ESSAYS ON PROCYCLICALITY OF FISCAL POLICY AND NATURAL RESOURCE FUNDS

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ABSTRACT

ESSAYS ON PROCYCLICALITY OF FISCAL POLICY AND NATURAL RESOURCE FUNDS

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Fiscal policy in resource-rich economies, particularly with low institutional quality, faces some major challenges since their government expenditures depend on volatile resource income. Most of them have set up natural resource funds (NRFs) to clear away this dependency; however, the effectiveness of these funds is still under debate. Besides, large government expenditures financed by transfers from the funds are not sustainable and can entail serious risk for these economies. Hence, it is essential to investigate the effects of NRFs and determine the optimal resource windfalls allocation rule for resource-rich countries. The dissertation consists of two essays. The first essay investigates the effects of resource funds and the roles of institutional quality in mitigating fiscal procyclicality in 32 oil-rich economies from 1984 to 2015 using dynamic common correlated effect (DCCE) panel estimation techniques. It is found that NRFs can contribute to mitigate procyclicality of fiscal policy in economics which have high institutional quality. In the second essay, Dynamic Stochastic General Equilibrium (DSGE) model was applied to Azerbaijan to examine the macroeconomic effects of temporary resource production and price shocks and the optimal spending and saving of resource revenues. The result shows that full spending of resource revenues leads to the Dutch disease effect. By contrast, this effect is mitigated by saving all these revenues. It is also found that if the policy maker is equally concerned with fiscal stability and household welfare, at least 41 percent of resource revenue should be saved.

Keywords: Fiscal Policy, Natural Resource Funds, Dynamic Common Correlated Effect, Institutional Quality, DSGE Model

ÖZ

MALİYE POLİTİKASININ KONJONKTÜREL YANLILIĞI VE DOĞAL KAYNAK FONLARI ÜZERİNE MAKALELER

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Kaynak zengini özellikle de düşük kurumsal kaliteye sahip ekonomilerde, hükümet harcamaları değişkenlik gösteren kaynak gelirine bağlı olduğu için, maliye politikaları bazı zorluklarla karşı karşıya kalmaktadır. Bu ülkelerin pek çoğu, bu bağımlılığı ortadan kaldırmak için doğal kaynak fonlarını kurmuşlardır. Ancak bu fonların etkinliği hala tartışılmaktadır. Ayrıca, bu fonlardan yapılan transferlerle finanse edilen devlet harcamaları sürdürülebilir değildir ve bu durum ekonomiler için ciddi riskler doğurabilmektedir. Bu nedenle, doğal kaynak fonlarının etkilerini incelemek ve ülkelerin kaynak gelirlerinin tasarrufu ile harcanması için en uygun kaynak tahsisini belirlemek önem arz etmektedir. Bu tez iki makaleden oluşmaktadır. İlk makalede, doğal kaynak fonlarının ve kurumsal kalitenin maliye politikasının konjonktürel yanlılığı azaltmadaki etkileri, 32 petrol zengini panel ülke örnekleminde dinamik ortak ilişkili etkiler panel yöntemi kullanılarak, 1984-2015 dönemi için analiz edilmiştir. Bu analizde yüksek kurumsal kaliteye sahip ekonomilerde fonların konjonktürelliği azaltmada oldukça etkili olduğu sonucuna ulaşılmıştır. İkinci makalede, geçici kaynak üretim ve fiyat şoklarının makroekonomik etkileri ve kaynak gelirlerinin harcama ve tasarruf arasında en uygun şekilde tahsisi Azerbaycan özelinde dinamik stokastik genel denge (DSGD) modeli kullanılarak incelenmiştir. Analiz sonuçlarına göre tüm kaynak gelirlerinin harcanması Hollanda hastalığı etkilerinin görülmesine neden olmaktadır. Buna karşın, bu etkiler kaynak gelirlerinin tamamıyla tasarruf edilmesi durumda azalmaktadır. Ayrıca, hükümetin mali istikrar ve hanehalkının refahına eşit derecede önem vermesi durumunda, kaynak gelirlerinin en az yüzde 41'inin tasarruf edilmesi gerektiği sonucuna ulaşılmıştır.

Anahtar Kelimeler: Maliye Politikası, Doğal Kaynak Fonları, Dinamik Ortak İlişkili Etkiler, Kurumsal Kalite, DSGD Modeli

To My Beloved Parents

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LIST OF ABBREVIATIONS

AMG	Augmented Mean Group
ARCH	Autoregressive Conditional Heteroscedastic
ACG	Azeri-Chirag-Guneshli
bcm	billion cubic meters
BTC	Baku-Tbilisi-Ceyhan
BTE	Baku-Tbilisi-Erzurum
BOPS	Balance of Payments Statistics
BP	British Petroleum
BLS	Bureau of Labor Statistic
CCE	Common Correlated Effects
CD	Cross-Section Dependency
CAB	Current Account Balance
DOTS	Direction of Trade Statistics
DCCE	Dynamic Common Correlated Effects
DSGE	Dynamic Stochastic General Equilibrium
EIA	Energy Information Administration
EGARCH	Exponential GARCH
EITI	Extractive Industries Transparency Initiative
FDI	Foreign Direct Investment
GARCH	Generalized Autoregressive Conditional Heteroscedastic

GLS	Generalized Least Squares
GMM	Generalized Method of Moments
GCI	Global Competitiveness Index
HBS	Household Budget Survey
INQ	Institutional Quality
ICRG	International Country Risk Guide
IMF	International Monetary Fund
IRF	Impulse Response Function
NRF	Natural Resource Fund
OLS	Ordinary Least Square
OPEC	Organization of Petroleum Exporting Countries
PIH	Permanent Income Hypothesis
PSA	Production Sharing Agreements
RGI	Resource Governance Index
SD	Standard Deviation
SSCAR	State Statistical Committee of the Azerbaijan Republic
SWF	Sovereign Wealth Fund
SOFAZ	State Oil Fund of Azerbaijan Republic
TAP	Trans Adriatic Pipeline
TANAP	Trans Anatolian Natural Pipeline
2SLS	Two-Stage Least Squares
USSR	Union of Soviet Socialist Republics
VAR	Vector Autoregression Model
VECM	Vector Error Correction Model

WCSS	Within Clusters Sum of Square
WCED	World Commodity Exporters Database
WEF	World Economic Forum
WEO	World Economic Outlook

CHAPTER 1

INTRODUCTION

Fiscal procyclicality is a severe problem, especially in resource-rich countries, since enormous inflows of revenue from the oil, natural gas, or minerals export can enhance dependence on highly volatile income. This dependence generates some problems such as income volatility and Dutch disease. Besides, excessive spending on resource revenues transforms income volatility into government expenditure volatility that has serious economic consequences. One of the harmful effects of fiscal procyclicality is that resource revenue constitutes a large share of resource-rich economies; therefore, a slight fall in commodity prices can result in serious financing needs in those countries. Additionally, when governments cut their expenditure, especially on capital following a decline in resource revenues, economic growth falls in the long-term, and the poor get harmed due to the weak safety net (Erbil, 2010).

A widespread institutional solution to restrain high fiscal procyclicality by overcoming the volatility of oil income is to set up NRFs, which became popular at the end of the 1990s. With the proliferation of NRFs, the studies that examine the effect of these funds on fiscal policy management have become more frequent. Nevertheless, only a few of them quantitatively analyze this effect, and results obtained from them are mixed. According to some studies, NRFs are effective tools to promote fiscal sustainability, whereas others suggest that these funds can perform poorly because of low institutional quality and poor corporate governance. Also, the existing analyses in literature are plagued with some problems. They sometimes do not choose the appropriate fiscal variable that fiscal authorities can directly control, do not carefully overcome the endogeneity problem, and do not take into consideration cross-section dependence (CD) and make a slope homogeneity assumption.

The CD can result from interdependencies between countries due to economic distance, spatial correlations, spillover effects and common unobserved shocks like oil shocks (Omay and Kan, 2010). In the presence of this type of dependency, using the ordinary least square (OLS) estimation technique gives inconsistent estimates, and using some common cointegration and unit root tests may give spurious results. Besides, when modeling economic issues, some studies estimate regressions which allow varied individual-fixed effects while imposing equal slope coefficients through the units. However, since the economic, financial, cultural, and institutional structures of the countries are very different from each other, it is an expected result that the slope coefficient will vary from country to country. Hence, imposing a homogenous slope restriction in the case of the existence of heterogeneous slope can cause a bias in the estimates obtained under the OLS framework. New estimation methods such as common correlated effects have recently been developed to solve these problems, considering slope heterogeneity and CD.

In addition, when the countries in a study's sample are heterogeneous on their institutional structure, the effects of institutional quality and oil funds on fiscal policy's procyclicality are likely different. In this case, the effect of institutional quality can be studied by dividing the whole sample into subsamples. In the literature, when the studies classify the countries in their samples according to their institutional quality, they generally use the mean or median values of the institutional quality data of all countries in the data set they used as a base point. Nonetheless, this method has some drawbacks. Firstly, it does not take the time history of institutional quality variables into account. Also, it is not possible to use multiple factors such as political and economic institutional quality measures separately while grouping countries by this method. By using machine learning clustering methods, countries can be broken into subgroups considering these two essential issues.

This dissertation consists of two essays. First essay examines the fiscal cyclicality in a set of 32 oil-rich economies from 1984 to 2015 using DCCE panel estimation techniques. It also investigates whether oil funds and institutional quality help countries implement less pro-cyclical fiscal policy. This research's contributions to literature are threefold. First, the fiscal policy's procyclicality and the mitigating effect of funds on fiscal procyclicality are tested using Chudik and Pesaran (2015) approach, which takes endogeneity, slope heterogeneity, and CD into account in the same estimation. Second, the effect of institutional quality is studied by dividing the whole sample into subsamples using machine learning clustering methods according to information on institutional quality data sets. Third, only a few studies in the literature use a variable to control for countries' susceptibility to oil price fluctuations in their regressions, and this variable is generally the oil price. By contrast, the volatility of rates of oil price changes is used to capture fluctuation in oil price more precisely in this study. The results show that an oil fund is an effective policy tool to break the link between fiscal policy and oil revenues which helps countries to stabilize their economies. Additionally, the results indicate that institutional quality has a crucial role in implementing the right fiscal policies in conducting volatile oil revenues.

