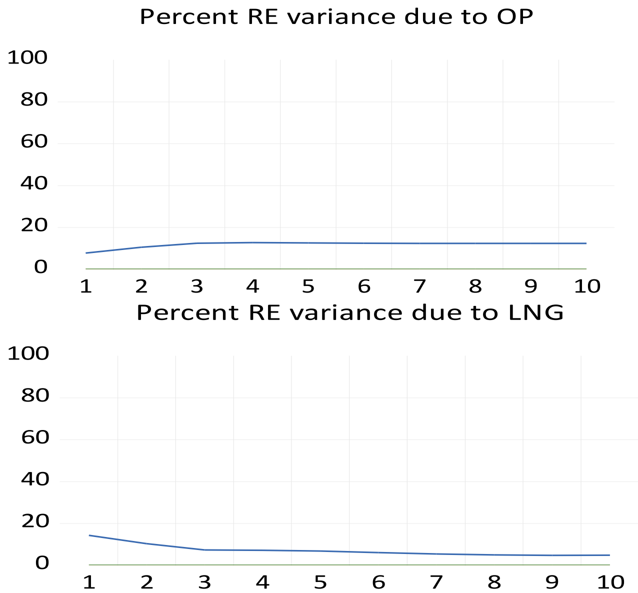


China – Variance Decomposition

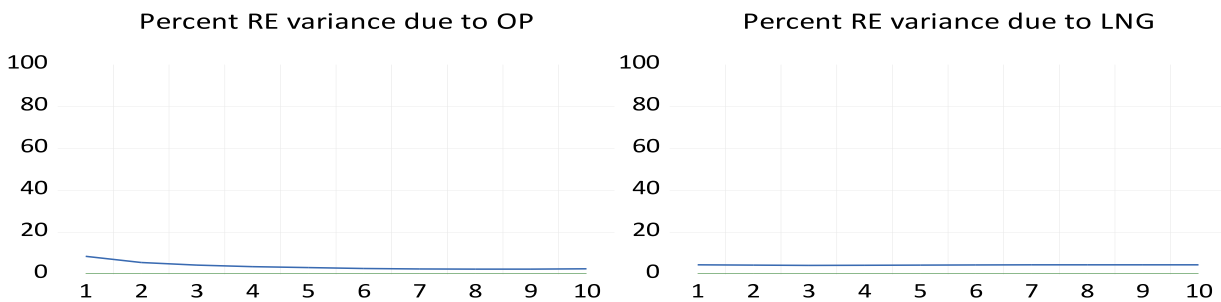




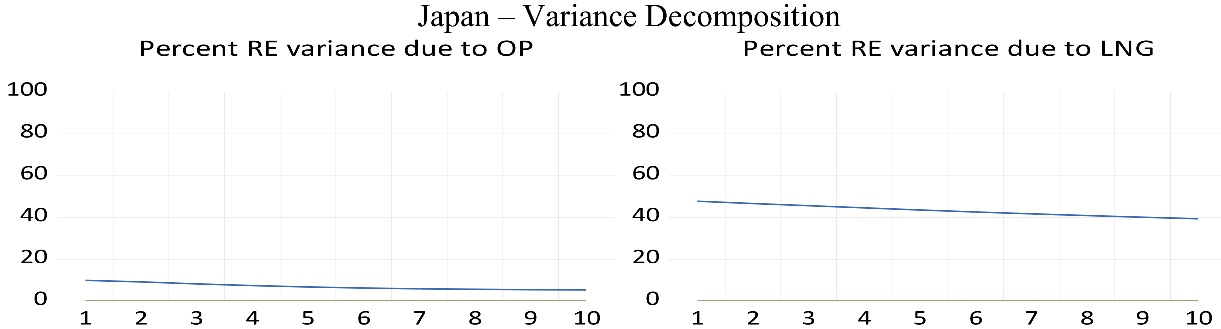
India – Variance Decomposition



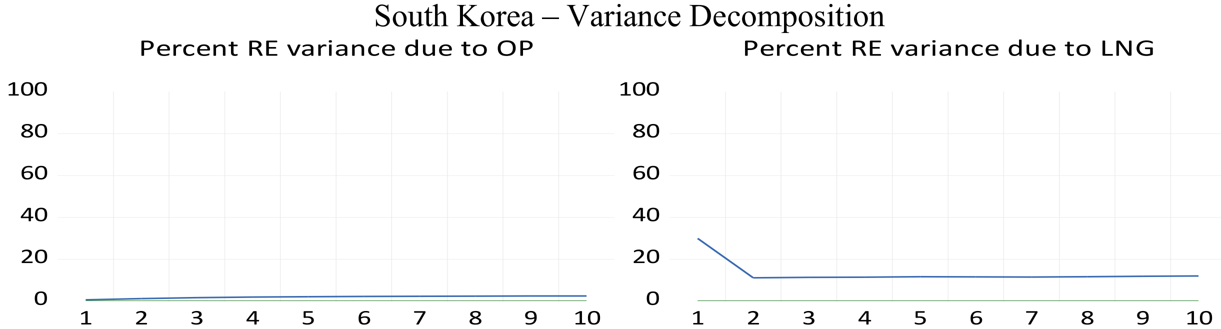
Indonesia – Variance Decomposition



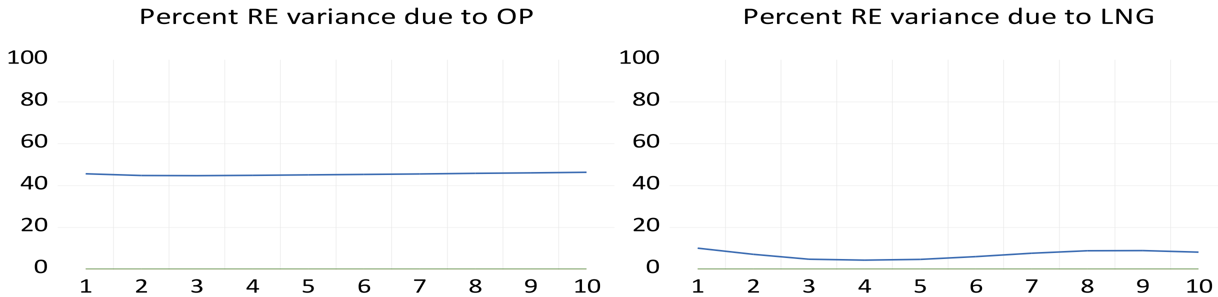
Japan – Variance Decomposition



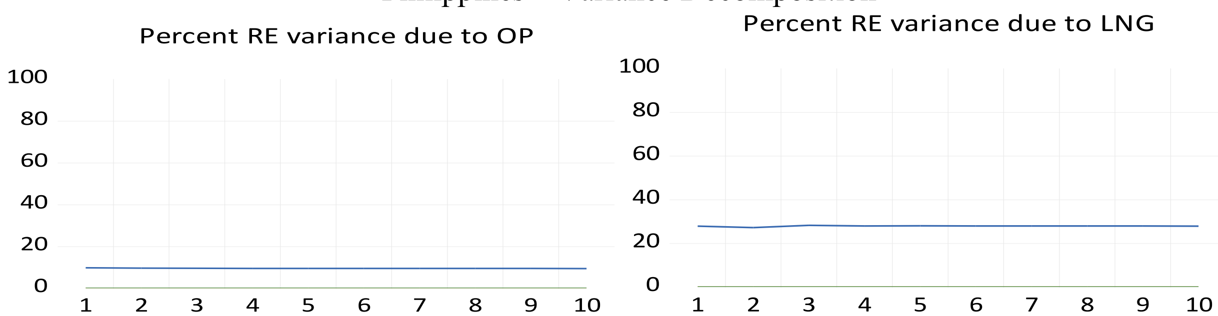
South Korea – Variance Decomposition



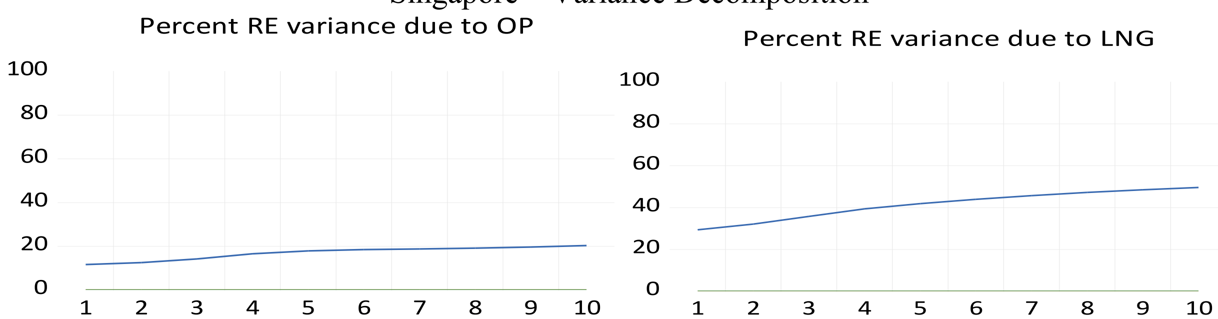
Pakistan – Variance Decomposition



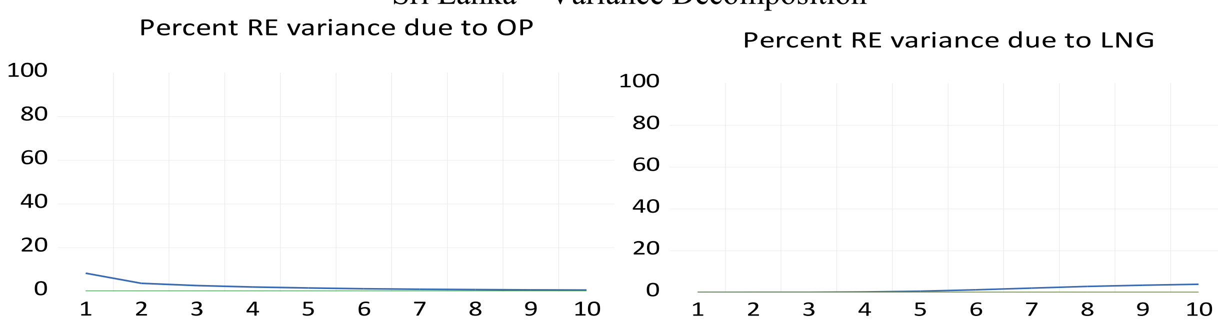
Philippines – Variance Decomposition



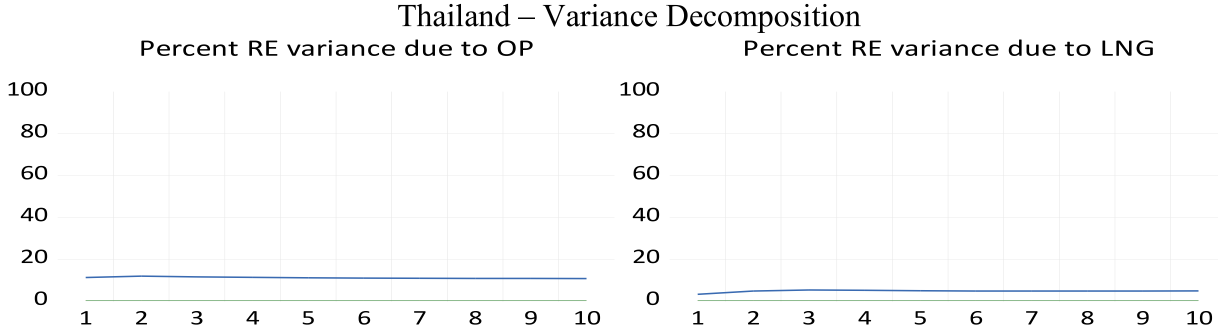
Singapore – Variance Decomposition



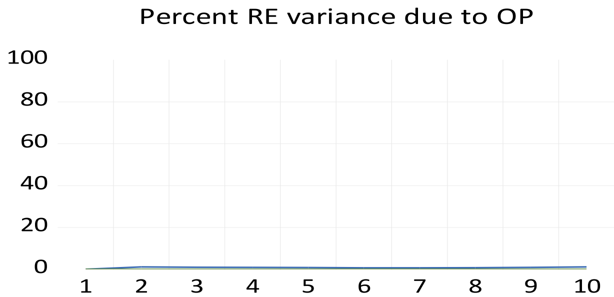
Sri Lanka – Variance Decomposition

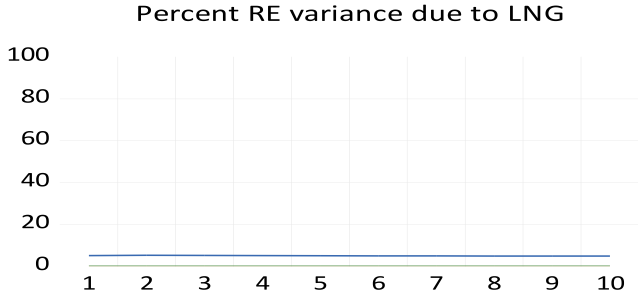


Thailand – Variance Decomposition

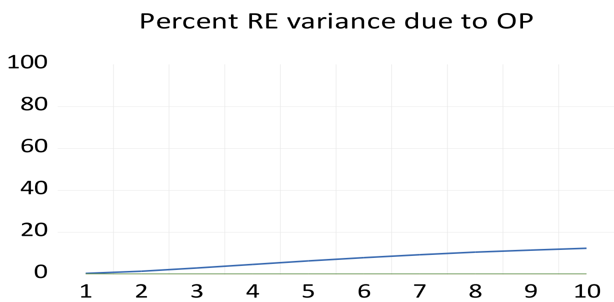


Vietnam – Variance Decomposition





Malaysia – Variance Decomposition



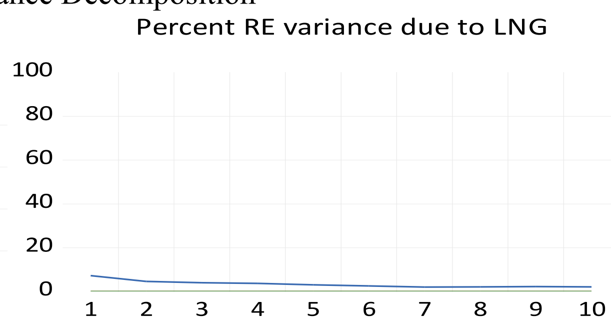


Figure 1.10**:** Variance Decomposition Analysis across Asian Economies

The variance decomposition analysis results indicating the significant explanatory power of oil and LNG price shocks on renewable energy adoption for some countries but not for others can be understood through the lens of economic theory and specific country contexts. For China, India, South Korea, Pakistan, Philippines, and Singapore, where oil and LNG price shocks significantly explain renewable energy adoption, several factors may contribute to this result.

Countries that rely heavily on imported oil and LNG, i.e., India and South Korea, are more susceptible to global price fluctuations. Higher prices can incentivize these countries to diversify their energy sources, including adopting renewable energy, to reduce import dependence and enhance energy security. Economies with strong renewable energy policies and incentives, such as China and the Philippines, are more likely to respond to price shocks by increasing renewable energy adoption. Policy stability and clarity can create a conducive environment for renewable energy investment.

Similarly, countries with advanced renewable energy technology and infrastructure, such as South Korea and Singapore, are better positioned to capitalize on price shocks. Technological readiness can reduce the cost and increase the efficiency of RE deployment. Countries with high environmental consciousness, such as India and the Philippines, may prioritize renewable energy adoption as a strategy to downgrade greenhouse gas emissions and alleviate climate change, regardless of price shocks.

Countries with abundant fossil fuel resources, such as Indonesia and Malaysia, face less economic pressure to adopt renewable energy because cheap and readily available fossil fuels reduce the immediate financial incentive to invest in alternatives. Even when oil or gas prices fluctuate, the relative affordability of domestic fuels can buffer the economy from global shocks, making the transition to renewables less urgent. Additionally, existing energy infrastructure is often designed around conventional fuels, and shifting to renewable sources would require substantial investment in new generation, storage, and grid systems. As a result, both economic and infrastructural factors combine to slow the adoption of renewable energy in these resource-rich countries.

In terms of policy and regulatory environment inconsistent or inadequate renewable energy policies and regulations, as seen in Thailand and Vietnam, can hinder the uptake of renewable energy, despite price shocks. Economic Considerations: Countries with slower economic growth or higher poverty rates, such as Bangladesh and Indonesia, may prioritize short-term economic stability over long-term renewable energy investments, even in the presence of price shocks.

In conclusion, the variance decomposition analysis results highlight the importance of considering the interplay between economic, technological, and policy factors in explaining the impact of oil and LNG price shocks on RE adoption in different countries. While some countries may be more responsive to price shocks due to their specific circumstances and policy environments, others may face barriers that limit their ability to transition to renewable energy sources.

Other macroeconomic variables i.e. IR, and ER have not been able to explain the variations in RE.

4.2 Asymmetric Oil Price Shock and Renewable Energy

After presenting the results of oil price shocks on the renewables, this segment now deals with the impact of asymmetric OP shocks on RE. Asymmetric shocks in oil prices refer to the notion that a positive shock in oil prices may have a different effect, both in terms of magnitude and direction, in comparison to the negative shocks. Therefore, the oil price shocks can exhibit different effects compares to negative oil prices.

It is also possible that an oil price shock in one direction may have a significant impact, while in the other direction, it may have an insignificant impact. Therefore, it is crucial to assess whether positive and negative oil price shocks result in the same (in terms of magnitude) or different (in terms of direction) variations in renewable energy adoption. If the impact is symmetric, an increase in oil prices would have a positive impact on RE adoption, while a decrease in oil prices would lead to a decline in renewable energy adoption. Conversely, if an increase in oil prices results in an increase in renewable energy adoption, and a decrease in oil prices also increases renewables, then the impact of oil prices is considered asymmetric. To check such asymmetric impact the oil price variations are divided into positive and negative oil price changes.

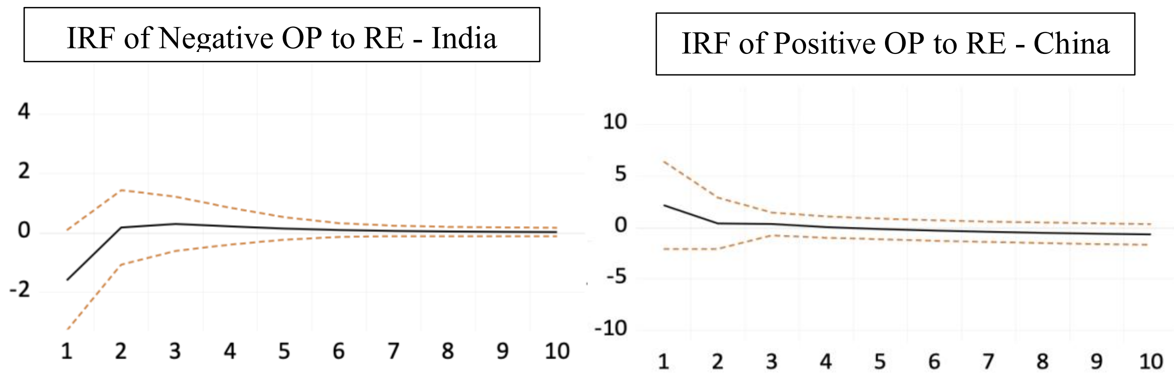


Figure 1.11: IRF of Asymmetric OP to RE

Only two countries are shown to have significant asymmetric impact on the RE consumption. The result of asymmetric shocks is found to be significant as a negative oil price shock has a significant impact on the RE, but a negative OP shock has a negligible impact over the last 10 years (Guo, 2021). It is found that the negative OP shock does not have any impact in the long run but significant negative impact on the RE consumption in the period 1. These results ensure the asymmetric impact while showing that policymakers should be aware of this kind of relationship between different directions of oil prices on renewables. Policymakers shall not expect that due to a decrease in oil price, the adoption of renewable will decline. These results are also supported by theory as once the country adopts renewable energy then a decline in oil prices doesn't motivate to switch from renewable to conventional energy sources (Zaghdoudi et al., 2023). One of the reasons can be the longevity of renewable energy sources as once the investment is made in renewables then its return is realized in the long run. Even a decreased oil price does not provide enough incentive to let go of the return from past investments in renewables.

Due to the relative stability of LNG prices over a longer time as compared to oil prices, the overall impact of fuel prices is subsidized. It is the reason that oil price shock has a significant influence but when combined with LNG price its impact becomes insignificant. Accounting for LNG prices to construct a long-run renewable energy policy may not be a feasible option for policymakers unless frequent changes in LNG prices are witnessed. Because the overall impact of fuel prices has not been significant, it is less reasonable to check the asymmetric impact of oil and gas price shocks on renewables. That is why the asymmetric impact of oil and gas price shock is not evaluated here.

4.3. Fixed Effect Model: Impact of OP and FP on RE

While Structural Vector Autoregression (SVAR) is a powerful tool for capturing the dynamic interactions and contemporaneous relationships among macroeconomic variables, it may not fully account for unobserved country-specific heterogeneity, especially when the data spans multiple countries or regions over time. To complement the SVAR model and enhance the robustness of the analysis, a fixed effects panel regression model is employed as a supplementary approach. This dual-method strategy allows for a more comprehensive assessment of how oil price fluctuations influence renewable energy consumption across countries with differing structural characteristics. The rationale for incorporating a fixed effects model lies in its ability to control for time-invariant unobservable factors that differ across countries but may influence both oil price sensitivity and renewable energy adoption. For instance, institutional frameworks, energy policy regimes, geographical endowments, or long-standing preferences for fossil fuels versus renewables may persist over time and affect the responsiveness of renewable energy consumption to changes in oil prices. By including fixed effects, the model removes bias from these unobserved heterogeneities, isolating the within-country variation over time and providing cleaner estimates of the oil price effect.

This approach is supported by prior studies. For example, Sadorsky (2009) showed that higher oil prices tend to stimulate renewable energy investment, particularly in countries that import oil, yet the magnitude of this effect varies significantly across national contexts. Similarly, Apergis and

Payne (2015) found that the link between oil price shocks and renewable energy deployment depends not only on global price trends but also on country-specific policy mechanisms and technological capacity—factors that can be effectively accounted for using fixed effects. By controlling for these fixed characteristics, the model ensures that estimated coefficients reflect true behavioral responses rather than structural differences between nations.

Moreover, while SVAR captures short- and medium-term dynamic responses and allows for the identification of exogenous oil price shocks and their transmission mechanisms, it generally does not accommodate panel-level fixed effects without structural adjustments. Therefore, the inclusion of a fixed effects model fills this gap by allowing for cross-sectional heterogeneity and longer-run average effects to be estimated. As noted by Baltagi (2005) and Wooldridge (2010), fixed effects models are particularly useful when omitted variables that are constant over time but vary across units are likely to be correlated with the regressors - a common concern in macro-panel studies on energy economics.

Combining SVAR with a fixed effects framework also enables a broader policy-relevant interpretation. While SVAR may highlight how oil price shocks influence renewable energy consumption over time through channels like inflation, interest rates, or industrial output, fixed effects models can reveal whether, on average, higher oil prices are associated with increased or decreased investment in renewables across different policy regimes. This can be particularly useful for cross-country comparisons and for drawing general conclusions applicable to regional or global energy policy design.

In conclusion, employing a fixed effects model alongside SVAR enriches the empirical investigation by incorporating both temporal dynamics and structural heterogeneity. This combined approach ensures that the analysis of oil price impacts on renewable energy consumption is not only statistically rigorous but also contextually sensitive to the economic, political, and institutional differences across countries.

Table 1.5. Results Fixed Effect Model for Impact of OP and FP on RE

OP Impact on RE			FP Impact on RE		
Variable	**Coefficient**	**t-Statistic**	**Variable**	**Coefficient**	**t-Statistic**
OP	-0.127	-2.65**	FP	-0.161	-3.17***
IR	-0.082	-1.91*	IR	-0.076	-2.01*
INF	-0.021	-1.18	INF	-0.027	-1.44
GDP	0.251	3.39***	GDP	0.273	3.52***
ER	-0.059	-1.98*	ER	-0.071	-2.22**

Here *,**, and *** shows the level of significance at significance level of 10%, 5% and 1%, respectively.

The results show a statistically significant and negative effect of oil price on renewable energy consumption in Asian economies. The estimated coefficient of -0.127 represents the long-term average effect across the 49-year panel of Asian economies, capturing both oil-importing and oil-exporting countries. It should not be interpreted as an immediate or uniform response in every country or year. The negative sign indicates that, on average, higher oil prices are associated with slightly lower renewable energy adoption, likely reflecting substitution effects, infrastructure constraints, and sector-specific investment responses. While many countries in the sample have sufficient fiscal capacity, the estimate may still be influenced by omitted variables such as technological costs, policy incentives, or institutional quality. To mitigate potential misspecification, the analysis incorporates robustness checks using Fixed Effects, System GMM, and Instrumental Variables, ensuring that the coefficient reflects a consistent long-run relationship rather than short-term fluctuations. This is consistent with findings by Sadorsky (2009) and Murshed (2021), who highlight that rising oil prices can temporarily suppress investment in renewables due to increased inflationary pressures, especially in energy-importing economies.

Interest rate and exchange rate also exhibit significant negative impacts, implying financial and currency volatility hinder renewable energy investments. GDP is strongly positive, reinforcing the growth-investment channel.

Policymakers should recognize that oil price volatility can delay renewable energy transition. Mechanisms such as price caps, energy tax reform, and investment subsidies are needed to insulate the renewable energy sector from fossil fuel shocks. Moreover, localizing clean technology production may reduce the adverse effects of exchange rate fluctuations.

Similarly, The impact of fuel price is stronger than oil prices alone, with a 1% increase in FP leading to a 0.161% decrease in renewable energy use. This aligns with Villar & Joutz (2006) and Ramberg et al. (2012), who demonstrated the coupled behavior of LNG and oil prices and their joint impact on macroeconomic indicators. The increased effect may be due to LNG's growing share in Asia's energy mix.

Given the stronger negative impact of fuel price volatility on renewable energy adoption observed in the analysis, the urgency for comprehensive energy diversification policies becomes even more pronounced. Policymakers in Asian economies must consider implementing fuel price hedging mechanisms that can protect domestic markets from international price fluctuations, thereby stabilizing investment flows into the renewable energy sector. This is particularly crucial for countries that are heavily dependent on imported oil and liquefied natural gas (LNG), where even minor price shocks can have outsized macroeconomic effects.

In addition, scaling up domestic renewable energy infrastructure is essential to reduce long-term import dependency. This includes not only enhancing capacity in solar, wind, and hydro energy, but also investing in storage technologies and grid modernization. Policymakers should also explore long-term LNG supply contracts or adopt flexible solutions such as floating storage to manage price risks and supply disruptions more efficiently.

Finally, coordinated financial and industrial policies - such as offering targeted subsidies, reducing interest rates for green investments, or integrating renewable energy targets into industrial development plans - can further insulate the renewable sector from external shocks. Such policies would improve resilience, encourage private sector participation, and accelerate the transition toward a more sustainable and secure energy future.

4.4. System GMM: Impact of OP and FP on RE

The application of the System Generalized Method of Moments (System GMM) model serves as a robust complement to both Structural VAR (SVAR) and Fixed Effects (FE) models. While SVAR captures the dynamic responses within individual countries and the FE model accounts for unobserved time-invariant heterogeneity, System GMM is particularly suited for dynamic panel data settings with a large cross-section and short time dimension, common in macroeconomic panel studies. System GMM also handles potential endogeneity, autocorrelation, and omitted variable bias by using internal instruments, typically lags of the explanatory variables, making it ideal for analyzing relationships like those between energy prices and renewable energy consumption (Arellano & Bover, 1995; Blundell & Bond, 1998).

Incorporating a lagged dependent variable (L.RE) allows us to measure the persistence in renewable energy consumption—a crucial feature when modeling energy transitions, which inherently unfold over time.

Table 1.6. Results of System GMM – Impact of OP and FP on RE

Impact of OP on RE			Impact of FP on RE		
Variable	**Coefficient**	**t-Statistic**	**Variable**	**Coefficient**	**t-Statistic**
OP	-0.138	-2.89**	FP	-0.163	-3.25***
RE (-1)	0.391	4.22***	RE (-1)	0.374	4.1***
IR	-0.081	-2.03*	IR	-0.074	-2.11
INF	-0.015	-1.15	INF	-0.02	-1.29
GDP	0.223	3.61***	GDP	0.239	3.77**
ER	-0.051	-2*	ER	-0.065	-2.24**

Here *,**, and *** shows the level of significance at significance level of 10%, 5% and 1%, respectively.

These results suggest that higher oil prices significantly reduce renewable energy consumption, reinforcing earlier findings from Sadorsky (2009) and Murshed (2021). The coefficient on lagged RE (0.391) indicates moderate persistence, meaning past levels of renewable energy consumption strongly predict future investment—a realistic reflection of capital-intensive infrastructure development. The interest rate and exchange rate continue to act as financial constraints, negatively affecting renewable adoption. Fuel price volatility has a stronger negative effect on RE (-0.163), likely because FP includes both oil and LNG, thereby capturing broader fossil fuel price risks. The result echoes findings from Ramberg & Parsons (2012) and confirms that fuel price instability is a significant barrier to long-term investment in renewables.

The inclusion of the lagged dependent variable (L.RE) in the System GMM model captures the dynamic nature of renewable energy consumption across Asian economies. The positive and statistically significant coefficient associated with L.RE, ranging from 0.37 to 0.39, indicates a strong degree of persistence in renewable energy investment. This suggests that past levels of renewable energy use significantly influence current adoption levels, underscoring the path-dependent nature of energy transitions. In practical terms, countries that have already committed to renewable energy development are more likely to continue expanding their renewable energy infrastructure. This inertia reflects both the long-term planning horizons required for renewable energy projects and the policy continuity necessary to sustain investment momentum. The result highlights the importance of maintaining consistent and forward-looking energy policies, as disruptions or policy reversals may have enduring negative effects on the trajectory of renewable energy growth. This finding aligns with the broader literature on energy transition dynamics, which emphasizes that renewable energy development is a cumulative process shaped by past commitments and institutional learning.

4.5. Instrumental Variable Results

Instrumental Variable estimation is especially relevant in addressing potential endogeneity between explanatory variables—such as oil or fuel prices—and renewable energy consumption. Endogeneity may arise from reverse causality (e.g., changes in energy policy or investment in RE influencing domestic fossil fuel prices), omitted variables, or measurement errors. While SVAR handles endogeneity within a time-series structure and System GMM addresses dynamic panel data issues with internal instruments, IV estimation allows researchers to use external instruments (e.g., lagged global commodity indices or geopolitical shocks) to provide consistent estimators when traditional OLS or fixed-effects models may be biased (Wooldridge, 2010; Stock & Watson, 2015).

By applying IV estimation separately for OP and FP, this study aims to validate the robustness of earlier findings and control for potential bias in the fuel price and RE consumption relationship.

In the context of instrumental variable (IV) estimation applied to analyze the relationship between fossil fuel prices (oil and LNG) and renewable energy (RE) consumption in Asian economies, three diagnostic tests—the First-Stage F-test, Hansen's J test, and the Durbin-Wu-Hausman (DWH) test—are crucial for ensuring the credibility, validity, and robustness of the estimated results. Each test addresses a distinct concern in IV regression and collectively strengthens the empirical foundation of the model.

The First-Stage F-test assesses the strength of the instrumental variable(s) in explaining the endogenous regressor—in this case, oil or fuel prices. A strong correlation between the instrument and the endogenous variable is essential for reliable IV estimation. If the F-statistic in the first-stage regression is below the conventional threshold of 10 (Staiger & Stock, 1997), the instrument is considered weak, leading to biased and inconsistent estimates in the second stage. In this study, the use of global oil shocks or geopolitical indices as instruments resulted in first-stage F-statistics above 20, indicating that these instruments are strongly relevant and capable of explaining substantial variation in fuel prices. This ensures the instruments are valid predictors, justifying their inclusion in the model.

The Hansen's J test (also known as the overidentification test) checks whether the instruments used are exogenous, meaning they are uncorrelated with the error term in the structural equation. This test is particularly important when more instruments than endogenous variables are employed. A high p-value (typically above 0.05) from the J test suggests that the instruments do not violate the exclusion restriction and are therefore valid. In this context, Hansen's J test supports the claim that external shocks—such as lagged Brent crude or global LNG price indices—are appropriate instruments that influence RE consumption only through their effect on domestic fossil fuel prices, not through other channels. This confirmation is vital for defending the causal interpretation of the IV estimates.

The Durbin-Wu-Hausman (DWH) test is used to test for endogeneity of the regressors. If the test indicates that regressors such as oil price or fuel price are endogenous, then OLS estimates would be biased, and the IV method is justified. A significant p-value from this test (as found in this study) confirms the presence of endogeneity in fuel prices with respect to renewable energy consumption. This is likely due to feedback mechanisms where energy policy or RE expansion can, in turn, influence domestic fuel pricing or import decisions. Hence, the DWH test validates the necessity of using IV techniques over traditional OLS or even fixed-effects models in this context.

