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The Spillover Effect of US Fiscal Policy on the OECD Countries Short-term Interest Rate

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The Spillover Effect of US Fiscal Policy On OECD Countries Short-term Interest Rate.

by

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Abstract

Many governments across the globe are considering adopting fiscal stimulants on a never-before-seen scale to fight economic recessions in the last ten years due to the development of debt and deficits in industrialized nations. A country's efforts to preserve economic stability are complicated by external economic shocks that can significantly influence the domestic economy through a monetary choice of decision and other links. Our analysis includes two interconnected stages. The first is SVAR analysis for the US economy, while the other investigates the international spillover of those shocks originating from the US. In the first stage, I adopt a Structural VAR to summarize the US economic activities and macroeconomic policy decisions.

Then I consider a Cholesky recursive identification strategy to extract the exogenous structural shocks in the US, such as the fiscal shock, the IS shock, the aggregate supply shock, and the monetary policy shock. Our particular concern is the fiscal shocks, which indicate the discretionary fiscal actions taken by the US government. In the second stage, we evaluate the spillover effect of the US fiscal shocks on the monetary policy decisions of OECD countries. The rich OECD countries tend to implement expansionary monetary policies confronting a fiscal stimulus shock identified in the US. In comparison, other OECD countries are more likely to have contractionary monetary policy, facing the same fiscal shock. For each country, the ARDL model assesses the dynamic impact of one unit of US fiscal shock on the policy interest rate.

Chapter 1: Introduction

The field of economics has spent much more time studying monetary policy than fiscal policy. The spillover effects of US fiscal policy are less investigated than those of US monetary policy. Experts' views on the impact of fiscal policy are more likely to be split than those of monetary policy in empirical studies. The consequences of individual policy changes may be harder to disentangle when dealing with fiscal policy, where decisions fall prey to takeover in a longer time than monetary policy. For instance, government spending programs or changes in tax policy could only partially take effect and impact the economy and other macro policies for many months or even years, making it more challenging to establish obvious cause-and-effect. For instance, scholars have examined how government expenditure and other fiscal indicators (such as the budget deficit) affect interest rates in recent years (for example, Ardagna et al. 2004 and Aisen and Hauner 2013). The studies establish a relationship between fiscal policy and interest rates in the US. For all those domestic macro policies analyses, although the estimated strength of the links varies from study to study, there is some agreement that more robust fiscal indicators are associated with lower interest rates. Recent recessions have shown how a local shock may swiftly spread over a region, eventually affecting economies all over the globe, as was the case with the global financial crisis (2008). The responses of domestic policymakers to shocks generated by foreign fiscal policy and foreign monetary policy shocks would differ across countries.

In this study, I generated four shocks from the US economy: fiscal policy shock, aggregate demand shock, aggregate supply shock, and monetary policy shock, as identified in a structural VAR model comprising the treasury debt level, the industrial output, the personal consumption expenditure (PCE) price index, and the federal fund rate. Our total concentration is on the spillover

effect of the US fiscal policy. Then, we pose the following question: What is the spillover effect of the US fiscal shocks on the monetary policy decisions in other OECD countries?

It is important to note that this research focuses on how OECD nations' monetary policies react to fiscal disturbance seen in the United States. That is to say, I do not respond to inquiries into how large the domestic multipliers of OECD countries are in response to the US fiscal shock spillover. There are two primary motivations for examining the effects of US fiscal shocks on other countries. First, due to interest rate bound limitation, the spillover from government spending shocks during a recession has a more significant impact than monetary policy shock. Second, although sizeable fiscal stimulus is seen as essential by many economists to stabilize the economy, the fast growth of government debt has prompted rising worries about the latter's negative impact on the economy and the financial system.

The analysis occurs in two phases. To describe US economic activity and macroeconomic policy, In the SVAR, I use Cholesky's recursive identification to extract structural shocks in the US economy, such as fiscal, IS-aggregate demand, aggregate supply, and monetary policy shocks. The shocks of our specific interest are the fiscal shocks, which show the discretionary budgetary decisions performed by the US government. In the second step, I examine the spillover effect of the US fiscal shocks on the monetary policy choices of OECD nations. The ARDL model looks at the dynamic effect of one unit of US fiscal shock on each nation's domestic policy interest rate. I find affluent OECD nations tend to undertake expansionary monetary policies facing a fiscal stimulus shock observed in the US. In contrast, other OECD nations are more likely to adopt a contractionary monetary policy, confronting the same fiscal shock.

In this paper, I first establish the grouping of the OECD countries as rich OECD countries and other OECD countries following the empirical selection used by Sakalauskaite et al. (2015).

According to Sakalauskaite et al. (2015), "rich OECD countries" are those countries that are comparable to the US concerning their economic systems and whose markets for public debt are integrated into the international capital market. Several interesting facts emerge from the analysis. We find that the US fiscal disturbances induce large and significant responses in monetary policies of the advanced and other OECD countries. There was heterogeneity in the monetary policy response to the US fiscal policy shocks across the OECD countries. The rich(advanced) OECD countries responded to the US fiscal policy by reducing their short-term interest rate. The transmission patterns are different from those of other OECD countries. Most "other OECD countries" respond to the US fiscal policy disturbance with an increase in the short-term interest rate. The short-term interest rate channel may be a crucial transmitter of US fiscal disturbances. As to the US monetary policy, a contractionary monetary policy shock causes a significant and instantaneous increase in short-term interest rates in those advanced OECD countries. Short-term interest rates in advanced OECD countries respond positively to aggregate supply and demand shocks. On the other hand, the contractionary US monetary policy shock has an insignificant impact on the "other OECD" countries.

In this article, I contribute to documenting how the two groups of OECD countries react to the spillover impact of the fiscal policy shock in the United States. In addition, I found out how the policy shock brought on by the fiscal stimulus program implemented by the United States affected the monetary choices implemented by countries that are members of the OECD. I combine the research strengths based on the structural Cholesky recursive identification technique to isolate the external structural shock from the United States. This study is not the first to look at debt level data; instead, it is the first to utilize shocks drawn from US treasury debt level data as a measure

of government expenditure shock to predict how the OECD's monetary policy decision would respond.

The policy implication could be profound: US fiscal policy has significant and heterogeneous external impacts, and the Fed's actions are not always synchronized with the monetary policies of all OECD countries. Mechanisms to internalize these effects might lead to better continental results. Because of the Interconnectedness of different countries' economies within the global trading system, the economic policies of one nation may have impacts that extend beyond the political boundaries of that nation. If policymakers consider the global economy's interdependence in their policy decisions, it will have significant consequences for empirical research and public policy.