Generally, the objectives of NRFs in resource-rich countries range from prompting fiscal stabilization to saving for the future generation. In order to realize these objectives, how much of the resource revenue to save in NRFs and how much to spend should be arranged by the clearly defined deposit and withdrawal rules. Additionally, policy makers should set up these rules in line with country's needs. However, many developing resource-rich countries specify deposit and withdrawal rules as ad-hoc which are not based on any meticulous framework. Also, they do not always obey these rules.

The common view on managing resource revenue is the Permanent Income Hypothesis (PIH) discussed in section 3.1. Some studies argue that the PIH approach is not applicable for low-income countries since these countries have limited access to credit and capital (Baunsgaard et al., 2012). Due to this limitation of the PIH approach, some discussions arose on the optimal spending and saving of resource revenues (Collier et al., 2010; van der Ploeg, 2011; van der Ploeg and Venables, 2011; van der Ploeg and Venables, 2013). One of these studies' drawbacks is that they examine the optimal spending and saving of resource revenues in only non-stochastic models using arbitrary allocation rules without any volatility measure. Nonetheless, DSGE framework is required to examine the macroeconomic effects of resource windfalls.

A DSGE model is an optimization-based method in macroeconomics that explains economic events such as business cycles, the effects of economic policies, and economic growth. These models have microeconomic bases; hence, they give a fully integrated structure so as to analyze the critical policy issues (Primus, 2016). Besides this, the general equilibrium and stochastic sides of DSGE models allow analyzing the interaction between agents' behavior and policy actions. DSGE methodology also enables researchers to examine the effects of several shocks and the transmission process of these shocks to the economy (Sbordone et al., 2010).

Agénor (2016) is the first study to contribute literature on optimal resource revenue allocation using social loss function determined in terms of macroeconomic or fiscal stability and consumption volatility. Agénor developed a DSGE model for a resource-rich low-income country with an insufficient infrastructure. This model incorporates a series of properties, including a direct complementarity effect between private investment and public capital and imperfect access to world capital markets. Also, public capital is subject to congestion and absorption constraints. Since this analysis is basically a methodological contribution, it is vital to apply properties of this model to a developing resource-rich country.

Oil has been produced in Azerbaijan's territory since the late nineteenth century. However, oil production came to a halt with the Union of Soviet Socialist Republics

(USSR) breakup and the Nagorno-Karabakh war in 1997. The economy experienced negative growth during 1991-1996. In 1994, Azerbaijan signed the "Contract of Century," including various Production Sharing Agreements (PSAs) with some big oil companies. After 2000, foreign direct investment (FDI) started to flow into the energy sector, leading to substantial increases in oil production in Azerbaijan with the signing of the PSAs. Thanks also to increasing oil prices, the economy experienced very high positive GDP growth until 2009. The vulnerability of Azerbaijan's economy to the fluctuation of oil production and oil price was also seen in 2011, when real GDP growth dropped sharply to -1.5 percent, due to the decline in oil production. Hence, Azerbaijan's economic history provides evidence that energy has a critical role in sustaining macroeconomic stability in a resource rich country.

In 1999, Azerbaijan established a fund to manage its natural gas and oil revenues. Although deposit rules for sovereign wealth fund are specified, withdrawal rules are unclear, and both types of rules do not take particular issues such as fiscal stability and household welfare into consideration. Furthermore, nearly three-quarters of resource revenue inflows to fund have been spent since the fund's establishment. The enormous transfers from the fund to the state budget of Azerbaijan have jeopardized macroeconomic and fiscal stability. Also, Azerbaijan's proven oil reserves are predicted to be run out in 22 years, according to British Petroleum (BP). Hence, it is crucial for policymakers to determine optimal spending and saving of resource revenues for Azerbaijan.

The second essay extends the model in Agénor (2016) and applies it to the Azerbaijan Economy due to the reasons mentioned above. However, this research differs from Agénor (2016) in the following ways: the model involves imperfect capital mobility; there is no perfect substitution between tradable and non-tradable products; natural resource products also are consumed domestically; distribution cost is excluded since completion of pipelines lowers transport costs of oil and gas in Azerbaijan. Furthermore, one of Agénor (2016) assumptions is that government spending consists of only non-tradable goods, while public investment consists of tradable and non-tradable goods. However, we assume that government spending also consists of both types of goods to be more realistic. Moreover, Agénor (2016) assumes a positive relationship between a country's risk premium and the ratio of government debt to tradable output. Contrary to this, it is assumed that risk premium is positively related to the ratio of government debt to non-resource output in this study since resource revenues have high volatilities and are seen as a risk by credit rating agencies. This model is used to examine the macroeconomic effects of resource revenues resulting from temporary resource price and temporary production shocks under two different fiscal rules: "full spending rule" and "full saving rule." There is no asset accumulation with the full spending rule, and the government entirely spends all resource revenues on investment and consumption needs. By contrast, in the full saving case, the resource revenues are completely accumulated in the fund, and merely the interest income earned from assets of the fund is transferred to the state budget so as to finance public investment and consumption. Moreover, optimal spending and saving of the resource revenues in the context of Azerbaijan is examined considering fiscal stability and consumption volatility in this essay.

This study contributes to the literature as a first actual developing country application of Agénor's model. It is also the first research to assess resource windfall allocation for savings and consumption in a general equilibrium setting that considers some characteristics of Azerbaijan's economy. The results indicate that spending all resource revenues generates high volatility and causes a Dutch disease effect. However, this effect is alleviated if all the revenue is saved. Furthermore, the results of optimum rule analysis suggest that the Azerbaijan government should reduce the amount of resource revenues spent in the state budget so as to generate more asset accumulation in its fund.

CHAPTER 2

PROCYCLICALITY OF FISCAL POLICY: EFFECTIVENESS OF RESOURCE FUNDS AND THE ROLE OF INSTITUTIONAL QUALITY IN OIL-RICH COUNTRIES

2.1. Introduction

Commodity prices have frequently fluctuated in the last decade. These unpredictable fluctuations have a large impact on the fiscal policy performance of natural resource-rich countries and aggravate the boom and bust cycles in these economies. Since most of these countries could not diversify their exports that constitute their commodity revenues as a big part of their total revenues, a slight decrease in commodity prices can create considerable financing needs. Apart from this, a low level of institutional quality, budget structure (lack of enough automatic stabilizers), and lack of access to credit markets compel governments to implement procyclical fiscal policies.

Keynesian economics defines the optimal fiscal policy as a countercyclical policy, and neoclassical theory supports a neutral policy with expenditure and tax smoothing (Ilzetzki and Vègh, 2008). However, many empirical studies illustrate that fiscal policy in most resource-rich developing countries is actually highly procyclical. These countries raise government spending with a resource revenue growth, and they cut down on expenditures with a decrease in resource revenue that results from a decline in resource price. Moreover, external capital inflows become highly procyclical, especially during the downturn, and these economies have liquidity and borrowing constraints due to the lack of developed domestic financial markets and remarkable foreign assets.

In order to mitigate this fiscal procyclicality by overcoming the oil revenue volatility, oil-rich countries set up oil stabilization funds, which started to be popular after the late 1990s. Stabilization funds offer mechanisms and arrangements to governments to reach their macroeconomic objectives. These funds invest on assets to manage revenues obtained from commodity exports and privatizations with the aim to protect their economies from abrupt revenue fluctuations. Sovereign wealth funds (SWFs), savings funds, and reserve investment funds are examples of stabilization funds.

Oil stabilization funds fall under the SWFs. Sovereign Wealth Institute data illustrates that the size of total SWFs assets under the management was about USD 7.45 billion, of which more than half are oil and gas funds, as of March 2018. Oil stabilization funds are typically established to save for the future (intergenerational equity and fiscal sustainability) or to smooth fiscal expenditures. During booms, the government can accumulate some amount of oil revenues in the oil fund and finance its budget deficit using the fund's assets during downturns.

In this chapter, evidence for fiscal policy's procyclicality of oil-rich countries is provided; however, this research actually aims to investigate whether oil fund and institutional quality help countries implement less procyclical policy, which is closer to an optimal policy defined by the Neoclassical and Keynesian theories (Ilzetzki and Vègh, 2008).

The present chapter is organized as follows. Section 2.2 presents a literature review on the cyclicality of fiscal policy and NRFs. In section 2.3, the empirical specification, the data, and the model variables are discussed. Section 2.4 presents the results of empirical analysis where the institutional quality's roles and oil funds on the alleviation of fiscal policy's procyclicality are examined using OLS, One Step System Generalized Method of Moments (GMM) and DCCE estimator techniques. Section 2.5 concludes.

2.2. Literature Review on Fiscal Policy's Procyclicality and Natural Resource Funds in Resource Rich Countries

A growing literature examines the relationship between the fiscal policy cyclicality and output fluctuations in different country groups or a single country. Some studies focus more on general country groups such as developing and industrial countries (Gavin and Perotti, 1997; Akitoby et al., 2004; Kaminsky et al., 2004 and Alessina and Tabellini, 2008), whereas others narrow the country sample to oil-exporting countries (Habibi, 1998; Villafuerte and Lopez-Murphy, 2010 and Erbil, 2011) or resource-rich countries (Bova et al., 2016). These studies' findings are somewhat mixed because they test various fiscal measurements on behalf of fiscal policy by using different econometric methods.

The most used fiscal policy indicator in the literature is government expenditure and its sub-indicators. Government expenditures are classified into several categories by their economic and functional characteristics. There are two categories of government expenditure under the economic classification: the first category contains expenditures on goods and services and transfer payments, and the second category is about expenditures on capital and current expenditures (Peacock and Wiseman, 1961). Current expenditures are on goods and services expenditure for current use to satisfy individual needs or community member's collective needs such as civil administration, education, and public health. These expenditures are incurred year over year. On the contrary, capital expenditures are on accumulating durable assets via investment in infrastructure and machinery which are expected to create future benefits.

Another useful government expenditure classification divides it into transfer and non-transfer payments. Transfer payments denote money transfers, such as unemployment benefits, social security payments, and pensions, and do not involve goods and services transactions. By contrast, non-transfer payment is an expenditure incurred on using or buying goods and services.

Besides, government expenditures can be classified in the following categories under the functional classification according to Eurostat: health, general public services, education, defense, economic affairs, environmental protection, housing and community amenities, recreation, culture and religion and social protection, public order and safety.