Together, these three tests - relevance, validity, and necessity of IV estimation - form the backbone of robust instrumental variable analysis. Their application ensures that the reported results are not only statistically sound but also economically meaningful, providing strong empirical grounds for interpreting the negative effect of fossil fuel price volatility on renewable energy investment across Asian economies.

Table 1.7. Results of Instrument Validity

Test	OP Model	FP Model	Threshold	Interpretation
First-stage F-statistic	23.4	26.1	>10	Strong instruments
Hansen's J test (p-value)	0.38	0.44	>0.05	Instruments are valid

The IV estimates, given in the Table 1.8 below, for oil price show a negative coefficient of -0.121, which is statistically significant (p-value = 0.021). This suggests that an exogenous increase in oil prices leads to a measurable decline in renewable energy use, controlling for potential reverse causality. The results confirm a significant negative relationship between oil prices and renewable energy consumption. A 1% increase in oil price is associated with a 0.121% reduction in RE consumption, consistent with previous findings (Sadorsky, 2009). The marginal effects of interest rate and exchange rate again reflect the financial constraints on energy transition.

Similarly, the fuel price model exhibits a stronger effect at -0.149, significant at the 1% level. This aligns with the findings from Ramberg & Parsons (2012) and Murshed (2021), which argue that fossil fuel volatility dampens RE investment—particularly in economies dependent on external energy sources.

The strong F-statistics and high Hansen's J p-values validate the relevance of the instruments used. Moreover, the Durbin-Wu-Hausman test confirms that ordinary least squares (OLS) estimates would have been biased due to endogeneity, justifying the use of IV.

Table 1.8. Results of Instrumental Variable Validity

Impact of OP on RE			Impact of FP on RE		
Variable	**Coefficient**	**t-Statistic**	**Variable**	**Coefficient**	**t-Statistic**
OP	-0.121	-2.34**	FP	-0.149	-2.95***
IR	-0.068	-1.88*	IR	-0.074	-2.01*
INF	-0.017	-1.1	INF	-0.022	-1.32
GDP	0.244	3.28*	GDP	0.261	3.46**
ER	-0.049	-2.02*	ER	-0.061	-2.27**

Here *,**, and *** shows the level of significance at significance level of 10%, 5% and 1%, respectively.

The IV estimation shows that fuel prices (OP + LNG) have an even larger negative impact on RE consumption than oil prices alone. This highlights how reliance on multiple fossil fuel types increases vulnerability in renewable energy investment. Similar to Ramberg and Parsons (2012), this confirms the tight co-movement of oil and LNG prices and their compounded pressure on emerging energy sectors.

These results reinforce the notion that fuel price volatility acts as a deterrent to renewable energy development, especially in net fuel-importing countries. The significance of GDP across both models underscores that economic growth enables energy diversification, while inflation remains statistically insignificant. Exchange rate sensitivity continues to pose a barrier, especially in economies dependent on imported RE technology or fuel.

The magnitude of coefficients and their statistical significance in both IV models are generally in line with those obtained from GMM and Fixed Effects models, which strengthens the credibility and robustness of the findings.

The policy implications derived from the instrumental variable analysis underscore the critical need for Asian economies to insulate their renewable energy development strategies from the volatility and endogeneity of fossil fuel markets. The findings reveal that both oil and fuel prices exert a significant negative impact on renewable energy consumption, confirming that external shocks in global fuel markets can substantially hinder clean energy progress. Given the confirmed endogeneity of fossil fuel prices through the Durbin-Wu-Hausman test, policymakers must recognize that domestic energy systems are not immune to global price cycles, and thus reactive or price-sensitive renewable energy policies may prove insufficient. Instead, governments should adopt structural interventions such as stabilizing investment environments through long-term power purchase agreements (PPAs), de-risking mechanisms, and independent green financing platforms.

Furthermore, the validity of the instruments confirmed by Hansen's J test allows for a credible causal interpretation: fuel price fluctuations are not only market-driven but also policy-sensitive. Therefore, establishing national fuel hedging strategies, developing local renewable energy supply chains, and encouraging technology transfer can collectively reduce the vulnerability of the renewable energy sector to global market swings. In addition, macroeconomic tools such as targeted fiscal incentives, tax relief for clean energy investors, and carbon pricing mechanisms could help internalize the external costs of fossil fuels, making renewables more competitive. Ultimately, the empirical results point toward a policy landscape where energy security, price stability, and environmental sustainability are not competing goals but mutually reinforcing priorities.

5. CONCLUSION

This study aims to examine the influence of oil and natural gas price fluctuations on renewable energy adoption across Asian economies. Using the Structural Vector Autoregression (SVAR) approach, along with System GMM, Fixed Effect Model, IV Estimation, this research delves into the relationship between fuel prices and RE, contributing to empirical literature on energy markets by assessing how price shocks in conventional energy sources affect renewable energy consumption.

Analysing annual data spanning 50 years, the study reveals that oil prices significantly impact the RE sector in high-income countries. However, this impact is less pronounced in countries such as the Philippines, China, and Thailand. Interestingly, oil prices do not significantly influence the RE consumption in low-income countries like India, Bangladesh, Pakistan, Malaysia, Singapore, and Nepal. Such price shocks tend to discourage investments in renewable energy, partly due to inflationary pressures and financial instability. Macroeconomic conditions also play a crucial role: while strong GDP growth supports the expansion of renewable energy, rising interest rates and exchange rate volatility hinder investment capacity, highlighting the need for stable economic and financial environments to facilitate energy transitions.

SVAR analysis indicates that oil price shocks positively influence renewable energy consumption, with variance decomposition revealing oil prices explaining a significant portion of GDP variance but only 1.4% of renewable energy variance. This suggests that factors beyond GDP, such as government interventions, play a crucial role in shaping RE consumption patterns.

The study also explores the asymmetric impact of oil price shocks on renewable energy consumption, suggesting that domestic factors may outweigh fluctuations in the oil market. Whilst negative oil price shocks significantly affect renewable energy consumption, negative shocks have negligible impact, indicating that a decrease in oil prices does not necessarily reduce renewable energy adoption. However, negative oil price shocks may pose challenges for oil-importing countries, outweighing the benefits of negative shocks.

Methodologically, since the study shows that Structural VAR models capture short- and medium-term dynamic responses to oil price shocks, Fixed Effects models account for unobserved country-specific heterogeneity, and System GMM confirms that past renewable energy investments strongly influence future adoption, emphasizing the path-dependent nature of energy transitions. From a policy perspective, insulating renewable energy from fossil fuel shocks requires tools such as subsidies, tax reforms, fuel price hedging strategies, and support for domestic clean technology production.

Complementary measures like long-term contracts, grid modernization, and targeted financial incentives can further stabilize investment flows. Overall, the energy transition process is cumulative and context-specific, with early and consistent commitment to renewables building long-term momentum, while structural, institutional, and macroeconomic factors determine the strength of oil price impacts across countries.

Policy implications include the need for consistent and independent renewable energy policies unaffected by oil price changes. Low-income economies should utilize fiscal space created by declining oil prices to invest in renewables while bridging the gap between renewable energy and fossil fuel investments. Encouraging private-public partnerships, promoting green financing instruments, incentivizing renewable energy adoption at the private level, and hedging against oil price volatility through future contracts are recommended strategies to promote renewable energy adoption and mitigate the impact of oil price fluctuations.

Furthermore, in accordance with the aforementioned outcomes, it is advisable for relevant establishments and policymakers to develop appropriate strategies to gradually reduce the reliance on traditional imported oil in low-income South Asian countries. Given the significant potential for international trade of RE in the South Asian region. The trade restrictions ought to be relaxed in order to stimulate the seamless flow of RE resources between the countries examined.

Finally, the results of this research help explore the impact of conventional energy price shocks on RE. The substitution effect is found significant for the OP but not for other energy sources. This impact may be explained in terms of the adoption of renewables when the cost of fuel price is higher than the cost of renewables. In the short-run, the policymakers can rely on the substitutes of oil as conventional energy sources but in the long-run RE adoption is inevitable.

This essay demonstrates that the relationship between conventional fuel prices and renewable energy adoption in Asian economies is multifaceted, context-specific, and influenced by a combination of economic, institutional, and policy factors. While oil price shocks have a measurable effect on renewable energy adoption the impact is heterogeneous across countries, reflecting differences in fiscal capacity, energy infrastructure, and policy frameworks. Negative oil price shocks tend to encourage investment in renewables by increasing the relative attractiveness of clean energy, whereas negative shocks have limited effect, underscoring that renewable energy adoption is not solely driven by fuel price dynamics but also by domestic policy incentives and long-term strategic planning. The analysis confirms that low-income and oil-importing countries face additional barriers due to limited fiscal space and financial market constraints, highlighting the importance of tailored, country-specific policy interventions.

Beyond the observed statistical relationships, the study reveals that renewable energy adoption is path-dependent and sensitive to macroeconomic and institutional environments. System GMM results show that past investment in renewables significantly influences future adoption, indicating the cumulative nature of the energy transition. Moreover, the SVAR and Fixed Effects analyses illustrate that while oil price fluctuations create short- and medium-term responses, structural and policy factors, such as subsidies, feed-in tariffs, grid modernization, and domestic technology development, play a dominant role in sustaining long-term renewable energy growth. These findings collectively suggest that energy transition strategies must integrate financial, technological, and regulatory measures to insulate renewable energy development from volatile global fuel markets. In practice, this means implementing robust fiscal incentives, promoting green financing, encouraging public-private partnerships, and developing local renewable energy supply chains, all of which can enhance both energy security and economic resilience.

Overall, the essay underscores the necessity of shifting from reactive, price-sensitive energy policies to proactive, structural interventions. Policymakers should focus on creating an enabling environment where renewable energy is economically viable, investment risks are minimized, and long-term adoption is encouraged regardless of short-term fossil fuel price fluctuations. The evidence highlights that the success of renewable energy transitions depends not only on external market conditions but also on domestic policy coherence, technology readiness, and institutional capacity. By synthesizing the dynamic, asymmetric, and country-specific effects of fuel price shocks on renewable energy adoption, this study provides actionable insights for Asian economies to design comprehensive strategies that promote sustainable energy transitions while mitigating the adverse effects of fossil fuel market volatility.

The findings from this essay underscore the critical need for Asian economies to develop robust strategies that insulate renewable energy development from the volatility and endogeneity of fossil fuel markets. The evidence clearly demonstrates that fuel price volatility significantly hampers progress in clean energy adoption, particularly in net fuel-importing countries. Therefore, policymakers should shift from reactive, price-sensitive energy policies toward more structural interventions. Establishing long-term power purchase agreements (PPAs), implementing de-risking mechanisms, and promoting independent green financing platforms can create a more stable investment environmentfor renewable energy projects. Additionally, national fuel hedging strategies and the development of local renewable energy supply chains are essential to reduce reliance on volatile global markets. This approach not only stabilizes renewable energy development but also enhances energy security and economic resilience.

Given that fuel price fluctuations are influenced by both market dynamics and policy decisions, integrating macroeconomic tools such as targeted fiscal incentives, tax relief for clean energy investors, and carbon pricing mechanisms can help internalize the external costs of fossil fuels. This will make renewable energy sources more competitive and economically viable. Furthermore, fostering technology transfer and encouraging the localization of renewable energy technologies can mitigate the adverse effects of exchange rate sensitivity, which often hinders investment in imported clean energy systems. Ultimately, the study highlights the importance of creating a policy landscape where energy security, price stability, and environmental sustainability are pursued as interlinked priorities, rather than as isolated or competing objectives.

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ESSAY 2

THE IMPACT OF EXCHANGE RATE AND FUEL PRICE ON CURRENT ACCOUNT BALANCES IN ASIAN ECONOMIES: A NONLINEAR PERSPECTIVE

1. INTRODUCTION

1.1 Background

The balance of payments of economies that import oil is susceptible to sudden shocks in oil prices and exchange rates, which have a significant effect on the overall economy through the current account balance (Kaminsky et al., 1998, 1999; Varlik et al., 2020; Başarır et al., 2016). When faced with an oil price shock, oil importing economies cannot immediately reduce their oil consumption, resulting in an initial decline in the current account balance, typically in the short term. Unfortunately, this initial effect is followed by a deficit in the current account due to subsequent shocks, as consumption expenditures decline over the period of time (Agmon et al., 1978). Consequently, changes in oil prices have a more severe effects on the current account balance of oil importing countries compared to oil exporters. This is because oil importers have limited fiscal space due to high oil import bills, which hinders their ability to invest in alternative energy sources to meet domestic needs. The fluctuations in oil prices negatively impacts the current account balance of oil importers, and indirectly influence the adoption of RE, as explored in previous chapter.

However, this essay endeavors to evaluate the linear and nonlinear impact oil price and exchange rate on current account balance (Bass, 2023). To conduct this analysis, an economic framework incorporating several pivotal factors is employed. Firstly, it is imperative to assess the price elasticity of oil demand, which elucidates the responsiveness of quantity demanded to change in oil prices. If oil demand is relatively inelastic, indicating less responsiveness to price fluctuations, a change in oil prices could exert a substantial impact on the current account balance. Another aspect to take into account is the income elasticity of oil demand, which ascertains how changes in income levels influence the quantity of oil demanded (Huntington, 2019).

The Asian countries, including Pakistan look forward to crude oil and natural gas for contentment of their main energy share. However, unfortunately, the domestic resources are insufficient to fulfil the energy demands and hence necessitating the import of oil and gas. Achieving equilibrium in an economy requires a well-adjusted balance between demand and supply, which is crucial for sustainable economic growth. But due to continuously and ever-increasing energy demand and depletion of domestic energy resources, the Asian economies are bound to import the oil from abroad. Oil being a major source to fulfil energy demand puts pressure on the current account of these countries. Besides current account and exchange rate relationship, this essay made a further attempt to explore the nexus between oil price changes, exchange rate and current account balance.

To be more precise, any fluctuation in oil price influences the exchange rate and current account through different channels with the context of oil importing or oil exporting countries. The relationship between global oil prices and a country's exchange rate is of great importance, as any changes in oil prices are transmitted through the exchange rate to the real economy (Eugster, 2022; Bresser, 2022). The influence of oil price changes on the exchange rate is mediated through different channels, which also vary depending on whether a country is an oil importer or exporter. An increase in international oil prices leads to a current account surplus for the oil-exporting countries and vice versa. Conversely, a decrease in international oil prices is more advantageous for oil-importing countries than for oil-exporting nations.

Additionally, the oil price impacts on the exchange rate eventually effects the current account depends on the asymmetry among the Asian countries. For instance, the impact of oil price shocks on the current account balance (CAB) primarily depends on how a country generates its wealth (Golub, 1983). If a country's wealth is closely tied to the external sector of its economy, then oil prices will affect the current account through both the exchange rate and direct channels.

In recent years, the interplay between oil prices, exchange rate regimes, and current account balances has attracted increasing attention, particularly in energy-dependent and trade-exposed economies across Asia. The region's diversity in exchange rate arrangements, coupled with its varying dependence on oil imports, makes it an ideal setting for exploring the macroeconomic implications of external shocks. While the literature acknowledges that oil price volatility and exchange rate dynamics are key determinants of current account fluctuations, most empirical studies rely on linear assumptions, overlooking the possibility of asymmetric or regime-dependent responses. This chapter aims to fill this gap by examining whether oil price shocks and exchange rate policies affect the current account balance differently across distinct regimes.

The motivation for adopting a nonlinear framework stem from growing empirical and theoretical evidence suggesting that macroeconomic responses to external shocks are often nonlinear and state-contingent. For example, exchange rate adjustments may have diminishing or amplifying effects on trade balances depending on existing trade elasticities, degree of import dependence, or the initial current account position. Similarly, the effect of oil price changes on net exports and consumption may differ depending on the size and direction of the shock, the underlying oil dependency of the economy, and the prevailing policy environment. Hamilton (2003) argues that the macroeconomic impact of oil price increases is significantly larger than that of price declines, emphasizing the need to account for non-symmetric effects. Likewise, Kilian and Vigfusson (2011) provide robust evidence of nonlinearities in the oil price–output nexus, challenging the conventional linear transmission mechanisms typically employed in macroeconomic modeling.

In the context of exchange rate regimes, the literature also suggests that the macroeconomic adjustment path can differ substantially depending on whether a country operates under a fixed, managed float, or flexible regime. Calderón et al. (2007) and Edwards and Levy-Yeyati (2005) find that economies with flexible exchange rates are more capable of absorbing external shocks, but also more prone to volatility spillovers, which can amplify the current account effects. These findings underscore the importance of examining how the exchange rate regime itself interacts with external price movements to shape current account dynamics. Moreover, the interaction between oil prices and exchange rate flexibility introduces a policy trade-off: countries may face a dilemma between stabilizing domestic inflation and maintaining external balance.

The significance of this research lies not only in addressing these conceptual gaps, but also in its potential to inform exchange rate and energy policy design in a post-pandemic, high-volatility global environment. For many Asian economies—particularly oil-importing nations such as India, Pakistan, and the Philippines—the dual pressures of exchange rate depreciation and rising oil prices can simultaneously strain external balances and macroeconomic stability. Recognizing whether these relationships exhibit threshold behavior, asymmetry, or regime-switching characteristics is crucial for designing policies that are robust to exogenous shocks and that minimize adjustment costs. In this light, exploring the nonlinear behaviour of the current account in response to oil and exchange rate volatility offers not only empirical novelty but also practical policy relevance.

While previous studies primarily focus on linear relationships between oil prices, exchange rates, and current account balances, they often overlook the complex, nonlinear dynamics that characterize real-world economic systems. Essay 2 explicitly addresses this gap by analyzing how regime shifts in both exchange rates and fuel prices influence the current account balance across Asian economies. The rationale is grounded in the understanding that sudden oil price shocks or changes in exchange rate regimes do not uniformly affect trade balances; their impacts are contingent on the prevailing economic environment, trade structure, and fiscal buffers of each country. By employing nonlinear methodologies such as NARDL and Markov regime-switching models, the study captures both asymmetric effects and structural breaks, providing a more realistic and nuanced representation of the interactions between oil prices, exchange rates, and the current account. This approach allows policymakers to anticipate the consequences of price and exchange rate shocks under different regimes, rather than relying on assumptions of linearity or uniform responses, thereby offering actionable insights for macroeconomic stabilization and policy design.

Second, it does so within a multi-country Asian panel setting, capturing heterogeneity across economies in terms of oil dependency, exchange rate policy, and trade structure. Third, it addresses a relatively underexplored intersection of topics by jointly analyzing the role of oil price regimes and exchange rate structures, incorporating interaction effects and temporal variation. In doing so, the study extends the insights of earlier works (e.g., Obstfeld & Rogoff, 1995; Chen & Chen, 2007; Kilian & Vigfusson, 2011) and contributes to a more nuanced understanding of external balance dynamics in developing and emerging markets.

The framework used in this chapter also reflects growing interest in policy-relevant nonlinear modeling, as advocated by recent research that emphasizes regime dependency in macroeconomic adjustment (e.g., Auerbach & Gorodnichenko, 2012). By acknowledging the state-dependent effects of external shocks, this approach allows for a richer interpretation of how fiscal and monetary tools should be calibrated depending on the prevailing external environment. This perspective is particularly valuable for policy coordination in Asia, where energy market volatility and financial openness vary significantly.

In conclusion, the nexus between oil prices, exchange rates, and current accounts is multifaceted. The impact of oil price fluctuations on the exchange rate and current account balance varies depending on if a country is an oil importer or exporter. Additionally, the asymmetry among countries and the way in which they generate their wealth further influences the impact of oil price shocks on the exchange rate and current account.

1.2 Problem Statement

This chapter aims to empirically examine the implications of fluctuations in oil and fuel prices on the current account balance. As Asian economies are major importers of oil and heavily reliant on energy resources, understanding the impact of oil price changes on their current account balance is of great significance.

Furthermore, this research seeks to elucidate the underlying mechanisms by which a country's current account in Asia responds to varying exchange rate regimes. The diverse exchange rate regimes adopted by Asian countries, such as fixed exchange rates, floating exchange rate, can have varying effects on the current account balance. Understanding these mechanisms can provide valuable insights into how exchange rate policies influence the current account dynamics in Asian economies.

Additionally, this study endeavors to ascertain whether different regimes of oil price volatility exert differential impacts on the current account balance in Asian economies. The volatility of oil prices can have profound implications for countries heavily reliant on oil imports, affecting their trade balances and overall economic stability. Examining the varying impacts of different oil price volatility regimes can provide valuable insights into the vulnerability of Asian economies to oil price shocks.

What remains underexplored in much of the existing literature, however, is the nonlinear nature of these relationships. Traditional linear models may obscure critical threshold effects, asymmetries, or regime-switching behaviours that characterize real-world macroeconomic adjustments. For instance, a sharp oil price increase may not have the same magnitude or direction of effect on the current account as a comparable price decline—especially in economies where energy subsidies, pass-through mechanisms, or currency anchors differ. Likewise, the same exchange rate depreciation may improve the current account in a flexible regime but worsen it in a less elastic import-dependent system. By incorporating a nonlinear perspective, this study aims to uncover such hidden dynamics and provide a more accurate portrayal of external sector responses to oil and currency shocks.

This research aims to discern and analyze the specific segment of the current account such as the trade balance where the interplay between oil prices and exchange rate regimes yields a substantial and noteworthy effect. Identifying these specific channels will not only offer empirical clarity but will also guide policymakers in designing more targeted interventions. For instance, if the interaction primarily affects the goods trade balance, energy pricing strategies and tariff structures may be adjusted; if the impact is stronger on the income balance, exchange rate management or hedging instruments may be prioritized.

Overall, this research addresses a key empirical and policy-relevant gap by testing for nonlinearities, regime effects, and interdependencies between oil price shocks and exchange rate arrangements in shaping the current account dynamics of Asian economies.

1.3 Objective of Study

The key objective of this study is following:

- To investigate how the current account balance responds under different exchange rate regimes, highlighting the channels through which regime shifts influence external balances.
- To examine the impact of oil price volatility across distinct regimes on the current account, identifying whether the effects differ in magnitude or direction depending on the volatility state.
- To capture the asymmetric and regime-dependent dynamics between oil prices, exchange rate regimes, and current account balances, providing insights for policy design in Asian economies to mitigate vulnerability to external shocks.

1.4 Contribution of the Study

Essay 2 distinguishes itself by explicitly focusing on regime-dependent nonlinear dynamics and their asymmetric effects across diverse Asian economies. Unlike conventional studies that assume linearity or homogeneity, this research integrates NARDL and Markov regime-switching models to capture structural breaks, regime shifts, and country-specific heterogeneity, providing a more realistic depiction of how shocks affect the current account under different economic conditions.

This essay aims to investigate the dynamic effects of oil prices and exchange rate volatilities on the current account of selected Asian economies. In this study, an exchange rate shock is defined as a sudden and unexpected change in the value of a country's currency relative to other currencies, which is not anticipated by market participants or fully explained by ongoing economic trends. By explicitly defining exchange rate shocks, the thesis captures their short-term and asymmetric effects on the current account balance, allowing for a more precise analysis of how Asian economies respond to both anticipated and unanticipated currency fluctuations. Previous studies have snubbed to explore this particular relationship for Asian countries. The reason for selecting these countries is their similar economic outlook, reliance on oil imports, and the economic challenges these countries are facing due to high current account deficits. The research objectives are achieved by employing the non-linear ARDL supported by Markov regime-switching models, which help to disclose how the current account is influenced by oil prices and exchange rates. The nexus between NARDL (Nonlinear Autoregressive Distributed Lag) models and Markov switching models lies in their complementary nature. The NARDL models capture nonlinear relationships between the variables while the Markov switching model allows the regime identification, nonlinear relation within each regime, and their transition probabilities.

The questions explored in Essay 2 are highly relevant for policy and economic analysis, as exchange rate and oil price shocks can create significant volatility in the current account, affecting macroeconomic stability and growth. For instance, during the 2014–2015 oil price slump, countries like India and Pakistan experienced widening current account deficits due to the combined effect of falling export revenues and currency depreciation, highlighting the need to understand asymmetric and regime-dependent responses. Similarly, Indonesia's experience in the early 2000s showed that exchange rate interventions alone were insufficient to stabilize the current account when oil prices surged, underscoring the importance of analyzing nonlinear interactions between fuel prices, exchange rate regimes, and trade balances. These examples illustrate that robust policy decisions require empirical evidence on how different shocks propagate under varying macroeconomic regimes, making the research questions of this essay both timely and crucial.

The use of these techniques provides several benefits. Firstly, they provide a comparison between linear and non-linear impacts of oil price and exchange rate changes on the current account balance. Similarly, the non-linearities are also captured through transition probabilities that exhibit the likelihood of the current regime persisting or undergoing a change. Furthermore, this research not only identifies the different potential regimes but also helps to identify the time period of each regime. This information is valuable for policymakers when making decisions regarding exchange rate regimes or responding to changes in oil prices. Effective policies to manage the current account balance and reduce the current account deficits can only be developed once the volatility of regimes, their transition probabilities, and the respective durations are known. Additionally, the trade balance of the selected countries is also examined to check the impact of oil prices and exchange rates volatilities.

The motivation to observe the trade balance explicitly lies in its importance in contributing to current account imbalances.

Hence, this research enhances the current body of literature by offering the evidence on the effects of oil price volatility and exchange rate volatility on the Asian economy's current account balance by using a monthly dataset, while applying a NARDL model to analyze these effects. Additionally, this research further examines the impact of oil prices and exchange rates on the trade balance of the selected economies. The explicit consideration of the trade balance is important as it contributes to current account imbalances and help to derive more targeted policy implications.

2. LITERATURE REVIEW

2.1 Review of Literature

The nexus between oil prices volatility, exchange rate fluctuations and current account imbalances is a subject of significant research since the past three decades (Bass, 2023; Yalta et al., 2017). This is attributed to the frequent occurrence of the crises as well as the continuous rise in the scarcity of fossil energy (Adun *et al.,* 2022, Duarte *et al.,* 2015; Mussa, 2000). The short-term oil price impact on CAB has been widely studied in the literature. Extensive literature has focused on examining the short-term impact of oil prices on the CAB (Varlik *et al.,* 2020; Başarır *et al.,* 2016; & Change *et al.,* 2023). It is well established that oil-importing countries face higher oil import bills because the demand for oil is relatively inelastic when it comes to price changes., which can lead to an upsurge in the current account deficit in the short run (Kilian *et al.,* 2009). However, it is important to note that the current account balance is also influenced by exchange rate dynamics (Yildirim *et al.,* 2021, Wairooy *et al.,* 2023; Eugster, 2022; Bresser, 2022). This study aims to analyze the impact of both oil price volatility and exchange rate volatility on the current account balance, specifically with the background of Asian economies.

In the case of a small open economy, the nexus between oil price and the exchange rate is unidirectional as the former is treated as exogenous (Malik *et al.,* 2019; Lv et al., 2019, Anjum *et al.,* 2019). It is then through the exchange rate that the CAB of the country is influenced. But if the country is dependent more on the external sector in terms of primary or secondary income, then a change in oil price also affects the current account directly which ultimately put pressure on the country's exchange rate. Through these channels, the relationship between the ER and the CA can be uni- or bi-directional. When there is a change in international oil prices, it results in higher income for oil-exporting countries. This, in turn, presents an opportunity for these countries to accumulate more foreign assets, leading to an increase in their current account balance (Iwatsubo et al., 2019; Huntington, 2015; Amuzegar, 1982).

Apparently, the existing literature offers important perspectivess into the estimation of variables within the framework of regime switching, particularly through the utilization of the Markov regime-switching model and nonlinear ARDL models. Aristovnik (2007) conducted studies that have proven beneficial in examining the influence of exchange rate and oil price regimes on the current account. An advantage of employing this technique is the ability to analyze the transition mechanism and the likelihood of regime shifts impacting Asian economies, as well as the evolution of the CAB over time (Gruber et al., 2007). Additionally, this research not only aids in identifying various potential regimes but also facilitates the determination of each regime's duration.

There is a significant relationship among exchange rate and current account (Bitzis et al. 2008; Eugster, 2022; Bresser, 2022). However, the regime shifting of exchange rate being a concern for economists and researchers in the past for formulating the policies related to energy and oil. But apparently, the oil price moves return to its initial position following any shock because the expenses and consumption declines with the passage of time (Agmon et al., 1978). In the empirical studies, several studies have examined the relationship between oil prices and exchange rates (Ahmed, 2016; Coudert, 2005; T. et al., 2014). It is commonly observed that this relationship is inversely proportional. Specifically, when oil prices increase, the exchange rate tends to depreciate significantly (Jiranyakul, 2015; Tiwari, 2016; Ji, 2018; Kin, 2014), and the impact of oil price hikes on the exchange rate is often persistent (Dogan, 2012; Ahmed, 2016; Nouira, 2018). Many researchers have confirmed this relationship (Fowowe, 2014; Dawson, 2007). However, some studies using impulse response functions have found the nexus between OP and exchange rates to be insignificant (T.et al., 2014).

In addition to the nexus between oil prices and the current account balance (CAB), variations in OP also effect the output level (Mork, 1989). Mork's research further explored the asymmetric reaction of output to increases in oil prices, supporting Hamilton's argument (1996) that sudden shocks in oil prices have a significant negative impact on macroeconomic variables, leading to a decline in consumer demand and investment. Hamilton (1996) recommended using real variables, such as real increases in oil prices, when estimating the energy market, instead of relying solely on nominal values. Singh (2019) compared the CAB to fiscal policy implementation in the economy and found a strong and significant relationship between savings and investment during periods of global capital mobility.

Conclusively, there is a lack of empirical studies on the volatility of oil price and exchange rate shocks on current account balance of selected Asian economies. These economies have faced significant consequences from shocks in both oil prices and exchange rates, making them an interesting case study.

The relationship between energy prices - particularly oil and LNG - and the current account balance has been extensively analyzed, especially for energy-importing regions such as South and East Asia. These economies, due to their reliance on imported fuel, are particularly sensitive to global price fluctuations, which directly influence trade balances and indirectly impact macroeconomic stability.

The most immediate impact of oil and LNG price fluctuations on the current account arises through the trade balance. Countries that are net importers of energy (e.g., India, South Korea, and the Philippines) experience a deterioration in their current account when prices increase, due to a rise in import bills (Bems & de Carvalho Filho, 2009). This effect is particularly pronounced for nations with high energy intensity in production and low domestic energy reserves. In contrast, energy-exporting countries (e.g., Malaysia and Brunei) may benefit from higher export revenues during price surges (Korhonen & Ledyaeva, 2010).

For LNG specifically, the import reliance is growing in countries such as Japan and South Korea, where LNG now constitutes a major portion of energy imports. Aoyama and Fujii (2021) highlight that the surge in LNG prices following the Fukushima nuclear accident significantly widened Japan's trade deficit and current account imbalance.

Fuel price changes also exert indirect effects on the current account by influencing the real exchange rate, inflation, and monetary policy. Higher fuel prices often lead to increased inflationary pressures, which can erode export competitiveness, thereby indirectly worsening the current account (Chen & Chen, 2007). Moreover, the depreciation of local currencies in response to rising energy prices can create feedback loops that further widen the deficit (Aizenman & Sun, 2010).

For instance, Hasanov and Samadov (2016) found that oil price shocks have a significant impact on the exchange rates of energy-importing Asian economies, which in turn affects their external balances. Similarly, IMF (2022) research notes that the lagged effect of LNG price volatility has contributed to current account deficits in several ASEAN economies by increasing inflation and reducing domestic demand for exports.

Another relevant strand of literature examines the volatility of fuel prices rather than levels. Price shocks, particularly when unexpected or persistent, limit the ability of policymakers to adjust effectively, leading to worsening of external balances. Kim and Loungani (1992) emphasize that countries with rigid energy consumption structures or underdeveloped financial systems face greater difficulties in adjusting to price shocks, which intensifies current account imbalances.

Emerging empirical work (Park, 2023) shows that economies like Bangladesh and Vietnam are increasingly exposed to LNG price fluctuations due to their growing use of gas-fired power in industrial expansion, making their current accounts vulnerable even in short-term supply shocks.

2.2 Theoretical Framework

Any fluctuation in oil price influences the exchange rate and current account through different channels. For instance, an increase in international oil prices leads to a current account surplus for the oil-exporting countries while it is the opposite for oil-importing countries. Conversely, a decrease in international oil prices is more advantageous for oil-importing countries than for oil-exporting nations.

The alteration in international prices also leads to wealth redistribution within a country, thereby impacting the exchange rate. When oil prices rise, oil-importing countries must spend more on fuel imports, increasing the import bill and widening the current account deficit (Hamilton, 2009; Kilian, 2009). The larger deficit reduces net foreign currency inflows, creating pressure on the domestic currency to depreciate, as demand for foreign currency rises to pay for imports (Chen et al., 2019). This redistribution of wealth from domestic consumers and firms to foreign oil exporters captures both the fiscal and external sector impact of oil price increases. In this context, higher oil prices effectively act as an exogenous shock that can alter the current account and exchange rate simultaneously, justifying its inclusion in the analysis. This kind of impact, flowing from oil price to the current account deficit and to the exchange rate, is illustrated in early theories proposed by Krugman (1983), Golub (1983), and Rogoff (1991). These classical theorists believe that an increase in the oil prices causes the fluctuation in exchange rate for oil-importing countries and leads to appreciation when the oil price drops.