Chapter 2: Literature

2.1 The US Fiscal Policy Interconnection

The US is a significant player in the global economy, and its monetary or fiscal policy changes can cause ripple effects worldwide. The spillover effect of US fiscal policy on other OECD nations may have significant and multifaceted effects on the economy of those other OECD countries. The decision-makers in these nations must be aware of these spillovers and ready for their possible implications. Uncertainty in policymaking has been made worse by the situation of the US economy (IMF, 2013). The US economy is connected globally via the markets for products, factors, and assets. The connections may appear in the flows of products and services in international commerce, the interconnections between local and foreign asset markets' asset pricing and capital flow relationships, and the correlations between domestic and overseas factor prices (Dornbusch & Fischer, 1984). According to CGTN BIZ (2022), "It is crucial to acknowledge that macroeconomic tightening in developed nations may have worldwide spillovers." Global shocks and spillovers from developed countries' policies often severely impact emerging markets in developing nations. For example, interest rates, trade policies, or government spending changes can affect exchange rates, trade flows, and investment decisions. Suppose the US policy shock is significant enough. In that case, it is a potential consequence to lead to an economic slowdown or recession in the affected countries and higher inflation, unemployment, and balance of payment problems (Strauss-Kahn, 2009). All nations might suffer the consequences of actions by individual countries looking out for their interests. Yet, as had occurred so often, governments hesitated to coordinate their responses when this crisis erupted. The first policies were often ad hoc responses to the immediate demands of certain entities. The financial industry was hit very hard by these issues. In this case, the authorities' responses to the concerns presented by systemic hazards

connected with huge cross-border financial conglomerates were only sometimes successful or coordinated.

2.2 Monetary Policy

Regarding the worldwide repercussions of monetary shocks, perturbations in US monetary policy cause sizable and statistically significant changes in several macroeconomic variables. The "sub-prime mortgage bubble" and the unusually lax monetary policies in the United States from 2001 to 2006 sparked the 2008 banking crisis, which sparked the global financial crisis. US monetary policy decisions, such as changes in the federal funds rate, can influence global financial markets, currency exchange rates, and international capital flow. The US monetary policy shocks can affect both consumers and businesses, as well as the overall growth and stability of the international economy. The transmission of US monetary policy to other OECD countries can have significant international effects. When the US raises interest rates, it can boost the US dollar and decrease international investment in US assets, leading to capital outflows from other OECD countries. On the other side, capital inflows to other OECD nations may occur from a devaluation of the US currency and an increase in worldwide investment in US assets if the US were to cut its interest rates. Also, changes in US monetary policy can impact borrowing costs and credit availability in other OECD countries. It must be stressed that while the transmission of US monetary policy to other OECD countries can be significant, the specific effects depend on many things, such as how the economy and finances of each country are doing. When it comes to amplifying US monetary disturbance, the interest rate channel is essential, whereas the trade channel is primarily irrelevant (Canova, 2005). For OECD nations where the United States is a significant trading partner or global financial circumstances are closely linked, the Federal Reserve's monetary policy actions can also spill over their respective interest rates. The US

monetary policy can also influence the monetary policy decisions of other central banks through the international transmission of monetary policy.

Research by Miranda Agrippino and Rey (2012) has revealed that the impact of US monetary policy extends beyond domestic borders, affecting risk premia, leverage, and credit growth in other parts of the world. Ehrmann and Fratzscher (2005) and Monticini et al. (2011) research to investigate how foreign markets and interest rates react when the Federal Reserve makes a statement. According to Belke and Gros (2005), changes in the federal funds rate have been the cause of variations in the ECB MRO rate ever since 1999's-euro introduction. The Federal Reserve impacts the European Central Bank's actions, although this influence is one-way only. Bernanke (2017) argues that monetary policy actions are primarily endogenous to economic conditions and have strong signaling and coordination effects. Clarida et al., (2000) estimate a forward-looking policy rule for the years before and including the Volcker-Greenspan era to assess the performance of the monetary policy. Their findings indicate that monetary policy was too accommodating before 1979 and had a stabilizing role in restraining inflation, starting with Paul Volcker's reign.

2.3 Fiscal Stimulus

The spillover of US fiscal stimulus, or the impact of increased government spending and lower taxes in the US, can significantly affect other OECD (Organization for Economic Cooperation and Development) countries. The US has one of the most significant economies, and its fiscal stimulus can increase demand for goods and services, boosting economic growth in other countries that export to the US fiscal stimulus can result in increased employment and higher incomes in these countries. However, the effects of US fiscal stimulus can also be transmitted through the exchange rate, as a more robust US economy may lead to a stronger US dollar. US

fiscal Stimulus can make exports from other OECD countries more expensive, hurting their competitiveness in international markets. An increase in US government borrowing to finance the stimulus can put upward pressure on global interest rates, making it more expensive for other OECD countries to borrow. US fiscal stimulus can also impact international capital flow and interest rates. It is crucial to emphasize that the particular spillover effects of US fiscal stimulus on other OECD countries will depend on various factors, including the size and openness of their economies, the level of trade and financial linkages with the US, and their fiscal and monetary policies. Large-scale fiscal stimulus in the US can lead to an influx of capital, affecting other OECD countries' capital flows and financial conditions. Corsetti et al. (2009), domestic fiscal stimulus (in large economies) may cause an increase in global interest rates and a subsequent decrease in international activity. According to research by the Bank of England's Monetary Policy Committee (MPC) and the Bank for International Settlements, real interest rates may vary even when capital markets are fully linked if spending patterns vary between nations. Depending on the scale of the public sector, government expenditure may have a more significant or less effect on interest rates in different countries Frenkel and Razin (1985). Researchers Auerbach and Gorodnichenko (2013) looked at the effects of government spending shocks on 30 OECD economies. They found that, while spillovers are large and statistically significant for the entire sample of countries during recessions, they are only significant for shocks from a few large OECD countries.

2.4 The US Fiscal Policy Shock

A fiscal policy shock occurs when the United States government's discretionary policies (spending or taxes) that stimulate the economy cause exogenous shocks to either a closed or open economy. Fiscal policy has far-reaching consequences at the global level but also far-reaching

implications at the national level. The government typically employs fiscal policy to promote quick, long-term growth and reduce poverty within the local economy of the United States. For instance, congress enacts a fiscal stimulus plan that involves increasing spending while lowering taxes because it anticipates stable revenue over the long term. Blanchard and Perotti (2002) make use of the fact that the reaction time of discretionary fiscal policy to changes in macroeconomic variables is often more than a quarter, allowing them to conclude that there is no discretionary response to macroeconomic data at the quarterly frequency. Several statistical approaches, including vector autoregression (VAR) models and local projection techniques, have examined the impact of US fiscal policy shocks on the macroeconomy. Fiscal policy shocks may have different impacts on the economy depending on many circumstances, including the kind of shock, the status of the economy at the time of the shock, and the Federal Reserve's reaction to the shock.