Apart from economical and functional classifications, government expenditures can also be classified whether they promote development. If expenditures endorse economic growth, they are called development expenditure. Expenditures on infrastructure, transport, education, health, and capital formation in the industrial and agricultural sectors are examples of development expenditures, whereas spending on civil administration, defense, and interest on public debt are put into the non-development expenditure category.

The first study that reveals the issue of procyclicality of fiscal policy belongs to Gavin and Perotti (1997). Using panel data over the period 1968–1995 for 13 countries and the panel OLS method, Gavin and Perotti (1997) provide evidence that government spending and its subcomponents were strongly procyclical.

By narrowing the country sample to oil-exporting countries, Habibi (1998) examines the impact of fluctuations in oil revenue of 5 Middle Eastern oil-exporting countries on their relative shares of different government expenditure categories employing a panel feasible generalized least squares (GLS) model from 1979 to 1999. The study finds that the economic affairs, defense and services expenditures' shares show pro-cyclical behavior, whereas this behavior is counter-cyclical in the social expenditure category. These results also indicate that social expenditures are protected against oil revenue changes due to their political importance, and budgetary cuts are covered by capital and defense expenditures.

In a single country study, Eltony and Al-Awadi (2001) evaluate the relationship between oil price and some macroeconomic variables using a vector error correction model (VECM) and a vector autoregression model (VAR) for the Kuwaiti economy over a time period 1984-1998. Empirical results indicate a unidirectional causality from oil price and revenue to current and development (construction) expenditure. However, oil price and revenue shock have relatively more influence on development expenditure.

For a large sample of developing countries, Akitoby et al. (2004) conduct analysis to test the short-run and long-run dependency between output and government spending, including subcategories such as capital spending, consumption spending (goods and services), non-wage and wage consumption, current spending, and non-interest total spending for 51 developing countries from 1970 to 2002 using an error correction model. The results give evidence about fiscal policy procyclicality in nearly half of these countries in the short term, yet the results are not uniform over the countries and spending groups. On the other hand, it is found a dependency between government spending (at least one category) and output in the long term for most countries. The authors also suggest that the political restraints and larger government size play an important role as a stabilizer by contributing less procyclical response of government spending to output, whereas financial risk and output volatility enhanced this procyclicality.

Villafuerte and Lopez-Murphy (2010) investigate fiscal policy's reaction to the oil price fluctuations for 31 oil-producing economies between the 2003-2008 periods. They show that these economies had procyclical fiscal behavior during the 2003-2008 oil price cycles. Additionally, the study provides evidence that the overall fiscal balance increased, whereas the non-oil primary balance deteriorated due to increased government spending in this period. They also indicate an inverse relationship between the degree of fiscal procyclicality and the countries' income levels.

Updating the data set of Villafuerte and Lopez-Murphy (2010), Erbil (2011) explores the fiscal cyclicality with testing relation between five fiscal variables (total government expenditure and its subcomponents, public investment, and consumption; non-oil revenue and the non-oil primary balance) and non-oil output by using difference GMM for 28 oil-producing economies over the period 1990-2009. The estimation results indicate that all these fiscal variables have highly procyclical behavior in the full country sample. However, the results show differences among the income groups of countries. To illustrate, the government expenditure is procyclical in middle-income countries and low-income countries, whereas it shows counter-cyclical behavior in high-income countries. The study also suggests that better political structure and institutions are associated with lower fiscal cyclicality in low-income countries. However, external financing constraints can affect fiscal policy only in middle-income countries and high-income countries.

In the context of political economy, Arezki et al. (2011) analyze the macroeconomic performance of a panel of 129 commodity-exporting countries throughout 1970-2007 by using Panel VAR models. The estimation results show that government spending has been procyclical, and a rise in the resource revenue initially crowds out non-resource sector GDP, which then increases with fiscal expansion. The study also states that the presence of high-quality political institutions helps in decreasing the procyclicality of government spending.

More generally, in their study covering 94 developed and developing countries, by using correlation analysis and Panel OLS estimation technique, Frankel et al. (2013) found that one-third of developing countries have structured their fiscal policies as countercyclical, which were procyclical before. Interestingly, nearly half of these countries are oil exporters, and the period corresponds to the time that oil funds began to be widespread. The authors also suggest that institutional quality has a crucial role in this process.

With the proliferation of NRFs, the studies that explore the effect of these funds on the management of fiscal policy have become more frequent. However, only a few academic studies quantitatively analyze this effect, and results obtained from them are mixed. Some papers conduct a study on a single country or analyze more than one country separately, whereas others investigate the effects of NRFs with panel data analysis.

In the former group, Fasano (2000) examines NRFs in 5 countries – Chile (copper), Kuwait, Oman, Venezuela, and the State of Alaska in his case study. The findings show that these funds increase the effectiveness of fiscal management by removing the dependence of government expenditure on resource revenue in some countries (Norway, State of Alaska, and Chile), while in remaining countries, this effect is not seen due to the deviation from the target of the funds and constantly changing fund rules. The author also emphasizes that NRFs' success on stabilization schemes results from the strong fiscal discipline.

Similarly, Davis et al. (2001) use time-series methods and structural break tests to investigate the effect of establishing of the NRFs on government spending in 12 resource-rich economies over the period between 1965 and 1999. The study finds that government expenditure in countries with NRFs is less correlated with resource export revenue than those without, though these results are not uniform across countries.

Besides, the test results indicate that the setting of resource funds has no significant impact on government expenditure.

In the second group, Crain, and Devlin (2003) explore the impact of NRF on fiscal volatility for 71 resource-rich countries through 1970-2000 using aggregate panel data. They found that NRF causes an increase in government expenditure volatility, especially in oil-rich countries. However, when the study sample comprised of only Norway, Chile and Oman, it was seen that the NRFs in Norway and Chile are successful in alleviating the expenditure volatility. The authors also emphasize that these differences can result from variations in countries' fiscal and fund management frameworks.

The oil funds in a group of 15 oil-rich economies are examined by Shabsigh and Ilahi (2007). The study assesses whether the oil fund induces macroeconomic volatility, including the volatility of broad money, inflation, exchange rate, and using panel OLS, fixed and random effect models through 1973–2003. The results show that there is an inverse relation between the volatility of broad money, inflation, and exchange rate and oil funds. However, the relation between the exchange rate and funds is not statically significant.

By considering the endogeneity problem, Ossowski et al. (2008) review fiscal rules and oil funds' effects on mitigating the volatility of three fiscal measures, including non-oil primary balance, government expenditure and the ratio of the change in government expenditures to the change in oil revenues for 31 oil-exporting countries over 1992–2005. Contrary to Shabsigh and Ilahi (2007), they could provide a statistically significant relationship between fiscal rules, fiscal outcomes and funds. However, the results indicate that better institutional quality brings an increased non-oil primary balance and reduces the government expenditure dependency on oil revenue.

Bagattini (2011) investigates the impact of NRFs on fiscal performance in 12 oil-producing countries for 1992-2007 by creating a new indicator that includes some fiscal measures such as non-resource fiscal balance (level and share of GDP) and public debt (share of GDP). The study indicates that only Chad in the sample has a decreasing fiscal performance after establishing its fund. The estimation results show that having NRF is associated with lower public debt and better non-resource fiscal balance. The study also confirms that fund structure and political stability are influential factors for better fiscal performance.

Using the quantile regression method, Tsani (2013) investigates the correlation between resource funds, the quality of institutions, and governance in two groups of countries (27 resource-rich countries and 81 countries) over the period 1996-2007. The analysis shows that resource fund's establishment contributes to an increase in governance and institutional quality. The study also suggests that countries can utilize the existence of resource funds without depending on whether they are placed at the upper or lower end of governance and institutional quality ranking.

Meanwhile, Coutinho et al. (2013) present a study covering 84 resource-rich countries for 1962-2011 using panel OLS and instrumental variables techniques. The study uses growth in government consumption and government consumption to GDP ratio as fiscal variables and provides evidence of the strong procyclicality of fiscal policy in these economies. The findings also conclude that higher democracy levels and more developed balances and checks in countries' management organs contribute to dampening fiscal policy's procyclicality. Another critical finding of this study is that fiscal rules do not affect procyclicality, whereas NRFs play a crucial role in its control

Sugawara (2014) explores whether NRFs help smooth the volatility of government expenditure for a panel of 68 resource-rich economies between 1988 and 2012. The estimation results reveal that the presence of funds mitigates the volatility of government expenditure. The findings suggest that fiscal rules and political institutions' quality are determinant factors in reducing this volatility. The study also provides evidence that larger economic size, well-structured real sector, diversification in exports and financial markets contribute to weakening the expenditure volatility.

Recently, Koh (2016) conducts a study for 42 oil-exporting economies throughout 1960-2014. By analyzing the period without and with oil funds using a panel VAR model, the estimation results indicate that in countries with high-quality institutions, government consumption's procyclicality is significantly mitigated with oil funds; in fact, fiscal policy becomes countercyclical with the establishment of funds in these economies. The study's findings also show that oil funds contribute to alleviating fiscal policy's procyclicality and real exchange rate volatility in economies with low institutional quality, yet the results are not statistically strong.

Finally, Gunes (2017) investigates whether oil funds are effective instruments to control government expenditure volatility in 29 oil-rich countries between 1980 and 2012 by using two-stage least squares (2SLS) models. In this study, the author takes the endogeneity of the oil funds establishment decision into consideration using some instrumental variables (such as urbanization and years of schooling). The estimation results show that oil funds help reduce government expenditure's procyclicality, while the author could not find a statistically significant effect of institutional quality measures (except socio-economic condition) on the fiscal policy's cyclicality in these economies.