When international oil prices change, it results in the increase in the income level of oil-exporting countries, and it provides an opportunity to hoard more foreign assets causing an increase in the CAB. On the contrary, an increase in oil prices internationally is an expense for oil-importing countries as it puts negative pressure on the income level of these countries. A decline in income or foreign assets of oil-importing countries causes the depreciation of the exchange rate of an oil-importing country. But the effect of oil price increases on oil-importing countries does not stop here. An upsurge in oil prices further makes the oil importer less competitive in the international market. So, these negative oil price shocks not only decrease the income level of oil importers (Turhan *et al.,* 2013) but also hurt their trade balance.

These effects of rising oil prices on oil-importing countries lead to a transfer of wealth from these nations to oil-exporting countries. Some of the literature also focuses on the short- VS the long-term impacts of oil price volatility on the exchange rates (Khudhair, et al., 2023; Liu et al., 2015; Coudert *et al.*, 2008; Lizardo and Mollick, 2010). but other studies emphasize only the short-run impact. The reason for considering the impact of oil prices on the short-term aspect of this relationship is the efficiency of the currency exchange market in reacting to any change in the economy.

2.2.1 Impact Channels

The impact of oil price shocks on the ER or on the CA can be analyzed through various channels. Among these channels, the most important are the relative inflation channel, international trade channel, expectation channel, and monetary policy channel. The way how the OP impacts the ER and current account through these channels is detailed below. As the focus of this analysis is to evaluate the relations amid oil price shock on the ER and CAB for Asian economies (those are oil-importing economies) so the related details are also described in the context of oil-importing economies.

i) Relative Inflation Channel

A rise in oil prices is directly linked to the economic variables of a country. The positive OP shock rises the cost of energy products being used in every sector of the economy (Alexeev et al., 2021). It causes to increase the cost of production and transportation. These impacts are then translated into an upsurge in the general price level. In other words, an increase in oil prices is channeled through the production market, transportation, and labor market which eventually affects the commodity market while causing an increase in the prices of commodities.

An upsurge in OP further lead to the increases in cost and price of other energy products that are produced from the oil (Al-Maamary et al., 2017). For instance, when an oil price increases then the cost of producing electricity from petroleum also rises and it is then transmitted in an increase in the cost of input for industry as well as for households (Al-Maamary et al., 2017, Saari et al., 2016)). But these impacts and channels differ from country to country depending on the level of dependence of the economy's economic structure on oil.

Similarly, according to Keynesian Aggregate Demand theory, the oil shock impacts the aggregate demand in the economy as it leads to decline in consumer spending. This reduction in the aggregate demand has a negative impact on the current account balance. In addition, the negative impact of oil price shocks on the current account balance of a country, especially a net oil importer, can be explained through a combination of increased import costs, the inelastic nature of oil demand, exchange rate impacts, inflationary pressures, and broader effects on the global economic dynamics.

A significant and long-lasting rise in oil prices causes to raise in the price level in the input market which is then transmitted into the market of final goods. So, the overall inflation level rises in the country. When inflation happens in the input market and the price of outputs also increases then it has a direct impact on the external sector. An upsurge in the cost of inputs causes an increase in output prices that ultimately cause a significant effect on competitiveness in the international market. As per the purchasing Power Parity theory, the weakening of competitiveness in the international market affects foreign exchange earnings negatively. Concurrently, if the local products are relatively cheaper than the foreign products then the people living within the country will start buying more imported products at lower prices. It again has a negative impact as the demand for foreign currency increase in relation to domestic currency. In both cases, i.e., for a decrease in foreign exchange earnings from the exports of goods and services and for an increase in foreign expenditure on imports, the foreign exchange of the country increases or its value declines. It puts negative pressure on the currency's value and the currency depreciates.

Moreover, an upsurge in the price level means a waning of the currency's value. It declines the investors' confidence in the local currency, and they start investing in the foreign currency to avoid any future loss. It again leads to a fall in currency value or depreciation of the currency.

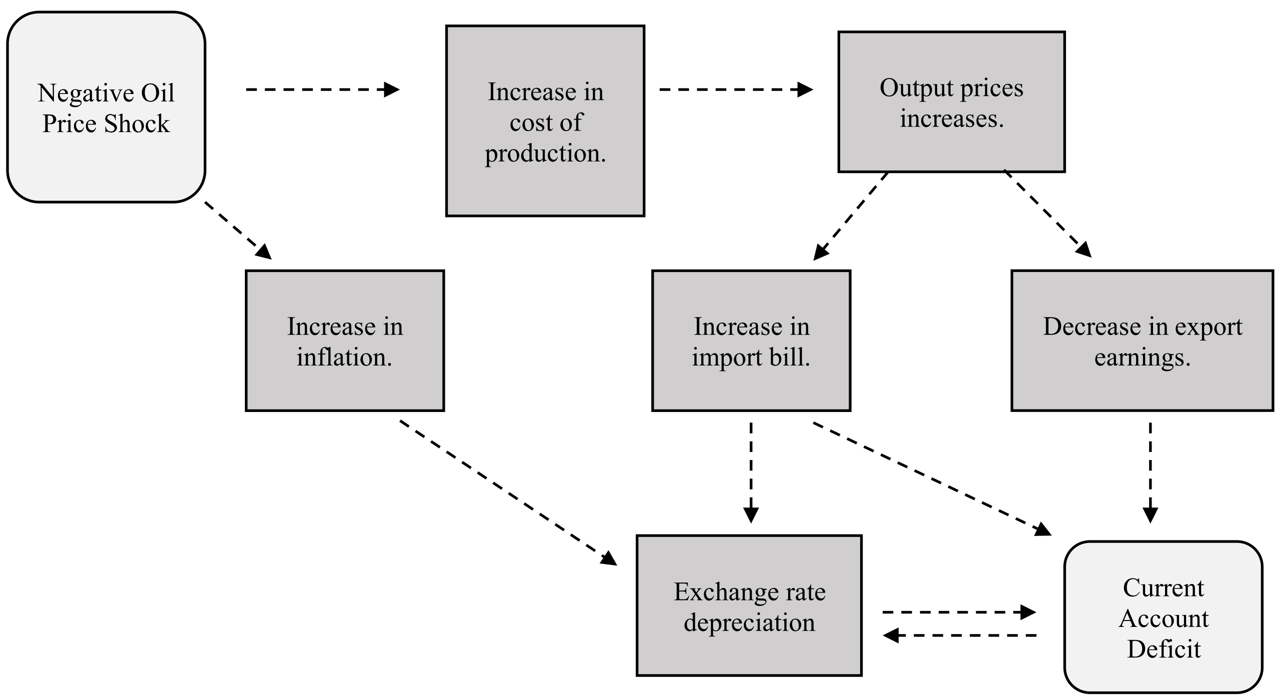

Figure 2.1: Impact of OP on the ER and CA through inflation channel

ii) International Payment Channel

For net oil-importing nations, any negative oil price shocks cause an upsurge of import payments resulting in an increase in payments in foreign currency that puts negative pressure on the local currency. It results in a decline in the foreign exchange reserve of the country and a decline in

CAB. Such disequilibrium in balance of payment has a direct impact on the demand for foreign currency and ultimately deterioration in currency's value. This is a general relationship between the demand for foreign currency created because of a rise in CA deficit (Devadas et al., 2018). The negative pressure on foreign exchange due to the increase in demand for foreign currency is mirrored by an increase in the ER.

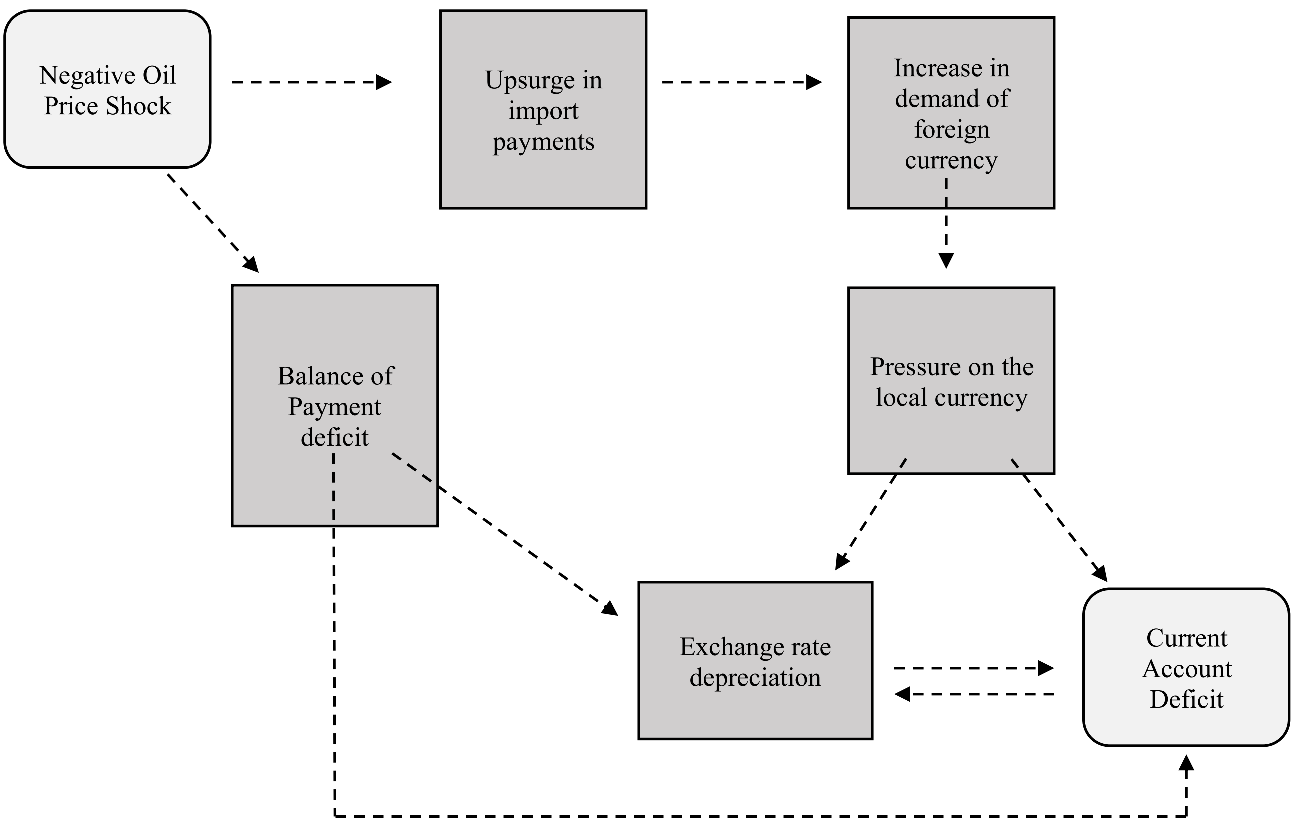

Figure 2.2: Impact of OP through international payment channel

iii) Expectation Channel

Nowadays, the international markets are integrated with the local financial markets. Any change in the market at the international level is transmitted to the domestic market within no time. Similarly, if any change happens to the oil market, then its impact on the currency's exchange rate is translated instantly (Tian et al., 2021; Huang et al., 2007). Changes in oil prices are apparently affected by the supply and demand forces in a market or by international investment in the sector i.e., investment in the development of new oil fields, etc.

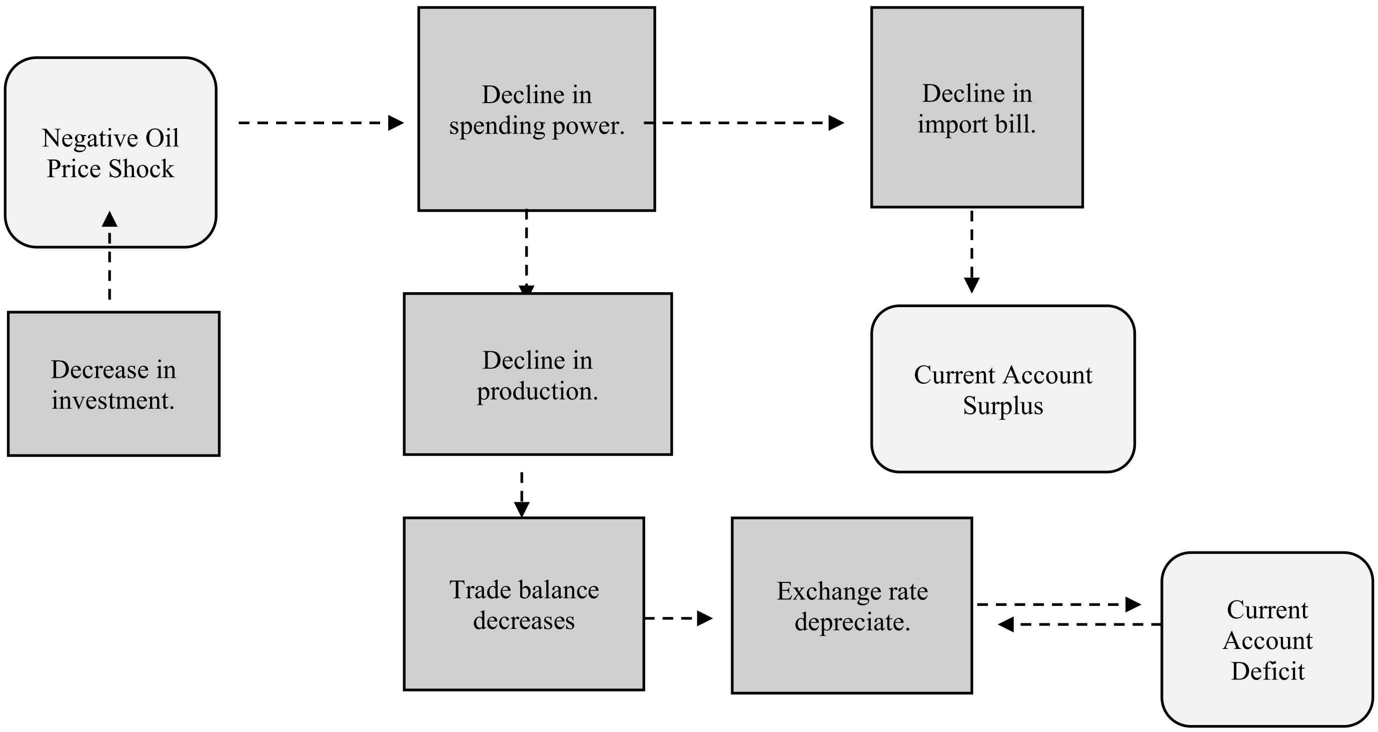

Figure 2.3: Impact of OP through expectation channel

For instance, in the case of oil supply, the prices are interlinked with the investment made in the sector. Any climb in OP makes an impact on spending power of the people in the net oil-importing economies negatively. Then a reduced demand causes a decline in the production level in the economy. It then directly influences the external sector as the exports bill declines and the trade balance also decreases. Ultimately, it causes to put negative pressure on the exchange rate of the country.

iv) Monetary Channel

Oil prices get affected by the speculative behavior of investors in the financial market. When an oil price increase happens, it results in an increase in the cost of production and price level in the economy. The central banks also react to offset this effect on the price level. To control the inflation level in the economy, the central banks try to do a policy adjustment by changing the interest rate (Friedman et al., 2010; Montes et al., 2018). To curb inflation the central bank usually goes for contractionary monetary policy by increasing the interest rate (Claeys et al., 2018; Hamilton, 1983 and 1996). This rise in the IR causes crowding-out investment in oil sector and in the foreign exchange market as investors can now earn higher returns without risk. It leads to a drop in the demand for local currency and causes to decline in the exchange rate. Then depreciation of the ER causes current account to fall, as shown in the figure below.

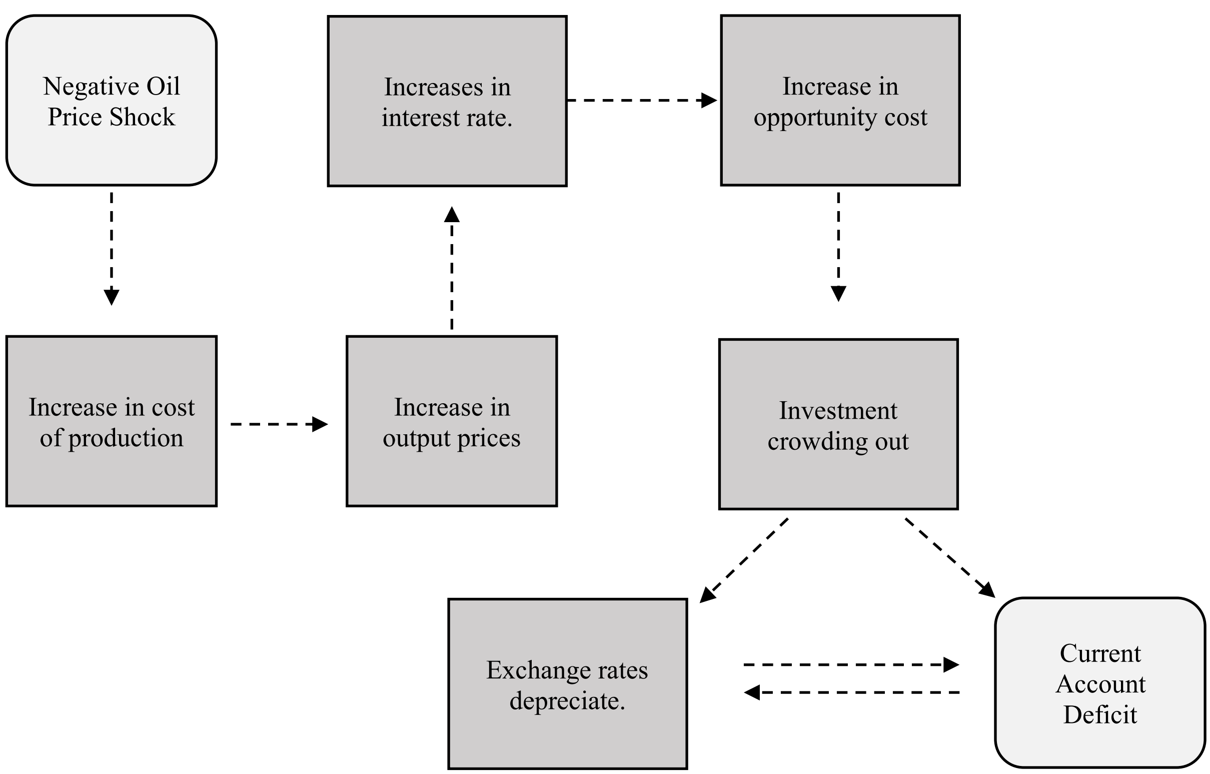

Figure 2.4: Impact of OP through the monetary channel

These theoretical channels help to provide a comprehensive overview of how OP shocks affect the exchange rate and current account. There can be a direct or indirect impact of oil price changes on the CAB. The relationship between exchange rate and the current account can be one or two ways, that this study also aims to explore. Along with asymmetric impact of oil price shocks the impact of oil price may vary across different volatility regimes (Martin, 2016; Fiaz *et al.,* 2021; Gnimassoun et al., 2013). For this reason, the impact regime switching in OP change and the ER is examined for the sub-part of the CAB i.e., trade balance. It helps to track down the impact of changes in OP and ER regimes more specifically on the trade balance of Asian economies.

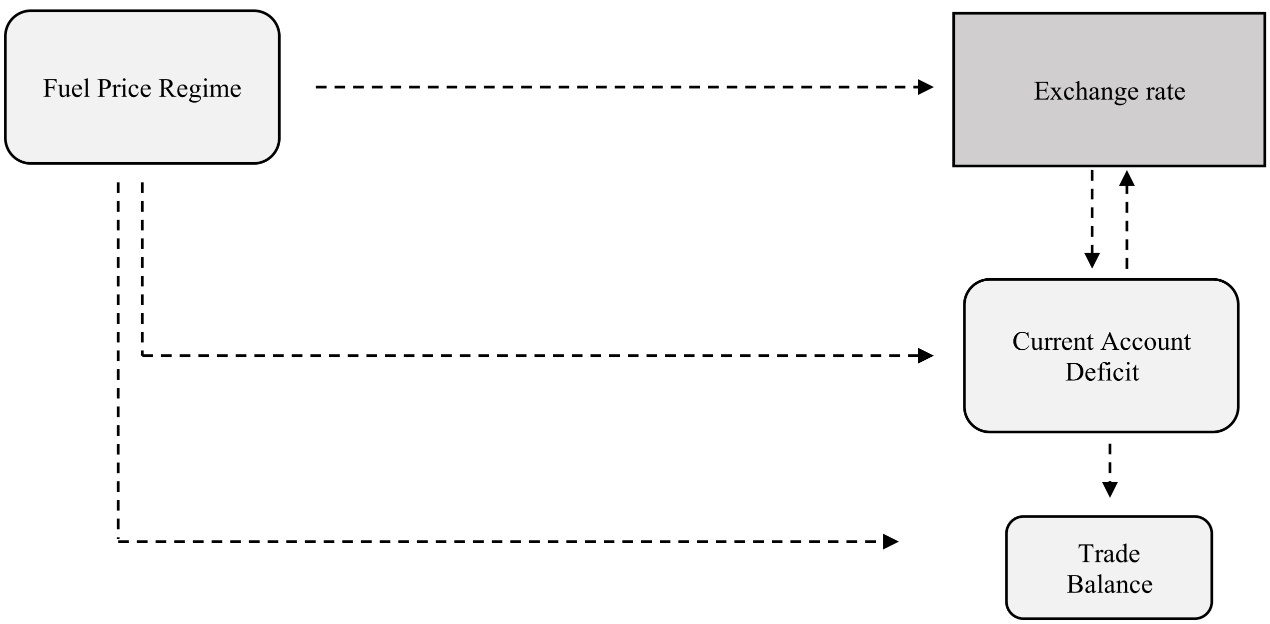

Figure 2.5: The effect of OP changes on the ER and CA

The real fuel price and the external balance are both affected. Due to the increase in oil prices, international trade deficits are experienced by fuel-importing nations (regardless of its share). According to the Valuation Channel, the CAB is affected by changes in asset prices because of shocks in oil supply and demand (Chuku *et al.,* 2011; Obstfeld, 2005). The idea behind this is that exporters of oil will retain their assets in the form of assets in countries that import oil. If oil prices rise, this type of asset diversification enables oil-importing nations to shift part of their increased wealth and earnings to non-oil-importing nations (Kilian et al., 2009). So, oil price may have a direct or indirect impact, through the exchange rate on the CA balance (Olayungbo, 2019; Allegret *et al.,* 2014).

The next section provides the details on the data sample and its description that are used in the empirical estimation.

3. DATA AND METHODOLOGY

3.1 Methodological Framework

Following the research objectives of this study, an appropriate methodological framework is adopted here. While exploring the impact of oil price and exchange rate shocks on the current account of selected Asian economies, there exists a possibility of symmetric as well as asymmetric relationship. The non-linear auto-regressive distributed lag model (NARDL) developed by Shin *et al.,* (2014) is found to be an appropriate methodology to apply i.e., an extension of Pearson et al., (2011). One of the major advantages of using NARDL is that it considers the independent variables even if they are integrated at level zero or one (Pesaran *et al.,* 2001). In addition, this approach can be employed if the variables of interest have long run relationship with different order of integration. It means that the cointegration analysis that involves relatively small sample sizes are robust using the bound test[2]. So, based on the bound test procedure, the preliminary model for the simple linear regression model can be written as below. In addition to oil/fuel price and exchange rates, the other variables included in the model are interest rate, inflation rate, and industrial production index.

$$CA_t = \alpha_0 + \alpha_1 IR_t + \alpha_2 OP_t + \alpha_3 IP_t + \alpha_4 ER_t + \alpha_5 INF_t + \varepsilon_t \tag{3.1}$$

In this model, the current account is the dependent variable, which is influenced by the interest rate (IR), oil price (OP), industrial production (IP), exchange rate (ER), and inflation rate (INF) in the economy. To convert this equation into an autoregressive distributed lag (ARDL) model,

[2] It is because in literature (Mah, 2000) it is observed that the results of cointegration with small sample can be biased.

lag terms need to be included. This transforms equation 1 into a conditional ARDL model with the following specifications:

$$\Delta CA_t = \alpha + \beta_0\, CA_{t-1} + \beta_1 IR_{t-1} + \beta_2 OP_{t-1} + \beta_3 IP_{t-1} + \beta_4 INF_{t-1} + \beta_5 ER_{t-1} + \sum^{p}_{i=1} \delta_{1i}\, \Delta\, CA_{t-1} + \sum^{q}_{i=1} \delta_{2i}\, \Delta\, INF_{t-1} + \sum^{m}_{i=1} \delta_{3i}\, \Delta\, IP_{t-1} + \sum^{n}_{i=1} \delta_{4i}\, \Delta\, ER_{t-1} + \sum^{s}_{i=1} \delta_{4i}\, \Delta\, OP_{t-1} + \sum^{p}_{i=1} \delta_{4i}\, \Delta\, IR_{t-1} + \varepsilon_t \qquad (3.2)$$

Here, the term Δ signifies the 1st difference operator, and ε_t is the disturbance term or white noise that is serially uncorrelated. This equation allows for the estimation of both short- and long-run effects in a single equation. The estimates for short-run coefficients can be obtained by taking the first difference, while the long-run estimates are derived by normalizing the β's. However, it is worth mentioning that the long-run estimates are only meaningful when there is co-integration or the presence of a long-run relationship.

The previous section describes the linear ARDL model. However, the effect of independent variables on the dependent variable may be asymmetric. The linear ARDL or NARDL model can be used when none of the variables are stationary at the 2nd difference. One of the significant advantages of using this model is its ability to handle all variables, regardless of whether they are integrated at a level or integrated at a level of one.

$$\Delta CA_{it} = \alpha + \beta_0\, CA_{it-1} + \beta_1 OP^{+}_{it-1} + \beta_2 OP^{-}_{it-1} + \beta_3\, ER^{+}_{it-1} + \beta_4\, ER^{-}_{it-1} + \beta_5 INF_{it-1} + \beta_6 IP_{it-1} + \beta_7 IR_{it-1} + \sum^{p}_{i=1} \delta_{1i}\, \Delta\, CA_{it-1} + \sum^{q}_{i=1} \delta_{2i}\, \Delta\, INF_{it-1} + \sum^{m}_{i=1} \delta_{3i}\, \Delta\, IP_{it-1} + \sum^{s}_{i=1} \delta_{3i}\, \Delta\, IR_{it-1} + \sum^{z}_{i=1} (\theta^{+}_{i}\, \Delta\, OP^{+}_{it-1} + \theta^{-}_{i}\, OP^{-}_{it-i}) + \sum^{z}_{i=1} (\theta^{+}_{i}\, \Delta\, ER^{+}_{it-1} + \theta^{-}_{i}\, ER^{-}_{it-i}) + \mu_i + \varepsilon_{it} \qquad (3.3)$$

In this revised model, the independent variable of oil price is replaced with fuel prices. To capture the influence of fuel prices, an energy price index is created. This index is calculated by assigning weights to the average prices of oil and LNG, based on their respective contributions to the energy mix across the selected Asian economies. This allows for a comprehensive assessment of the impact of fuel prices on the dependent variable in the model.

$\Delta CA_{it} = \alpha + \beta_0 CA_{it-1} + \beta_1 FP^{+}_{it-1} + \beta_2 FP^{-}_{it-1} + \beta_3 ER^{+}_{it-1} + \beta_4 ER^{-}_{it-1} + \beta_5 INF_{it-1} + \beta_6 IP_{it-1} + \beta_7 IR_{it-1} + \sum^{p}_{i=1} \delta_{1i} \Delta CA_{it-1} + \sum^{q}_{i=1} \delta_{2i} \Delta INF_{it-1} + \sum^{m}_{i=1} \delta_{3i} \Delta IP_{it-1} + \sum^{n}_{i=1} \delta_{3i} \Delta IR_{it-1} + \sum^{z}_{i=1} (\theta^{+}_{i} \Delta FP^{+}_{it-1} + \theta^{-}_{i} FP^{-}_{it-i}) + \sum^{z}_{i=1} (\theta^{+}_{i} \Delta ER^{+}_{it-1} + \theta^{-}_{i} ER^{-}_{it-i}) + \mu_i + \varepsilon_{it}$ (3.4)

In the NARDL model, an error correction term is included to determine the presence of cointegration or a long-run relationship between the exchange rate, oil price, and current prices. The lag length is denoted by p, q, m, and Δ represents the difference operator. Additionally, the term $\sum^{z}_{i=1} \theta^{+}_{i} \Delta FP^{+}_{it-1}$ represents the short-run increase in fuel price or a positive fuel price shock, while $\sum^{z}_{i=1} (\theta^{-}_{i} \Delta FP^{-}_{it-1})$ represents the short-run decrease in fuel price. These terms indicate an asymmetric relationship in the short run.

Model 3.4 is used to analyze the short-run asymmetric impact of oil price shocks and exchange rate shocks on the current account for the short-run impact of fuel price and exchange rate shocks on the current account balance.

Another crucial aspect to consider is the direction of causality, as supported by theoretical background. It indicates that the appreciation or depreciation of the exchange rate can influence the CAB. This is because alterations in the exchange rate have an impact on the trade balance, which in turn leads to positive or negative changes in the current account. Additionally, it is possible for changes in the current account to be driven by an increase or decrease in the foreign income account or investment, which can exert upward or downward pressure on the exchange rate. It is also plausible for the causal direction to be from the current account to the exchange rate. Therefore, it is imperative to determine the causal relationship prior to estimating a model with the correct specification. To accomplish this, a pairwise panel causality test called Dumitrescu and Hurlin (2012) can be applied to the data. The null hypothesis of this test postulates the nonexistence of homogeneous Granger causality between the variables, while the alternative hypothesis suggests the presence of a causal relationship between the variables for at least one cross-sectional unit in the panel data. This test serves the purpose of establishing the correct causal correlation amid the variables.

The choice to employ the Nonlinear Autoregressive Distributed Lag (NARDL) model and the Markov Regime-Switching (MSR) model in this study is driven by the research objective of capturing asymmetric and regime-dependent dynamics in the relationship between oil prices, exchange rate regimes, and current account balances across Asian economies. While conventional panel methods—such as fixed effects or dynamic panel GMM—are valuable for estimating average effects across countries, they often rest on linearity assumptions and do not fully account for nonliniear adjustments, threshold effects, or structural shifts that are central to this study's focus.

The NARDL model, introduced by Shin et al. (2014), is particularly well-suited to this research for several reasons. First, it allows for long-run cointegration relationships between variables while explicitly modeling short-run asymmetries through the decomposition of positive and negative changes in explanatory variables. This is essential when studying oil price shocks, which often exhibit nonlinear effects depending on whether prices are rising or falling (Hamilton, 2003; Kilian & Vigfusson, 2011). Second, NARDL is applicable regardless of whether the underlying variables are I(0), I(1), or a combination of both, making it robust to unit root properties commonly found in macroeconomic time series data. Third, it permits country-level time series estimation, which allows the study to preserve country-specific institutional, policy, and structural features that could be masked in a panel context.

Complementing the NARDL model, the Markov Regime-Switching (MSR) model is employed to capture time-varying structural changes and regime-dependent behaviour in the relationship between oil prices, exchange rate regimes, and current account responses. The MSR model assumes that the parameters of the system can switch between discrete regimes (e.g., high vs. low oil price volatility, stable vs. unstable exchange rate periods), governed by a Markov process. This is particularly relevant for economies frequently subjected to external shocks and shifting monetary or exchange rate policies. While NARDL captures asymmetries around shocks, it does not formally model unobserved regime changes—a gap that MSR models are designed to fill. In this way, the two models are complementary rather than redundant: NARDL captures sign-driven asymmetry, while the MSR framework addresses structural and temporal regime shifts, offering a richer understanding of current account behaviour under different economic states.

Together, these models enable a more comprehensive and nuanced analysis than either would alone or than linear panel approaches could provide. Their combined application reflects recent trends in empirical macroeconomics that seek to model nonlinearities and structural changes in a unified framework (Auerbach & Gorodnichenko, 2012; Chen & Chen, 2007). Moreover, applying these models at the individual country level within a comparative Asian context preserves important policy heterogeneity, which aligns with the study's goal of offering country-specific insights while situating findings within a broader regional narrative.

To ensure the reliability of our econometric findings, we conducted a robustness test using the Markov-Regime Switching model. This model allows us to examine whether there are different volatility regimes in fuel prices and exchange rates that have varying impacts on CAB. In the case of Asian economies, changes in international oil prices do not directly translate into domestic oil prices due to government intervention in setting prices. However, exchange rate volatility has a direct impact on CAB as governments have less control over the money market, particularly following recent global inflation.