Macroeconomics publications have examined the impact of US fiscal shocks on the US real exchange rate, terms of trade, and trade balance. Much debate has been about how much the government debt level affects interest rates, and estimates range substantially. All these studies assessed the influence compared to other countries, not individual nations. Enders et al. (2011), Monacelli and Perotti (2010), Kim and Roubini (2008), and Ravn, Schmitt-Groh'e, and Uribe (2007) all find that increases in US government spending or the primary budget deficit cause the real exchange rate to go down. Corsetti and Muller (2006) and Enders et al. (2011) also find that spending shocks worsen trade terms. Kim and Roubini (2008), Corsetti and Muller (2006), and Monacelli and Perotti (2010) all find that an increase in the primary deficit has a small but positive effect on the current account or trade balance. A study that included the U.S., Boileau, and Normandin (2008) found that tax cuts in the US worsen the external deficit.

Blagrave et al. (2018) look at fiscal shocks under various monetary policy settings and find that the monetary authority's reaction to price pressures explains the sign of fiscal spillovers. The local economy is also crucial. According to Ardagna et al. (2004) and Aisen and Hauner (2013), fiscal spillovers in the euro area have been subject to analysis. Their studies contribute to the understanding of these spillovers and their potential implications for the region's economies. Furthermore, Attinasi et al. (2017) conducted a model-based analysis on fiscal spillovers in the euro area, emphasizing the interconnectedness of fiscal policies within the region (Attinasi et al. 2017). Additionally, Alloza et al. (2018) reexamined the size of spillovers arising from fiscal policies in the euro area (Alloza et al., 2018).

Macroeconomic studies have used numerous statistical tools, including vector autoregression (VAR) models and local projection methods, to examine the consequences of US fiscal policy shocks. Several types of fiscal policy shocks, the current economic climate, and the Federal Reserve's reaction all have a role in shaping the magnitude and duration of the impacts on the economy.

Chapter 3: Data and Methodology

3.1 Data

This study uses time series data on key macroeconomic variables from January 1999 to March 2021. All the variables are monthly. The Federal Reserve Economic Data (FRED) database provides time series data for the US economy, including Industrial Production, Personal Consumption Expenditure, and Federal Fund Rate Expenditure. The database known as OECD Statistics (Organization for Economic Cooperation and Development Statistics) offers information on many economic indicators, including the monthly short-term interest rate used in the research for several nations that are members of the OECD. Additionally, we use data from the United States Treasury database, which provides data on the United States government securities (debt growth). Aside from the benefits these data provide in terms of standardized variable definitions and measurement, we also have a grouping of the OECD countries prepared by Sakalauskaite et al. (2015) regarding the short-term interest rate.

3.1.1 Domestic US Economy Data

The variables in our analysis are; US debt growth, industrial production, personal consumption expenditure, and federal fund rate. The debt growth was derived from the US treasury securities, calculated by subtracting the beginning securities outstanding from the ending securities outstanding and the added issued securities. The debt level is expected to have a negative relationship with interest rates and a positive relationship with personal consumption expenditure and industrial production. Industrial production is the output of the economy's manufacturing, mining, and utilities sectors. Industrial output is expected to have a positive relationship with personal consumption expenditure and a negative relationship with interest rates, as higher rates can increase the cost of borrowing and reduce profitability. Personal consumption expenditure is

the spending by households on goods and services. Personal consumption expenditure is expected to have a positive relationship with debt growth and industrial production but also a negative relationship with interest rates, as higher rates can reduce disposable income and increase the cost of borrowing for households. A federal fund rate is an essential tool for US monetary policy. The federal fund rate is expected to negatively affect debt growth, personal consumption expenditure, and industrial production.

Our concept of fiscal variables substantially resembles that of relevant literature. The debt level data used in the research measured the fiscal policy after extracting the debt growth from the US treasury securities. Debt growth is often used as a fiscal policy tool, as it can stimulate the economy in the short term. However, sustained high levels of debt growth can lead to concerns about the long-term sustainability of government finances and limit future policy options. Supply-side economics is a theory that emphasizes the importance of tax cuts, deregulation, and investment in physical and human capital to stimulate economic growth. Industrial production is a crucial indicator of the economy's supply side, and policies that aim to boost industrial production are often associated with supply-side economics. Personal consumption expenditure is closely linked to inflation, as demand for goods and services increases faster than supply. Policies stimulating personal consumption expenditure, such as low-interest rates or fiscal stimulus, can lead to higher inflation. Monetary policy uses interest rates, money supply, and other tools to influence the economy. The Federal Reserve sets the federal fund rate, influencing borrowing costs, investment, and consumer spending. Rates can be raised or lowered to control inflation or stimulate economic growth.

We conduct a stationarity test on the variables that decide between two hypotheses: whether the time series is stationary (without a unit root). A stationarity test was performed on each of the

variables of interest to test the stationarity of the variables. I employ Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, and KPSS test (Kwiatkowski–Phillips–Schmidt–Shin test) in testing the hypothesis for each of the variables.

A stationary time series is desirable for time series analysis because it has constant mean and variance over time, simplifying the modeling process, for the federal fund rate was likely to be stationary. The debt growth level data is non-stationary after testing the ADF test and KPSS test. The p-value was 0.9 was greater than the alpha of 0.05, making it non-stationary. The industrial production data was non-stationary after testing the ADF test and KPSS test. The p-value was 0.4 was greater than the alpha 0.05, making it non-stationary. The personal consumption expenditure was non-stationary after testing the ADF test and KPSS test. The p-value was 0.01, and 0.2 between ADF and KPSS test was greater, making it non-stationary. The federal fund rate was non-stationary after testing the ADF test and KPSS test. The p-value was 0.7 was greater than the alpha 0.05, making it non-stationary.

The variables are non-stationary; therefore, we employed Johansen-procedure to check the long-term co-integration relationship among the variables. We apply the logarithm to the fiscal policy, industrial production, and personal consumption expenditure to deal with stationarity.