Table 2.1: List of Empirical Studies on Natural Resource Funds and Fiscal Policy's Procyclicality

Author(s)	Methodology	Sample	Countries in Our Sample	Conclusion(s)
Gavin and Perotti (1997)	Panel OLS	13 Countries 1968–1995	Colombia, Ecuador, Mexico, Venezuela	Fiscal policy is procyclical.
Habibi (1998)	Panel Feasible GLS	5 Countries 1970–1999	Bahrain, Iran, Kuwait, Oman and the UAE	Government defense, economic affairs and services expenditures are procyclical. Government social expenditure is countercyclical.
Davis et al. (2001)	Time-Series Methods and Structural Break Tests	12 Countries 1965–1999	Algeria, Bahrain, Kuwait, Mexico, Norway, Oman, Papua New Guinea, Saudi Arabia, Venezuela and UAE	NRFs have no significant effect on government expenditure.
Eltony and Al-Awadi (2001)	VAR and VECM	Kuwait 1984-1998	Kuwait	Government development and current expenditures are procyclical.
De Cima (2003)	Regression Analysis	Mexico 1970–1988	Mexico	Government capital, education and social expenditures are procyclical.
Crain and Devlin (2003)	Panel Feasible GLS	72 Resource Rich Countries, 3 Countries (Norway, Chile, Oman) 1970–2000	Bahrain, Colombia, Congo Rep., Cote d'lvoire, Indonesia, Kuwait, Mexico, Norway, Oman, Papua New Guinea, Syrian Arab Republic, the UAE and Venezuela	The volatility of government expenditure increases in 72 countries sample with NRFs. The volatility of government expenditure reduces in 3 countries sample with NRFs.

Table 2.1: (Cont'd) List of Empirical Studies on Natural Resource Funds and Fiscal Policy's Procyclicality

Author(s)	Methodology	Sample	Countries in Our Sample	Conclusion(s)
Kaminsky et al. (2004)	Correlation Analysis	104 Countries (Low, Middle Income and OECD Countries) 1960-2003	Angola, Chad, Cameroon, Colombia, Congo Rep., Cate d'lvoire, Ecuador, Gabon, Indonesia, Iran, Iraq, Mexico, Nigeria, Norway, Oman, Saudi Arabia, Sudan, Syrian Arab Republic, Trinidad and Tobago, Venezuela, Vietnam and Yemen	Fiscal policy is procyclical in developing countries, and this procyclicality is clearer in middle-high income economies.
Akitoby et al. (2004)	ECM	51 Developing Countries 1970-2002	Cameroon, Colombia, Congo Rep., Indonesia, Iran, Mexico, Papua New Guinea and Venezuela	In short term; total spending and spending of all subcategories (Cameroon, Indonesia and Iran),wage spending (Mexico), capital spending (Venezuela) and spending on good and services, wages spending, non-interest total spending (Papua New Guinea) are procyclical.
Baldini (2005)	Hodrick-Prescott Filter (HP), ARIMA	Venezuela 1991-2003	Venezuela	Fiscal policy (total revenues, oil and non-oil revenues, total expenditures, non-oil expenditures, non-oil primary expenditures, and non-oil primary balance) is procyclical.
Talvi and Végh (2005)	Hodrick-Prescott Filter (HP), Correlation Analysis	(6 G-7 Countries, 14 Industrial Countries, 36 Developing Countries) 1970-1994	Colombia, Indonesia, Mexico, Nigeria, Norway, Syrian Arab Rebuplic, Venezuela	Government consumption (Except G-7 Countries Group) is procyclical.

Table 2.1: (Cont'd) List of Empirical Studies on Natural Resource Funds and Fiscal Policy's Procyclicality

Author(s)	Methodology	Sample	Countries in Our Sample	Conclusion(s)
Shabsigh and Ilahi (2007)	Panel OLS, Fixed and Random Effects Model	15 Oil Exporting Countries 1973-2003	Mexico, Bahrain, Kuwait, Norway, Sudan, Oman, Trinidad and Tobago, Venezuela, Indonesia, Nigeria, Saudi Arabia, UAE	There is negative correlation between oil fund and volatility of broad money and inflation.
Ossowski et al. (2008)	Panel GMM Model	31 Oil Exporting Countries 1988-2012	All Sample Countries (Except Iraq, Colombia, Papua New Guinea)	Better institutional quality increases non-oil primary balance. Also, it reduces government expenditure dependency on government revenue.
Ilzetzki and Vegh (2008)	Panel and OLS GMM Model	49 Countries (27 Developing and 22 Industrial Countries) 1960-2006	Colombia, Ecuador, Indonesia, Mexico, Norway, Russia and Venezuela	Government spending in developing countries is procyclical.
Alessina and Tabellini (2008)	OLS	87 Countries (23 OECD and 64 Non-OECD Countries) 1960-1999	Cameroon, Chad, Colombia, Congo Rep., Ecuador, Gabon, Indonesia, Iran, Mexico, Norway, Papua New Guinea, Cote d'lvoire, Trinidad & Tobago, Venezuela	Government expenditure (OECD Countries) is counter-cyclical. Corruption increases procyclicality of fiscal policy.
Arezki and Ismail (2010)	Panel OLS and Panel System GMM Models	32 Oil-Producing Countries 1992-2009	All Sample Countries (Except Iraq, Colombia, Papua New Guinea)	Government current spending is procyclical when oil price increases. Government current spending is downwardly sticky. Government capital spending is procyclical when oil price decreases. Government capital spending is upwardly sticky.

Table 2.1: (Cont'd) List of Empirical Studies on Natural Resource Funds and Fiscal Policy's Procyclicality

Author(s)	Methodology	Sample	Countries in Our Sample	Conclusion(s)
Erbil (2011)	Difference GMM Model	28 Oil Producing and Developing Countries 1991-2009	All Sample Countries (Except Iraq, Colombia, Norway, Papua New Guinea)	Fiscal policy (measured using five fiscal measures) is procyclical for the full sample. Only government expenditure shows procyclical behavior for low and middle-income country groups; however, countercyclical behavior for high-income country groups. Better political structure and institutions are associated with lower fiscal cyclicality in low-income countries.
Farzanegan and Markwardt (2011)	Impulse Response Functions (IRF) and Variance Decomposition	Iran 1959-2007	Iran	Government security and military expenditure react to oil price shock. However, government social expenditure does not have procyclical behavior under oil price shock.
Iwayemi and Fowowe (2011)	IRF, VDC and Granger-Causality	Nigeria 1985-2007	Nigeria	Oil price shock does not cause a fluctuation in government expenditure.
Bagattini (2011)	Panel-Corrected Standard Errors Model (PCSE)	12 Oil Producing Countries 1992-2007	Algeria, Iran, Ecuador, Kazakhstan, Colombia Nigeria, Russia, Trinidad & Tobago, Azerbaijan, Chad	Oil funds increase fiscal performance, and improve non-resource balance, and reduce public debt. Political stability and better fund structure enhance fiscal performance.
Arezki et al. (2011)	Panel VAR and Panel Pooled Mean Group Models	129 Commodity Exporting Countries 1970-2011	Not Available	Government spending is procyclical. High-quality political institutions decrease procyclicality.

Table 2.1: (Cont'd) List of Empirical Studies on Natural Resource Funds and Fiscal Policy's Procyclicality

Author(s)	Methodology	Sample	Countries in Our Sample	Conclusion(s)
Hamdia and Sbiab (2013)	Cointegration and ECM	Bahrain 1960-2010	Bahrain	Government spending is procyclical
Frankel et al. (2013)	Correlation Analysis and Panel OLS Models	94 countries 1960-2009	All Sample Countries (Except Brunei, Chad, Iraq, Kazakhstan, Papua New Guinea, Russia)	In one-third of developing countries in the sample, fiscal policy graduates from being procyclical, becoming countercyclical. Institutional quality is vital in this graduation.
Tsani (2013)	Panel OLS and Quantile Regression Method	27 Resource Rich Countries and 81 Countries 1996-2007	All Sample Countries (Except Angola, Brunei, Chad, Cote d'lvoire, Iraq, Vietnam, Libya, Papua New Guinea)	Resource funds contribute to increase quality of governance and institutions.
Sugawara (2014)	Panel Fixed and Random Effect Models and Difference-in-Difference Technique	68 Resource Rich Countries 1988-2012	All Sample Countries	Resource funds reduce government expenditure volatility. Fiscal rules, quality of political institutions, economic size, well-structured real sector, diversification in exports, and financial markets play an essential role in reducing expenditure volatility.
Azhgaliyeva (2014)	ECM	Kazakhstan 1994-2013	Kazakhstan	Government expenditure is procyclical. Oil funds stabilize the government expenditure.
Coutinho et al. (2014)	Panel OLS and Instrumental Variable Techniques	84 Resource Rich Countries 1962-2011	Not Available	Fiscal policy (government consumption growth and government consumption to GDP ratio growth) is strongly procyclical. Developed government institutions and more developed balances and checks in management organ of countries reduce procyclicality.

Table 2.1: (Cont'd) List of Empirical Studies on Natural Resource Funds and Fiscal Policy's Procyclicality

Author(s)	Methodology	Sample	Countries in Our Sample	Conclusion(s)
Bova et al. (2016)	Panel Fixed Effect and Pooled Mean Group (PMG) Models	48 Resource Rich Countries 1970-2014	All Sample Countries (Except Vietnam)	Government spending is procyclical. Fiscal rules do not have any impact on procyclicality. Higher institutional quality induces fiscal procyclicality
Koh (2016)	Panel VAR Models	42 Oil-Exporting Countries 1960-2014	All Sample Countries (Except Cote d'lvoire)	In economies with high institutional quality, oil funds reduce government consumption's procyclicality.
Rahma et al. (2016)	VAR Models	Sudan 2000-2011	Sudan	The government current expenditure is procyclical.
Güneş (2017)	2SLS	29 Oil-Exporting Countries 1980-2012	All Sample Countries (Except Brunei, Cote d'lvoire, Iraq, Papua New Guinea)	Oil funds reduce volatility and procyclicality of government expenditure. Institutional quality does not have any effect on fiscal policy's cyclicality.

Although the number of studies on the fiscal policy's procyclicality in resource-rich economies continues to increase, few have studied the effect of NRFs and institutional quality on this procyclicality. However, the existing analyses are plagued with some problems. They do not choose the appropriate fiscal variable that fiscal authorities can directly control, do not carefully overcome the endogeneity problem, and do not take into consideration slope heterogeneity and CD. Additionally, when the studies in the literature classify the countries in their samples according to their institutional quality, they generally use the mean or median values of the institutional quality data of all countries in the data sets they use as a base point. This study contributes to the literature in the following ways.

Firstly, the fiscal policy's procyclicality and the effect of funds on this procyclicality are tested using Chudik and Pesaran (2015) DCCE approach with GMM/2SLS. Therefore, endogeneity, slope heterogeneity and also CD are taken into account in the same estimation. Moreover, different econometric methods such as system GMM and fixed-effects (or random-effects) are used, and the results of these estimations are compared.