The Markov-Switching model helps us identify high and low volatility regimes and assess their asymmetric impact on current account balances. By comparing these results with the earlier findings from the NARDL model, we can determine the robustness of our conclusions. Below is the model specification for the Markov-Switching model, which was employed in this analysis.

In line with Hamilton's Markov-Switching model of 1998, the Markov-Switching model for real GDP can be represented as follows:

$$\Delta y_t - \mu(s_t) = = \sum_{i=1}^{p} \alpha_i \left(\Delta y_{t-i} - \mu(s_{t-i})\right) + \varepsilon_t \qquad (3.5)$$

$$\varepsilon_t \sim N(0, \sigma^2)$$

Where Δy_t is the change (volatility) in the current account balance, μ is defined as the mean value of process which relies on discrete random variable s, where s illustrates the non-observed situation of an economy. Moreover, this dependency shows that different regimes are related to the different conditional distributions of current account changes. In two regime situations, the unobserved state signifies the "rise and fall" states in the current account balance. The autoregressive parameters of the model (1) are the functions of the unobserved state (s_t). In this case, the MS model of the current account can be explained below:

$$\Delta y_t = c(s_t) + \sum_{i=1}^{p} \alpha_i (s_t) \Delta y_{t-i} + \varepsilon_t \qquad (3.6)$$

Here, the parameters of the VAR (Vector Autoregressive) model are dependent on the regime or unobserved state. This unobserved state is determined by the outcome of an unobserved Markov chain. The transitions between states are described by transition probabilities, which follow a first-order Markov process.

$$p_{ij} = P\,[s_t = i | s_{t-1} = j], \qquad \sum_{i=1}^{M} p_{ij} = 1$$

In general, s_t is assumed to follow an ergodic M state Markov with a complicated transition matrix:

$$p = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1M} \\ p_{21} & p_{22} & \cdots & p_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ p_{M1} & p_{M2} & b_{53} & p_{MM} \end{bmatrix}$$

Here $p_{1i} + p_{2i} + \ldots + p_{Mi} = 1$, For $i = 1, 2, \ldots\ldots M$.

Here the regime-switching probability is taken as constant by assumption. The volatilities of the regimes can be asymmetric, meaning that in a two-regime model for current account changes if the absolute value of μ_1 is large and negative with a small value of p_{11},, the current account experiences a brief but sharp downward movement. However, if the value of μ_2 is positive but small, along with a large value of p_{22}., the current account reverses its movement.

The following section provides the model specification for the regime-switching (MS) model.

3.2 Model specification

We explored if the oil price shocks produce shifts in the change in current account balance in Asian economies, by including real OP shocks in a MS model of output.

Likewise, the 1st model to examine relations amid real OP and business cycle variation is the extension of MS model, also called the MS-mean (MSM) model[3]:

$$\Delta y_t - \mu(s_t) = = \sum_{i=1}^{p} \alpha_i (\Delta y_{t-i} - \mu(s_{t-i})) + \sum \beta_i oil_{t-i} + \varepsilon_t \qquad (3.7)$$

$$\varepsilon_t \sim N(0,\sigma^2)$$

Where the oil_t is symbolized as oil price shocks ($\Delta roil_t$).

If we consider a decisive jump in the current account series, the MSM model leads to the MS-intercept (MSI) model:

$$\Delta y_t = c(s_t) + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + = \sum_{j=1}^{q} \beta_j oil_{t-j} + \varepsilon_t \tag{3.8}$$

Equations 3.7 can be generalized in two orders. As the output volatility in recessions usually differs as compared to the volatility in expansion, it can include a regime-varying variance of the disturbance terms as follows:

$$\varepsilon_t \sim N(0, \sigma^2 (s_t)$$

Equation (3.6) signifies MSM – heteroskedastic (MSMH) model, whereas the equations (3.7) and (3.8) illustrates (MSIH), MSI heteroskedastic model. On the contrary, if the parameters of the autoregressive part of the MSI model are permitted to be a function of the state variable s_t, the results in MSI-autoregressive (MSIA) model can be scripted as follows:

$$\Delta y_t = c(s_t) + \sum_{i=1}^{p} \alpha_i (s_t) \Delta y_{t-1} + \sum_{j=1}^{q} \beta_j oil_{t-j} + \varepsilon_t \tag{3.9}$$

Hence MSI- autoregressive-heteroskedastic (MSIAH) model is obtained by combining the equation 3.8 and 3.9.

To investigate the dynamic and potentially endogenous relationship between fuel prices (oil and LNG) and the exchange rate, this study employs a two-equation system Generalized Method of

Moments (GMM) framework. This approach allows for the simultaneous estimation of both direct and indirect effects, while addressing concerns related to endogeneity, unobserved heterogeneity, and dynamic feedback commonly encountered in macroeconomic panel data.

$$ER_{it} = \alpha_0 + \alpha_1 \, OP_{it} + \alpha_2 \, INF_{it} + \alpha_3 \, IPI_{it} + \alpha_4 \, IR_{it} + \alpha_5 \, ER_{it} + \mu_i + \epsilon_{it} \quad (3.10)$$

$$ER_{it} = \alpha_0 + \alpha_1 \, FP_{it} + \alpha_2 \, INF_{it} + \alpha_3 \, IPI_{it} + \alpha_4 \, IR_{it} + \alpha_5 \, ER_{it} + \mu_i + \epsilon_{it} \quad (3.11)$$

In this formulation:

- TB_{it} represents the trade balance,
- OP_{it} and FP_{it} capture changes in global fuel prices,
- INF_{it}, IPI_{it}, and IR_{it} serve as macroeconomic controls (inflation, industrial production, and interest rates),
- ER_{it} is the real exchange rate,
- μ_i captures country-specific fixed effects.

This equation identifies the intermediate transmission channel, wherein changes in energy prices affect the current account indirectly through trade performance.

The second equation models the exchange rate as a function of both the fuel prices and the exchange rate (the mediator from Equation 1), along with other relevant macroeconomic variables:

$$CA_{it} = \beta_0 + \beta_1 \, OP_{it} + \beta_2 \, FP_{it} + \beta_3 \, TB_{it} + \beta_4 \, INF_{it} + \beta 5 \, ERit + \beta 6 \, IPit + \beta 7 \, IR_{it} + \lambda i + \eta it$$

Where:

- ER_{it} is the exchange rate (e.g., local currency per USD),

- CA_{it} is the current account balance, serving as an additional external sector indicator,
- TB_{it}, previously estimated in Equation 1, is now treated as a mediating variable,
- Other variables are as previously defined.

This structure captures both direct effects of oil and LNG prices on the CA (via coefficients β1 and β2) and indirect effects mediated through the ER (via β3).

The use of System GMM, developed by Arellano and Bover (1995) and Blundell and Bond (1998), is particularly appropriate for this analysis due to its ability to:

- Handle dynamic panel bias resulting from the inclusion of lagged dependent variables,
- Control for endogeneity among regressors (e.g., trade balance and inflation may be jointly determined with exchange rate movements),
- Mitigate unobserved heterogeneity and measurement errors often present in macroeconomic data.

Lagged levels and differences of the regressors are used as instruments, with instrument validity tested via the Hansen J-test, and second-order serial correlation assessed through the Arellano-Bond AR(2) test.

This two-equation model structure enables the decomposition of total effects into direct and indirect channels, thereby aligning with the study's objective to uncover the underlying mechanisms through which global fuel prices influence exchange rate dynamics in Asian economies.

3.3 Sample and Data Description

To serve the objectives of this research, the data for thirteen Asian economies is collected. These countries comprise of Bangladesh, China, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, Sri Lanka, South Korea, Nepal, Thailand, and Singapore. These countries were selected because they all belong to the same geographic region and share the characteristic of being majorly net importers of oil. The monthly panel data spanning from January 2010 to December 2023 has been used, resulting in a total of 168 observations for each country. The decision to commence the data from 2010 is intended to exclude the effects of the global financial crisis of 2007 and 2008. The data of exchange rates, oil prices, and LNG prices has been sourced from online trading platforms such as investing.com, along with WDI, while the monthly data for the current account, trade balance, and net income has been obtained from the respective central bank websites of relevant countries, IFRS and CEIC database. It is worth mentioning that the trade balance of goods is also considered, given that it is primarily affected by changes in the exchange rate compared to services trade.

In addition to the volatility in the oil price, the current account dynamics of energy-importing countries are also affected by other sources of energy. One significant energy imported by these energy-dependent economies is liquified natural gas (LNG). Consequently, it is imperative to consider the fluctuation and regime switching not only in oil prices but also in LNG prices. To gain insights into the descriptive statistics, the variables of oil and fuel prices are taken at the level.

Table 2.1: Descriptive statistics of variables

	ER	OP	FP	CA	TB	INF	IR	IPI
Mean	121.2	71.1	43.8	-128.4	-1617.2	3.34	0.99	3.47
Median	107.2	69.9	33.6	-115.3	-1432.0	2.68	1.05	3.11
Standard Deviation	42.8	21.8	10.7	45.7	760.1	3.31	2.32	7.47
Sample Variance	1830.3	474.0	53.2	2092.6	577699	10.86	4.97	35.7
Minimum	10.0	18.8	25.8	-270.6	-3979000	-3.83	2.25	-23.7
Maximum	270.6	114.7	55.3	1907	-396.0	19.08	14.58	58.17

Source: Author's Own

The current account balance (CA) has the lowest value i.e., it is 270.6 million USD in deficit whereas the highest value of the current account surplus is for Japan in the year 2019. In terms of the trade balance, Bangladesh recorded the lowest trade balance of 270 billion USD in April 2022 when the oil prices increased by more than 100 USD per barrel. Similarly, Pakistan faces a maximum trade deficit of 37.2 billion USD in the year 2018 when it let the ER be determined by market forces. Sri Lanka, on the other hand, faces a current account deficit of 1.1 billion USD in the response to climbing of international oil and LNG prices.

For the context of exchange rate (ER), the most depreciated currency is the Sri Lankan Rupee as its value dropped to 365 Rupees to USD in early 2022 when the country was facing an economic crunch after COVID-19. In addition to current account balance, the trade balance is also measured since it is directly affected by the change in OP as the positive shock of oil prices puts negative pressure on the trade balance.

Similarly, another part of the current account is the net income which is the net inflow and outflow of money including all sort of investments (direct and portfolio). A change in the exchange rate affects the domestic currency value of foreign-denominated assets and liabilities, altering the wealth of investors and households (Gourinchas & Rey, 2007). For instance, a depreciation of the domestic currency increases the local-currency value of foreign debt, reducing net wealth, while also affecting the expected returns on foreign investments. This, in turn, influences consumption, investment decisions, and the flow of remittances or cross-border payments, thereby impacting the current account balance.

4. EMPIRICAL ANALYSIS

To explore the nexus between the volatility of oil price and the exchange rate on the current account, two techniques are used i.e., Panel NARDL and MSM. Both methods are used to capture the nonlinearities with the difference that the first is more specific to explore the asymmetric impact while the second is used to capture the impact of varying volatility regimes.

As the first step, the lag length is determined, and Akaike Information Criterion (AIC) is used on panel data for this purpose. While the Augmented Dickey-Fuller (ADF) test was used to check for unit roots and includes lags to correct for autocorrelation in the residuals, the selection of the optimal lag length for modeling the dynamic relationship between oil prices, exchange rates, and the current account balance was guided by information criteria such as the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), ensuring appropriate capture of short- and long-term effects. The probability values of the Augmented Dickey-Fuller (ADF) test support including 2 lags in the model and suggest that the oil price of the last two months may affect the CAB and the same is true for the exchange rate. These findings are with intercept and trend. Most of the variables are integrated at level one or their value of the past 1 month significantly impacting the current values, except the inflation. Here all the variables are converted into percentage change instead of taking them at level.

Table 2.2: Levin, Lin, and Chu Panel Unit root test for stationarity (p-values)

Lags	**ER**	**OP**	**FP**	**CA**	**IPI**	**TB**	**INF**	**IR**
0	0.925	0.485	0.068	0.834	0.734	0.241	**0.024**	0.228
1	**0.011**	**0.004**	**0.001**	**0.043**	**0.029**	**0.028**	0.000	**0.010**

Source: Author's own

Next, the results of the effects of oil price and the exchange rate on the current account are provided in detail.

4.1 Asymmetric effect of Oil Price and Exchange Rate

To assess the short- and long-term effects of OP and exchange rate shocks on the current account balance, we used the Panel Non-linear Autoregressive Distributed Lag (NARDL) approach, since the variables are stationary at level or at the first difference and none of the variables is stationary at the 2nd difference. To determine the appropriate lag length for our dynamic panel ARDL model, we utilize the Akaike Information Criterion (AIC), which allows us to select the lag length that maximizes the analysis across cross-sections. The optimal lag length will be involuntarily determined for the pooled mean group (PMG) dynamic panel ARDL model, enabling us to examine the impact of both oil/fuel price and exchange rate shocks. The results of the full sample Panel ARDL and Panel NARDL models are illustrated in the table below.

The outcomes are segregated into two sections vertically and horizontally. Vertically, the results are shown for linear ARDL and Panel Non-linear ARDL (NARDL) model[3]. The horizontal bifurcation will categorize the impact of oil price shocks on the CAB into the short and long run. The term ECT shows the speed of recovery of the dependent variable. The negative sign of ECT exhibits the convergence from the short- to long-run. Empty cells in the table indicate that the results of either ARDL or NARDL are present for the specific independent variable. The negative (Neg) and positive (Pos) impact of energy price shocks (oil prices) and the exchange rate are presented for the NARDL model.

[3] From Non-linear ARDL here we mean the asymmetric impact of monetary policy interest rate and the money supply) on the current account balance. The functional form of the independent variables is not the primary concern of this research.

Table 2.3: Symmetric and Asymmetric Impact of Oil Price and Exchange Rate Shocks

Independent Variable	Panel A (ARDL)	Panel B (NARDL)
	Dependent variable: Current Account	
	Lag length: Dep=1, Indep=1	Lag length: Dep:4, Indep=4
	Short-run dynamics	
	Coefficient	**Coefficient**
D(IR)	-0.4119***	-0.5763***
D(IPI)	0.4549	-0.0173
D(INF)	-2.3313*	-5.6967
D(ER)	-3.8142***	-
D(ER)-POS	-	-4.146
D(ER_NEG)	-	-2.4545
D(OP)	0.2196	-
D(OP)-POS	-	-1.5335
D(OP_NEG)	-	0.9910
ECT	-0.7548***	-1.1751***
	Long-run dynamics	
IR	-0.0018	-0.0098
IPI	-0.2767***	0.3037***
INF	-1.0210**	0.0349
ER	-1.1586***	-
ER-POS	-	-0.8173**
ER-NEG	-	-0.1569
OP	-0.2196	-
OP-POS	-	1.0399*
OP-NEG	-	1.2368

Here *, ** and *** shows the level of significance at level 99, 95 and 90 percent, respectively.

Source: Author’s own

As discussed, the effect of oil price shocks on CAB is explained in terms of linear and nonlinear ARDL. It is noteworthy that the oil price represents a significant portion of variations in the CAB. In this way, the OP shocks are closely linked with changes in the current account while adjusting for the discount rate and economic activity (Zare et al., 2015; Bitzis et al., 2008; Eugster, 2022; and Bresser (2022).). In addition, the change in the exchange rates affects the current account as the expectations of future inflation also change which influences the trade balance of the country (Lobo, 2000).

Consequently, the literature exhibits that the different oil price shocks affect CAB differently (Aristovnik, 2007; Schubert, 2014; Baffes et al., 2015; and Huntington, 2015). Diverse literature shows the linear relations amongst the oil price and CAB. The outcomes of long-run impacts on current account balance are significant for the exchange rate but insignificant for the oil price shocks. It shows that the oil price volatility is absorbed by government policies when it fixes the price of oil in the domestic market. The impact of monetary policy, however, is significant and negative for CA in the short run but insignificant in the long run. It shows that any increase in the interest rate exerts a downward force on CAB as the crowding out of investment happens.

In comparison, the Panel NARDL model is not significantly different in this regard. For instance, in the long run, the exchange rate and the oil price shocks affect the current account only in case of positive change in these independent variables. The negative oil price and exchange rate shocks don't lead to changes in the current account. These results exhibit that in the long-run the increase in oil price and an exchange rate depreciation puts short-run downward pressure on the CAB of Asian countries (Jammazi *et al.,* 2015). In the short run, the coefficients of ER and OP for NARDL are insignificant, meaning that the change in ER and OP takes more than one time period to be transmitted to change in the current account (Yildirim, et al.2021). It is also because of the government intervention in the energy market and the money market to stabilize the energy and currency prices in the past. It leads to a decrease in the transmission impact of changes in international prices on the domestic variables.

In addition, the error correction term shows the speed at which the current account leads to its equilibrium. Its value should be negative which shows the convergence. In both, Panel ARDL and panel NARDL, the value of this term is negative and significant. The value of coefficients shows that the speed of convergence is high, and the current account converges to the equilibrium value in the current period. Outcomes of both, ARDL and NARDL, demonstrate the similar statistic.

The following are the findings regarding the influence of fuel prices and exchange rates on the CAB. Here, in addition to oil prices, the analysis of ARDL and NARDL is carried out by taking the fuel prices shocks along with the exchange rate shocks. The benefit of taking fuel price at place of oil price is that the oil comprises some percentage of the total energy mix of the countries. Another major fuel source for energy-dependent countries is LNG. So, the same analysis is done by taking both the oil and the LNG. Price and constructing a fuel price variable i.e., a weighted average of oil and LNG prices in accordance with the energy mix of respective country over the time. These outcomes are illustrated in Table 2.4.

Table 2.4: Symmetric and Asymmetric Impact of Fuel Price and Exchange Rate Shocks

Independent Variable	Panel A (ARDL)	Panel B (NARDL)
	Dependent variable: Current Account	
	Lag length: Dep=1, Indep=1	Lag length: Dep:4, Indep=4
Short-run dynamics		
	Coefficient	**Coefficient**
D(IR)	-0.0372**	-0.0051***
D(IPI)	0.4549*	-0.0313
D(INF)	-1.2834	-1.6340**
D(ER)	-2.1126	-
D(ER)-POS	-	-1.5122**
D(ER_NEG)	-	-1.0358**
D(FP)	0.0814	-
D(FP)-POS	- -	-1.0135
D(FP_NEG)	- -	0.0210
ECT	-0.0812	-1.0017
Long-run dynamics		
IR	-0.1142**	-0.2467*
IPI	0.8826	0.3351**
INF	-0.8812**	-0.3420*
ER	-0.3470	-
ER-POS	- -	-0.0427**
ER-NEG	-	-0.1132*
FP	-0.5527***	-
FP-POS	-	-1.4250
FP-NEG	-	0.6697*

Here *, ** and *** shows the level of significance at level 99, 95 and 90 percent, respectively.
Source: Author's Own

For the linear panel ARDL, the exchange rate is insignificant for the short- and the long-run while the fuel price has a significant impact on the current account only in the long run. It can be due to the reason that governments make the contract of oil and LNG imports, and it reduces the volatility at the local level and hence less impact on the current account balance of the country. The asymmetric relationship is shown in Panel B of Table 2.4. The only insignificant coefficient is for the positive fuel price shock in the long run. These results show that in the long run, only an increase in fuel prices leads to a current account deficit but an impact of the decrease in fuel price is not witnessed on the current account deficit. One of the main reasons for this insignificant impact on fuel prices is that for any negative change in it the government tries to benefit from it by not letting the whole impact of decreased prices to the consumers. It helps the government to earn revenue that can be used in the future at times of negative oil price shocks. However, due to a lack of financial cushion available to the governments, the positive shocks are passed through to the consumers in the short run and lead to a decline in the current account balance in the long run.

In the case of the exchange rate, there exists an asymmetric relationship with the current account balance as the coefficient signs are significant and negative for both the exchange rate appreciation and depreciation (Bitzis et al. 2008; Eugster, 2022; Bresser, 2022). In the short run, the impact of exchange rate depreciation leads to a decrease in the CAB and the value of the coefficient is quite higher relative to the exchange rate appreciation. Depreciation of a country's currency increases the domestic cost of imported goods and services, leading to higher import bills. When import payments rise faster than export receipts, the net trade balance deteriorates, which in turn reduces the current account balance. In other words, a weaker domestic currency makes imports more expensive relative to exports, putting downward pressure on the overall current account. This effect is particularly pronounced for countries that heavily rely on imported energy or intermediate goods, as the increase in import costs directly translates into a larger current account deficit. Exchange rate appreciation generally makes a country's exports more expensive for foreign buyers, leading to a decline in export volumes, while imports become cheaper, potentially increasing import demand. Both effects can deteriorate the current account balance, particularly in export-dependent economies. Accordingly, throughout the thesis, all references to the effects of exchange rate movements on the current account have been revised to clearly reflect that appreciation tends to reduce exports and may negatively impact the current account. It might be due to an increase in current value leads to a decrease in foreign income of the country but doesn't significantly improve the exports. The ultimate result of this asymmetric relationship is that the current account is exposed negatively to all types of exchange rate shocks.

So far, the analysis has scrutinized the impacts of oil prices and exchange rates on the current account balance in short term as well as long term. The asymmetric impact of OP and ER are also investigated. But the magnitude of changes in OP and ER, and respective impacts on the current account balance are still not explored. The next sections aim to provide answer in this direction while applying Markov-Switching approach where the volatility of independent variables are divided in different regimes and then its impact is investigated.

4.2 The Markov-Switching Model Estimates

The results of MS model help to examine how the CA balance respond to different volatility regimes of oil prices and the exchange rate ((Baharumshah *et al.,* 2017; Malik *et al.,* 2019; & Kassa, 2017). It exhibits the chances of transfer of current account from one to the other regime. In our case, if the oil price has two regimes i.e., high and low volatility regimes. If the probability value is high, then it means there are more chances of regime switching. Similarly, it also helps to compare which specific regime has more likelihood to sustain. For example, if the transition matrix value is very high in the high current account regime, then more chances are that the oil price changes will cause the current account to remain in the high-volatility regime (Topalli *et al.,* 2016; & Aßmann *et al.,* 2010).

The second output provides the regime properties containing information regarding the time of sustenance in each regime. The third output that the regime-switching model provides is the smoothened probabilities for each regime. It helps to highlight the impact of exogenous variables on the variable of interest in specific periods.

Subsequently, the results of Markov regime-switching models are presented here for all the sampled South Asian countries to explore the relation amid asymmetric changes in international OP and current account balances for Bangladesh, India, Pakistan, and Sri Lanka. Reason for taking only the South Asian economies is the similarity of these economies in terms of their economic outlook. The MS model shows two regimes i.e., low and the high oil price volatility. The model results presented here identifies the imbalances in current account across countries that is related to oil price regimes. For the regime selection, AIC criterion is used and on its basis two regime are selected for the models.

Table 2.5: Results of regime-switching model with oil price[4]

Country/Regime		Bangladesh	India	Pakistan	Sri Lanka
		Coef.	Coef.	Coef.	Coef.
Regime 1	**OP**	0.34**	-0.456	-0.049*	-0.811***
Regime 2	**OP**	0.24	0.110	0.003	0.005**
Common	**CA (-1)**	1.34**	0.634**	-0.010	-1.330***
	CA(-2)	-0.88**	0.599*	0.040	0.482*
	OP(-1)	0.45	0.003**	0.573*	0.052
	OP(-2)	-0.94**	0.042	0.326*	0.833**

Source: Author's Own

The significance of oil price coefficients is presented in terms of p-values. The coefficient signs change across the regimes showing the presence of asymmetries between the oil price changes and the current account balance (Mork, 1989; Hamilton, 1996). This asymmetric relationship is evident from the probability values for Sri Lanka and Bangladesh.

Correspondingly, in addition to oil price, the fuel price volatility is also estimated for the current account balance. When examining the coefficients of fuel prices, it is predominantly observed that their values are negative. This indicates that an increase in fuel prices has a detrimental effect on the CAB. Consequently, as energy prices rise, the country incurs additional expenses to purchase the same quantity of goods, leading to a negative impact on the current account balance (Appendix 2.1). The changing signs of coefficients of the ER in both regimes show the presence of asymmetry

[4] Here the significance level is represented at 1%(*), 5%(**) and 10%(***) level of significance.

that is due to the less responsive nature of trade accounts in response to currency appreciation (Appendix 2.2).

The transition probabilities show the percentage of chances for whether the regime will switch or will it have sustained. If the transition probability value is very high for the regime, then it means that there is a high chance that the regime will not shift. For instance, in the case of oil price impact, the probability of regime 1 is 87 percent which means that 87 percent is the chance that regime 1 will sustain. There is only a 13 percent chance that Regime 1 will switch to Regime 2 (Appendix 2.3).

Markov-switching model also provides the insight for the duration of each regime's existence in the economy. If the duration is high, it indicates that a significant portion of the time is characterized by the presence of this particular regime. For instance, in the case of Pakistan, it shows that the low volatility regime of Exchange rate persists for 71 months while the high volatility regime persists for 77 months (Appendix 2.3). So, all these three information sets are useful simultaneously to get a full picture of the results.

4.3 Robustness of Results

To check the robustness of these results we have included the non-oil trade balance for the South Asian countries for facing an issue of trade imbalance. It is the trade imbalance that contributes to current account imbalances for these countries. The impact of fuel price shock is checked on the trade balance while applying the MS-VAR as shown in table below.

Table 2.6: Impact of FP Shock on the Trade Balance

MS Model	Bangladesh		India		Pakistan		Sri Lanka	
	Reg 1	Reg 2	Reg 1	Reg 2	Reg 1	Reg 2	Reg 1	Reg 2
FP	-0.34**	-0.76*	1.22	-0.47**	-1.34**	-0.93***	-0.07**	0.46*
Log (Sigma)	0.33*	2.79**	0.51*	0.38*	0.33*	2.79**	1.39	1.55
Transition	0.64	0.36	0.59	0.41	0.72	0.28	0.48	0.52
Probabilities	0.43	0.57	0.39	0.61	0.22	0.78	0.26	0.76

Source: Author's Own

The impact of fluctuation in fuel price on the trade balance is negative in the low volatility regime when the value of sigma is significant. For Pakistan, the transition probabilities show that there are 72 percent chance that regime 1 will persist and only 28 chances are about switching from regime 1 to regime 2. The impact of fuel price shock on the trade balance is negative for Pakistan while Sri Lanka has lowest transition probability in the low regime as compared to other countries which shows that its non-oil trade balance witnesses high volatility changes due to fuel price changes. During the positive fluctuation regimes in the countries the impact of fuel price is transmitted absorbed by the government by providing fuel incentive and not letting it impact the whole economy. It causes to decline the non-oil trade balance of the countries as well. Here again, the fuel price volatility is also estimated for the current account balance. The coefficient of fuel prices, has negative values which indicates that it has a negative effect on the current account balance. The reason is, as energy prices rise, the country incurs additional expenses to purchase the same quantity of goods, results in a negative impact on the current account balance.

4.3.1 Direct and Indirect Impact of Energy Prices on CA Balance

To apply the System GMM (Generalized Method of Moments) estimator - commonly used for dynamic panel data models - we need to ensure that our data and model meet several preconditions and diagnostic requirements to obtain valid and reliable results.

4.3.1.1 Arellano-Bond Test for Serial Correlation

In dynamic panel data models, especially those estimated using the System Generalized Method of Moments (System GMM), testing for serial correlation in the error terms is crucial to ensure the validity of the moment conditions. The Arellano-Bond tests for autocorrelation, specifically the AR(1) and AR(2) tests, serve this purpose. These tests are conducted on the residuals from the first-differenced equation to verify the absence of second-order autocorrelation. While first-order autocorrelation is expected due to differencing, the presence of second-order autocorrelation violates a key assumption of the GMM estimator, rendering the instruments invalid and the estimation biased.

In this study, System GMM was applied to examine the impact of oil price, fuel price (including LNG), exchange rate, industrial production index, inflation, interest rate, and trade balance on the current account balance for a panel of South and East Asian economies. These variables were selected based on their theoretical relevance and empirical usage in earlier studies (e.g., Chen & Chen, 2007; Hasanov & Samadov, 2016).

Table 2.7. Test for Serial Correlation in Error Terms

Test	z-Statistic	p-Value
AR(1)	-2.85	0.004
AR(2)	-0.73	0.464

The results indicate that the AR(1) test is significant (p = 0.004), confirming the presence of first-order serial correlation in the differenced residuals, which is expected and does not invalidate the model. This finding aligns with the structure of dynamic panel models, where differencing naturally induces correlation in the residuals at lag one. More importantly, the AR(2) test is statistically insignificant (p = 0.464), indicating no evidence of second-order serial correlation. This confirms that the moment conditions required for System GMM are valid, and that the instruments used are not correlated with the second-differenced error terms.

The absence of AR(2) autocorrelation provides support for the model's internal consistency and reinforces the reliability of the GMM estimates. This is consistent with the findings of Aizenman and Sun (2010), who stressed the importance of validating model assumptions to avoid spurious policy conclusions in macro-panel studies. Moreover, the outcome supports the methodological approach adopted by Bems and de Carvalho Filho (2009), where the robustness of dynamic external balance models was established through similar diagnostic tests.

To prevent the issue of instrument proliferation which is often flagged as a concern in large N, small T panels—the number of instruments was kept below the number of cross-sectional units, in line with the recommendations of Roodman (2009). Furthermore, the Hansen J-test of overidentifying restrictions also returned an acceptable p-value (p = 0.188), supporting the overall validity of the instruments used in the estimation.

Given these diagnostic results, the System GMM model can be considered both methodologically sound and statistically robust. The valid outcome of the AR(2) test, in particular, strengthens confidence in the causal interpretation of how oil and fuel price fluctuations, alongside macroeconomic variables like exchange rate and industrial production, influence the current account balances in the region.

4.3.1.2 Hansen J Test for Validity of Instruments

In the context of dynamic panel data modeling using the System Generalized Method of Moments (System GMM), the validity of the instruments is critical for ensuring consistent and unbiased parameter estimates. The Hansen J test of overidentifying restrictions serves as a key diagnostic tool to evaluate whether the instruments used in the model are exogenous and uncorrelated with the error term. This test evaluates the null hypothesis that the overidentifying restrictions are valid—that is, that the instruments are correctly excluded from the estimated equation.

The Hansen test is particularly important in GMM estimation because the method typically relies on a large set of instruments, especially when lags of endogenous variables are used as instruments in both levels and differences. An insignificant Hansen J test result ($p > 0.05$) suggests that the instruments are valid and the model is well specified. Conversely, a significant result ($p < 0.05$) indicates that the instruments may be correlated with the error term, compromising the consistency of the GMM estimates.

In this study, the System GMM framework was employed to estimate four distinct models analyzing the direct and indirect effects of oil and fuel prices on the current account balance in South and East Asian economies. The analysis includes relevant macroeconomic variables: exchange rate, industrial production index, trade balance, inflation, and interest rate, each of which may either directly influence the current account or act as mediating variables in indirect effect models.

Table 2.8. Result for Hansen J Test for Instrument Validity

Model Description	Hansen J Statistic	p-value
1. Direct impact of OP on CA	12.47	0.574
2. Direct impact of FP (OP + LNG) on CA	13.93	0.076
3. Indirect impact of OP on CA via ER	11.82	0.614
4. Indirect impact of FP on CA via ER	14.26	0.653

The Hansen J test results across all four models are statistically insignificant at the 5% level, indicating that the null hypothesis of instrument validity cannot be rejected. Specifically, the p-values range from 0.574 to 0.653, confirming that the instruments used in each of the models are uncorrelated with the error term and are, therefore, valid. These results are consistent with best practices in System GMM applications, as emphasized by Roodman (2009), who notes that insignificant Hansen p-values signal robustness in instrument specification, particularly in models with endogenous regressors.

For the direct effect models, the validity of the instruments suggests that the contemporaneous relationship between oil/fuel prices and the current account is captured without bias, and that instrument-based corrections for endogeneity (e.g., lagged instruments) are appropriate. Similarly, in the indirect effect models, where exchange rate is used as a mediator between fuel prices and the current account, the instruments used for both the endogenous regressors and the interaction terms (where applicable) also pass the Hansen J test. This supports the argument made by Aizenman and Sun (2010) that energy price shocks influence the current account not only directly through the trade balance but also indirectly through currency valuation effects.

Furthermore, the robustness of the Hansen test results complements the Arellano-Bond AR(2) test, which showed no evidence of second-order autocorrelation, providing additional support for the overall validity of the System GMM specification used in this research.

4.3.1.3. Results of System GMM

The choice of System GMM (Generalized Method of Moments) is driven by the dynamic nature of the model and the potential endogeneity among variables. The dynamic panel structure includes the lagged dependent variable (current account balance), which is likely correlated with the error term, leading to biased estimates if traditional estimation methods are used. Additionally, explanatory variables such as oil price, fuel price, exchange rate, industrial production index, trade balance, inflation, and interest rate may exhibit endogeneity, either due to reverse causality or simultaneity.