Table 1

Descriptive Statistics

Date: 04/18/23 Time: 11:23
Sample: 1 267

	DEBT_GRO	FFR	PCE	INDPROD
Mean	269.2710	1.844765	10370.13	102.0899
Median	225.3043	1.157000	10182.30	101.0626
Maximum	702.8632	6.544516	15458.90	111.3505
Minimum	90.08029	0.049000	6073.900	85.20920
Std. Dev.	165.2706	1.973863	2472.576	4.290928
Skewness	0.514418	0.936250	0.083291	0.326575
Kurtosis	2.040759	2.521138	1.970236	3.350535
Jarque-Bera	22.01243	41.55814	12.10581	6.112972
Probability	0.000017	0.000000	0.002351	0.047053
Sum	71895.36	492.5522	2768824.	27258.00
Sum Sq. Dev.	7265621.	1036.372	1.63E+09	4897.609
Observations	267	267	267	267

Note. Table 1 shows the overview of the domestic macroeconomic variable used in the research.

Table 2

The Co-integration table of the variables

```
######################
# Johansen-Procedure #
######################

Test type: trace statistic , without linear trend and constant in cointegration

Eigenvalues (lambda):
[1]  1.283622e-01  6.211190e-02  4.179106e-02  1.359805e-02 -7.592487e-17

Values of teststatistic and critical values of test:

          test 10pct  5pct  1pct
r <= 3 |  3.56  7.52  9.24 12.97
r <= 2 | 14.66 17.85 19.96 24.60
r <= 1 | 31.33 32.00 34.91 41.07
r = 0  | 67.05 49.65 53.12 60.16
```

Note. Table 2 shows that we reject the null hypothesis because the system has at least three variables relationship. The co-integration among the variables established our pre-assumption of the variable's interdependence.

3.1.2 Monetary Policy Decision Data of OECD Countries

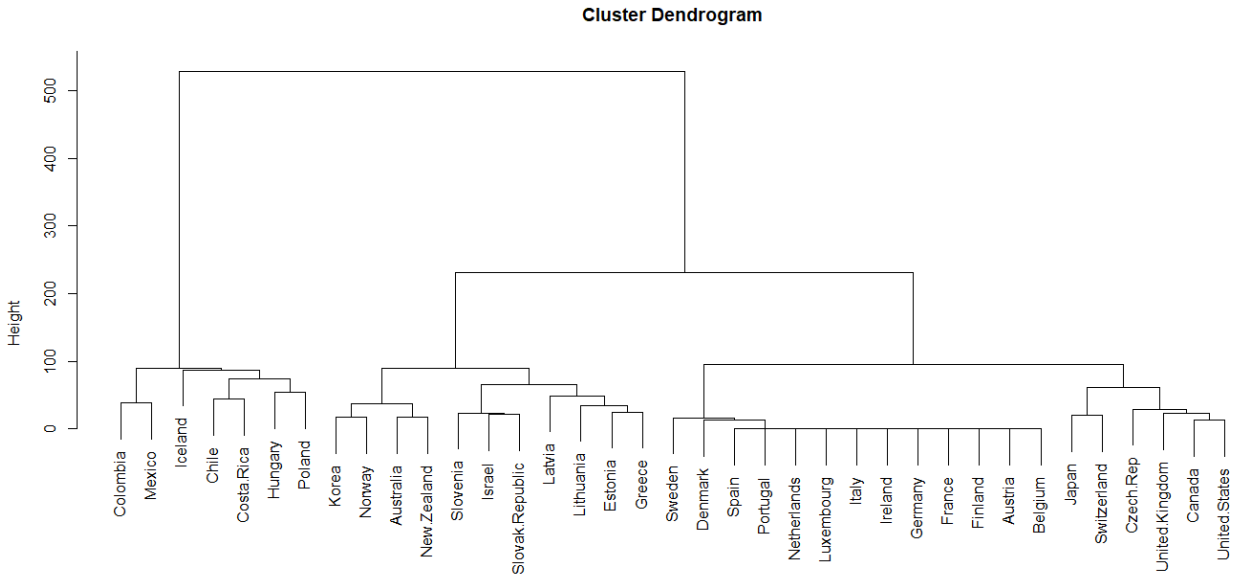
The study focuses on the short-term interest rate of 38 OECD countries, including Australia, Canada, Japan, New Zealand, United Kingdom, Austria, Belgium, Chile, Colombia, Denmark, Estonia, Finland, Czech Republic, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, Costa Rica, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland. The sample period covers the years 1999 to 2021.

Short-term interest rates are often used as a proxy for the monetary policy stance of a central bank. The short-term interest rate was used in the research to measure the monetary decision of the OECD countries because the central bank can directly control the short-term interest rates in the economy by setting the target for the federal funds rate (in the case of the US Federal Reserve) or the policy rate (in the case of other central banks). Aside from the benefits these data provide in terms of standardized variable definitions and measurement, we also have a grouping of the OECD countries prepared by Sakalauskaite et al. (2015) regarding the short-term interest rate.

The OECD was split between the rich OECD nations chosen by Sakalauskaite et al. (2015) and the other OECD countries (the latter being the name given to the rest of the OECD excluded in the former group). We determine the groups' average and term it as average1(average short-term interest rate of the rich OECD countries) and average2(average short-term interest rate of the other OECD countries).

Figure 1

OECD's classification of short-term interest rate correlation



The study also employs an unsupervised method to determine the causal relationship between US fiscal policy and the short-term interest rate of OECD countries. The method provides insights into a grouping of countries regarding short-term interest rates. Specifically, Utilizing the Unsupervised approach to cluster the short-term monetary policy decisions of OECD nations as a vital check on the choice of rich OECD countries in the capital market trading of public debt made by Sakalauskaite et al. (2015). The cluster dendrogram hierarchy grouped the OECD countries into two groups when it cuts across the level height of 400 regarding the correlation between the short-term interest rate of the OECD countries.

3.2 Methodology

We incorporate Structural Vector Autoregression (SVAR) and Autoregressive Distributed Lag (ARDL) for analyzing the spillover effects of shocks and policy interventions on macroeconomic variables. SVAR is a flexible model that can capture both contemporaneous and lagged interactions between variables, and it is particularly useful for identifying structural shocks and analyzing their effects on the economy (Kilian & Lütkepohl, 2017). ARDL is a cointegration-based approach that can account for both short- and long-run relationships among variables, making it well-suited for studying the dynamics of spillovers over time (Sari & Soytas, 2006).