Secondly, the effect of institutional quality is studied by dividing the whole sample into subsamples using machine learning clustering methods according to information on Kuncic institutional quality data sets. Since the sample countries are not homogenous due to the variation in their institutional and political structure, the effect of institutional quality on fiscal policy's procyclicality is likely different.

Thirdly, only a few studies in the literature use a variable to control for countries' susceptibility to oil price fluctuations in their regressions, and this variable is generally the oil price. By contrast, the volatility of rates of crude oil price changes is used to capture fluctuation in price more precisely in this study.

2.3. Empirical Model Estimations, Data and Variables

2.3.1. Empirical Model Estimations

Kaminsky et al. (2004) state that countries' fiscal policies are defined as procyclical if they show expansionary behavior in boom periods and contractionary behavior in the time of recessions. In literature, empirical studies regress fiscal measures (growth) on the gross domestic product (growth) so as to determine whether fiscal policy is procyclical or not. A statistically significant and positive coefficient is expected for most of the fiscal measures (such as government expenditure and consumption) when country's fiscal policy is procyclical.

After 2000, NRFs start to enter these empirical studies with the increase in the number of funds established. NRFs took part in these studies' models as a dummy variable and interacted with GDP (or its growth). And, the statistically significant and negative coefficient of interaction term indicates that NRFs contribute to preventing fiscal policy's procyclicality. However, in these empirical studies, there are some difficulties in setting a robust relationship between fiscal measures and NRFs, such as sample selection bias, CD, endogeneity, using the suitable fiscal policy variable.

The first issue in measuring the performance of fiscal policy is to choose the most appropriate fiscal outcomes that policymakers can control. If the fiscal variable is not fully controlled, it can give misleading results. Ilzetzki and Vegh (2008) emphasize that tax rates and government expenditures are the key fiscal policy instruments. Contrary to these variables, tax revenue and budget balance variables are hard to control by policymakers. Asik (2017) suggests that since tax revenue depends on the business cycle, it is highly cyclical. Therefore, even though countries pursue a neutral fiscal policy of smooth government expenditure, choosing a balanced budget as a dependent variable would indicate that fiscal policy behaves countercyclical.

Another issue is that authors scale fiscal variables in GDP, or they take deviations of these fiscal variables and GDP from their long-run trends using the HP filter. Nonetheless, both processes have drawbacks. In the former, the GDP cyclicality can dominate fiscal policy's cyclicality, and hence interpreting fiscal procyclicality results can be difficult. In the later, if samples have different volatility levels, the HP-based cyclicality testing will give misleading results.

Selection bias is another shortcoming of studies in the literature. Generally, studies include just a subset of natural resource exporter or producer countries; therefore, the result of these studies does not represent whole natural resource exporting economies as a group.

Another challenge is that the set-up of NRFs is not a random occurrence; however, it could be owing to country-specific time-invariant unobserved factors. Shabsigh and Ilahi (2007) emphasize that the establishment of NRFs could be more prudent; hence, it would not be right to attribute successful fiscal policy performance to these funds. Ossowski et al. (2008) suggest that countries may be more willing to set up funds as an instrument of self-control mechanism because of having non-oil deficit. Then, the establishment of a NRF may appear to be positively related to higher government expenditures. In this case, current studies use fixed effect estimators to clean up the effect of time-invariant variables.

Lots of existing studies assume that disturbances in panel data models are cross-sectional independent. However, these models can have CD that arises from interdependency between countries because of the economic distance, spatial correlations, spillover effects and common unobserved shocks (Omay and Kan, 2010). In that case, using some common cointegration and unit root tests can give spurious results. Hence, it is vital to check whether a model has a CD problem and uses second-generation estimators with the existence of this problem.

The final challenge the author face is endogeneity. First, endogeneity issues can result from the reverse causality of fiscal policy and GDP growth. The fiscal policy literature depends on the basis that fiscal policy exasperates the business cycle by responding to output; however, the causality can also be opposite direction, as Jaimovich and Panizza (2007) argued. The second channel that endogeneity might arise is the correlation between the lagged fiscal variable and the error term. In this case, existing studies handle this problem by using appropriate instrumental variables.

The methodology used in this study is based on DCCE estimator technique developed by Chudik and Pesaran (2015). DCCE estimator allows for CD, heterogeneous slopes, static and dynamic specifications, fixed effects and endogenous regressors. Early empirical panel studies made the assumptions of cross-section independence of errors and slope homogeneity. In these studies, fixed and random effect estimators with instrumental variable technique and the GMM were generally used to handle endogeneity problems. Since there are CD and slope heterogeneity in most real-world data, using the DCCE estimator method can provide more robust and unbiased outcomes than the existing studies.

Pesaran and Smith (1995) and Pesaran et al. (1999) contributed to panel data literature by developing Mean Group and Pooled Mean Group first-generation panel data estimators that allow heterogeneity in the coefficients of the slope, respectively. However, while both these estimators allow for slope heterogeneity, they are inconsistent in the case of CD. Shortcomings of these estimators have improved with the introduction of the Common Correlated Effects (CCE) estimator by Pesaran (2006) and Augmented Mean Group (AMG) estimator by Eberhardt and Bond (2009) that are robust to not only slope heterogeneity but also to CD. The static CCE approach is extended to a heterogeneous and dynamic panel data model that includes weakly exogenous regressors and lagged dependent variables by Chudik and Pesaran (2015). Moreover, Neal (2015) made a further contribution by using GMM/2SLS in place of OLS and also using lags form of variables as instrumental variables to handle endogeneity problem in the CCE approach of Chudik and Pesaran (2015) and Pesaran (2006). Neal (2015) states that Monte Carlo simulations indicate that the CCE estimation technique is robust to endogenous regressors by this extension in static and dynamic models.

In this study, the DCCE estimator is used to examine the response functions of government expenditure in oil-rich countries. Consider the below dynamic heterogeneous panel data model when $i \in \{1,...,N\}$ is the individual panel unit and $t \in \{1,...,\mathscr{T}\}$ represents time:

$$y_{i,t} = \mu_i + \rho_i y_{i,t-1} + \beta_i x'_{i,t} + u_{i,t}, \tag{2.1}$$

$$u_{i,t} = \alpha_i f'_t + e_{i,t}, \tag{2.2}$$

where for unit $i \in \{1,...,N\}$ $\beta_i = \left[\beta_{1,i},..........,\beta_{K,i}\right]$ is the vector of K slope coefficients for unit , $x'_{i,t}$ is the transpose of the vector of K contemporaneous explanatory variables $x_{i,t} = \left[x_{1,i,t},...........,x_{K,i,t}\right]$, f'_t is the transpose of the vector of unobserved common factors $f_t = \left[f_{1,t},........,f_{M,t}\right]$ and $\alpha_{i,t} = \left[\alpha_{i,1},.....,\alpha_{i,M}\right]$ is the vector of M heterogeneous factor loadings. Besides, for unit $i \in \{1,...,N\}$, ρ_i is the autoregressive parameter, μ_i is the individual-specific fixed effect, and $e_{i,t}$ is the idiosyncratic error term where $E(e_{i,t}) = 0$ and $Var(e_{i,t}) = \sigma^2_{e,i} < \infty$. Note that $e_{i,t}$ and $e_{j,t}$ are independently distributed where $i \neq j$, $i \in \{1,...,N\}$ and $j \in \{1,...,N\}$.

Since the dependent variable $y_{i,t}$ and vector of the explanatory variable $x_{i,t}$ depend on the vector of unobserved common factors f_t, using mean group or pooled OLS will bring inconsistent estimates for ρ_i or β_i. However, by adding a cross-section average of regression variables, CCE estimation approximates the unobserved common factors' projection space. CCE is extended by Chudik and Pesaran (2015) into weakly exogenous regressors and dynamics specification with adding lags of cross-section averages of the contemporaneous explanatory variables to the regression equation as follows:

$$y_{i,t} = \rho_i y_{i,t-1} + \beta_i x'_{i,t} + \sum_{p=0}^{p_T} \delta_{x,i,p} \bar{x}'_{t-p} + \sum_{p=0}^{p_T} \delta_{y,i,p} \bar{y}_{t-p} + u_{i,t} \,. \tag{2.3}$$

In this equation, p_T represents the number of lags of the cross section average included in the regression. Chudik and Pesaran (2015) indicate that if $p_T = T^{1/3}$ estimators will be consistent. GMM and 2SLS are used instead of OLS so as to handle endogeneity problem. Our empirical model specification is as follows:

$$g_{i,t} = v_i + \rho_i g_{i,t-1} + \beta_i y_{i,t} + \alpha_i D_{i,t} + \gamma_i D_{i,t} * y_{i,t} + \lambda_i o_{i,t} + \delta_i p_t + \varepsilon_{i,t} \,, \tag{2.4}$$

where $g_{i,t}$ is the government expenditure growth in real terms, $y_{i,t}$ is real GDP growth, v_i is constant, $o_{i,t}$ is the oil rent-GDP ratio, p_t is the volatility of rates of changes in crude oil prices, $D_{i,t}$ is a fund dummy variable which is one if NRF exists and zero otherwise, $D_{i,t}*y_{i,t}$ is the interaction of fund dummy variable with real GDP growth and $\varepsilon_{i,t}$ is the error term which is an independently and identically distributed random variable (i.i.d.). The t and i denote the time period and the country, respectively. The equation is a fiscal policy reaction function, which shows fiscal outcomes respond to simultaneous changes in output, the lagged fiscal outcome, fiscal shocks ($\varepsilon_{i,t}$) and other variables. Size and sign of β coefficient determine fiscal policy's cyclicality. Positive and also statistically significant β is expected when the fiscal policy of countries is procyclical. Furthermore, statistically significant and negative coefficient γ for interaction term points out a less procyclical fiscal policy in countries with NRF.

The shocks to the previous year's policy decision and fiscal balance could have a lasting impact on the later period; therefore, the lag of the dependent variable is entering into the equation to see a long-term mean reversion of fiscal policy variable.