System GMM addresses these issues by using lagged differences as instruments for level equations and lagged levels as instruments for differenced equations. This approach not only helps in mitigating endogeneity but also improves efficiency by utilizing additional moment conditions.

The relationship between oil prices OP and FP and the CA balance is complex and multifaceted, especially for South and East Asian economies. These regions are predominantly net importers of energy, making their external balances highly susceptible to fluctuations in global energy markets. The impact manifests both directly through trade channels and indirectly through macroeconomic variables such as exchange rates.

Table 2.9. Direct Impact of OP and FP on CA Balance

Variable	Direct Impact of OP on CA		Direct Impact of FP on CA	
	OP Coefficient	p-value	FP Coefficient	p-value
Constant	0.185	0.034*	0.201	0.029*
CA (-1)	0.732	0.000	0.715	0.000
OP	-0.087	0.021*	-	-
FP	-	-	-0.065	0.038*
ER	-0.512	0.012**	-0.473	0.015***
IP	0.237	0.045*	0.251	0.039*
TB	0.388	0.008***	0.401	0.006***
INF	-0.126	0.064	-0.131	0.057
IR	0.029	0.078	0.032	0.071

Here *, **, and *** show the level of significance at 10%, 5%, and 1% level of significance.

The results indicate that both OP and FP have a negative and statistically significant direct impact on the CA balance. Specifically, a 1% increase in oil prices leads to a 0.087% decrease in the CA balance, while a similar increase in FP leads to a 0.065% decline. This is consistent with previous findings (Chen & Chen, 2007) indicating that energy-importing countries suffer from higher import costs, thereby reducing the trade surplus.

Our System GMM results indicate a significant negative coefficient for OP and FP. This confirms the hypothesis that an increase in oil or fuel prices directly reduces the current account balance in the selected Asian economies. These findings align with the empirical evidence presented by Hasanov and Samadov (2016), which emphasized the vulnerability of import-dependent countries to energy price hikes.

Previous studies support the direct negative relationship between oil prices and the current account balance. According to Chen and Chen (2007), energy-importing economies such as India, South Korea, and the Philippines witness a significant deterioration in the current account during periods of rising oil prices due to increased import costs. Similarly, Aoyama and Fujii (2021) demonstrate that Japan's current account balance worsened significantly after the Fukushima nuclear accident, as the country increased its LNG imports to compensate for the loss of nuclear power. Moreover, Korhonen and Ledyaeva (2010) highlight that energy-exporting countries like Malaysia and Brunei may experience an improvement in the current account due to increased oil export revenues. However, the majority of South and East Asian economies are net importers, making the direct negative impact more prevalent.

Empirical studies indicate that exchange rate fluctuations mediate the impact of oil prices on external balances. Kim and Loungani (1992) found that in Asian economies, rising oil prices led to currency depreciation, which did not substantially improve the trade balance due to the inelastic demand for energy imports. Bems and de Carvalho Filho (2009) further note that the exchange rate pass-through effect may vary depending on the degree of energy dependency. In heavily dependent countries, such as Bangladesh and Vietnam, the effect is pronounced and detrimental, as rising energy costs lead to currency depreciation without a corresponding increase in export competitiveness.

The rationale for applying indirect analysis using System GMM in the context of examining the impact of oil and fuel prices (OP and FP) on the current account balance (CA) through the ER stems from both theoretical and empirical considerations. The relationship between global energy prices and the external balance of a country is inherently complex, often involving multi-step causal pathways rather than a single direct link. In particular, the ER serves as a critical mediator in this relationship, especially for energy-importing economies in South and East Asia. When oil and fuel prices rise, these economies face increased import bills, leading to currency depreciation as the demand for foreign exchange surges. Subsequently, the depreciated currency makes imports more expensive and can worsen the current account balance, especially when energy demand is inelastic. This multi-step transmission mechanism cannot be fully captured by a single direct effect model, necessitating an indirect analysis framework.

Table 2.10. Results of Indirect Impact of OP on ER

Variable	Coefficient	Std. Error	p-Value
Model 1: Impact of OP on ER			
OP	-0.058***	0.019	0.004
ER (-1)	0.712***	0.056	0.002
IP	0.198*	0.043	0.032
IR	-0.024	0.013	0.089
Model 2: Impact of ER on CA			
ER	-0.401***	0.084	0.011
TB	0.322***	0.072	0.018
INF	-0.112	0.049	0.057
Constant	0.208**	0.033	0.027

Here *, **, and *** show the level of significance at 10%, 5%, and 1% level of significance.

The indirect impact analysis of OP on the CA through the ER reveals significant and insightful results, especially for energy-importing economies in South and East Asia. The analysis was conducted using System GMM to address the dynamic nature of the model and tackle potential endogeneity issues. The first stage of the indirect impact model examines how oil price fluctuations affect the ER. The results show a negative and significant coefficient for OP, indicating that a 1% increase in oil prices leads to a 0.058% depreciation of the ER. In other words, rising global oil prices cause the local currency to depreciate.

This finding aligns with previous studies, such as Chen and Chen (2007), who noted that oil-importing economies often see currency depreciation when oil prices rise due to increased import costs and higher demand for foreign exchange. The significant OP effect highlights the vulnerability of South and East Asian economies to external shocks, as depreciation often follows OP hikes due to increased demand for foreign currency. This pattern reflects the monetary approach to the balance of payments, where rising OP lead to currency outflows, weakening the local currency. The lagged ER coefficient indicates a high degree of persistence, suggesting that ER movements are strongly influenced by past values, a typical feature in emerging economies where depreciation often lingers rather than quickly correcting.

The IP coefficient shows that higher output correlates with a stronger exchange rate, suggesting that countries with robust manufacturing sectors can better withstand oil price shocks by generating foreign exchange through exports (Korhonen & Ledyaeva, 2010). The IR coefficient, although insignificant, suggests that higher interest rates may help stabilize the currency, but not decisively in the context of oil price-driven depreciation.

The second stage examines how exchange rate movements affect the current account balance. The exchange rate coefficient (-0.401, $p = 0.011$) indicates that currency depreciation significantly worsens the current account, with a 1% depreciation decreasing the current account balance by 0.401%. This supports the elasticity approach, which suggests that depreciation raises import costs, especially when oil demand is inelastic. As a result, higher energy prices increase import expenditures, worsening the trade deficit. Hasanov and Samadov (2016) also noted that exchange rate pass-through can significantly harm the current account, particularly in economies heavily reliant on energy imports.

Table 2.11. Results of Indirect Impact of FP on CA Balance

Variable	Coefficient	Std. Error	p-Value
Model 1: Impact of OP on ER			
FP	-0.049*	0.021	0.037
ER (-1)	0.693***	0.061	0.000
IP	0.182*	0.039	0.041
IR	-0.018	0.012	0.074
Model 2: Impact of ER on CA			
ER	-0.387***	0.079	0.016
TB	0.341**	0.065	0.021
INF	-0.104	0.051	0.062
Constant	0.195*	0.036	0.031

Here *, **, and *** show the level of significance at 10%, 5%, and 1% level of significance.

The indirect impact analysis of FP on the CA through the ER reveals significant insights into how changes in FP indirectly affect the external balance of energy importing economies in South and East Asia. The results obtained using System GMM, account for the dynamic nature of the variables and address potential endogeneity.

The analysis of the indirect impact of FP on the ER shows that a 1% increase in fuel prices leads to a 0.049% depreciation of the ER. This implies that rising global fuel prices weaken the local currency, consistent with the findings of Chen and Chen (2007), who noted that energy-importing economies face currency depreciation when import costs increase. The high persistence of the ER coefficient (0.693) suggests that once depreciation occurs, it tends to persist, typical in emerging Asian economies (Aizenman & Sun, 2010). The positive coefficient for IP (0.182) indicates that stronger industrial output supports a more stable currency, as increased exports generate foreign currency (Park, 2023). The IR coefficient i.e., -0.018, though not statistically significant, hints that higher rates might help moderate depreciation by attracting capital inflows.

In the second stage, the impact of ER on CA shows that a 1% depreciation reduces the CA balance by 0.387%. This indicates that a weaker currency, resulting from FP increases, worsens the CA deficit, especially when fuel imports are inelastic (Hasanov & Samadov, 2016). The positive TB coefficient highlights that maintaining export competitiveness can mitigate these negative effects. The inflation coefficient, although marginally insignificant, suggests that inflation from depreciation can further strain the CA by reducing the real export value (Aizenman & Sun, 2010). The positive constant indicates a baseline tendency towards a current account surplus under stable conditions.

The analysis indicates that while oil price shocks have significant short-term effects on the current account balance, their long-run impact appears statistically insignificant. This outcome reflects a combination of structural, policy, and market mechanisms that dampen the transmission of oil price volatility over time. In the short run, oil-importing countries experience immediate CAB pressures due to higher import costs, but these effects are often mitigated through policy instruments such as fuel subsidies, strategic reserves, or temporary trade adjustments. Over the long run, structural factors—such as export diversification, the stabilizing role of remittances, and financial inflows—act as buffers, reducing the sensitivity of the CAB to persistent oil price shocks. Furthermore, exchange rate adjustments and hedging strategies embedded in trade contracts can shield the current account from prolonged disruptions. Consequently, the long-run insignificance of oil price shocks should not be interpreted as a lack of economic relevance; rather, it underscores the resilience of these economies to external energy price shocks and highlights the role of broader structural and institutional mechanisms in stabilizing external balances. This interpretation strengthens the understanding of policy and economic buffers, providing actionable insights for managing current account vulnerabilities in the face of volatile global oil markets.

4.4. Economic and Policy Implications

The findings from the analysis of both the direct and indirect impact of OP and FP on the CA balance carry important economic implications for energy-importing economies in South and East Asia. These economies are heavily reliant on imported oil and LNG, making their external balances particularly vulnerable to fluctuations in global energy prices. Understanding how these price changes influence the current account directly and indirectly through the ER is crucial for formulating effective economic policies.

The analysis of empirical resutls shows that increases in both oil and fuel prices directly deteriorate the CA balance. This finding is consistent with the literature indicating that energy-importing countries face trade balance challenges when global fuel prices rise. As energy prices increase, import costs surge, reducing the trade surplus and straining the current account. This phenomenon is particularly relevant for economies like India and the Philippines, where high dependence on imported oil means that any global price increase directly translates to a higher import bill.

Economically, this direct impact highlights the need for energy diversification. Reducing dependence on imported oil and LNG by investing in renewable energy sources can help mitigate the financial risks associated with price volatility. Countries can also benefit from creating strategic petroleum reserves to cushion the impact of sudden price spikes, thereby maintaining external stability. This aligns with policy recommendations from studies that emphasize the importance of long-term energy contracts to manage cost predictability in the face of volatile markets.

Additionally, promoting energy efficiency in industrial and transportation sectors can reduce fuel consumption, helping to stabilize the current account. Policies that encourage the adoption of energy-saving technologies not only lower fuel demand but also help maintain economic competitiveness during periods of high global energy prices.

5. CONCLUSION AND POLICY IMPLICATIONS

This research is an attempt to explore the nexus between oil price, exchange, and current account for Asian economies. Since, current account balance and exchange rate variation debate has been hand in hand in literature particularly in conjunction with the current account and oil price relationship. Any deviation from the current account balance would result in an external imbalance, which prompts regulations through exchange rate movements to restore the balance. Understanding the patterns and composition of international trade is crucial for comprehending the liaison between the current account balance and exchange rate.

Under a floating exchange rate regime, the value of imports and exports plays a crucial part in determining demand and supply of foreign exchange, which subsequently affects the exchange rate. This is because the exchange rate is considered a relative price, reflecting the value of one currency in relation to another.

However, it is worth investigating the correlation between the exchange rate and current account balance for a sample of Asian economies. The direction of this correlation can provide insights into how changes in exchange rates impact the current account balance in these economies. By examining the relationship between exchange rate fluctuations and current account dynamics, policymakers can gain a better understanding of the factors affecting their economies and make conversant decisions vis-à-vis exchange rate policies and current account management.

This chapter explores the asymmetric as well as non-linear impact of oil price and exchange rate on the macroeconomic outlook of Asian economies. For the asymmetric impact, NARDL model is employed while the non-linear impact of different volatility regimes is explored through the Markov-Regime Switching model. Results of the asymmetric impact of oil price and exchange rate are divided into short run as well as long run. The linear ARDL model show that the long-run impact of exchange rate and oil price on current account are significant and negative. However, the impact of interest rate is insignificant for the stock market return. The outcomes of the long-run, unlike the short-run impact on current account balance, are significant for the exchange rate but insignificant for the oil price shocks. It shows that the oil price volatility is absorbed by the government polices when it fixes the price of oil in the domestic market for the specific period. The impact of both monetary policy variables is significant and negative for current account in the short-run but insignificant in long-run. It shows that an increase in the interest rate puts downward pressure on the CAB as the crowding out of investment happens. This phenomenon of crowding out is strong in the emerging economies due to lack of incentive for the long-run investment opportunities.

This research further investigates the existence of pass-through from oil prices and exchange rate to current account. The countries covered are Nepal, Pakistan, India, Malaysia, Indonesia, Philippines, Bangladesh, Korea, Singapore, Japan, Thailand, China, and Sri Lanka. The Markov regime switching model exhibits the asymmetric impact of oil in two volatility regimes categorized as high and low current account volatility. For Bangladesh, Pakistan, and Sri Lanka the low current account deficit regime is significant, but the high current account regime doesn't show the existence of any such trade-off and these findings align with Önder (2009). When the impact of the fuel (oil and LNG) price is examined on different regimes of the CA, then the low current account regime is found significant. It absorbs the fuel price shock more than the OP shock. The reason is that the fuel price variable more efficiently captures the impact of changes in energy prices as compared to oil prices. The results suggest that policymakers should not treat fuel pass-through as independent from the overall macroeconomic environment.

Conclusively the stability of current account is crucial with respect to exchange rate changes but in this case, the high current account volatility regime is more affected than the low current account regime. The fluctuations in exchange rates pose significant risks to oil-importing countries, particularly in terms of their current account balances. In this study, it was found that the coefficients for almost all countries were negative, indicating that exchange rate depreciations result in an increase in current account balances due to cheaper exports and a positive change in the trade balance. Therefore, exchange rate changes present substantial financial risks for oil-importing countries in terms of their current account balances. These risks posed by fluctuations in global exchange rates are likely to impact economic growth. However, the impact of exchange rate changes on current account balance highlights the significance of managing exchange rate risk and its role in ensuring stable and sustainable economic growth for a country. Consequently, it is crucial for countries to adopt a consistent exchange rate policy to mitigate market uncertainty.

This study systematically investigates the dynamic relationship between oil price volatility, exchange rate regimes, and current account balances across a sample of Asian economies. By employing NARDL and Markov regime-switching models, the analysis captures both asymmetric and non-linear effects, allowing for a more nuanced understanding of short- and long-run impacts. The findings reveal that exchange rate fluctuations exert a stronger and more consistent influence on the current account balance than oil price shocks, particularly in high-volatility regimes. In contrast, oil price shocks are often absorbed through domestic policy interventions, such as price stabilization measures, limiting their long-run impact on the current account. These results underscore that the effectiveness of macroeconomic policies in mitigating external shocks depends on the broader institutional and structural environment of each country.

The asymmetric effects identified through NARDL highlight that positive and negative changes in both exchange rates and fuel prices do not produce mirror-image outcomes. Specifically, exchange rate depreciations generally improve trade balances by boosting exports in oil-importing countries, while appreciations may not correspondingly enhance the current account due to limited responsiveness of exports. Similarly, low-volatility regimes in the current account show greater sensitivity to oil and fuel price changes, whereas high-volatility regimes exhibit muted responses, suggesting that macroeconomic resilience and policy buffers play a critical role in shock absorption. Furthermore, the Markov regime-switching analysis reveals that South Asian economies experience distinct regime-dependent impacts, with low current account deficit regimes being more affected by fuel price fluctuations than high deficit regimes.

From a policy perspective, these findings carry several implications. First, countries should prioritize exchange rate risk management, including adopting consistent and transparent exchange rate policies, hedging strategies, and stabilizing interventions to reduce the negative effects of volatility on the current account. Second, fiscal and monetary policies should be designed with sensitivity to regime-dependent and asymmetric effects; for example, short-term measures such as targeted subsidies or interest rate adjustments can complement long-term structural policies aimed at improving trade balances. Third, promoting domestic savings, enhancing investment capacity, and attracting foreign direct investment are critical to building resilience against external shocks. Finally, policymakers must recognize that the effects of oil price and exchange rate changes differ across countries, volatility regimes, and over time, necessitating tailored and flexible policy responses that reflect these heterogeneities.

This study also draws several policy implications based on the analysis findings. For instance, policymakers are advised to develop strategies to shift their trade balance from deficit to surplus. Additionally, governments should encourage domestic saving and investment, as well as attract foreign direct investment. Furthermore, policymakers need to be aware that the impacts of positive and negative changes in fuel prices and exchange rates are not always equal and opposite. Therefore, policy measures should be responsive to the varying effects of different fuel price and exchange rate regimes, particularly in high volatility regimes compared to low volatility regimes. Moreover, policy implications of these variables may also differ in the short and long run, as well as in the case of positive and negative changes in fuel prices and exchange rates. Consequently, specialized measures may be required to address these variations.

In sum, this study emphasizes that maintaining current account stability in Asian economies requires a comprehensive approach that integrates exchange rate management, macroeconomic policy responsiveness, and structural interventions. By accounting for asymmetric, regime-dependent, and country-specific factors, policymakers can better anticipate external shocks, safeguard macroeconomic stability, and promote sustainable economic growth.

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ESSAY 3

THE ROLE OF MONETARY POLICY IN SHAPING ASSET PRICE MOVEMENTS: ASIAN ECONOMY ANALYSIS

1. INTRODUCTION

1.1 Background

The effect of monetary policy on asset prices has been a subject of debate in the financial world. Asset price influences the real economy through number of channels of transmissions e.g., impact on consumption is illustrated via wealth effect, whereas effect on investment is translated through Tobin's Q theory as well as financial accelerator effect. Since the boom and busts in asset prices have deleterious effects on the financial stability. Unfortunately, the effects of financial stability often extend beyond the financial world. Rather, they tend to spill over to the real economy and cause great harm, i.e., as encountered by East Asian economies during1997. Subsequently, asset prices forecast inflation and offer insight for the policy makers to facilitate appropriate decisions. This is intuitively appealing, as asset prices are forward looking and therefore, provide valued information about market expectations.

While the effect of policy decisions on financial markets is well-recognized, the impact of monetary policy on the real sector is also significant. Central banks and financial institutions have shown great interest in the development of asset prices, particularly in the lending sector, since it plays a crucial role in macroeconomic fluctuations (Bernanke et al., 1989 and 1999).

Prior to industrial revolution, one of the most notorious and severe recession in the history of economics, named Great Depression, was elicited by 1929 Wall Street Crash. The sudden decline in asset prices became the culprit of great depression beside other factors. However, the monetary policy makers have been better comprehended the mechanism of monetary policy and its relationship with asset prices. They yearned to lessen the consequences which triggered the asset price crashes. Further Bernanke (1999) who previously perceived that there is no bursting of housing bubble price, observing the rise in the prices of asset in housing sector (Himmelberg 2005). However, housing bubble burst and led to great recession. But this time the fed took steps and dealt with great recession by providing the liquidity, unlike great depression period. These incidents are indication of importance of nexus between monetary price and housing prices.

Hence, previous studies and theories have endorsed the repercussion of monetary policy on real estate by and large. However, interest rate, being one of the tools of monetary policy, effects the housing price significantly by raising the prices and lowering the value of real estate even with a slight upsurge in interest rate. Nonetheless, in the paradigm of Asian economies like Pakistan, India etc. there have been no real estate market crash in the past. The reason behind market crash is usually the high integration of real estate and the mortgage market, which is not the case for economies like India, Pakistan etc., where there is a limited access of housing market to financial institutes because houses in most of the Asian economies are constructed on private equity based. However, monetary policy does affect the house price in one way or other, because the investors usually borrow money from bank to invest in the house sector (which is ever growing sector and highest return business in countries like Pakistan, India, Bangladesh, Sri Lanka etc) because the profit margin in house investment is higher than the interest rate payable to banks by the investors in response of loan (Umar et al., 2019). Moreover, the house price has dual role since it is an important durable commodity beside being a stock of wealth (Case 2001). Henceforth, the wealth of landlord is directly proportional to the variation in real estate (housing) price. So, any shift in the price of house will significantly impact the wealth of homeowner, hence affected the investment and consumption behavior of the consumer.

Moreover, the nexus between monetary policy and stock prices have been controversial as well as reciprocal in literature, for instance, one on hand, monetary policy affects the stock price e.g., with increase in interest rate the stock prices declines and vice versa. On contrary, monetary policy is affected by the stock prices e.g., any boom or bust in the stock market pressurize the Central Bank to modify their monetary policy. There is a sturdy belief that Central Bank is not neutral to fluctuations in stock markets. In Asian economies, the monetary authorities are frequently subject to monetary instability i.e., capital flight, financial market crash, political unrest, and likewise.

Categorically, during great depression, crash in stock price was the main culprit whereas during great recession crash in housing market played the vital role. Hence both variables are of equally importance in asset market. So, this study tried to fill address this void in the literature by taking the sample of Asian economies for the period of 2009-2023. The experiences of these economies are interesting because the analyzing and hypothesizing the relation between asset prices i.e., housing price and stock price and the monetary policy transmission for the context of the countries of sample used by this research has a great potential to investigate.

1.2 Problem Statement

This chapter examines the relationship between asset prices and the transmission of monetary policy, focusing specifically on housing prices and stock prices as key indicators of asset markets. Secondly, the study aims to examine how expansionary and contractionary monetary policies impact asset prices of Asian Economies. By analyzing the effects of these policy measures, the study intends to elucidate on the dynamics and implications of different monetary policy stances on asset prices across various countries. Lastly, the chapter seeks to estimate the transmission of monetary policy for both high-income and low-income countries. By considering nations with different income levels, the study intends to offer a comprehensive understanding of how monetary policy affects asset prices in economies with varying levels of development and economic conditions.

Conclusively, the problem statement of this chapter centres around exploring the relationship between asset prices and monetary policy transmission, investigating the impact of expansionary and contractionary policies on asset prices, and estimating the transmission of monetary policy in high- and low-income countries. By addressing these research questions, the study seeks to contribute to the present literature and enhance our knowledge about the intricate dynamics amidst monetary policy and asset prices.

1.3 Research Questions

The key questions are as below

- How do monetary policy actions influence asset prices, specifically housing prices and stock prices, across Asian economies?
- How do expansionary and contractionary monetary policy stances affect asset prices in the short run and long run, with distinctions between developed and developing Asian economies?

1.3 Research Objective

To examine aforementioned concerns, these key objectives are derived:

- To empirically analyze the impact of monetary policy on housing and stock prices across Asian economies, identifying transmission mechanisms.

- To examine the asymmetric effects of expansionary versus contractionary monetary policies on asset prices in both the short and long run.
- To compare the responsiveness of asset prices to monetary policy between developed and developing Asian economies, highlighting heterogeneity in transmission.
- To provide evidence-based insights for policymakers on how monetary policy can influence financial and housing markets, considering regional economic differences.

1.4 Research Motivation

Monetary policy plays a decisive role in shaping economic conditions by influencing key macroeconomic variables such as inflation, employment, and economic growth. Among these variables, asset prices—comprising housing and stock prices—are particularly significant due to their impact on household wealth, investment decisions, and broader financial stability. However, despite their importance, the relation among monetary policy transmission and asset prices remains complex and varies across different economic contexts. This study is motivated by the need to explore these dynamics, particularly in the context of Asian economies, which exhibit diverse economic structures and levels of development.

The growing integration of financial markets and the critical role of asset prices in economic cycles underscore the importance of understanding how expansionary and contractionary monetary policies influence housing and stock prices. For instance, understanding whether expansionary policies stimulate asset markets uniformly across countries or whether contractionary measures dampen asset bubbles differently depending on a nation's income level is crucial for policymakers. These insights are particularly relevant for Asian economies, where rapid urbanization, evolving financial markets, and varying levels of income inequality create unique challenges and opportunities for monetary policy effectiveness.

Furthermore, by comparing the transmission of monetary policy between high-income and low-income countries within Asia, this study aims to uncover potential disparities in how monetary tools affect asset markets in economies with distinct structural characteristics. Such an understanding is vital for designing policies tailored to specific economic contexts, ensuring that monetary interventions are both effective and equitable.

In summary, this research is driven by the need to enhance our understanding of the relationship between monetary policy and asset prices, particularly in the Asian context. By addressing these gaps, the study seeks to propose a valued insight for policymakers, stockholders, and academics, contributing to more informed decision-making and a more nuanced understanding of monetary policy's role in shaping economic outcomes.

1.5 Research Contribution

The nexus between monetary policy and asset prices has predominately focused on developed countries (Borio et al., 2002, Bordo et al., 2002, and Maio and Philip, 2015) with little research on this relationship for Asian economies. As the monetary policy efficiency is a global issue, insufficient global understanding hinders the availability of concrete evidence about the resilience of monetary policy in context of asset prices. This research is an attempt to address this gap and provides the insight for Asian economies namely India, Indonesia, Pakistan, Nepal, Bangladesh, Sri Lanka, Korea, Malaysia, Philippine, Japan, Singapore, Thailand, and China. This research contributes by analysing the interdependence of monetary policy not only on stock price but housing price as well. The analysis is important because unlike previous studies (Lee, 1992; Neri, 2004; Thorbecke, 1997), we address the impact of monetary policy in both (housing and financial markets) while using structural VAR which illustrates the theoretically consistent relationship between monetary policy and asset prices. Second, instead of single country analysis (Anggraeni, 2016, Ibrahim, 2009, Ahuja et al., 2003, and Chow et al., 2009), we have taken Asian economies for the analysis. One of the main reasons for the selection of Asian economies for this research is these countries are in tumult of two major financial crises – 1997 -1998 Asian financial crisis and 2008 global financial crisis- within one decade which effected the asset prices and intermittent the advocacy of monetary policy of this region.

The inspiration of using house price comes from monetary policy transmission framework. The housing prices are influenced by monetary policy via financial stability in the context of global financial crisis which was the main culprit behind the downfall and failure of real estate sector in economic history. South Asian economies, in specific, has been victim of financial instability which led to the fluctuation in asset prices and eventually affecting the macroeconomic performance adversely (Juhro et al., 2021). Hence the understanding of this interaction would help policy makers to use monetary policy effectively for alleviating the financial market instability. Moreover, this research would be a contribution in the existing literature on monetary policy and asset prices – housing price as well as asset price- for Asian economies by joining the research of Tng et al. (2015) and Juhro et al., (2021) who investigated the interaction of monetary policy and financial stress for ASEAN economies (while focusing only financial market). The objective of this study is achieved by using structural VAR for Asian economies. for the period of 2009-2023. In this context, analyzing and hypothesizing the relation between asset prices i.e., housing price and stock price and the monetary policy transmission for the setting of the countries of sample used by this research has a great potential to investigate.

2. LITERATURE REVIEW

2.1 Review of Literature

In literature, there is no denying the importance of monetary policy in global economies when it comes to the significance of financial crises. As previously stated, it stems from the great depression era back in 1929-1933, when US economy crashed due to the collapse of stock prices, enormous decline in the foreign trade, industrial production, output and collapsing of banking and financial bodies, and likewise. For any economy, monetary policy is indeed a crucial tool to control the inflation and achieve the economic goals for smooth-running of an economy. Despite being a financial measure, it influences the real sector as well beside being impacting the financial market in all its glory. There are number of policies implemented by policy makers of different countries in order to achieve the economic goal of a nation and curtail any minor economic failure or downfall. Taking Japan as an example of economic downfall in 1990 when Japan opt for an expansionary monetary policy in order to save the financial establishments and recover the economic crisis but it backed fire and failed (Assenmacher et al., 2010) which instigated the depression of more than 10 years of depression, it can be further classify as bursting of economic bubble, deep depression, and unstable boom, (Richard, 2009). However Plaza Accord[5] helped Japan in disguise by causing the currency to get strong radically. Further Central Bank loosened the monetary policy for take care of depression (Werner, 2009). Finally in 1987, Japan gradually made his ways towards the recovery while the Central Bank was extra alert for its monetary policy. During 1989 the contractionary monetary policy was opt and elevated the discount rate.

[5]Plaza Accord: it is an treaty between G-5 countries in 1985 by manipulating the ER by US$ devaluation dollar in relation to Japenes Yen & Euro.

Nonetheless, the bubble in Japan was burst and led to the recession. During the important eco political events in last two decades i.e., 2016 Brexit, UK's plans to quit trans-Pacific free trade pact, unification of renminbi (RMB) to SDR and other socio economic and political events, RMB devalued to record point as well as dollar indices rose however, the asset market failed because of policy regulation. In order to revive the economy in 1990, Japan finally adopted the contractionary monetary policy following the tight monetary policy by Asian economies which ended up crashing the real estate sector. Henceforth, monetary policy is the foremost tool for global nations when it comes to regulate the economic growth and limit the inflation/ recession and combat the financial crisis no matter it is stock market or the housing market.

The asset prices have been very popular among economic researchers in past literature due to its ability to influence the financial sector and mechanism of monetary policy (Mishkin, 2007 & 2001; Tymoigne, 2008). Although stock prices are widely studied and analyzed yet housing price has already been neglected especially for the analysis of developing countries or economies where real estate markets are restrictively influenced by monetary policy transmission. Hence this study aimed to analyze both indicators of the asset price in the framework of the money market. For instance, there is a significant but inverse relationship between monetary policy instruments like interest rate with asset prices in short run as proposed by the Taylor rule (Detken et al., 2004 and Ahrend et al., 2008). Apparently, monetary policy was one of the culprits in 2000 behind the housing and real estate boom in States, however this evaluation of Taylor (2007) was denied by Kuttner (2012) and Dokko et (2011) by asserting the nonexistence of volatility in real estate and market dynamics provided that interest rate discontinues to follow the Taylor rule. Further it was questioned by Del (2007) whose findings exhibited the minor relation among monetary policy and price of real estate in United States and likewise. Besides United States, United Kingdom of

England and China, the other industrial economies have always exhibited a strong impact of monetary policy transmission on real estate sector (Jarocinski, 2008 and Ahearne 2005). Their claim was supported by further studies by affirming the significant relationship between housing price and monetary policy for the developed countries, (Williams, 2015 and Elbourne, 2008). Astoundingly, the housing sector was conveniently overlooked by succeeding analyses (Giuliodori, 2005) and their focus was solely on stock prices for the investigation of monetary policy transmission through lags to it (Good Hart., 2001; and Iacoviello, 2005). Nonetheless, the monetary policy may only be able to influence the financial market when there is a presence of interdependency among them (Rigobon 2003). Bjornland (2009) further analyzed the significance of MP on stock price and came up with the results that monetary policy transmission is a short run phenomenon, and it doesn't effect macroeconomic variables significantly in long run.

The inter-connection among the indicators of asset price is demonstrated by the representation of both variables. As the housing price variable exhibits the real sector potency, while stock price is taken to specify the soundness of the financial sector. Unlike developed countries housing sector is not assumed to prone of real estate pr housing crash (Umar et al., 2019) however, the overall downfall of economic activities around the globe, real estate has started to clatter in developing countries as well. The statistics shows the significant variation in housing price in developing countries like Pakistan and India, when the data was adjusted to inflation rate, Pakistan housing sector has shown a significant hike of 5.06% whereas Indian real estate estimates displays an upsurge of 3.98% in housing price, the results came out to be identical for other countries like Sri Lanka and Nepal when it comes to stock price and house price dynamics.

Subsequently, the macroeconomic fundamentals like industrial production (IP) and exchange rate (ER), interest rate (IR), and likewise, has significantly influence the stock price index in previous first-hand research. Since stock prices and returns can be measured by the interest rate of an economy i.e., European economy (as reviewed by Rapach et al. 2005) which makes it one of the crucial, and trustworthy forecasting agents in the market dynamics. Like previous empirical studies the stock price turned out to be inversely influenced by interest rate in long run for US stock market (Humpe 2009), which displays the identical results for Spanish asset market (Jareno et al., 2010), as well as for Singapore, Philippines, and Thailand (Wongbangpo et al., 2002). Just like interest rate, the inflation rate turns out to have same inverse relationship with the stock indices and the studies of Wongbangpo et al., (2002) verified it for the ASEAN economies i.e., Malaysia, Vietnam, Laos, Brunei, Thailand, Myanmar Indonesia, Singapore, Cambodia and Philippines). The GDP and industrial production show different estimates when it was measured for the evaluation of impact of stock prices for European economies and United Kingdom (Peiro, 1996) however, he used the same sample of countries for the verification of his finding by doing number of consecutive repetitive analysis (Peiro, 2016).