In our study, we are interested in examining the spillover effects of fiscal policy, industrial production, personal consumption expenditure, and federal fund rate on the short-term interest rate of OECD countries. SVAR is appropriate for this analysis as it can help us identify the causal relationships among these variables and assess the impact of fiscal policy shocks, changes in industrial production, personal consumption expenditure, and federal fund rate on the short-term interest rate of the OECD countries. SVAR can also help us estimate the magnitude and persistence of these spillover effects.

ARDL is particularly pertinent to our investigation since it may assist us in determining the long-run correlations among the variables of interest and analyzing the extent to which spillover effects remain stable over time. By analyzing the impact of fiscal policy, industrial output, personal consumption expenditure, and the federal fund rate on the short-term interest rate of OECD nations, we may learn how successful policy interventions are in securing macroeconomic stability.

3.2.1 SVAR and Cholesky Decomposition in Recursive Identification Analysis

$$A_0 X_t = A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_p X_{t-p} + \varepsilon_t \qquad (1)$$

X_t Is one vector of endogenous variables, including fiscal policy, industrial production, personal consumption Expenditure, and the federal funds rate, at time t

A_1 to A_p , represent the coefficients on the lagged endogenous variables, up to p lags.

ε_t, is a vector of the error term. Unless otherwise specified, the error term is unconditionally homoskedastic.

While determining the optimum number of lags for the VAR model, the AIC (Akaike Information Criterion) and the BIC (Bayesian Information Criterion) were used as evaluation tools with the help of Eviews. The lag selection may be accomplished by estimating the VAR model using a variety of choices for p (the number of lags), then comparing the values obtained for their respective AIC and BIC. We use the highest accuracy model based on the AIC or the BIC.

To enable an estimate of the structural model, we must first extract its representation in reduced form. We pre-multiply both sides of the entire VAR function by A_0^{-1}

$$A_0^{-1} A_0 X_t = A_0^{-1} A_1 X_{t-1} + A_0^{-1} A_2 X_{t-2} + \cdots + A_0^{-1} A_p X_{t-p} + A_0^{-1} \varepsilon_t \qquad (2)$$

Hence, the reduced form of the equation.

$$X_t = \sum_{i=1}^{P} a_i X_{t-1} + e_t \qquad (3)$$

$a_i = A_0^{-1} A_i$ and $e_t = A_0^{-1} \varepsilon_t$, are the reduced-form residuals.

$$e_t = \begin{bmatrix} e_{it} \\ \cdot\ \cdot \\ e_{pt} \end{bmatrix}$$

Therefore, the compactly of the model;

$$A(L)X_t = e_t$$

Where $A(L) = I - A_1L - A_2L^2 \ldots A_pL^p$, denotes autoregression lag order polynomial of the endogenous and exogenous. According to Lutkepohl (2005), standard estimation enables us to get consistent estimates of the reduced-form parameters, the error, and the covariance matrix.

SVAR and Cholesky Decomposition in Recursive Identification Analysis

In this section, I use SVAR models to generate the four shocks to the US economy. In addition, I provided an overview of the SVAR system and an explanation of the Cholesky identification methodology.

We decompose the residuals into their structural shock components as follows.

$$X_t = A_1LX_{t-1} + e_t^*$$

Where X_t , is a vector of time-t observations of endogenous variables, A_1, is the lower triangular matrix derived by Cholesky decomposition of the matrix, L is a matrix of time-t delayed observations of endogenous variables, and e_t^* , is a vector of residuals.

$$e_t^* = A_1^{-1}X_t - A_1^{-1}A_2^{-1}L\,X_{t-1} \qquad (4)$$

Where A_2 is a matrix representing the model's long-term constraints? The vector e_t, represents the structural shocks, written as:

$$e_t = A_1e_t^*$$

The e_t, the vector contains the structural shocks for fiscal policy, industrial production, personal consumption expenditure, and the federal fund rate. The ith element of the vector corresponds to the structural shock to the ith endogenous variable in the model. The vector e_t^* , contains the residuals for fiscal policy, industrial production, personal consumption expenditure, and federal fund rate. The ith element of the vector corresponds to the deviation of the ith endogenous variable from its predicted value based on the SVAR model.

3.2.2 The Recursive Identification: Using Cholesky Decomposition

I explore numerous identification systems proposed by earlier scholars to choose the fundamental identification techniques for fiscal policy shocks. Although those researchers demonstrated the viability of their plans, I reevaluated them since the estimated period (the time of the debt growth, 1999–2021) and data frequency (monthly, in most instances) diverged from earlier research.

One method we incorporate is the recursive approach used by Sims (1990), where A_0^{-1} is constrained to a k-dimensional identity matrix, and A_0 is limited to a lower triangular matrix with a unit diagonal. This results in the breakdown of the variance-covariance matrix $\sum_\varepsilon = A^{-1} \sum_e ({A_0}^{-1})^1$. We obtained the decomposition from the Chloesky decomposition $\sum_\varepsilon = PP^1$ by defining matrix B with the same diagonal as P and specified $A_0^{-1} = PB^{-1}$ and $\sum_e = BB^1$. The recursive method infers that the model variables follow a certain sequence of causation. Remember that there are k! , distinct ways to put things in order. Cholesky's decomposition technique imposes an ordering of these variables within the context of the SVAR model for the US fiscal policy, industrial production, personal consumption expenditure, and the federal fund rate. The variables' assumed causal relationships determined this ordering. The order of the SVAR variables was as

follows: fiscal policy came first, then industrial output, then personal consumption expenditure, and last, the federal fund rate.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -\delta indpfiscal & 1 & 0 & 0 \\ -\delta pcefiscal & -\delta pceIndpro & 1 & 0 \\ -\delta ffrfiscal & -\delta ffrIndpro & -\delta ffrpce & 0 \end{bmatrix} \begin{bmatrix} {e_t}^f \\ {e_t}^I \\ {e_t}^p \\ {e_t}^{ffr} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} {e_t}^{*f} \\ {e_t}^{*I} \\ {e_t}^{*p} \\ {e_t}^{*ff} \end{bmatrix}$$

The layout implied that the fiscal policy at the top of the matrix had no direct effect on the other variables (such as industrial production or the federal funds rate) and is thus more exogenous. While fiscal policy has an impact on industrial production, it does not have any direct effect on industrial production. Third in the matrix is personal consumption expenditure on goods and services, which is affected by industrial production but does not directly affect it. The last variable in the model, the federal fund rate, is affected by industrial production and personal consumption expenditure.