In oil-rich economies, the establishment of NRFs may concur with the beginning of the boom period. An increase in expenditure following high oil revenue would seem as if NRF is associated with higher government expenditure growth. In literature, studies try to solve this problem by using the ratio of government oil revenue to total government revenue, indicating governments' dependence on oil revenues. However, the oil rents-GDP ratio is used instead of this variable due to the lack of data.[1]

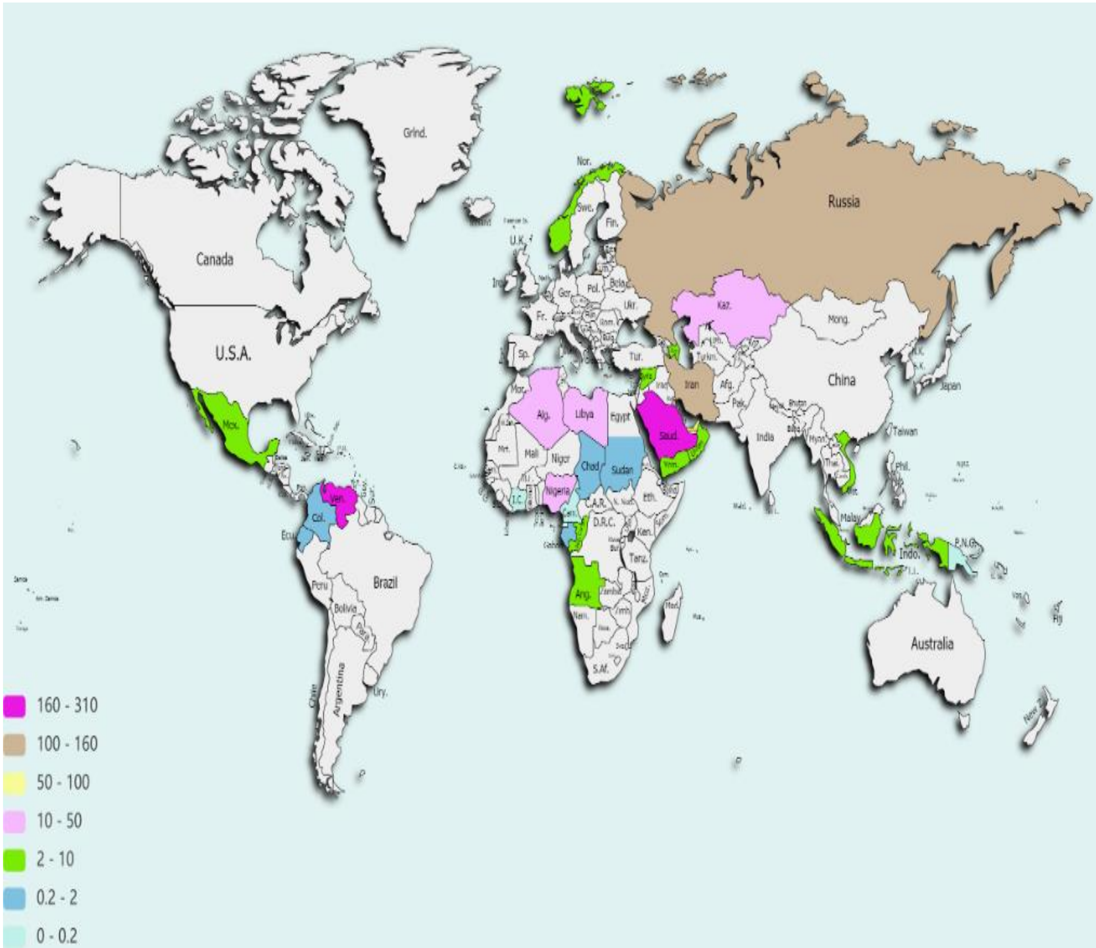
To handle the endogeneity problem, two lags of government expenditure growth and GDP growth are used as instrumental variables. Also, as an instrument, the export-weighted GDP growth of each country's trade partners, proposed by Jaimovic and Panizza (2007), and its lag are added to the model for GDP growth.

2.3.2. Data and Model Variables

This study uses annual data covering the period between 1984 and 2015 for panel of 32 oil-rich economies, namely, Algeria, Angola, Azerbaijan, Bahrain, Brunei, Cameroon, Chad, Colombia, Cote d'Ivoire, Republic of Congo, Ecuador, Gabon, Indonesia, Islamic Republic of Iran, Kazakhstan, Kuwait, Libya, Mexico, Nigeria, Norway, Oman, Qatar, Papua New Guinea, Russian Federation, Saudi Arabia, Syrian Arab Republic, Sudan, Trinidad and Tobago, United Arab Emirates, Venezuela, Vietnam, and Yemen.

[1] World Development Indicator reports that oil rent is the difference between the production of crude oil and costs of this production.

Crude oil productions and proved oil reserves of countries are presented in Figure 2.1 and Table 2.2. These countries were selected concerning one of the following criteria: the ratio of oil exports to total exports or the ratio of oil exports to GDP should be at least 20 percent, and the ratio of oil revenues to total government revenues should be at least 20 percent. In the appendix, Table 1.A.1 and 1.A.2 give the list of countries and several oil-dependency measures, respectively. Availability of data varies from country to country.



Source: British Petroleum (BP) Statistical Review of World Energy and Energy Information Administration (EIA).

Note: Bahrain, Cameroon, Cote d'Ivoire and Papua New Guinea statistics are as of 2016.

Figure 2.1: Study's Countries and Their Proved Oil Reserves, 2018

(Thousand Million Barrels)

Table 2.2: Countries Crude Oil Production (Thousand Barrels Daily)

Country	1998	2018	World Share 2018
Saudi Arabia	9,267.00	12,261.00	13.00%
Russia	6,110.00	11,438.00	12.10%
Iran	3,855.00	4,801.00	5.00%
UAE	2,610.00	3,912.00	4.20%
Kuwait	2,232.00	3,050.00	3.20%
Mexico	3,499.00	2,068.00	2.20%
Nigeria	2,023.00	2,007.00	2.20%
Kazakhstan	558	1,927.00	2.00%
Qatar	701	1,900.00	2.00%
Norway	3,138.00	1,845.00	1.90%
Angola	731	1,519.00	1.60%
Algeria	1,452.00	1,511.00	1.60%
Venezuela, RB	3,447.00	1,475.00	1.60%
Libya	1,480.00	1,165.00	1.10%
Oman	905	978	1.00%
Colombia	775	865	0.90%
Indonesia	1,520.00	808	0.90%
Azerbaijan	231	796	0.80%
Ecuador	385	517	0.50%
Congo, Rep.	264	330	0.40%
Vietnam	253	257	0.30%
Gabon	337	193	0.20%
Chad	24	116	0.10%
Brunei	157	112	0.10%
Sudan	12	100	0.10%
Cameroon	121.5	92.4	0.10%
Trinidad and Tobago	134	87	0.10%
Yemen, Rep.	380	83	0.10%
Bahrain	49.6	63.8	< 0.1%
Papua New Guinea	79	56	< 0.1%
Cote d'Ivoire	n.a.	50	< 0.1%
Syria	576	24	< 0.1%

Source: BP Statistical Review of World Energy and Energy Information Administration (EIA).

Notes: Bahrain, Cameroon, Cote d'Ivoire and Papua New Guinea statistics are as of 2016 instead of 2018. n.a. denotes not available.

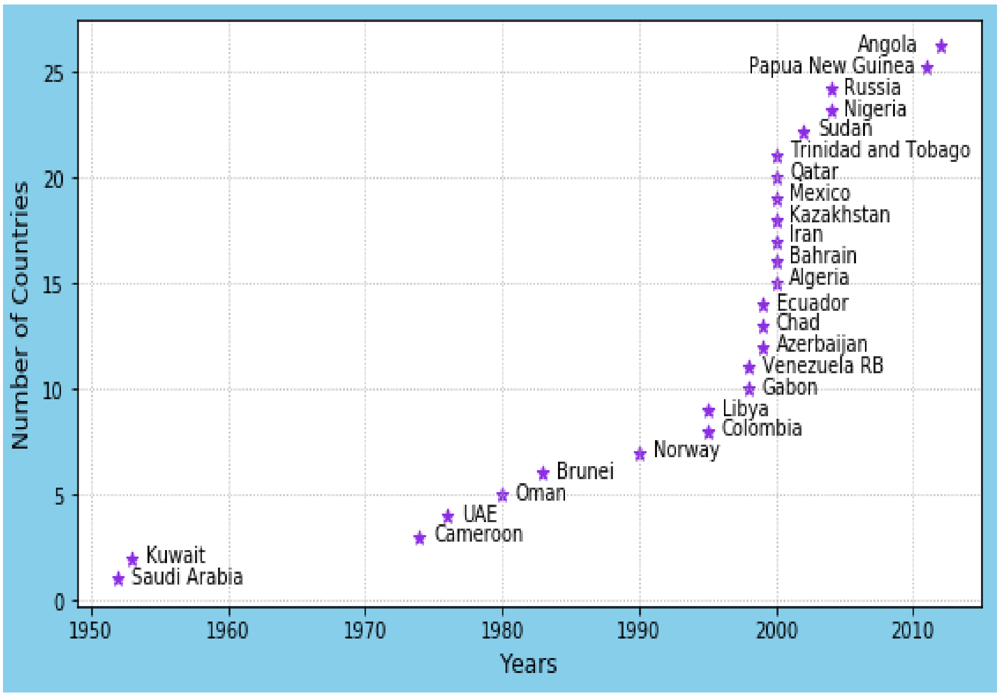
As mentioned above, the panel data model variables include government expenditure growth, GDP growth, fund dummy, export-weighted GDP growth, oil rents as a percent of GDP, volatility of rates of changes in crude oil prices, and some institutional quality variables.

- ***Government expenditures' growth rates*:** Government expenditure growth is used as a fiscal policy variable in this study. The government expenditure and GDP (in local currency) data are extracted from the World Commodity Exporters Database[2] (WCED) of the International Monetary Fund (IMF) and the World Economic Outlook (WEO) database of IMF. These data are in nominal terms, and they are deflated by using GDP deflator extracted from the World Development Indicator (WDI) database of the World Bank.