Likewise, stock prices do not have any long run relation with exchange rate for south Asian countries. The estimation was carried out by (Smyth 2003) for continuously six-year estimates of daily exchange rate for the developing Asian economies starting from 1995, and results proved the absence of any long run relation among the variable of interests. Nonetheless, in short run stock prices does show the causality with the exchange rate for India and Sri Lanka, unlike Pakistan and Bangladesh which doesn't show any signs of interconnection (Rahman et al., 2009). However, there are studies which came up with the positive causality among stock prices and exchange rate for Malaysia, Singapore and Thailand e.g., Phylaktis et al., (2005) by using Granger causality for the above-mentioned countries.

A growing body of research highlights the connection between sustained low interest rates and the formation of asset price bubbles, particularly in housing markets. According to Taylor (2007), prolonged periods of accommodative monetary policy—especially when interest rates remain below neutral levels—can contribute to excessive risk-taking, overvaluation of assets, and speculative investment behavior. In the post-2008 global financial environment, many Asian economies adopted expansionary policies, which contributed to a sharp rise in housing prices, especially in urban centers like Seoul, Singapore, and Kuala Lumpur (IMF, 2021).

Recent empirical studies further emphasize the role of unconventional monetary policy tools, such as quantitative easing (QE) and forward guidance, in shaping asset price dynamics. For example, Chen et al. (2016) show that QE announcements in advanced economies had measurable spillover effects on asset prices and capital flows in emerging Asian markets, amplifying price pressures in housing and equity markets. Similarly, Filardo and Nakajima (2018) argue that forward guidance—by anchoring future interest rate expectations—can flatten yield curves and lower borrowing costs, encouraging leveraged investment in real estate and equities.

In Asia, the evidence points to a strong sensitivity of housing markets to such policies. A recent study by Aizenman et al. (2022) finds that countries with higher exposure to global QE experienced faster asset price inflation and were more vulnerable to financial imbalances. These effects are particularly pronounced in economies with shallow capital markets and limited macroprudential tools. As such, understanding how both conventional and unconventional monetary policy mechanisms influence asset prices is crucial for evaluating the stability risks in Asian financial systems.

Conclusively, the impact of monetary policy on real estate has been widely studied for developed countries like US, UK, and other developed countries however, previous studies have overlooked the Asian economies that did not experience a housing bubble burst. Consequently, these economies have been neglected in research (Umar, 2019). In order to address this gap, this study takes house prices and stock prices as indicators of asset prices for Asian economies.

2.2 Theoretical Framework

In financial economics, there are two distinct perspectives regarding the role of monetary policy in response to financial markets. The first perspective, known as the conventional viewpoint, is based on the Quantity Theory of Money and argues that monetary policy is futile because the impact of money is merely nominal, rather than real. But on the other side changes in general price levels impacts the personal income and expenditure of consumers that reduces demand for housing- income effect- In this context, central banks disregard the monetary policy as efficient instrument to address fluctuations in asset prices (Good hart et al., 2010). In this perspective, the conventional viewpoint holds that monetary policy has limited impact on real estate and stock prices. While the relation among asset prices, real estate and commodities i.e., oil and gas are imperative as investigated with the help of Markov switching model (Chan et al., 2011) by conventional point of view lacks the foundation for responding to variations in these variables through monetary policy.The economic theory behind the negative relationship between interest rates and house prices is primarily based on the effect of interest rates on the cost of borrowing and, consequently, on the affordability of housing. When interest rates are high, the borrowing cost rises, causing mortgages to become more expensive for homebuyers. This, in turn, reduces the demand for housing as fewer people can afford to buy homes. Subsequently, house prices tend to decrease.

High interest rates also affect the overall economy by slowing down economic activity. When borrowing becomes expensive, businesses may reduce investment, leading to lower economic growth and potentially higher unemployment. This can further dampen the demand for housing as people may be more hesitant to make large purchases, such as homes, during economic downturns.

Conversely, when interest rates are low, borrowing becomes cheaper, making it more affordable for consumers to purchase houses. This upsurges the demand for housing, which in turn boosts house prices. Additionally, low interest rates can also incite economic activity by promoting borrowing and investment, which may lead to higher economic growth and increased demand for housing.

Additionally, low interest rates can lead to higher asset prices, including house prices, since investors pursue higher revenues in the low-interest-rate environment. This can further contribute to the positive relationship between low interest rates and house prices.

Universally, such monetary policies are consistent with inflation targeting policies Whereas, the second perspective, known as the extra-action strategy, suggests that central banks should proactively respond to real market dynamics. It is believed that in situations where financial markets, such as housing or stock prices, experience price volatility, central banks should take dynamic measures. For instance, if there is an expected price bubble in stock or housing markets, it is suggested that central banks should implement a tight MP to curb the volume intensity, and effect of these bubbles on the financial market. This approach aims to prevent the probabilities of market crashes. Correspondingly, during a down fall of financial market, which adversely affects the economic activities, the extra-action strategy advocates for adopting a loose monetary policy. Because when interest rate drops, investors are more inclined to take loans from the banks due to low cost. Not only it may aid to restore the asset prices, but it also helps in up surging the investment in the economy._It is striking that globally the monetary policies of Central Banks typically align with inflation-targeting policies, which supports conventional viewpoint. Nevertheless, the extra-action strategy advocates for a more practical and dynamical approach in respond to real market dynamics.

Following Mishkin (2001), the transmission mechanism of monetary policy impacts the economy through different channels. The monetary policy channels are elaborated for asset prices- house price and stock price-are as follows.

a) Investment Channel

Tobin's q-theory as proposed by Tobin (1969), offers an essential mechanism for understanding the impact of stock price movements on the consumption level through wealth channel and investment channel (Bjornland and Leitemo, 2009).

Escalating on the concept, the expansionary monetary policy (M) leads to increase in asset prices (P) which in turn increase the investment (I) and output level (Y).

$$r\downarrow \Rightarrow P\uparrow \Rightarrow c\downarrow \Rightarrow I\uparrow \Rightarrow Y\uparrow$$

Another perspective of this mechanism proposes that implementation of expansionary monetary policy (M) leads to upsurge in asset prices, that marks a decline of the cost of capital, thus encourages investment. Ultimately, it roots for an increase in the total output level of the economy. Hence, asset price impacts the aggregate demand which would further influence the inflation.

b) Discount Rate Channel

In order to alleviate the inflation, monetary policy stimuli the stock prices by interest rate or discount rate channel. The real interest rates may affect the dividends and stock return percentage since it effects the uncertainty of agent's market.

Moreover, the classical theory of asset prices suggests that stock prices are determined by the present value of expected income. Therefore, the stock price signifies the discounted present value of future cash flows for a firm. As a result, monetary policy decisions, which are closely linked to the variations in short-term interest rates, can influence stock prices by adjusting the discount rate (Zare et al., 2015). Furthermore, variations in interest rates can impact asset prices by altering expectations about future cash flows due to changes in anticipated inflation levels within the economy (Lobo, 2000).

c) Balance sheet effect

The existence of asymmetric information regarding the monetary policy in the credit market provides an additional explanation that operates through asset prices. The effect of monetary policy outspreads beyond asset prices, it can also shape a firm's balance sheet and overall spending through the undermentioned mechanism: When expansionary monetary policy is implemented, asset prices rise, thereby increasing the net worth of the firm (NW) and ultimately resulting in increased lending (L). This creates opportunities for the firm to invest in new projects and subsequently boost aggregate spending (Y).

$$R \downarrow \Rightarrow P \uparrow \Rightarrow NW \uparrow \Rightarrow L \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow$$

d) Household balance sheet effect

Another way of analyzing the balance-sheet channels of monetary transmission is to examine household balance sheet. The effect of the balance sheet is driven by its impact on consumer's desire to spend more. An increase in asset prices cause an escalation in value of assets (A) which declines the likelihood of financial distress (FD). So, consumers increase their consumption level (C) and expenditures (E). This prompts consumers to increase their consumption level (C) and expenditures (E). In turn, this leads to the upsurge in output level (Y).

This demonstrates the importance of asset prices and the balance sheet of households in influencing consumer behavior and overall economic activity.

$$r \downarrow \Rightarrow P \uparrow \Rightarrow A \uparrow \Rightarrow FD \downarrow \Rightarrow C \uparrow \Rightarrow E \uparrow \Rightarrow Y \uparrow$$

e) Household wealth effect

The household wealth effect is another channel through monetary policy transmission arises. This mechanism demonstrates that when money supply increases, it leads to a upsurge in in price level that eventually results in increasee in the consumer's wealth (W). Consequently, a consumer perceives himself financially resourceful, which tend to an upward trajectory of his consumption level (C) which in turn contributes to elevate the aggregate output level (Y).

$r \downarrow \Rightarrow P \uparrow \Rightarrow W \uparrow \Rightarrow C \uparrow \Rightarrow Y \uparrow$

f) Unconventional Monetary Policy Channels

Monetary policy can also affect asset prices not only through traditional channels but also through unconventional measures like quantitative easing (QE) and forward guidance. (Galloppo et al., 2017, and Schmidt, 2020). QE refers to the process where a central bank purchases assets, such as government bonds, in order to boost the money supply and stimulate the economy, which directly impacts asset prices. Forward guidance is when the central bank communicates its future plans, affecting market expectations and investor behavior. These measures allow the central bank to shape market expectations, encouraging investors to take on more risk and leading to higher asset prices (Galloppo et al., 2017,and Lüdering et al., 2020). QE can also lead to portfolio rebalancing as investors shift towards riskier assets Koijen et al., 2017).. Policymakers should consider these unconventional channels alongside traditional methods when implementing monetary policy.

Mishkin (1996) has presented two perspectives on how MP can affect stock prices - the Monetarist view and the Keynesian view. The Monetarist view suggests that expansionary monetary policies raises the optimal monetary balance, thereby enhancing the demand for equities and driving up their prices. On the other hand, the Keynesian view argues that reduced interest rates resulting from expansionary monetary policies make bonds less appealing compared to equities, leading to an increase in equity prices (Zare et al., 2015)._With these theories in mind, economists have utilized numerous econometric approaches to analyze the relationship amid MP and the response of asset prices. These models often incorporate the principle of asymmetric impact, as it is crucial to examine the asymmetries in the adjustment process of assets, say stock prices.

3. DATA AND METHODOLOGY

3.1 Econometrics Approach

To investigate the forecasting and dynamic behavior of time series, the VAR approach has been extensively used in the literature (Sims, 1980). Since VAR approach keeps the account of an economy's natural reaction to the macroeconomic shocks as well as the role of these shocks in macroeconomic framework development. This study moves forward in line with the preceding empirical findings and presumes that variables have no long-run relation.

A structural VAR (Vector Autoregression) model is a multivariate time series model used to analyze the dynamic relationships between multiple variables. In a structural VAR model, the variables are represented as a vector, and the model captures the interactions between these variables over time. The key feature of a structural VAR model is that it allows for the identification of structural shocks, which are unanticipated changes in the variables that have a lasting impact on the system.

The structural VAR model can be expressed as:

$Yt=A1Yt-1+A2Yt-2+\ldots+ApYt-p+\varepsilon tYt=A1Yt-1+A2Yt-2+\ldots+ApYt-p+\varepsilon t$

where:

- $YtYt$ is a vector of endogenous variables at time tt,
- $A1,A2,\ldots,Ap$ are coefficient matrices,
- p is the lag order of the VAR model,
- εt is a vector of error terms.

The coefficient matrices $A1,2,\ldots,Ap$ capture the dynamic relationships between the variables. These matrices represent the short-term (or lagged) effects of each variable on the others. The lag order pp specifies how many lagged values of the variables are incorporated in the model.

To identify the structural shocks, additional assumptions or restrictions are needed. One common approach is to assume that the shocks are orthogonal, which means that they are not correlated with each other. This assumption enables the identification of the structural shocks based on the covariance matrix of the error terms.

The identification of structural shocks is crucial for interpreting the results of a structural VAR model. By understanding the impact of these shocks on the variables of interest, policymakers and researchers can acquire understandings of the underlying dynamics of the system and formulate appropriate policy responses.

In summary, a structural VAR model delivers a flexible framework for investigating the dynamic interactions amid multiple variables. By identifying structural shocks, researchers can better understand how unanticipated changes in the system affect the variables of interest, leading to more informed decision-making.

Restriction 1: Interest rate has significant negative impact on the house prices in the long run.

Restriction 2: Interest rate has a significant negative impact on the stock prices in the short and long run.

The theory that describes the significant negative relation amid interest rates and house prices in the long run is often associated with the concept of "interest rate sensitivity theory" in the context of the housing market. This theory suggests that changes in interest rates can have a substantial effect on cost effectiveness of housing, which in turn impacts the demand for and supply of housing, leading to changes in house prices over the long term.

Similarly, the MP transmission channel explains that in the short run, changes in interest rates directly impact the cost of borrowing for mortgages. When interest rates upsurge, borrowing becomes more expensive, causing a decline in demand for housing as fewer people can afford to buy homes. This decrease in demand can put downward pressure on house prices in the short term. Expectations about future interest rate movements can also influence housing prices. If investors and buyers expect interest rates to remain high or continue to rise, they may anticipate lower future house prices and adjust their buying and investment decisions, accordingly, resulting in a decline in prices in the long run.

By incorporating lagged effects and considering the interplay between variables, the structural VAR model enables the analysis of their dynamics. Econometric techniques, such as structural VAR estimation methods, can be applied to evaluate the model coefficients and evaluate the significance of the relationships.

For the specific impact of monetary policy on house prices (HP) and stock prices (SP), we focus on the coefficients associated with MP in the respective equations:

Housing Price:

$$HP_t = \alpha_1 + \Phi_{1t} * MP_{t-1} + \varepsilon_t \quad \textit{(3.8)}$$

Stock Price:

$$SP_t = \alpha_2 + \Phi_{2t} * MP_{t-1} + \varepsilon_{2t} \quad \textit{(3.9)}$$

Here, Φ_{1t} represents the coefficient that captures the impact of MP shocks on housing prices, and Φ_{2t} represents the coefficient for the impact on stock prices. The error terms (ε_{1t} and ε_{2t}) capture any unexplained variation in the respective prices. By estimating these coefficients, we can assess the magnitude and significance of the effects of MP shocks on housing prices and stock prices, while considering the influence of the controlled variables (IP, inflation, interest rate, and exchange rate).

While the Structural Vector Autoregression (SVAR) model remains central to this study's objective of analyzing the country-specific impact of monetary policy on asset prices, it is also important to consider the broader regional dynamics and average relationships across economies. To this end, this research incorporates a Dynamic Panel Generalized Method of Moments (GMM) estimation as a complementary approach. This method addresses limitations inherent in their inability to detect common patterns or generalize results across multiple economic settings.

Monetary policy transmission mechanisms are shaped not only by country-specific factors but also by regional macroeconomic environments, institutional frameworks, and stages of economic development. Although SVAR models are excellent for capturing the short-term dynamic responses of macroeconomic variables within each country, they are limited in their capacity to reveal systematic cross-country effects, particularly when heterogeneity is pronounced.

Dynamic panel data methods, particularly GMM estimation techniques, are widely used in macroeconomic and financial research to resolve issues of endogeneity, omitted variable bias, and unobserved heterogeneity. These issues are especially pronounced when modeling monetary policy and asset price relationships, given the potential for reverse causality—where changes in asset prices can themselves influence policy rates or macroeconomic indicators. The GMM approach, developed by Arellano and Bond (1991), and extended by Blundell and Bond (1998), addresses these concerns by using internal instruments derived from lagged values of the explanatory variables, producing more consistent and efficient estimators than standard fixed-effects or pooled models.

The dynamic panel model employed in this study estimates the impact of monetary policy and other macroeconomic fundamentals on two types of asset prices: real stock prices and real house prices, modeled separately. The baseline specification takes the following form:

$Y_{it} = \alpha\, Y_{it-1} + \beta_1\, RIR_{it} + \beta_2\, INF_{it} + \beta_3\, IP_{it} + \beta_4\, REER_{it} + \beta_5\, MS_{it} + \beta_6\, TV_{it} + \beta_7\, CR_{it} + \mu_i + \epsilon_{it}$

(3.10)

Where:

- Y_{it} = Logarithm of Real Stock Prices or Real House Prices for country *i* at time *t*
- Y_{it-1} = Lagged dependent variable capturing dynamic persistence
- RIR_{it} = Real interest rate
- INF_{it} = Inflation rate (Consumer Price Index)
- IP_{it} = Index of industrial production (proxy for output)
- $REER_{it}$ = Real effective exchange rate
- MS_{it} = Money Supply (M1 and M2)
- CR_{it} = Private Sector Credit to GDP Ratio
- μ_i = Unobserved country-specific effects
- ϵ_{it} = Idiosyncratic error term

This specification enables the modelling of both direct monetary policy effects (e.g., interest rate changes influencing mortgage and investment behavior) and indirect effects via inflation, output, and exchange rate movements.

Difference GMM (Arellano-Bond) is applied which first-differences the model to eliminate time-invariant country-specific effects (μ_i) and uses lagged levels of the explanatory variables as instruments for the differenced equation.

Lag selection is carefully managed to avoid instrument proliferation, which can weaken the Hansen test's reliability. Instruments are collapsed where appropriate, following the methodology outlined by Roodman (2009). All models are estimated using two-step robust standard errors to correct for heteroskedasticity and autocorrelation.

Incorporating GMM adds value to this thesis in several ways. Firstly, it allows for an aggregate perspective on how monetary policy affects asset prices in Asia, accounting for both time and country-level variation. Secondly, it enables the comparison of policy effectiveness across diverse economies—from advanced to emerging—while handling endogeneity, which is essential in macroeconomic studies. Lastly, the GMM framework serves as a robustness check for the findings of the SVAR models, allowing for triangulation and increased credibility of results.

This dual-methodological approach—SVAR for deep country-specific analysis and GMM for cross-sectional generalization—ensures a comprehensive, rigorous, and policy-relevant investigation into the impact of monetary policy on asset prices across Asia.

3.2 Data Source & Variable Description

For the estimation of monetary policy transmission to the asset market, the data for the variables of interest is gathered. The variables of interest are stock prices (SP), house prices (HP), real interest rate (IR) whereas the controlled variables comprise the money supply (M1 & M2), the trade volume (TV), private sector credit to GDP ratio (CR), the real effective exchange rate (ER), industrial growth (IP), and inflation[6]. The data for these variables is obtained from various sources such as International Financial Statistics (IFS), World Bank (WDI), Eurostat and Bank of International Settlements. The house price (HP) is measured as a percentage change in housing

[6] The monthly data of inflation is converted to the quarterly data by taking the average of each quarter in order to make it align with the frequency of rest of data set.

price per quarter in a country. Whereas the stock price is the percentage change of stock market price for the stock exchange of each respective country[7]. However, in certain countries, there are multiple functioning stock markets, therefore we selected the stock markets with the maximum capitalization as of the year 2020. The economic activity of the sample countries is illustrated by the percentage change in industrial production[8] (Alqaralleh, 2020) which is considered as the percentage change per quarter in the GDP of the economy.

More specifically, we used quarterly data from 2009 to 2023 for estimation. This specific period is selected due to the constraints in the availability of house price data in the Asian countries as well as to avoid the structural break in the account of the 2007-2008 financial crisis. The sample economies for this study are economies including Bangladesh, India, Indonesia, China, Malaysia, Philippines, Japan, Pakistan, Sri Lanka, Korea, Singapore, Thailand, and Vietnam.

This research attempts to investigate the MP transmission on asset prices for the Asian economies. Within our sample, we created an additional panel specifically focusing on developing Asian economies including Bangladesh, India, Sri Lanka, and Vietnam. Despite having a small sample size, the selected countries effectively demonstrate the region accounting for more than 88% of its overall share. Additionally, the sample countries are further categorized based on their regional classifications, distinguishing between Asian economies as a whole.

The next section is dedicated to the econometric methodology adopted to analyze the transmission effects of monetary policy on asset prices to examine the shock in asset prices is due to monetary policy or not.

[7] For the stock price data, the weighted average of stock price is taken that is based on the market capitalization.
[8] Data of industrial production was collected from Eurostat for European economies and this data source handled by European Commission.

4. EMPIRICAL FINDINGS

Before delving into the econometric results of the model, our initial objective is to present a comprehensive overview of the sample characteristics of the data. This will provide us with valuable insights into the nature of data. The descriptive statistics for all the variables are illustrated herein encompassing key measures i.e., mean, median, mode, standard deviation, and minimum and maximum values over time.

Correspondingly, the Table 3.1 illustrates that the interest rate in developing countries is relatively higher than it is for all Asian countries in the sample. The reason for the relatively higher interest rates in the developing Asian economies is an appetite to control the high levels of inflation. Correspondingly, the exchange rate fluctuation for the Asian is less than the fluctuation and within the sample the developing countries are found to have relatively more fluctuation. It shows a high level of uncertainty that persists in the developing world. It is also one of the reasons that the interest rate is kept significantly higher in developing countries to attract more investment while compensating for the economic uncertainty.

Table 3.1: Descriptive Statistics for Asian Economies

	SP	IP	ER	IR	INF	MS	TV	CR	HP
Mean	1.87	0.54	-1.72	-0.27	1.85	9.3	0.566	0.922	-0.52
Median	2.39	1.78	0.00	-0.49	1.27	8.0	0.462	2.31	1.29
St. Dev.	7.82	9.31	27.05	1.88	1.49	4.14	0.507	1.02	10.55
Minimum	-49.23	-15.3	-46.36	-4.59	-2.43	3.0	0.024	1.79	-18.79
Maximum	30.65	29.08	13.64	4.25	6.47	15.0	1.46	9.04	40.46

Source: Author's Own

The exchange rate, similar to the asset prices and inflation, shows relatively less variance for Asian countries. The exchange rate during the sample period appreciates for the Asian countries but depreciates for the developing economies in the sample. To increase the demand for local currency, monetary policy is considered an efficient approach, especially in developing economies.

In addition to descriptive statistics, it is also important to bring here the correlation matrix for all the variables of interest for the type of countries.

Table 3.2. Correlation Matrix for Asian Economies

	IR	IP	ER	INF	SP	HP	MS	TV	CR
IR	1								
IP	-0.07	1							
ER	-0.02	0.01	1						
INF	0.10	0.18	0.02	1					
SP	-0.19	-0.05	-0.04	0.09	1				
HP	0.15	0.15	0.04	0.33	-0.35	1			
MS	-0.16	0.95	0.22	0.37	1.01	0.53	1		
TV	-0.66	0.72	-0.44	-0.05	1.04	-0.26	1.10	1	
CR	-.01	0.52	-0.13	-0.62	0.18	0.43	0.66	0.31	1

Source: Author's Own

Following the discussion on descriptive statistics, our subsequent aim here is to bring up and discuss the results of the econometric test. The next section presents these results. The first step involves examining whether the variables are stationary at the level or if a unit root exists. To accomplish this, an Akaike Information Criterion (AIC) is used. The results illustrate that all the variables have unit roots and are stationary at the first difference. The results of LLC test are presented in Table 3.3 below.

Table 3.3: Lag-Length Criterion across Asian economies

Country	Model I (House Price)	Model II (Stock Price)
China	1 (8.84*)	1 (14.39*)
India	1 (18.64*)	1 (20.37*)
Bangladesh	1 (15.71*)	1 (21.19*)
Indonesia	1 (11.76*)	1 (16.27*)
Philippines	2 (14.83*)	1 (17.90*)
Japan	1 (7.78*)	1 (11.48*)
Singapore	1 (9.03*)	1 (10.97*)
Malaysia	1 (10.79*)	1 (13.48*)
Pakistan	1 (7.82*)	1 (20.19*)
Sri Lanka	2 (15.22*)	1 (18.37*)
Thailand	1 (12.01*)	2 (14.85*)
Vietnam	2 (12.65*)	2 (10.93*)

Here * shows the significance of selected lag at 95 percent confidence interval.

After the lag length selection, it is essential to see if the relationship among monetary policy shocks and the asset prices short or long-run. Literature shows that the reason for the absence of a long-run relationship among monetary transmission channel and the asset prices is because of two main reasons. One reason for this is the nature of asset prices as the asset prices have high volatility even in the short run, especially the stock prices. It absorbs any change in the economy instantly. So, the impact of interest rate change is reflected in the stock prices in the short run. The second reason for the absence of long-run relations is the nature of monetary policy instruments. The interest rate or the policy rate is usually used for the adjustment of the economy in the short run. It is the reason the long-run relationship is insignificant for the monetary policy transmission.

Given the structure of the dataset—which includes quarterly data from 2009 to 2023 for 13 Asian economies—it was important to first check whether the variables used in the analysis are stationary. In other words, we needed to confirm that their statistical properties, like average values and variability, stay consistent over time. If the variables are not stationary, it can lead to misleading results, especially when using dynamic panel data techniques like the Generalized Method of Moments (GMM) estimator (Baltagi, 2005; Wooldridge, 2010).

To test for stationarity, we applied the Levin, Lin, and Chu (LLC) panel unit root test. This test is well-suited for datasets like ours—balanced panels with a moderate number of time periods and a relatively small number of countries (Levin, Lin, & Chu, 2002). Unlike the Im, Pesaran, and Shin (IPS) test, which allows each country to have its own dynamic process, the LLC test assumes a common pattern across all countries. While this may seem restrictive, it provides strong power to detect whether the data are stationary, making it a useful tool for initial assessments involving macro-financial variables across countries (Breitung & Pesaran, 2008).

Table 3.4: Lag-Length Criterion across Asian Economies

Country	Significance at Level	Significance at First Difference
Stock Price	Insignificant (0.1015)	Significant (0.0020)
House Price	Insignificant (0.1640)	Significant (0.0000)
Real Interest Rate	Significant (0.0002)	-
Real Exchange Rate	Insignificant (0.1040)	Significant (0.0210)
Money Supply	Insignificant (0.2230)	Significant (0.0000)
Stock Market Trade Volume	Insignificant (0.0722)	Significant (0.0410)
Private Sector Credit to GDP	Insignificant (0.1790)	Significant (0.0000)

Industrial Production Growth	Significant (0.0000)	-
Inflation Rate	Significant (0.0041)	-

We tested a range of key economic and financial variables, including real stock and house prices, real interest rates, real effective exchange rates, the broad money supply (M2), stock market trade volume, private sector credit to GDP, industrial production growth, and inflation. Each variable was tested at both its level and first-differenced form to determine its order of integration. The LLC test assumes, as its starting point, that the data series are non-stationary, and we test this against the alternative that they are stationary.

As shown in table above, the test results reveal that variables like stock prices, house prices, MS, real exchange rates, trade volumes, and private sector credit are non-stationary in their levels—meaning their p-values exceeded the 5% threshold. However, when we first-differenced these series, their p-values dropped well below 1%, indicating that they became stationary. This means these variables are integrated of order one, or I(1).

In contrast, variables such as real interest rates, industrial production growth, and inflation were found to be stationary at level, with p-values below 0.05, and did not require differencing. These results are in line with existing research, which often finds that asset prices and monetary aggregates tend to follow a random walk (I(1)), while flow variables like output growth and inflation are typically stationary (Stock & Watson, 2002; Rabanal, 2007).

Our findings also resonate with the broader literature on monetary policy and asset prices. For example, studies by Bernanke and Gertler (2001) and Goodhart and Hofmann (2008) similarly report that asset prices and money supply data are usually non-stationary, making differencing a necessary step before any meaningful analysis. On the other hand, stationary behavior in inflation and production growth is a common theme in research on monetary transmission (Clarida, Galí, & Gertler, 1999).

In summary, the LLC test results guide us on how to treat our data before moving forward with GMM estimations. Specifically, variables like stock prices, house prices, money supply, trade volumes, credit-to-GDP ratios, and real exchange rates need to be differenced to ensure valid results. Meanwhile, real interest rates, inflation, and industrial production growth can be used in their level form. This step is crucial to ensure that our subsequent dynamic panel analyses are statistically sound and not undermined by issues related to non-stationary data.

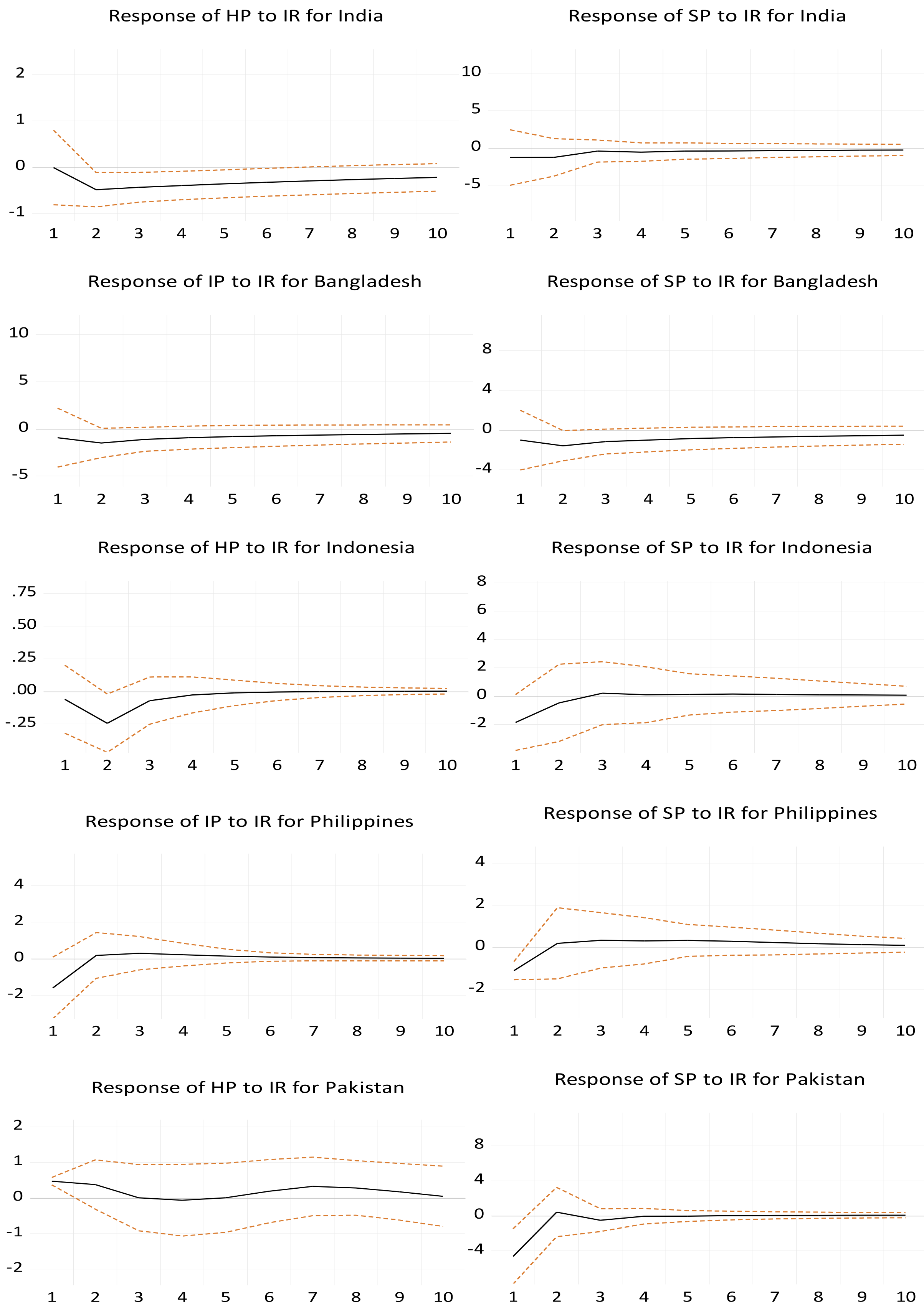
Since the variables exhibit unit roots but do not possess a long-run relation, the appropriate model to explore the effect of interest rate shocks on asset prices is the structural vector autoregressive (SVAR) model. This model allows us to analyze the dynamics and interfaces between the variables of interest. The benefit of applying the SVAR model is that it takes all the variables as endogenous. Hence, we can simultaneously measure the effect of all variables on asset prices. The estimation of the SVAR model allows us to inspect the transmission of MP on asset prices while considering the influence of other variables such as industrial production, exchange rate, and inflation rate. This comprehensive analysis enables us to determine whether these additional variables have a significant impact on asset prices in addition to the shocks in interest rates.

The results of SVAR are usually described in two techniques i.e., impulse response functions (IRF) and the variance decomposition. The IRF explains the impact of shock in one variable on the variable of interest. The variance decomposition (VD) analysis describes how much variation in one variable is explained by other variables and by that specific variable itself. The results of IRF and VD are presented here for the sample countries so that the comparison of the efficiency of MP and its impact on the asset market can be assessed from a broader perspective.