3.2.3 ARDL Model and Spillover

In the study on spillover analysis, we use the ARDL approach to incorporate a regression estimation of both the lag of the endogenous and exogenous variables—the properties of our variables display non-stationarity and co-integration. Bhattarai et al. (2019) utilized a similar ARDL model to examine the spillover effects of fiscal policy shocks on the economies of seven small open economies in the Asia-Pacific region. They included variables such as real GDP, inflation, exchange rate, and interest rate in their model, in addition to the fiscal policy variable.

3.2.3.1.1.1 ARDL Model

$$\Delta y = \beta_0 + \beta_1 y_{t-1} + \beta_2 fiscal_{t-1} + \beta_3 ip_{t-1} + \beta_4 pce_{t-1} + \beta_5 ffr_{t-1} + \sum_{i}^{p} \delta_{i1} \Delta fiscal_{t-i} + \sum_{i}^{p} \delta_{i1} \Delta ip_{t-j} + \sum_{i}^{p} \delta_{i1} \Delta pce_{t-k} + \sum_{i}^{p} \delta_{i1} \Delta ffr_{t-l}$$

Where $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$, are coefficients, Δy represents the change in the OECD short-term interest rate, Δfiscal represents the change in US fiscal policy, Δip represents the change in US industrial production, Δpce represents the change in US personal consumption expenditure, Δffr represents the change in the US federal fund rate, and ε represents the error term.

To examine whether the variables are cointegrated over the long term, we apply the Johansen Method. For co-integration analysis, we propose the following hypothesis:

$$H_0 = \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$$

$$H_1 = at\ leat\ one\ \beta \neq 0$$

Figure 2

Co-integration of Variables

```
Eigenvalues (lambda):
[1] 3.331054e-01 1.654090e-01 1.440523e-01 9.113366e-02 6.032692e-02 1.098074e-02
[7] 1.800376e-16

values of teststatistic and critical values of test:

           test 10pct   5pct   1pct
r <= 5 |   2.86  7.52   9.24  12.97
r <= 4 |  18.98 17.85  19.96  24.60
r <= 3 |  43.72 32.00  34.91  41.07
r <= 2 |  84.01 49.65  53.12  60.16
r <= 1 | 130.84 71.86  76.07  84.45
r = 0  | 235.77 97.18 102.14 111.01

Eigenvectors, normalised to first column:
(These are the cointegration relations)

                Average11.l8  Average12.l8 Debt_growth.l8   Indprod.l8       pce.l8
Average11.l8    1.000000e+00  1.000000e+00   1.000000e+00  1.000000000  1.000000000
Average12.l8   -5.467564e-01  3.406425e-01  -1.666635e-01 -0.750280770 -0.309107906
Debt_growth.l8  3.861946e-03  5.188381e-03   6.238699e-04  0.020787703 -0.009491613
Indprod.l8     -3.366486e-02  6.244992e-02  -2.447118e-01 -0.020893181 -0.278069763
pce.l8         -5.744202e-05  4.386942e-04   2.591456e-05 -0.001420678  0.001147313
ffr.l8         -2.909537e-02 -6.821603e-01  -9.726449e-02  0.256339601  0.765447194
constant        2.540641e+00 -1.357190e+01   2.280949e+01 11.658098869 17.457301776
```

The results of the Johansen procedure indicate that we do not have sufficient evidence to reject the null hypothesis for five variable relationships. Therefore, we estimate the long-run equation of the ARDL model.

The long ARDL (p,q) model can be represented as follows;

$$y_t = \beta_0 + \beta_1 fiscal_t + \beta_2 ip_t + \beta_3 pce_t + \beta_4 ffr_t$$

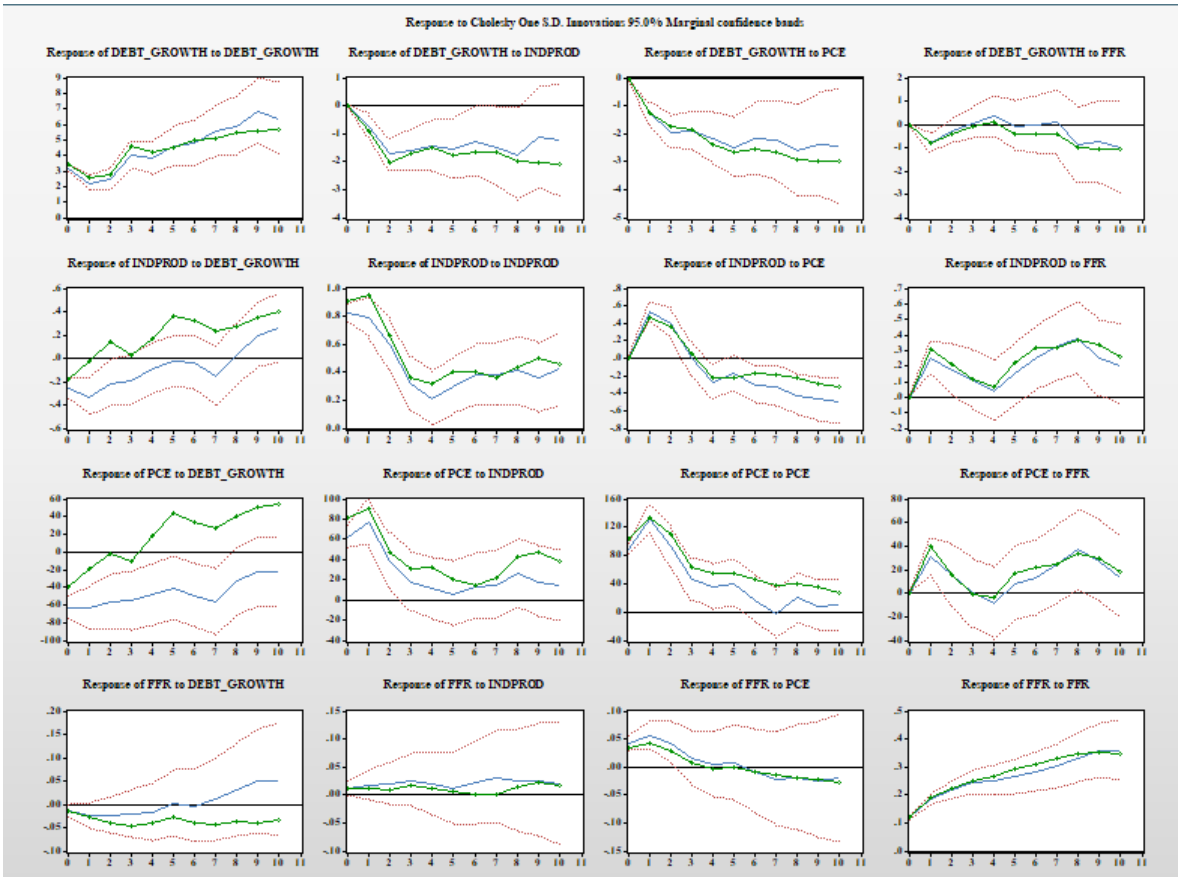
The long-term error term is denoted as p, and q is the largest lag allowed by the ARDL model.