- ***Fund dummy variable*:** To create a fund dummy variable, the saving and stabilization funds are assumed to be the same since they generally serve the same aim in the economies of study's sample. Furthermore, if there is more than one fund in a given country, the first fund's establishment year is used in the creation of the fund dummy variable. There are 26 economies with saving and stabilization funds in the sample, and most of them were established after 2000. As Figure 2.2 illustrates, there were only nine countries with funds as of 1995, whereas 17 more countries started to utilize some fund arrangements after 1995.

[2] The World Commodity Exporters Database (WCED) covers key macro-fiscal indicators, and its primary sources are WEO, Balance of Payments Statistics (BOPS), DOTS and International Financial Statistics (IFS). This database covers 51 commodities (metals, oil and gas) exporter countries where these commodity exports constitute a high share (20 percent or more) of total exports or fiscal revenues.

The characteristics of these funds that the Truman Scoreboard includes are represented in Figures 2.3-2.4. The scores of SWFs scoreboard constructed by Truman[3] (2013) for 58 countries (48 SWFs and 9 government pension funds) are showed in Figures 2.3. 19 of these countries[4] are the ones focused on in this study. The scoreboard scores funds in four areas: behavior, accountability and transparency, structure, and governance using 33 questions. Figure 2.3 shows an index where equal weight (0.25) is assigned to each category, with a maximum possible score of 1 overall. These scores (overall) vary between 0.06 for Libya and 0.97 for Norway. The difference in the overall score of funds arises from governance and, to a lesser extent, accountability and transparency areas. Furthermore, most of the funds have scores close to the maximum in the structure category, whereas their governance scores change widely.

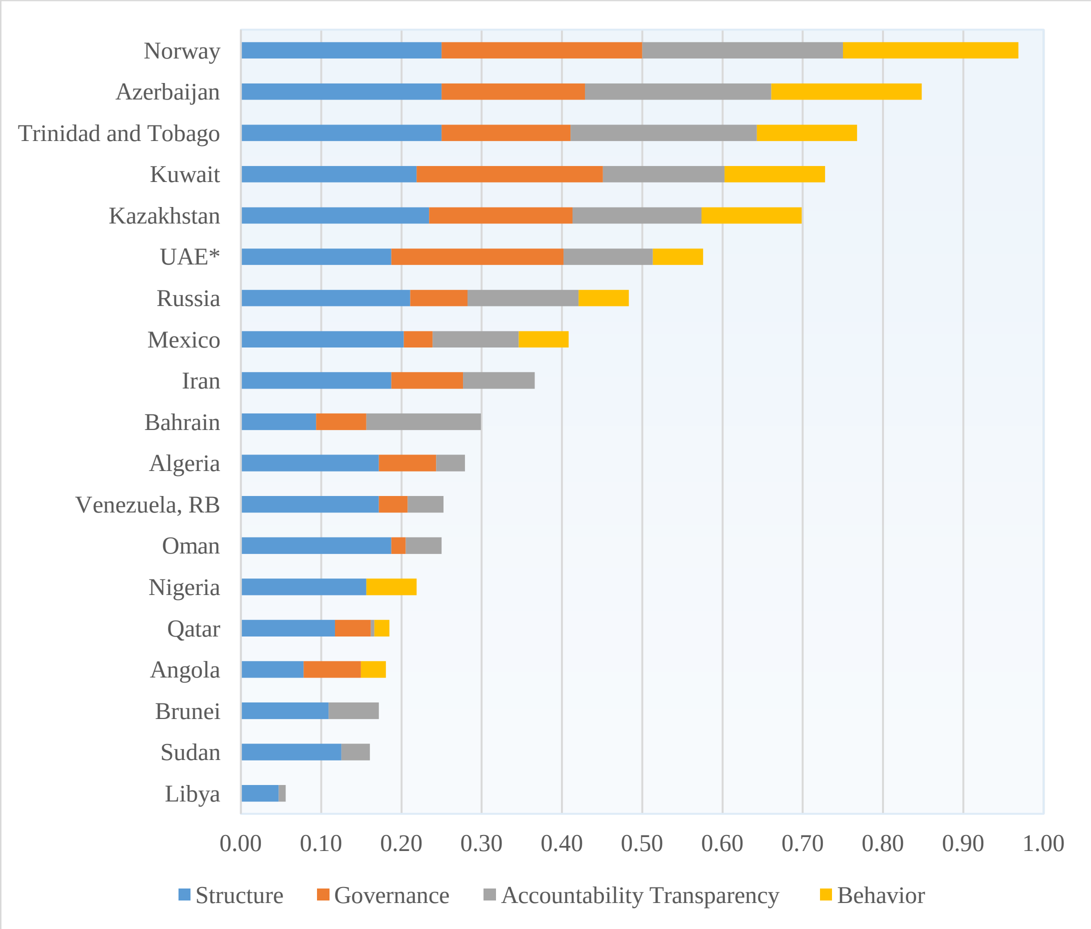


Source: Eseda (2013).

Figure 2.2: Countries with Oil Savings and Stabilization Funds

[3] Truman first constructed this scoreboard in 2009, and it is updated every year.

[4] Revenue Stabilization Account is admitted here as being owned by South Sudan and Sudan.

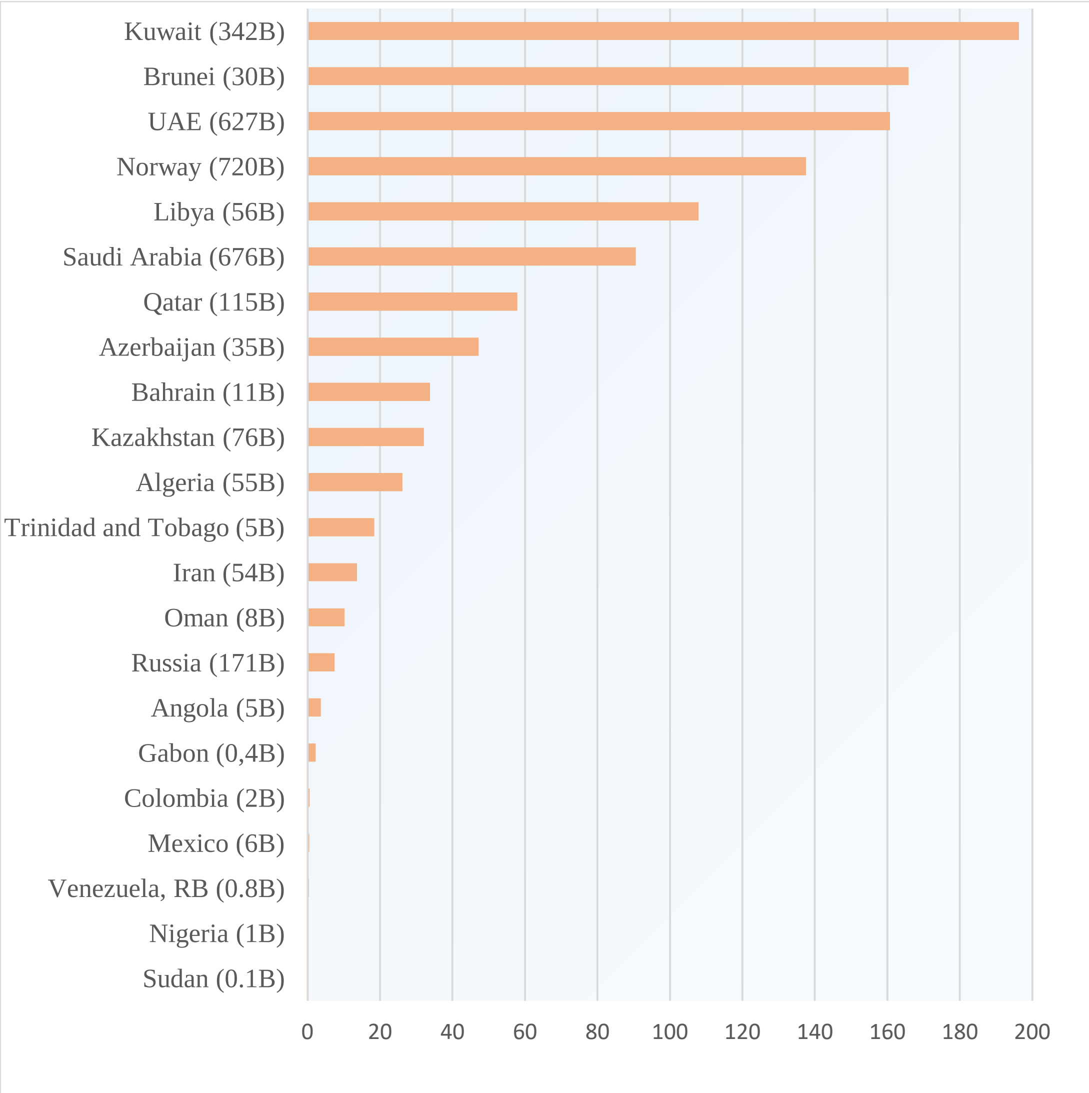


Source: The author's calculation is based on Truman (2013).

Note: Abu Dhabi Investment Authority statistics are used for United Arab Emirates (UAE).

Figure 2.3: Characteristics of Oil Stabilization, Savings or Sovereign Funds

Figure 2.4 shows the US dollar values of the funds' assets under management and their ratios to the country's GDPs in late 2013. These ratios range from 196 percent for Kuwait to less than 0.2 percent for Nigeria and Sudan. The ratios of the fund's asset values to the GDPs and the number of assets themselves are quite high in Central Asia and the Middle East. This indicates that these countries' funds are key players in the domestic and the international financial markets. However, funds in African and Western Hemisphere countries are relatively small, both domestically and internationally.



Source: The author's calculation is based on Truman (2013), IMF WEO and Eseda (2013).

Notes: Numbers in parentheses are the values of assets (billions of US dollars) in stabilization funds. Abu Dhabi Investment Authority statistics are used for the UAE.