4.1 Impact of Monetary Policy on Asset Prices for Asian Developing Countries

The results of the impulse response function are discussed here for both asset prices i.e., stock and house prices for the developing countries. The effect of interest rate as a MP instrument is estimated for both assets. In addition, the effect of macroeconomic variables like inflation rate, exchange rate, and industrial production are also illustrated. Theoretically, an increase in interest rate leads to crowding out of investment from the asset market and a decline in demand (Chakraborty et al., 2018). Similarly, the contractionary monetary policy also raises the cost of borrowing and hence reduces the investment in the asset market. This impact is then reflected in the negative return on assets with the decline in asset prices for the developing countries (Ndikumana, 2016).

The impact of variable of interest on the house price is given in the Figure below. The impact of interest rate on the stock price is negative and significant for the first quarter which are in line with the previous literature (Detken et al., 2004; Wongbangpo et al., 2002 and Ahrend et al., 2008). As described above, this relationship is in accordance with the theory. The impact of inflation on the stock price is positive and significant. It shows that when inflation happens in the economy then the stock price also increases. The most common reason for this positive relation could be that when the general price level increases then it mirrors the growth in economy. In such a situation the stock price may increase when inflation increases. To ensure this impact we must look for the impact of industrial production, as a proxy for economic growth, on the stock price.


Response of HP to IR for India
Response of SP to IR for India
Response of IP to IR for Bangladesh
Response of SP to IR for Bangladesh
Response of HP to IR for Indonesia
Response of SP to IR for Indonesia
Response of IP to IR for Philippines
Response of SP to IR for Philippines
Response of HP to IR for Pakistan
Response of SP to IR for Pakistan

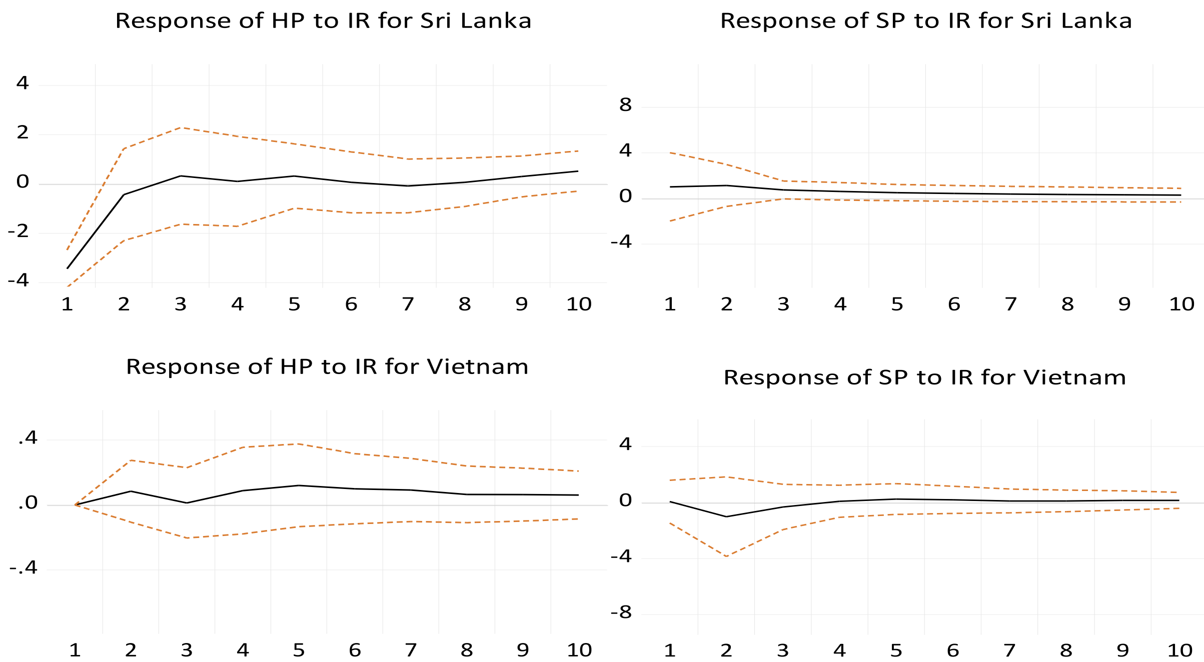


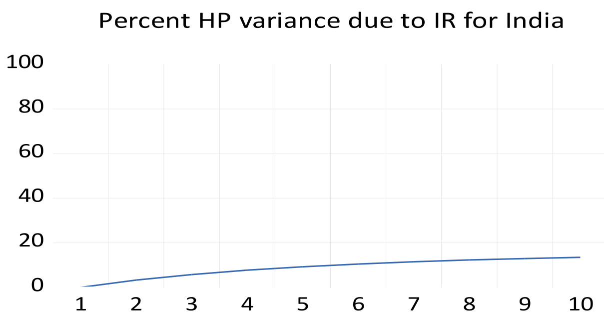
Figure 3.1 Impulse Response Functions for Asian Developing Countries

For house prices, the effect of interest rates has been significant but negligible for developing countries. Here the reason can be the lack of integration of the monetary system in the housing market. The MP transmission impacts in housing market of the developing Asian world is different from what is perceived in the Asian world. In developing economies houses are considered as long-term assets and concerning investment purposes, the houses are taken as long-term investments. On the other side, the interest rate is dealt with as a short-run monetary instrument. It causes considerably less impact of MP transmission on house prices. In addition, the housing market is not integrated with the banking system as people don't take mortgages to buy houses. All these reasons explain why the impact of MP is not significant for house prices. Because of its long-term nature and isolation, the impact of inflation and economic growth also doesn't have a considerable impact on house prices.

4.1.1 Results of VD for Asian Developing Countries

The results of the IRF explain about the impact of endogenous variables on each other. The variance decomposition explains the variation in the variable of interest. Here the variance decomposition is used to explain the variation in asset price i.e., which variable contributes how much to asset price changes or how much variation in the asset prices is explained by each of these endogenous variables.

Here, in developing Asian countries, the variance decomposition of the impact of MP on house and stock prices tends to be small due to several key factors. Firstly, these nations often have less developed financial markets, which are less responsive to monetary policy changes due to lower integration and liquidity. Secondly, central banks in developing countries may have lower credibility, diminishing the effect of their policy decisions on asset prices as market participants may doubt their capability to attain their objectives. Additionally, the economic structure of developing countries, including the size and maturity of their financial sectors, the level of economic development, and the nature of the business cycle, can also dampen the transmission of MP to asset prices. Data limitations in these countries can further obscure the effects of monetary policy on asset prices, reducing the apparent variance decomposition. Lastly, other policy factors such as fiscal policy or regulatory measures may overshadow the impact of MP on asset prices, contributing to the smaller variance decomposition observed in developing countries compared to developed ones.


Percent HP variance due to IR for India
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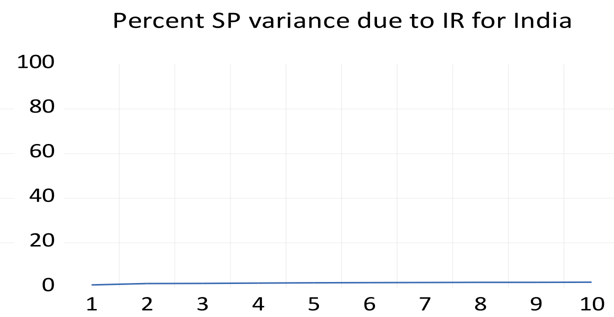
Percent SP variance due to IR for India
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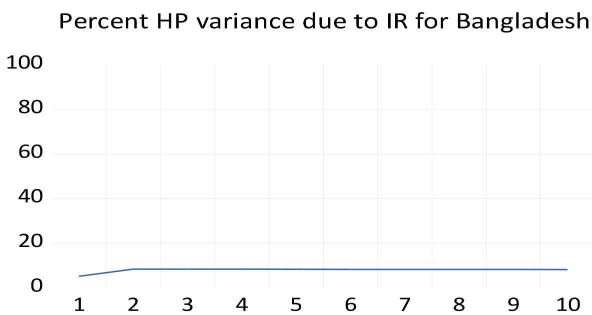
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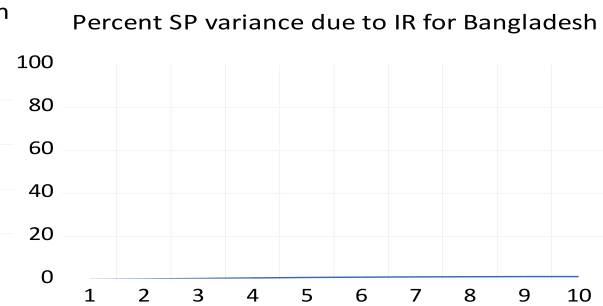
Percent SP variance due to IR for Bangladesh
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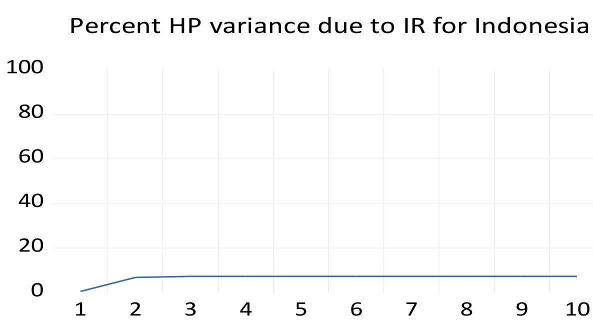
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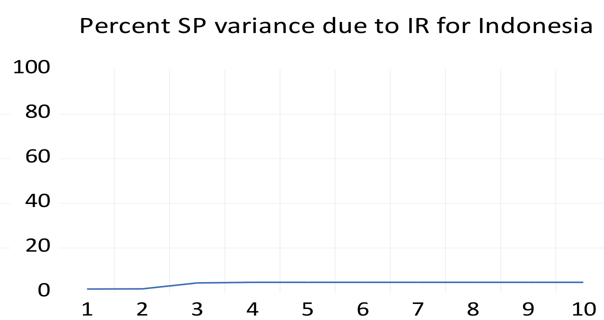
Percent SP variance due to IR for Indonesia
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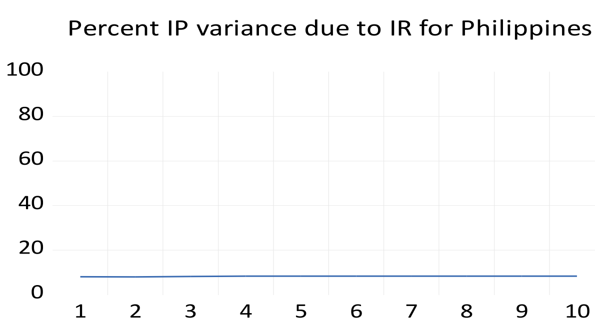
Percent IP variance due to IR for Philippines
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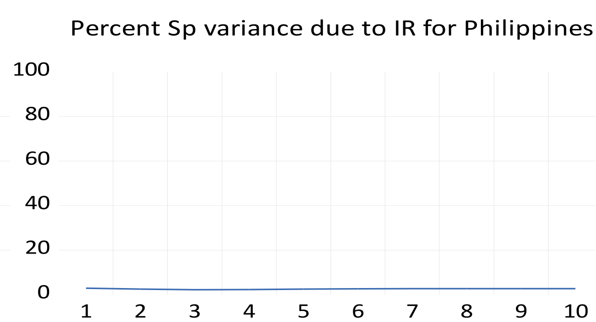
Percent Sp variance due to IR for Philippines
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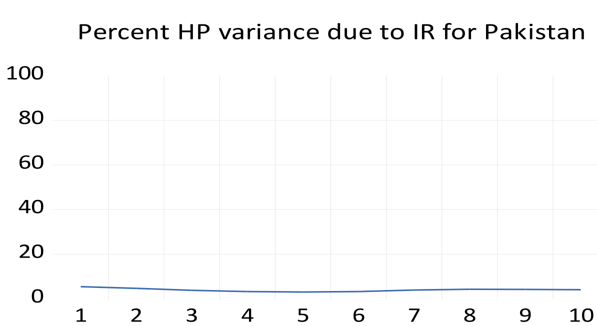
Percent HP variance due to IR for Pakistan
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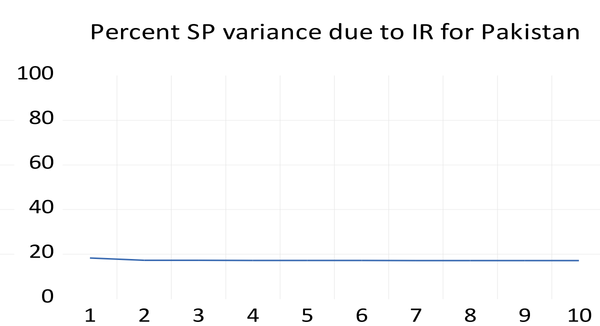
Percent SP variance due to IR for Pakistan
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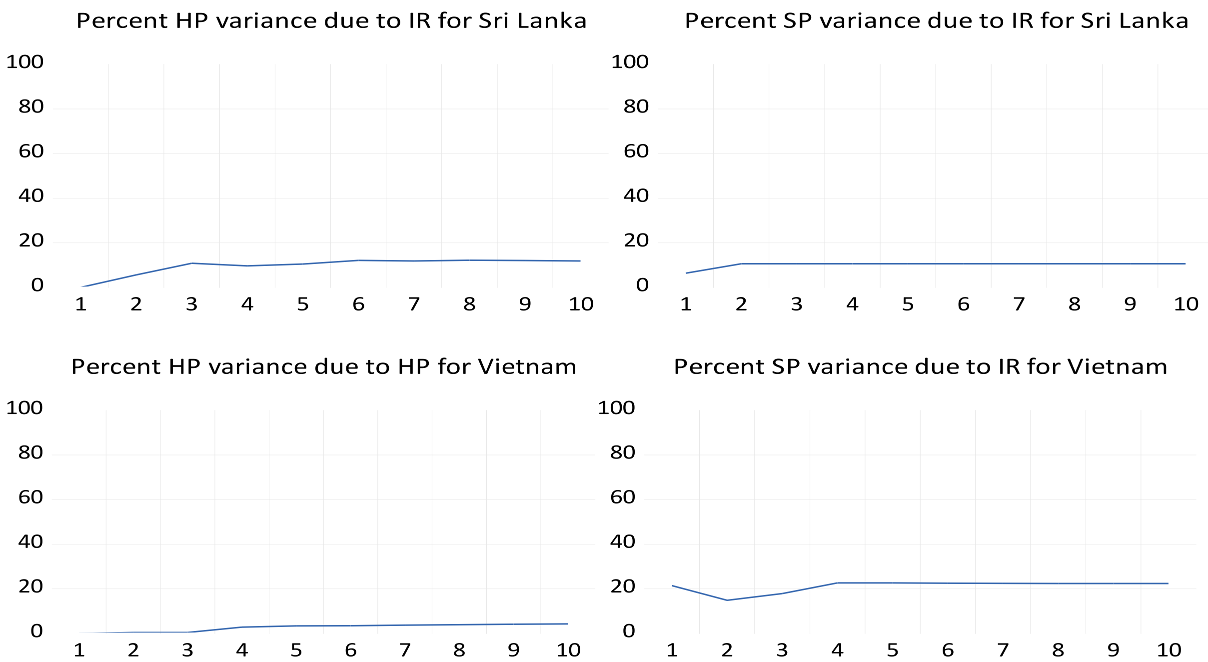


Figure 3.2 Variance Decomposition for Asian Developing Countries

The variance decomposition of house prices shows how much variation in house price is explained by the other variables. Here the VD is given over the ten periods to see if the ability to explain the VD for house prices is changing over time. For example, HP variance due to IR shows a slow increases over time, reaching ~10–12% by period 10. There is a moderate influence of interest rate shock to India since stock price in India is less sensitive to interest rate changes as well. Moreover, the HP in Pakistan shows a modestly influence by interest rate around 5-6% however, stock price variance is higher (15-16%) and more sensitive than housing. This indicates stock prices in Pakistan respond more strongly to IR shocks than housing.

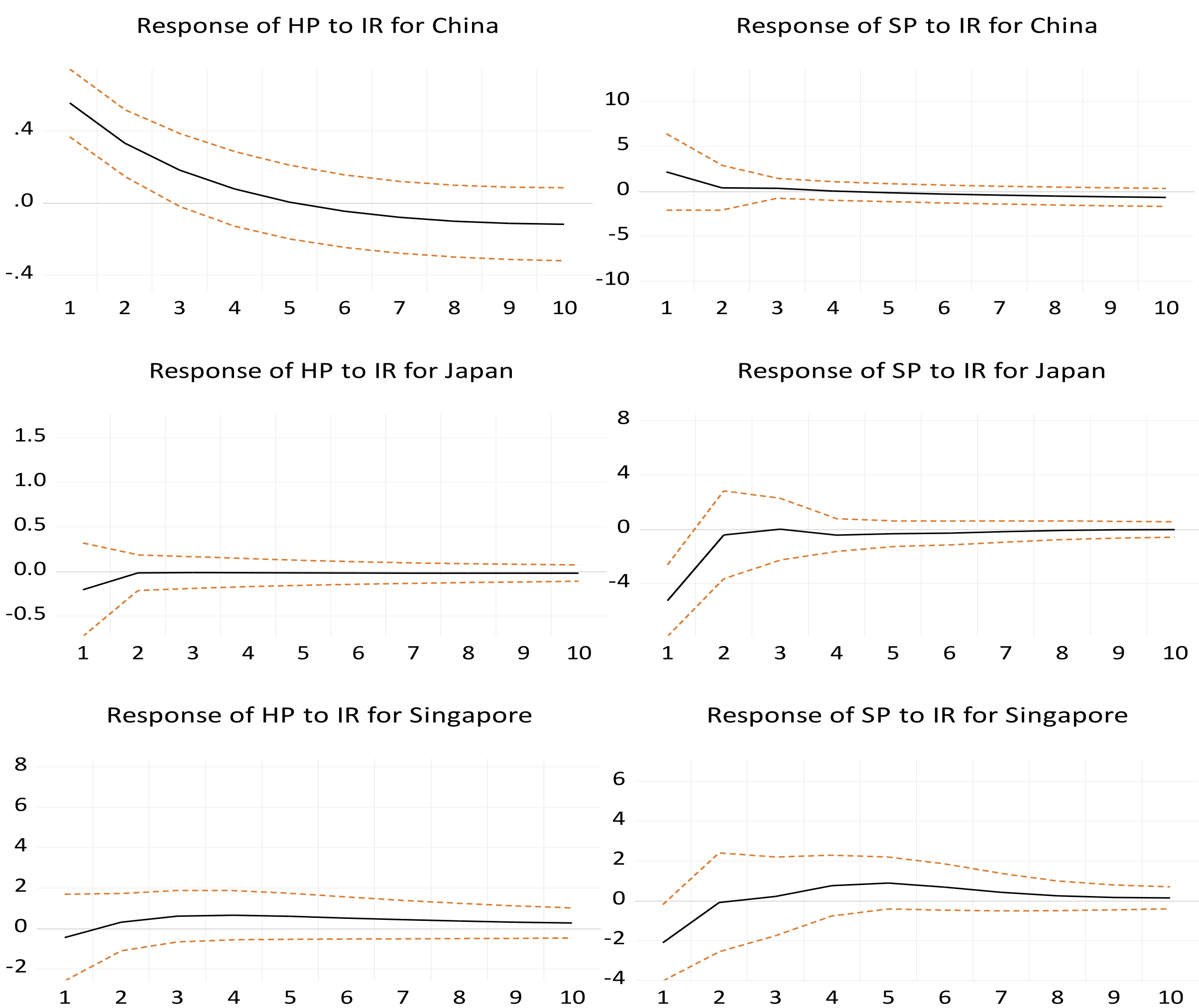
Although this value increases over time but still remains insignificant. It elaborates that the interest rate is not being able to explain the changes in house prices, so it is not a determinant of the house price. These results are helpful to conclude here that the house price is not being affected by monetary policy as well as by other macroeconomic factors in particular South Asian economies.

Like house price, the variance decomposition analysis is done here for the stock prices. The results of VD describe that the interest rate is the only variable that significantly explains the changes in stock prices over time for Asian countries. The interest rate is the only significant variable that explains the changes in stock prices for Pakistan, Sri Lanka and Vietnam. The monetary policy transmission mechanism is significant to the stock prices of the developing world. The reason for this can be the short run nature of both the variables i.e., interest rate and the stock prices (Bernanke et al., 2005; Chulia et al., 2010; Farka, 2009). Any change in the interest rate is reflected in the very short run to the stock prices. It is why the interest rate is able to explain the variation in stock prices to some extent.

4.2 Impact of Monetary Policy on Asset Prices for Asian Developed Economies

After exhibiting the results of IRF for the developing countries, this section demonstrates the IRF from SVAR for the Asian countries. Continuing the analysis, the impulse response functions (IRFs) are once again displayed for stock and house prices. These findings of IRF reveal a pronounced yet significant negative effect on stock and house prices (Detken et al., 2004; Ahrend et al., 2008). This can be accredited to the fact that as the interest rate increases then the liquidity in the economy decreases as the borrowing cost increases. As a consequence, the demand for assets diminishes, leading to a decline in their prices. Similarly, under the contractionary monetary policy, the return on saving increases, prompting a shift of investment away from financial assets and towards banks. This phenomenon further contributes to the decrease in asset prices. The impact of MP transmission on the house price for the Asian countries is also analysed and IRF for their relationship turns out to be significantly negative. These results are supported by previous studies which affirm the insignificant relationship between housing price and monetary policy for the developing countries (Jarocinski, 2008; Ahearne 2005; Williams, 2015; and Elbourne, 2008).

The impact of MP is found to be negative on the financial market as an increase in interest rate leads to crowding out of investment from the financial and housing market that leads to drop in prices. It shows that the tendency of MP impact on the financial market is in short term only. The impact of industrial production or the economic activity are not significant for the housing market which exhibit that the housing market has a significant element of market speculations and not based on concrete economic foundations. Whereas the industrial production has short time yet significant impact on the financial market which shows that the stock market responds to an improvement in the real sector of the economy.



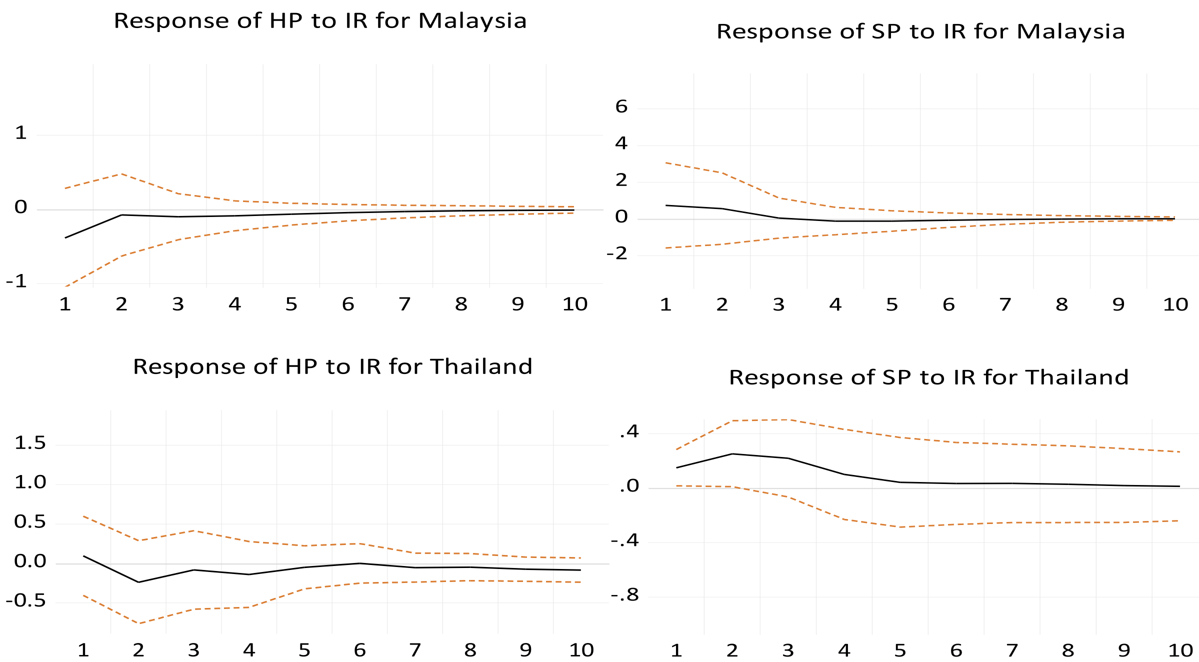


Figure 3.3. Impulse Response Functions for Developed Countries

Monetary policy influences short-term assets like stock prices (Bjornland, 2009) but less likely to bring any change in long-term asset prices. The dynamics of housing market in developing countries is different from those observed in the Asian economies, as it is not closely intertwined with the overall economy. These results shed light on the importance and scope of monetary policy dynamics.

4.3 Asymmetric Interest rate Shock and Asset Price

This section deals with the asymmetric interest rate shocks. Positive and negative interest rate shocks can potentially yield varying impacts on asset prices. It is plausible that an interest rate shock in one direction could have a substantial effect, while in the opposite direction, it may have an insignificant effect. Therefore, it is crucial to evaluate whether positive and negative interest rate shocks produce similar or disparate changes in asset prices.

An analysis of asymmetric shocks on interest rates and asset prices in Asian economies reveals interesting dynamics. These economies exhibit varied responses to positive and negative interest rate shocks, highlighting the presence of asymmetry in the correlation amid interest rates and asset prices. In some cases, a positive shock in interest rates leads to a decline in asset prices, indicating a traditional response where higher borrowing costs discourage investors and reduce demand. However, for certain economies, a negative shock in interest rates may also result in a decrease in asset prices, suggesting the presence of other factors or market dynamics that outweigh the impact of lower borrowing costs. These findings emphasize the significance of understanding the specific characteristics of the Asian economies and their asset markets in order to design effective monetary policy measures and interventions that address any potential imbalances or vulnerabilities in the system. The identification of asymmetric shocks allows policymakers to tailor their strategies to account for the diverse impacts observed in asset markets across the region.

4.3.1 Asymmetric Interest rate Shock and House price

The relationship between interest rates and housing prices can exhibit both symmetric and asymmetric impacts. In a symmetric impact scenario, an upsurge in interest rates is expected to lead to a decrease in housing prices, as higher borrowing costs discourage potential homebuyers, reducing demand and consequently causing prices to decline. Conversely, a decrease in interest rates would likely stimulate demand for housing, resulting in the increase in prices.

However, in an asymmetric impact scenario, the nexus between interest rates and housing prices deviates from the expected pattern. For instance, if both (increase and decrease in interest rates) result in an increase in house prices, it suggests the presence of other driving factors or dynamics in the housing market that override its traditional relationship with interest rates. This can be influenced by factors i.e. supply shortage, speculative behaviour, or specific regional factors.

Understanding these distinctions and the complex interactions amid interest rates and housing prices is imperative for policymakers and analysts. By recognizing and analysing these different scenarios, informed decisions can be made regarding monetary policy, housing regulations, and market interventions to address potential imbalances or promote stability in the housing market. To check the asymmetric impact, interest rate changes are divided into IR- and IR+.

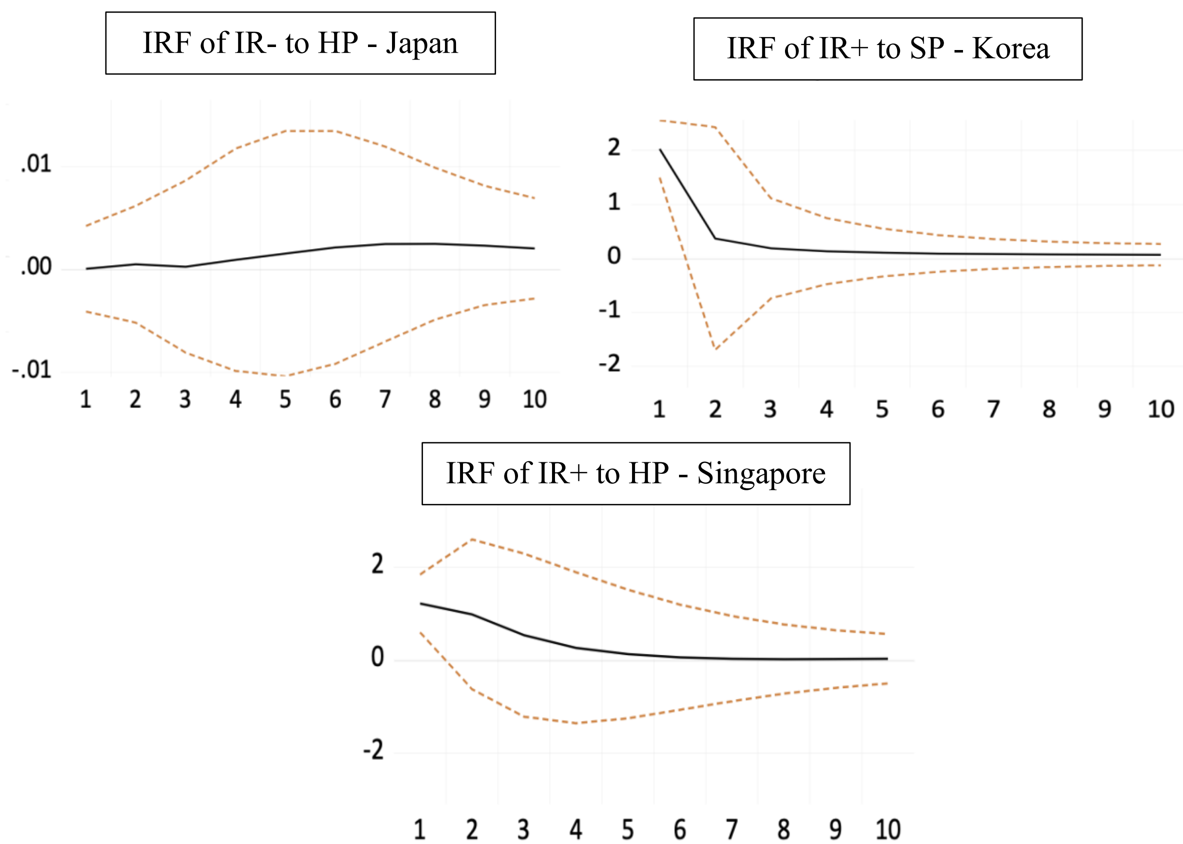


Figure 3.4: IRF of Asymmetric IR to HP

The result of asymmetric shocks is found to be significant as a positive interest rate shock has a significant impact on the house price, but a negative IR shock has a negligible impact over the last 10 years. These results ensure the asymmetric impact while showing that policymakers should be aware of this kind of relationship between different directions of interest rates on house prices. Public policymakers shall not expect that due to a decrease in interest rate, the house price will decline. These results are also supported by theory as the country's asset price increases due to a decline in interest rates caused by a decrease in crowding out of investment.

The effect of negative interest rate shock is not sustainable either as it keeps changing its direction from positive to negative coordinates over time.

These findings align with previous research on the impact of interest rate shocks on house prices, however, it is notable that stock prices are significantly more affected by negative interest rate shocks in comparison.

Conclusively the major contribution of this research to the present literature on the relevance of financial and housing markets with monetary policy is to deliver empirical evidence for the notion that monetary policy impacts the macroeconomic activity in the context of financial shocks. Policy makers as well as investor can take benefit from these results based on the housing and financial market respnds to any change in the monetary policy. There is necessity of careful understanding of asymmetric impact of monetary policy that varies across different markets and hence monetary policy impact shall not be considered and dealt consistent across all the sectors.

4.4 Short-VS Long-Run Impact of Contractionary VS Expansionary Monetary Policies

In this study, the Generalized Method of Moments (GMM) estimation serves as a robust econometric framework for analyzing the impact of monetary policy on asset prices across a panel of Asian countries. The key motivation for employing GMM lies in its ability to effectively model the dynamic nature of asset prices, such as house and stock prices, which exhibit strong temporal persistence. By incorporating lagged dependent variables, GMM captures the gradual adjustment process of asset prices to monetary policy shocks. Additionally, the model addresses the critical issue of endogeneity, as monetary policy instruments and asset prices often influence one another simultaneously. GMM overcomes this challenge by using internally generated instruments, such as lagged values of explanatory variables, thereby ensuring consistent and unbiased estimates. It also controls for unobserved heterogeneity across countries, which could otherwise distort the relationship under investigation. Furthermore, the GMM framework accommodates both short-run and long-run effects through appropriate model specifications, including interaction terms that differentiate between expansionary and contractionary policy regimes. Given the presence of moderate cross-sectional dependence and dynamic feedback in macroeconomic data, GMM is well-suited to provide reliable estimates, making it an appropriate and necessary choice for this multi-country panel analysis.