Chapter 4: Empirical Results

To answer the main question of the research—the spillover effect of the US fiscal policy on the monetary decision of the OECD countries—we structure our discussion of the empirical results around the impulse response of US innovation shocks from fiscal policy, supply policy, demand policy, and monetary policy and their spillover effect on OECD short-term interest rates. Figure 1 displays graphs of impulsive reactions compared to local projections of shocks resulting from the expansionary fiscal policy that is one standard deviation and 95.0% of the marginal confounding range.

Figure 3

Impulse Response of the US Domestic Economy



4.1 Impulse Response of US Fiscal Policy

The first row of Fig.2 shows the current fiscal policy's impulse response to the previous year's fiscal policy shock, Industrial production shock, personal consumption shock, and monetary policy shock. The fiscal policy shocks immediately affect the fiscal policy at declining response and increase in the long term. The fiscal policy received an insignificant response to supply, demand, and monetary shocks. Both one standard error and 95% confidence bands are supplied for accurate inference.

4.2 Impulse Response of US Industrial Production

The second row of Fig.2 shows the industrial production's impulse response to the fiscal policy shock, industrial production shock, personal consumption shock, and monetary policy shock. The short-term effect of the industrial production's reaction to the expansionary fiscal policy shock was minimal, but it had a major influence over time. The local prediction of the industrial production's response to the expansionary fiscal policy shock exceeds one standard deviation, indicating that the industrial shock will be very responsive to the expansionary fiscal policy since the innovation shock of the expansionary fiscal policy has a positive impact on industrial production. In the short term, industrial production reacts positively to the innovation shock of the industrial production itself, but in the long run, it is unresponsive. In the short run, industrial production increased due to a rise in PCE from an innovation shock. Still, in the long run, the impact of a PCE innovation shock on industrial production was largely unresponsive because firms lacked the resources to meet the rising demand. The innovation shock of the monetary policy shock has an immediate and beneficial effect on industrial output, which subsequently declines in the short run but rises in the long run-in response to the monetary policy decision.

4.3 Impulse Response of US Personal Consumption Expenditure

The third row of Fig.2 shows the personal consumption expenditure's impulse response to the fiscal policy shock, industrial production shock, personal consumption shock, and monetary policy shock. The personal consumption expenditure response to fiscal shock was irresponsive such that PCE's response to the fiscal policy shock was below zero standard deviation for both the short and long run. But for the local projection response of the PCE to the fiscal policy considering other dynamic effects of the other variable in the system, the PCE responds positively to the fiscal policy. The response of the PCE to IP shock is immediately positive and significant. Still, the magnitude and persistence of the response may vary depending on the specific shock and the economic conditions. The PCE immediately responded to itself with a positive response but declined in the short run and long term. The PCE response to the IP shock in the short-term and long decreases but remains significant. The response of the PCE to monetary policy shock received immediate positive and significant. Still, the magnitude and persistence of the response changed in the short-term and long-term as it declined in the short-term and rose in the long term.

4.4 Impulse Response of US Monetary Policy

The fourth row of Fig.2 shows the personal consumption expenditure's impulse response to the fiscal policy shock, industrial production shock, personal consumption shock, and monetary policy shock. The monetary policy responds to the PCE shock with an immediate positive effect and falls within the short-term but irresponsive in the long term. The impulse response of the monetary policy to the fiscal policy shock was insignificant since the two parties operate sovereignty independently. The Industrial production shock to the monetary policy response was irresponsive, with the dynamic effect of the other variable in the system.

4.5 Results of Spillover Response of OECD Countries to US Fiscal Policy

Table 3

Spillover Response of Rich OECD Countries

Fiscal Policy	Australia		Canada		France		Germany		Japan		United Kingdom	
lag	Coefficient	Prob***	Coefficient	Prob ***	Coefficient	Prob ***	Coefficient	Prob ***	Coefficient	Prob ***	Coefficient	Prob ***
L0	-0.02075	0.08565(insign)	-0.0012	0.8878(insignf)	0.0120	0.1935(insignf)	0.0120	0.1935(insignf)	0.0013	0.3594(insignf)	0.0135	0.0845(insignf)
L1	N/A	N/A	N/A	N/A	-0.0147	0.1184(insignf)	-0.014	0.1184(insignf)	N/A	N/A	-0.0305	0.0080(insignf)
L2	N/A	N/A	N/A	N/A	-0.02613	0.0052*	-0.02613	0.0052*	N/A	N/A	-0.0504	0.0000***
L3	N/A	N/A	N/A	N/A	-0.0303	0.0013**	-0.0303	0.0013**	N/A	N/A	-0.0340	0.0030**
Monetay Policy												
L0	0.029843	0.0098	0.0501	0.0000***	0.0134	0.1425(insignf)	0.0134	0.1425(insignf)	0.00015	0.9092(insignf)	-0.0009(0.01113)	0.9383(insignf)
L1	N/A	N/A	0.0580	0.0000***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	0.0336	0.0001***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	0.03651	0.0000****	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Supply policy												
L0	0.037819	0.00011***	0.0318	0.0003***	0.0150	0.1014(insignf)	0.0150	0.1014(insignf)	0.0049	0.0005**	0.0225	0.044(insignf)
L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Phlilps Curve												
L0	0.025662	0.0262**	0.0292	0.0009***	-0.0068	0.4546(insignf)	-0.0068	0.4546(insignf)	0.00002	0.9836(insignf)	-0.0041	0.7104(insignf)
L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note. Table 3 shows the sign coeffiecient response of the rich OECD Countries responds to spillover shocks of the US fiscal policy, monetary policy, supply policy, and demand policy.