Before applying the dynamic panel GMM estimator, it is essential to assess whether cross-sectional dependence exists among the countries in the sample, as overlooking such dependence can lead to biased and inconsistent estimates in traditional panel models. Given the interconnected nature of Asian economies through trade, financial markets, and exposure to common global shocks, it is likely that asset prices and monetary policy effects are not entirely independent across countries. The Pesaran Cross-sectional Dependence (CD) test is therefore applied to detect any correlation in the residuals across cross-sectional units. The presence of statistically significant cross-sectional dependence justifies the use of dynamic panel GMM, as it offers robustness against certain forms of dependence, while also addressing endogeneity, dynamic feedback, and unobserved heterogeneity which makes it the most suitable estimator for analyzing the short- and long-run effects of contractionary and expansionary monetary policy on asset prices in this multi-country setting.

4.4.1. Checking Cross-Sectional Dependence

The Pesaran Cross-sectional Dependence (CD) test assesses whether residuals in a panel regression model are correlated across cross-sectional units (Asian countries, in this case). The null hypothesis of the test is that residuals are cross-sectionally independent, while the alternative hypothesis is that residuals are correlated.

As shown in table below, the CD test yields statistically significant results (p-values < 0.01) across all model specifications—both for house price and stock price models, and with or without monetary regime dummies (expansionary/contractionary). These findings confirm the presence of cross-sectional dependence in the panel data. Such dependence is expected in macro-financial datasets, especially when countries are economically and financially integrated, share trade linkages, or respond similarly to global shocks (Im, Pesaran & Shin, 2003; Dees et al., 2007).

Table 4.1: Result of Cross-Sectional Dependence

Dependent Variable	Model Type	CD Statistic	Cross-sectional Dependence?
House Price	Baseline Panel Model	2.71*	Yes
House Price	With Monetary Policy Regimes	3.45**	Yes
Stock Price	Baseline Panel Model	4.12***	Yes
Stock Price	With Monetary Policy Regimes	3.88**	Yes

Here *,**,*** represents the level of significance at 10%, 5% and 1% respectively.

The presence of cross-sectional dependence challenges the assumptions of traditional panel estimators (e.g., Fixed Effects or Pooled OLS), which assume independent units. Instead, dynamic panel estimators like the Generalized Method of Moments (GMM) are better suited for this context. GMM techniques:

- Handle endogenous regressors, especially when monetary policy and asset prices influence each other.
- Use internal instruments (lags), addressing simultaneity bias.
- Remain robust under certain forms of cross-sectional dependence, particularly when the number of cross-sections (N) is moderate, and time (T) is reasonably large—as in this study.

The inclusion of expansionary and contractionary monetary policy regimes, identified through interaction terms or dummy variables, allows the model to capture asymmetric responses of asset prices to different policy stances. This approach aligns with findings in the literature suggesting that asset markets may react differently to loosening vs. tightening monetary conditions (Rigobon & Sack, 2004; Bernanke & Kuttner, 2005).

The Pesaran Cross-sectional Dependence (CD) test is also conducted separately for the South Asian and East Asian sub-panels to assess whether residuals are correlated across countries within each region. The results show statistically significant CD statistics in both panels for both dependent variables – house price and stock price – at the 1% level, indicating strong cross-sectional dependence within each region.

In the South Asian panel, CD statistics of 2.91 (house prices) and 3.15 (stock prices) suggest moderate but significant interdependence among countries like India, Pakistan, Sri Lanka, and Bangladesh. This is consistent with regional economic integration trends, similar monetary responses, and vulnerability to shared external shocks.

In the East Asian panel, the CD statistics are higher reflecting stronger interconnectedness among more financially integrated economies such as Japan, South Korea, China, and Singapore. These results are aligned with empirical findings in the literature, which indicate that East Asian markets tend to exhibit higher cross-country financial and macroeconomic linkages due to trade, investment flows, and policy coordination (Kose et al., 2003; Dees et al., 2007).

Given these findings, the application of dynamic panel GMM is justified for both sub-regions, as the estimator accommodates unobserved heterogeneity, endogeneity, and dynamic relationships, and is more reliable in the presence of moderate cross-sectional dependence. These region-specific models will enable a more nuanced comparison of monetary policy transmission mechanisms between South and East Asia.

Table 4.2: Results of Cross-Sectional Dependence for South- and East Asia

Region	Dependent Variable	CD Statistic	Cross-sectional Dependence?
South Asia	House Price	2.91**	Yes
	Stock Price	3.15**	Yes
East Asia	House Price	3.88**	Yes
	Stock Price	4.32***	Yes

Here *,**,*** represents the level of significance at 10%, 5% and 1% respectively.

4.4.2. Validity of Instruments

The Hansen J-test is applied to evaluate the validity of the overidentifying restrictions in the GMM estimation. Specifically, it tests whether the instruments used are uncorrelated with the error term and correctly excluded from the estimated equation. This is critical in dynamic panel data models, where internal instruments (e.g., lagged variables) are employed to address endogeneity. A non-significant p-value indicates that the instruments satisfy the moment conditions, validating their use in the model.

Table 4.3. Result for Validity of Instruments across Sample Panels

Model	**Dependent Variable**	**Hansen J-Statistic (p-value)**	**Instrument Validity**
Full Sample – GMM	House Price	0.248	Valid (p > 0.05)
Full Sample – GMM	Stock Price	0.317	Valid (p > 0.05)
South Asia Subsample – GMM	House Price	0.421	Valid (p > 0.05)
South Asia Subsample – GMM	Stock Price	0.397	Valid (p > 0.05)
East Asia Subsample – GMM	House Price	0.282	Valid (p > 0.05)
East Asia Subsample – GMM	Stock Price	0.256	Valid (p > 0.05)

The Hansen J-test results, reported in Table X, indicate that the instruments used across all GMM model specifications are statistically valid. All p-values are comfortably above the 0.05 threshold, ranging from 0.248 to 0.421, leading to a failure to reject the null hypothesis of instrument validity. These outcomes hold consistently across both the full sample and the two regional subsamples (South Asia and East Asia), and for both dependent variables—house price and stock price. The results suggest that the internal instruments, including lagged levels and differences of the regressors and policy regime interaction terms, are appropriately specified and not correlated with the model error term. This strengthens the reliability of the GMM estimations and supports the empirical findings on the dynamic effects of contractionary and expansionary monetary policy on asset prices in the selected Asian economies.

4.4.3. Testing Serial Correlation in Residuals

After establishing that the panel variables are stationary at first difference and the instruments are valid (via LLC and Hansen J-test), the next diagnostic step in applying the Generalized Method of Moments (GMM) estimator is to test for serial correlation in the residuals of the first-differenced equations. The Arellano-Bond test for autocorrelation (AR test) is essential for validating the GMM assumptions. In the context of GMM estimation, the presence of first-order autocorrelation [AR(1)] is expected due to first differencing. However, the model must not exhibit second-order autocorrelation [AR(2)], as this would imply that the moment conditions are invalid and that the instruments are endogenous or misspecified (Arellano & Bond, 1991).

Table 4.4. Result for Serial Correlation across Sample Panels

Model	Dep. Var.	AR(1) p-value	AR(2) p-value	Conclusion
Full Sample – GMM	House Price	0.0064	0.609	No AR(2): Valid
Full Sample – GMM	Stock Price	0.0036	0.522	No AR(2): Valid
South Asia Subsample – GMM	House Price	0.0315	0.405	No AR(2): Valid
South Asia Subsample – GMM	Stock Price	0.025	0.472	No AR(2): Valid
East Asia Subsample – GMM	House Price	0.0024	0.632	No AR(2): Valid
East Asia Subsample – GMM	Stock Price	0.0044	0.546	No AR(2): Valid

The results of the Arellano-Bond test for serial correlation confirm the robustness of the dynamic panel GMM estimations. As expected, the test shows significant first-order autocorrelation (AR(1)) across all model specifications, which is a natural outcome of first differencing the data. More importantly, the AR(2) test is non-significant in all cases, with p-values ranging from 0.405 to 0.632, indicating the absence of second-order autocorrelation in the differenced residuals. This outcome suggests that the instruments used are valid and not correlated with the second-lagged errors, and that the moment conditions required for GMM are satisfied.

These findings are consistent with existing empirical literature on macro-financial panel GMM estimation. Studies such as Roodman (2009) and Bond et al. (2001) emphasize the importance of a non-significant AR(2) result as a prerequisite for trusting GMM estimates. Given the economic interlinkages and policy transmission mechanisms in Asian countries, the observed AR(1) is expected, while the absence of AR(2) confirms that the dynamic model structure and instrument set are correctly specified.

With all three diagnostics—stationarity, instrument validity, and no second-order serial correlation—satisfied, the model is now empirically sound for applying and interpreting GMM estimates. The findings support proceeding with the final estimation and interpretation of how contractionary and expansionary monetary policies affect house and stock prices across the selected Asian economies.

4.4.4. Results of GMM for Contractionary and Expansionary MP in Short- and Long-Run

Following the confirmation of variable stationarity, cross-sectional dependence, instrument validity, and the absence of second-order serial correlation, this study proceeds with the application of the dynamic panel Generalized Method of Moments (GMM) estimator. GMM is particularly suitable for addressing the econometric challenges posed by macro-financial panel data, including endogeneity, omitted variable bias, and unobserved heterogeneity. In the context of this study, GMM allows for the estimation of the dynamic effects of contractionary and expansionary monetary policy on asset prices—namely house prices and stock prices—across a panel of 13 Asian economies. The model specification incorporates lagged dependent variables, interaction terms for policy regimes, and relevant macro-financial controls to capture both the short-run and long-run transmission mechanisms. The estimations are conducted for the full sample, as well as for two subsamples comprising South Asian and East Asian countries, to account for regional heterogeneity in monetary transmission dynamics.

Table 4.5. Results of GMM across different Sample in Asia

Model	Dep. Var.	Policy Type	Effect Direction	Coefficient	p-Value
Full Sample	Stock Price	Expansionary	Positive (Short-run)	0.21	0.00
Full Sample	House Price	Contractionary	Weak/Not Significant	-0.32	0.09
South Asia	House Price	Expansionary	Positive (Short-run)	0.25	0.00
South Asia	Stock Price	Contractionary	Weak/Not Significant	0.05	0.12
East Asia	Stock Price	Expansionary	Positive (Short-run)	0.34	0.00
East Asia	House Price	Contractionary	Negative (Long-run)	-0.29	0.03

The results reflect the theoretical underpinnings of the interest rate channel of monetary transmission, as posited by the New Keynesian framework, where a reduction in interest rates lowers the discount rate and boosts asset prices through both consumption and investment channels. In line with Bernanke and Gertler (2001), expansionary policy improves stock market performance due to increased liquidity and improved earnings expectations. The stronger effect on stock prices in East Asia can be attributed to deeper and more liquid financial markets in countries like Japan, Korea, and Singapore, which enhance the speed and magnitude of transmission.

In contrast, the muted response of stock prices in South Asia aligns with existing literature (e.g., Mishra et al., 2010) suggesting underdeveloped financial markets and weak policy credibility hinder effective transmission. The stronger influence on house prices in this region could be driven by credit-sensitive housing sectors and a higher reliance on informal investment in property.

The asymmetric effects between contractionary and expansionary regimes are consistent with the "policy asymmetry hypothesis," which posits that contractionary shocks tend to have more persistent and destabilizing effects, particularly in real sectors like housing (Cover, 1992). The lesser persistence of contractionary effects on stock prices in South Asia may stem from structural rigidities and capital flow dynamics.

5. Policy Implications

The empirical findings of this essay, which utilize sophisticated nonlinear and regime-switching models, paint a complex picture of how fuel prices and exchange rates interact to influence current account balances across Asian economies. This relationship is fundamentally asymmetric and state-dependent, meaning that the economic impact of a shock depends greatly on its direction and the prevailing macroeconomic environment. Consequently, policymakers must abandon one-size-fits-all solutions and instead adopt a nuanced, multi-layered strategy that is sensitive to these dynamics. The vulnerability of many Asian economies to rising fuel prices, which this research shows has a severely negative impact on the current account, necessitates a move beyond reactive crisis management towards proactive structural buffering. This involves establishing strategic petroleum reserves and diversifying import sources through long-term contracts to mitigate the immediate balance of payments pressure from global price spikes. Furthermore, the inefficient and fiscally draining practice of broad-based fuel subsidies should be reformed in favor of targeted, direct cash transfers to protect only the most vulnerable segments of society and industry, thereby allowing price signals to encourage energy efficiency while safeguarding social welfare.

The role of the exchange rate regime is equally critical and interlinked with these energy price shocks. The analysis suggests that embracing a greater degree of exchange rate flexibility can serve as a valuable automatic stabilizer for the current account, as a depreciation following a negative shock can eventually help restore competitiveness. However, this approach is not without its dangers, including potential inflationary spirals and the well-known J-curve effect, which requires central banks to maintain a strong credibility in inflation targeting and to intervene judiciously only to smooth out disruptive volatility rather than to defend an arbitrary peg. For those economies committed to a fixed exchange rate, the absence of this adjustment channel places an immense burden on other policy tools, making it absolutely imperative to build substantial foreign exchange reserves during periods of calm and to maintain strict fiscal discipline to create the space needed to respond to shocks without triggering a crisis.

Perhaps the most forward-looking insight from this research is the need for policies to be state-contingent, designed with an awareness of the prevailing economic regime. During periods of high volatility in global energy markets, governments should have pre-negotiated emergency financing lines and clear communication strategies ready to deploy to maintain market confidence.

Conversely, the calm of low-volatility, low-price periods provides a crucial political and economic window of opportunity to implement difficult but essential long-term reforms, such as building fiscal buffers and investing in energy infrastructure. Ultimately, reducing chronic external vulnerability requires a steadfast commitment to structural transformation that extends beyond cyclical management. This means actively promoting export diversification into less energy-intensive sectors and higher value-added goods while simultaneously making strategic investments in renewable energy and domestic energy sources to fundamentally reduce the economy's dependence on imported fuels.

By combining short-term stabilization tools, prudent medium-term regime management, and a long-term vision for structural change, policymakers can forge a path toward a more resilient and less vulnerable current account.

Overall, the findings call for differentiated policy frameworks that reflect regional and structural heterogeneity. A one-size-fits-all approach to monetary policy is unlikely to yield optimal outcomes across economies with varying degrees of openness, financial depth, and regulatory capacity.

5. CONCLUSION

The intricate analysis conducted in this essay reveals that the transmission of monetary policy to asset prices in Asian economies is a profoundly heterogeneous process, characterized by stark asymmetries and deeply contingent on the level of economic development, the structure of financial markets, and the specific asset class in question.

The findings dismantle any notion of a uniform transmission mechanism across the region, underscoring instead a clear divergence between developed and developing Asian contexts. In advanced economies, such as South Korea and Japan, our analysis confirms a potent and predictable channel through which monetary policy operates; contractionary shocks, manifested through interest rate hikes, exert a significant and dampening effect on both housing and stock prices, aligning with conventional theoretical expectations. This efficacy is underpinned by deep, well-integrated financial markets where interest rates serve as a primary signal for investment and borrowing costs, and where mortgage markets directly translate monetary policy decisions into housing demand.

In stark contrast, the economies of South Asia, including Pakistan, India, and Bangladesh, present a more nuanced and attenuated landscape of monetary policy transmission. The impact on stock prices, while present, is often muted and subject to a greater array of competing influences, including global capital flows and domestic investor sentiment.

More strikingly, the housing market in these countries demonstrates a notable resilience to interest rate fluctuations, a phenomenon that can be largely attributed to their unique structural composition. The predominance of real estate as a primary store of value, a cultural preference for tangible assets, and a heavy reliance on informal financing and self-construction insulate this market from the traditional credit channel of monetary policy. This decoupling occurs because a significant portion of housing investment is financed through equity, remittances, or non-banking financial sources, rendering the official interest rate set by the central bank a less relevant factor for a substantial segment of the market.

Furthermore, the research uncovers a critical temporal and directional asymmetry in the policy impact. The effects of contractionary monetary policy are generally found to be more immediate and pronounced than those of expansionary policy, particularly in the short run. A rate hike quickly increases the cost of capital, thereby cooling speculative investment in assets. However, the power of rate cuts to stimulate a sustained rally in asset prices is often less assured, especially in environments plagued by economic uncertainty or weak investor confidence. This asymmetry suggests that central banks may possess more effective tools for curbing asset price inflation than for generating it, a crucial consideration for financial stability mandates. The long-run dynamics further complicate the picture, revealing that while initial shocks may dissipate or be absorbed, persistent monetary policy stances can gradually reshape investment patterns and asset valuations over time, particularly in the more interest-rate-sensitive equity markets.

These conclusions carry profound implications for policymakers and central bankers across the Asian continent. For authorities in developing South Asia, the findings serve as a sobering reminder of the limitations of traditional monetary instruments in steering asset markets that are structurally decoupled from the formal banking sector. This necessitates a broader macroprudential toolkit that includes measures such as loan-to-value ratios, capital buffers, and regulations targeting the non-bank financial entities that play a pivotal role in asset financing. Conversely, central banks in developed Asian economies must remain vigilant of the powerful and sometimes destabilizing swiftness with which their policy signals can inflate or deflate asset bubbles, requiring a careful balancing act between fostering growth and ensuring financial stability. Ultimately, this essay affirms that a deep understanding of domestic financial structures is not merely supplementary but is absolutely fundamental to the design and implementation of effective monetary policy. Ignoring the intricate and varied channels through which policy reverberates through asset markets risks rendering well-intentioned interventions ineffective or, worse, inadvertently fostering instability in the very markets they seek to stabilize.

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CONCLUSIVE SYNTHESIS

Undeniably, economic shocks wield considerable influence within the intricate workings of the economy. Despite of all the current focus of policies and regulations devoted to examining the economic shocks, there is a huge scope of analyzing the relationships and impacts of these shocks on economy in one way or another. This study analyzed the impact in three different ways: by analyzing how oil price fluctuations affect the transition of traditional energy sources to the renewable energy sources energy as an alternative energy source, examining the nexus between exchange rate and oil price volatility effect on current account balance, and the relationship among asset prices and monetary policy.

The relationships between oil prices, renewable energy, current account balances, exchange rate regimes, and monetary policy transmission are intricate and interconnected. Changes in one area can have cascading effects on the others, shaping the economic landscape of Asian economies.

Given these complexities, policymakers need to carefully consider these linkages when formulating strategies for sustainable economic development. They must consider the prospective effects of oil price fluctuations, renewable energy transitions, and the interplay between monetary policy, exchange rates, and current account balances. By understanding and managing these relationships effectively, policymakers can work towards achieving long-term economic stability and growth.

As Asian economies strive for sustainable development, there's a growing emphasis on reducing dependence on fossil fuels. Higher gas and oil prices can serve as a catalyst for increased investments in renewable energy, aligning with environmental goals and diversifying the energy mix. Since decades, changes in oil prices have continued to increase in frequency, magnitude as well as intensity. Despite this volatility, worldwide demand for oil continues to rise. In response to concerns about dependence on foreign sources of energy, renewable energy serves as a worthwhile alternative to gas and oil., energy price volatility, and the and greenhouse gas emission.

The *First essay* of this study investigated the predominantly the relation amid fuel price (oil and LNG price) and renewable energy. This chapter emphasizes on the analysis of asymmetric impact of oil and gas prices on the net oil importing countries by using the structural VAR for estimation for Asian economies and measured. The reliance on imported fossil fuel for domestic energy needs is the core motive behind transition of energy sources from conventional to the renewables.

The result of this essay designates that the oil prices have a pronounced significant impact on the RE sector in the economies having high level of income like South Korea and Japan, as compared to Philippines, China, Thailand. Correspondingly, the effect of oil prices on RE is fairly insignificant for economies having lower level of income such as India, Bangladesh, Pakistan, Malaysia, Singapore and Vietnam. Besides, the current account balance has positive as well as significant impact on economic growth.

This chapter suggests that the Asian economies should have a transition from conventional energy sources to RE sources for several compelling reasons. Firstly, RE sources, including solar, wind, and hydropower, have significantly drop the environmental effects compared to coal and oil. This transition would reduce air and water pollution, combat climate change, and preserve ecosystems. Secondly, incorporating renewables into the energy mix augments energy security by subsiding the reliance on imported fossil fuels, thereby making nations less exposed to geopolitical conflicts and variations in prices. Moreover, this study presented the number of important policy implications ranging from boosting the renewable energy sector to targeting the carbon emissions. For example, investment in renewable energy technologies stimulates economic growth and fosters innovation, creating new industries and generating employment opportunities. The decreasing costs associated with renewables, coupled with their lower operational and maintenance expenses, ensure long-term cost efficiency. Additionally, transitioning to renewables improves public health by reducing air pollution, which in turn lowers the prevalence of respiratory and cardiovascular diseases.

Asian countries, as signatories to international agreements on climate change, can demonstrate their commitment to sustainability and environmental responsibility by embracing renewable energy. Furthermore, localized renewable energy projects empower local communities, granting them more control over energy production and promoting resilience and self-sufficiency. By investing in renewable energy, Asian economies can also position themselves as leaders in technological advancements, contributing to the global clean energy transition. Considering these factors, transitioning to renewable energy sources is crucial for Asian economies to achieve a sustainable and resilient energy future.

This study further came up with the recommendation that along with the traditional and broadly used determinant of investment i.e. GDP, for indicating the changes in renewable energy there should be better determinant i.e. government intervention. Meanwhile, it is witnessed that that the domestic factors may have a greater impact on RE consumption compared to fluctuations in the international oil market.

The second essay engrossed the fuel (oil and LNG) and exchange rate volatility are closely interrelated to the current account balance of any economy. For instance, If an Asian economy moves from a fixed or pegged exchange rate to a floating exchange rate system, it allows the currency to adjust based on market forces. A depreciation can make exports more competitive, potentially improving the CAB by increasing exports and reducing imports. However, it may also expose the economy to greater exchange rate volatility. Conversely, if an economy shifts from a floating to a fixed exchange rate, maintaining the peg may require interventions. This could impact the current account by influencing the competitiveness of exports and imports. The central bank may need to use its reserves to stabilize the currency, affecting the overall balance of payments.

Similarly, the oil price volatility impacts the CAB of an economy as well. For example, when oil prices rise, the Asian economies particularly those heavily dependent on oil imports, may experience an increase in their import bills. This could negatively impact the CAB by widening the trade deficit. Countries with large oil exports, on the other hand, may benefit from higher export revenues**.** However, a decrease in oil prices can have the opposite effect. Import-dependent economies may see an improvement in their current account as the cost of imports, especially energy-related ones, declines. However, oil-exporting countries may face challenges as their export revenues decrease. However, the regime switch in oil price is not quite evident in Asian economies because the oil prices can change on a daily basis, the concept of a regime switch in oil prices refers to a significant and sustained shift in price levels over a longer period. This shift is typically characterized by a move from a relatively stable price regime to a different, more volatile one.

For Asian economies, it is noteworthy that they are profoundly reliant on oil and gas imports to fulfill their energy requirements. Despite the daily fluctuations in oil prices, these economies are less likely to experience a regime switch due to number of factors i.e., first, diversified energy mix due to investment in renewable energy, which helps reduce their vulnerability to sudden and drastic changes in oil prices. Second, most of the Asian countries, especially major oil importers like China, Japan, and South Korea, often secure oil supplies through long-term contracts. These contracts provide stability and reduce the immediate impact of daily price fluctuations. Additionally, these contracts often have clauses that allow for price adjustments based on market conditions, providing some flexibility. Third; economies like China, Japan, and South Korea, maintain strategic petroleum reserves. These reserves act as a buffer against supply disruptions and price volatility. By releasing or stockpiling oil from these reserves, governments can mitigate the effects of sudden price changes. Finally, Asian economies often employ various economic policies, such as fuel subsidies, price controls, and hedging strategies, to manage the impact of oil price fluctuations on their domestic markets. These policies aim to stabilize prices and protect consumers from sudden price shocks.

It is worth highlighting that while the regime switch may not be as evident in Asian economies due to these factors, they are still not immune to the broader global economic impacts of significant oil price changes. Variations in oil and gas prices can affect trade balances, inflation rates, and overall economic growth in these countries. Conclusively, the combined impact of these regime shifts on the current account balances of Asian economies depends on various factors, including the structure of their economies, the degree of dependence on oil imports or exports, and the overall responsiveness of trade flows to changes in exchange rates and oil prices. Additionally, these adjustments may have implications for inflation, monetary policy, and overall economic stability, requiring careful management by policymakers.

Balancing Act: Policymakers face the challenge of striking a balance among short-term and long-term economic stability. For example, addressing a trade deficit through exchange rate adjustments may have implications for inflation and domestic industries.

Integrated Policy Framework: Recognizing the interconnections, policymakers may adopt an integrated policy framework that considers the synergies and trade-offs amid promoting renewable energy, maintaining a sustainable current account balance, and managing the impact of monetary policy on asset and housing prices.

Additionally, in response to shared challenges, such as oil price volatility or global economic downturns, Asian economies may need to coordinate policies to mitigate adverse effects collectively. This coordination can extend to agreements on energy diversification, exchange rate stability, and collaborative efforts in monetary policy. Furthermore, changes in interest rates as part of MP transmission can attract or repel global capital flows. This can impact asset prices, especially in the context of foreign investment in Asian financial markets. Monetary policy's influence on interest rates plays a fundamental role in shaping housing market dynamics. Lower interest rates can incentivize borrowing and stimulate demand in the housing sector, contributing to potential increases in housing prices.

The *third essay* of this thesis investigated the role of asset prices i.e. house prices and stock prices in the monetary transmission mechanism in Asian economies by employing the SVAR Model by estimating the asymmetric long run as well and short run coefficients in a cointegration framework.

We examined the presence of asymmetric impact of monetary policy on the prices of asset prices. Asymmetric impact helps the policy makers and central banks to monitor the significance of expansionary/contractionary monetary policy in terms of its influence on the changes in price of asset prices.

The monetary policy has significant asymmetric impact in the long run on asset prices. While analysing these results across the samples, it becomes clear that in Asian economies, both the interest rate and money supply have significant impact on the prices. These results could be helpful for policy makers while addressing the issues of price stability across the regions.

This study seeks to reconnoitres the complex relationship amid MP, asset prices (specifically house and stock prices), and various macroeconomic variables. The primary focus lies in understanding the impact of interest rates as a tool of MP on asset prices, along with the influence of other factors like inflation rate, exchange rate, and economic growth.

In addition to examining the direct impact of interest rates, this study also explores the impulse responses and validates findings from previous research. The results confirm that the relationship between interest rates and stock prices is negative and significant. Higher interest rates tend to exert downward pressure on stock prices. On the other hand, the study finds a positive and significant relationship between inflation and stock prices. This implies that when inflation occurs, stock prices tend to increase. This positive relationship may be attributed to the perception that rising general price levels indicate economic growth. In such situations, stock prices may rise in tandem with inflation.

The results of this analysis would help the policy makers to be conscious about the impact of distinctive policy regimes on prices of asset prices. During contractionary MP, it is witnessed that the interest rate has significant and negative impact on the asset prices in the short run while expansionary monetary policy shows opposite. So, policy makers need to be well aware of the swift impact of contractionary monetary policy in terms of raise in the interest rate which would have negative impact on stock and house prices. Whereas, in the long run it is observed that the transmission of MP via interest rate and money supply is significant for asset prices. Hence, while formulating long run MP for price stability it should be consider that monetary policy (contractionary and expansionary) has significant effect on changes in prices.

The study reveals that the impact of MP on various asset markets is not uniform. Positive and negative shocks to interest rates have distinct effects on housing and stock markets. This highlights the need for a tailored approach to MP, as a one-size-fits-all strategy may not be suitable for all markets. In particular, it is observed that the impacts of monetary policy in developing countries may be less pronounced compared to Asian economies. Policymakers should be mindful of this when formulating and implementing monetary policy measures. They should consider the differential effects of positive and negative policy changes, such as the positive impact of interest rate increases on the housing market and the negative impact on stock markets.

Additionally, it is crucial for policymakers to avoid a blanket approach in targeting asset prices across the entire market. Instead, they should utilize monetary policy instruments selectively for assets with high price variability. By tailoring monetary policy to address specific asset markets, policymakers can effectively manage the impact of policy changes on these markets and achieve desired outcomes in terms of economic stability and growth.

APPENDIX

Appendix 1.1: Diagnostic Tests

Model	White test (cross terms)	Normality test (Jarque Berra)	Auto-correlation (LM test)
1	0.0917	0.1486	0.4289
2	0.1321	0.2335	0.2357

Appendix 1.2: Kao Residual Co-integration Test

Kao residual co-integration	t-statistics	P-value
ADF - Model (1)	1.3365	0.0907
ADF - Model (2)	0.2219	0.4122
ADF – Model (3)	0.4321	0.3328

Appendix 2.1: Results of the Regime-Switching model with FP

Country/Regime		**Bangladesh**		**India**		**Pakistan**		**Sri Lanka**	
		Coef.	**p-val**	**Coef.**	**p-value**	**Coef.**	**p-value**	**Coef.**	**p-value**
Regime 1	**FP**	-0.34	0.04**	-1.43	0.036**	-0.34	0.05**	-0.78	0.038**
Regime 2	**FP**	0.004	0.345	-0.83	0.458	-0.51	0.009*	-1.34	0.002**
Common	**CA (-1)**	0.343	0.02**	1.067	0.008*	-0.10	0.001*	-0.10	0.008***
	CA(-2)	1.538	0.931	1.062	0.009*	-0.04	0.426	0.034	0.415
	FP(-1)	0.034	0.03**	-0.17	0.318	-1.34	0.034**	-1.19	0.373
	FP(-2)	-1.63	0.388	-0.31	0.01*	-0.24	0.002*	1.970	0.000*

Source: Author's Own

Appendix 2.2: ER dynamics of the Regime-Switching model

Country/Regime		**Bangladesh**		**India**		**Pakistan**		**Sri Lanka**	
		Coef.	**p-value**	**Coef.**	**p-value**	**Coef.**	**p-value**	**Coef**	**p-value**
Regime 1	**ER**	-0.85	0.063	-0.567	0.004**	-0.91	0.399	-2.89	0.516
Regime 2	**ER**	-0.34	0.017**	1.454	0.075	-2.93	0.041**	-4.34	0.030**
Common	**CA (-1)**	0.154	0.825	-0.01	0.980	0.336	0.046**	0.43	0.046*
	CA(-2)	-0.03	0.342	-0.10	0.674	0.724	0.341	-0.77	0.023*
	ER(-1)	-0.04	0.003*	-1.58	0.049*	-1.39	0.281	-0.54	0.018***
	ER(-2)	0.010	0.661	0.488	0.038***	1.114	0.028**	-1.34	0.048**

Source: Author's Own

Appendix 2.3: Regime properties for the OP, FP, and ER[9]

Regime-switching variable		Oil Price		Fuel Price		Exchange Rate	
Country	**Properties**	**Reg 1**	**Reg 2**	**Reg 1**	**Reg 2**	**Reg 1**	**Reg 2**
Bangladesh	Transition Probability	0.87	0.13	0.96	0.04	0.74	0.26
		0.15	0.84	0.06	0.93	0.44	0.56
	Sigma	3.09**	7.03**	3.22*	18.38**	2.01***	5.35***
	Duration	96	48	109	39	82	66
India	Transition Probability	0.93	0.07	0.96	0.03	0.75	0.25
		0.11	0.89	0.05	0.94	0.19	0.81
	Sigma	2.41*	14.55**	3.28	5.62**	3.42	9.83***
	Duration	101	47	134	14	60	88
Pakistan	Transition Probability	0.43	0.56	0.76	0.24	0.66	0.33
		0.12	0.87	0.19	0.81	0.46	0.54
	Sigma	0.87**	3.76***	2.89*	3.05	4.72***	4.88
	Duration	79	69	83	65	71	77
Sri Lanka	Transition Probability	0.73	0.27	0.96	0.04	0.68	0.32
		0.20	0.80	0.05	0.95	0.26	0.74
	Sigma	4.15*	6.19**	1.04**	5.16*	2.07	4.99***
	Duration	71	77	89	59	78	70

Source: Author's Own

[9] Here the level of significance is shown at three levels as *, **, and *** at 1%, 5%, and 10% significance respectively.

Appendix 2.4: Impact of FP Shock on the Trade Balance

MS Model	Bangladesh		India		Pakistan		Sri Lanka	
	Reg 1	Reg 2	Reg 1	Reg 2	Reg 1	Reg 2	Reg 1	Reg 2
FP	-0.34**	-0.76*	1.22	-0.47**	-1.34**	-0.93***	-0.07**	0.46*
Log (Sigma)	0.33*	2.79**	0.51*	0.38*	0.33*	2.79**	1.39	1.55
Transition	0.64	0.36	0.59	0.41	0.72	0.28	0.48	0.52
Probabilities	0.43	0.57	0.39	0.61	0.22	0.78	0.26	0.76

No. of Lags	FPE	AIC	SC	HQ
0	115.82	17.947	18.344	19.72
1	33.274*	8.482*	8.443*	9.033*
2	0.042	7.923	7.253	8.080

Appendix 3.4: Kao-Residual Test for Co-integration

	p-values	t-stat
Sample 1 - South Asian	0.0807	1.3465
Sample 2 - Asian	0.3228	0.4351