Table 4

Spillover Response of Other OECD Countries and Non-OECD Countries

Fiscal Policy	Chile		Indonesia		Mexico		Poland		India		South Africa	
lag	Coefficient	Prob***	Coefficient	Prob ***	Coefficient	Prob ***	Coefficient(	Prob ***	Coefficient	Prob ***	Coefficient	Prob ***
L0	0.1700	0.0030**	0.0094	0.9295(insignf)	0.0397	0.2397(insignf)	0.0530	0.0265*	-0.0014	0.9967(insignf)	-0.0350	0.3606(insignf)
L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Monetay Policy												
L0	0.0088	0.8762(insignf)	-0.3432	0.0015**	0.0162	0.630(insignf)	0.1034	0.5731(insignf)	-0.018483	0.5865(insignf)	-0.0350	0.0228**
L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Supply policy												
L0	-0.0087	0.8784(insignf)	0.1701	0.1170(insignf)	-0.0063	0.8511(insignf)	0.0212	0.3731(insignf)	0.0463	0.1735(insignf)	0.0751	0.0527*
L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Phlilps Curve												
L0	0.0220	0.6970(insignf)	-0.0873	0.4124(insignf)	-0.0201	0.5514(insignf)	0.0448	0.0600(insignf)	0.0087	0.7988(insignf)	-0.0252	0.5096(insignf)
L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note. Table 4 shows the sign coeffiecient response of the other OECD and non-OECD Countries responds to spillover shocks of the US fiscal policy, monetary policy, supply policy, and demand policy.

4.6 Spillover Effects of US Fiscal Policy on Short-Term Interest Rate of OECD Countries

4.6.1 Rich OECD Response

We selected a short-term interest rate of 6 rich OECD countries out of the 16 rich OECD countries specified by Sakalauskaite et al. (2015). The six countries represent the OECD countries from the Euro area, north America, and Asia countries. We use sign restriction to detect the effect of the expansionary US fiscal policy on the rich OECD countries. The results depict a trend of the

negative spillover effect of expansionary US fiscal policy on the short-term interest rate of the rich OECD countries.

The US expansionary fiscal policy immediately affects Australia's monetary policy negatively, with a coefficient of 2.1% at a 10% significant level. The expansionary US fiscal policy does not affect the monetary decision of Australia in the long term. The US expansionary policy has an insignificant negative effect on Canada's short-term interest because the Bank of Canada is an independent institution that sets its monetary policy based on its assessment of the Canadian economy and its inflation target. The expansionary fiscal policy negatively affects France and Germany's short-term monetary decisions with a marginal coefficient of 2.6% at a 5% significant level.

The US expansionary policy does not significantly affect the short-term interest rate of Japan. The US and Japan have different goals, such as zero bound interest rates; therefore, the impact of the US fiscal stimulus shock does not significantly affect Japan's monetary decision because, irrespective of the magnitude of the shock, the short-term interest rate remains fixed at zero bounds. The United Kingdom followed the expansionary fiscal policy of the United States when the US adopted a fiscal stimulus policy. The US fiscal stimulus shock negatively reduced short-term interest rates of the United Kingdom by 5% at a 5% significant level.

In the open economy, the sovereign financial independence of the rich OECD countries permits them to issue government bonds and securities in their currency in the capital market. The rich OECD countries follow the US expansionary fiscal policy to protect the investors in their economy and solve the flight to safe asset issue.

4.6.2 Other and Non-OECD Countries Response

The US expansionary fiscal policy shock positively impacted other OECD which were not selected as rich OECD countries by Sakalauskaite et al. (2015). We selected OECD countries in North America, Euro Area, Asia, and non-OECD countries. The results depict a trend of the positive spillover effect of expansionary US fiscal policy on the short-term interest rate of the other OECD countries.

The US expansionary fiscal policy had an immediate effect on the monetary decision of Chile as it increased its short-term interest by 17% at a 5% significant level, which means anytime the US resort to expansionary fiscal policy, for Chile to protect its economic investors, the country to rise their interest rate to protect the depreciation of assets of the investors in the economy. The US expansionary fiscal policy had an immediate impact on the monetary decision of Poland as it increased its short-term interest rate by 5.3% at a 5% significant level. The "other-OECD" and rich OECD countries follow the US economy as they adopt expansionary fiscal policy because the US fiscal policy may directly impact the ECB decision, although it is an independent institution.

The North American countries, although considered strong US trade partners, follow the same trend of the impact of the US expansionary fiscal policy of the two groups. Still, the impact of the US fiscal shock on their monetary decisions is insignificant. Mexico responded positively to the expansionary US fiscal policy shock as other OECD countries, but the impact of the policy was insignificant as of Canada in the rich OECD countries.

The Asia OECD countries in the other OECD countries groups also follow the positive trend of the US expansionary fiscal policy. Still, the impact was insignificant as that of Japan in the rich OECD countries.

4.7 Spillover Effects of US Monetary Policy on Short-Term Interest Rate of OECD Countries

The US contractionary monetary policy shock does not impact Euro Area OECD countries' decisions because of the European Central Bank. The monetary decision of the Federal Reserve may not directly affect the members of the ECB's decision because of the institution's sovereign financial independence. The US contractionary monetary decision had no impact on the short-term interest of Australia, France, and Germany, which were selected to represent rich OECD in the Euro Area. However, it followed the trend impact of the positive on the contractionary monetary policy adopted by the US.

The US contractionary monetary policy significantly affected Canada's short-term and long-term monetary decisions. The Canadian economy immediately responded positively to the US contractionary monetary policy, increasing its short-term at 5% and 3% in lag one(1) and two (2), respectively. The United Kingdom and Japan's economies responded insignificantly to the monetary shock from the United States.

On the other hand, the US monetary policy had significant implications on the monetary decisions of non-OECD countries and some emerging economies. The contractionary monetary policy of the United States affected the monetary decision of both Indonesia and South Africa. Indonesia responded immediately to the US contractionary monetary policy with a 17% increase in the short-term interest rate. South Africa responded to the contractionary monetary policy of the United as it decreased its short-term interest rate by 3% to adjust to the contractionary monetary policy shock of the United States.

Chapter 5: Conclusion

The sneeze of the US fiscal and economic policies does catch a cold on the rich and other OECD countries. Despite previous studies examining the impact of the US's expansionary monetary policy on other countries, few studies have combined monetary and fiscal policy to determine how US fiscal policy affects other nations. These events have become causative subjects due to the use of different techniques and observation times. We analyzed the short-term interest to see how the United States' fiscal policies affected the monetary decision of OECD countries. Results showed the heterogenous movement of rich and other OECD countries when exposed to exogenous shocks from the United States' fiscal policies. In response to US expansionary fiscal policy, rich OECD nations lowered their interest rates via expansionary monetary policy while other OECD nations raised theirs through contractionary monetary policy.

The US should recognize that its policies can significantly affect other nations and should take steps to mitigate any negative impacts on those countries. When establishing such policies, the US must consider its fiscal policy's impact on OECD countries. By considering the international implications of its fiscal policy, the US can promote global economic stability and prosperity for all nations involved.

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