Figure 2.4: Assets of Stabilization Funds, Percentage of GDP, 2013

- ***External shock variable*****:** External shock variable for each country is produced as a result of a cumbersome data collection and analyzing process by the author of the thesis. At time *t*, for each country *i*, its trading partner's weighted average of growth rates are adjusted with the ratio of country *i*'s exports to GDP:

$$SHOCK_{i,t} = \frac{EXP_i}{GDP_i} \sum_j \varphi_{i,j,t-1} GDPGR_{j,t}\ , \tag{2.5}$$

where $GDPGR_{j,t}$ shows growth rate of real GDP of country *j* in period *t*, $\varphi_{i,j,t}$ represents the fraction of export from country *i* to country *j*, EXP_i/GDP_i is the ratio of country *i*'s exports to its GDP. Jaimovic and Panizza (2007) claim that using a time-invariant ratio of exports to GDP would be less sensitive to changing domestic factors and real exchange rate fluctuations than its time-variant measure. Jaimovic and Panizza (2007) state that this shock variable is a sound instrumental variable for the GDP growth rate since those external shocks are likely to have no direct effect on government expenditures except their indirect effect via the GDP channel. The ratios of the exports to GDPs, the real GDP growth rates[5] and the values of exports from one country to another country used in the construction of each country's external shock variables are extracted from the WDI and Direction of Trade Statistics (DOTS) Database of IMF, respectively.

- ***The ratio of oil rents to GDP*:** This variable is used as a proxy for oil dependency instead of the ratio of government oil revenue to government total revenue because of the lack of data. It also proxies the share of country's oil GDP in the total GDP. The data for the ratio of oil rents to GDP is obtained from the WDI database.

Additional variables included in the empirical analyses are as follows:

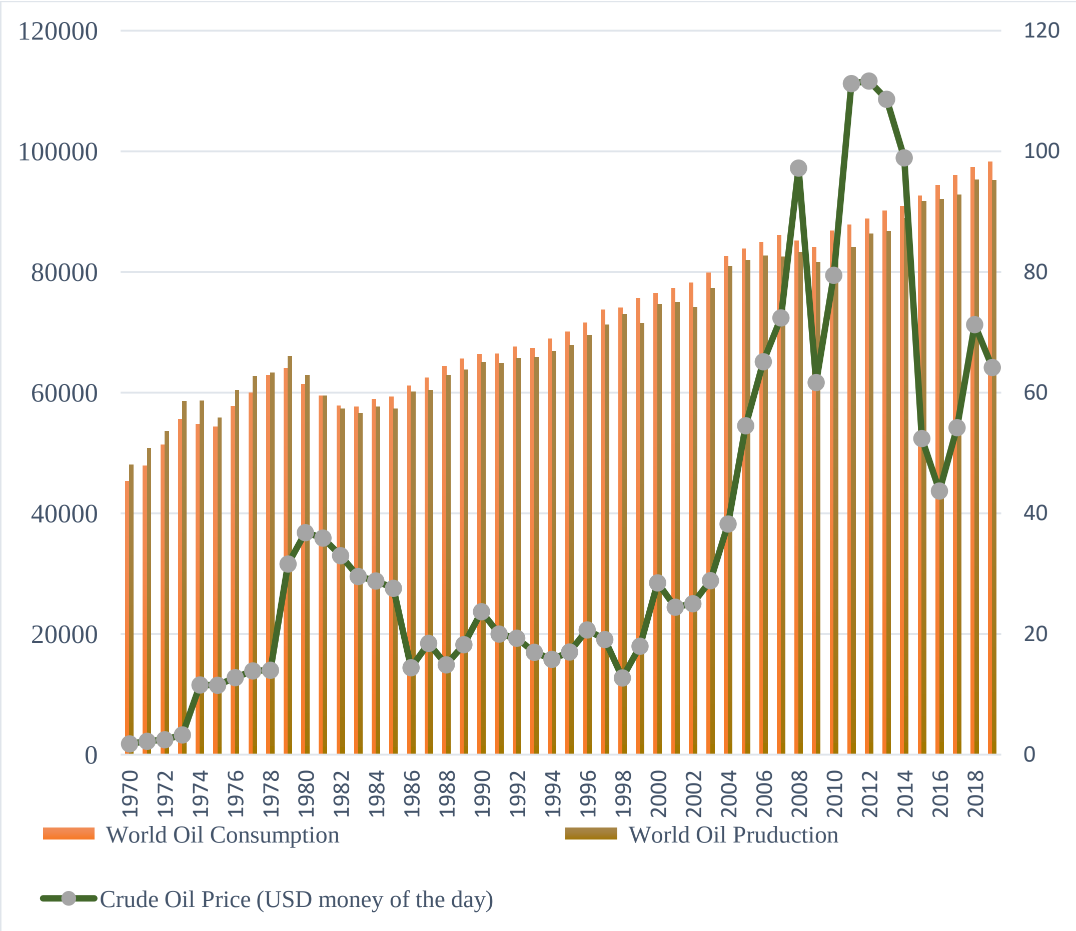
- *predicted volatility levels of rates of changes crude oil prices derived in Section* 2.3.2.1,

[5]The real GDP growth rate statistics for the Union of Soviet Socialist Republics and Former Yugoslav Republics are taken from the United Nations Database.

- *institutional quality levels obtained from Kuncic (2014) World Institutional Quality Rankings and International Country Risk Guide* (*ICRG*) *Political Risk Scores analyzed in Section* 2.3.2.2.

2.3.2.1. World Oil Prices and Estimations Oil Rate of Return Volatilities with GARCH Models

Oil is the most widely used energy source, with a share of approximately 33 percent in global primary energy consumption. Although the alternative sources' shares in consumption are increasing, it is estimated that oil will remain the most consumed energy source in the coming years. Oil consumption has had an increasing trend over the years since most economic activities are dependent on oil. As can be seen from Figure 2.5, while daily world crude oil consumption was approximately 61.2 million barrels in 1980, it increased to about 97.3 million barrels in 2018. The amount of world oil production has also increased over the years. In 2018, it reached approximately 95.2 million barrels per day. The critical part of world oil production is being controlled by the Organization of Petroleum Exporting Countries (OPEC). Although the primary determinant of oil prices is the supply-demand balance, the oil market supply-demand mechanism differs from other markets due to the reasons such as limited reserve of oil, the global economy's dependence on oil, and the market power of OPEC. The magnitude of oil prices' impacts on the economies generally depends on the country's dependence on oil. Fluctuations in oil price affect various macroeconomic variables such as the general price level, national income, balance of payments and employment in oil-importing countries. The most important effect of this fluctuation on the oil-exporting countries is on the national income through export revenues.



Source: BP Statistical Review of World Energy, 2018.

Figure 2.5: World Oil Production and Consumption (Thousand Barrels Daily)

Crude oil is one of the most traded commodities between countries since it is the main raw material of petroleum products used in many industries and transportation sectors. The crude oil price has an essential role in the commerce market and international trade; therefore, it significantly affects the world economy. On the other side, crude oil markets are exposed to many shocks and hence are highly volatile.

The crude oil demand has a very low short-run price elasticity. In the literature, various studies calculate this elasticity. Martinez et al. (2018) conducted research using a meta-analysis technique and collecting estimates from 75 studies published from 2000 to 2015. They found that short-run oil price elasticity values vary between -0.07 and -0.14 depending on selected price variables. In another study, Krichene (2005) calculated short-run demand price elasticity as -0.05 for the period 1918-1973 and -0.003 for the 1974-2004. These findings confirm that a large oil price change has only a slight effect on the quantity of oil demand. The main reasons are that energy-using capital stock cannot be changed in the short run, and also, there is no close substitute for crude oil.

Crude oil supply is also highly inelastic in the short run. It is determined by sales contract and existing production capacity, which cannot be changed easily in the short run. Also, the pumping cost of a marginal oil barrel is low after the capital expenses for exploration and building an oil rig are met. The oil field will continue to be operated nearly at the same cost regardless of whether it produces half capacity or full capacity. Since crude oil producers generally tend to produce at their maximum capacity, an oil price increase results in a slight rise in existing short run crude oil production. The short-run price elasticity is also low for the crude oil supply. In their study, Dario et al. (2018) calculated mean values for short-run supply price elasticity as 0.10 using recently published six papers' estimation results. Krichene (2005) also found low short-run supply price elasticity, which is -0.01 in 1918-73 and -0.05 in 1973-2004. The author states that the negative sign of elasticity could be for two reasons. First, recognizing short-run demand inflexible nature, the producer can make a temporary discount when crude oil demand is sluggish. Second, the oil industry could work on a downward short-run supply curve, taking economies of scale advantage.

In the long run, crude oil demand and supply are elastic contrary to the short run. High oil prices can encourage oil-importing countries to reduce their consumption by applying energy-saving policies or shift to other energy forms such as renewable energy. Similarly, investment in developing technologies and increasing oil exploration activities can result in larger oil quantities coming onto the market. In their studies, Martinez et al. (2018) found that the long-run price elasticity of crude oil demand ranges from -0.26 to -0.83 based on selected price variables. In another study, Krichene (2005) calculated price elasticity of crude oil supply in the long run as 0.46 in 1918-1973 and 0.25 in 1974-2004.

Overall, both demand and supply price inelasticity impact crude oil equilibrium prices and explain these prices' volatility. Concerning the price inelasticity of the oil demand in the short-run, a fall in oil supply can result in a high short-run rise in oil price. Similarly, an increase in oil supply can cause a high short-run reduction in oil price. For the price inelasticity of the oil supply in the short run, a fall in oil demand would entail a sharp drop in crude oil price. Likewise, a rise in oil demand would cause a high rise in the crude oil price (Krichene, 2005).

To control for countries' vulnerability to fluctuations in oil price, volatility of the rate of oil price change is calculated by using the exponential GARCH (EGARCH) model and monthly data in this study. Oil price data is obtained by taking the average of three (U.K. Brent, Dubai and West Texas Intermediate) oil prices extracted from the IMF's Primary Commodity Price Database. The crude oil rate of return graph in Figure 2.6 indicates the volatility clustering in the various periods, mostly during the global crises. Volatility clustering is characterized by periods with high (small) fluctuations following further high (small) fluctuations. In order to obtain volatility series, the mean model is firstly fitted for the rate of return on crude oil in ARMA (1,1) setting. The choice of the mean model depends on the autocorrelation and partial autocorrelation functions. Then, Engle (1982) ARCH test is applied to investigate the the ARCH effect[6]. The test results[7] show that the homoscedasticity hypothesis is rejected.

[6] ARCH effect means that residuals of mean model are heteroscedastic.

[7] The Obs*R-squared value and probability of Chi-Square (1) are 7.18 and 0.007, respectively. This means that ARCH effect exists in the model.

Let the rate of return on crude oil at time t is r_t. Then the ARMA (1,1) specification for r_t with δ coefficients is:

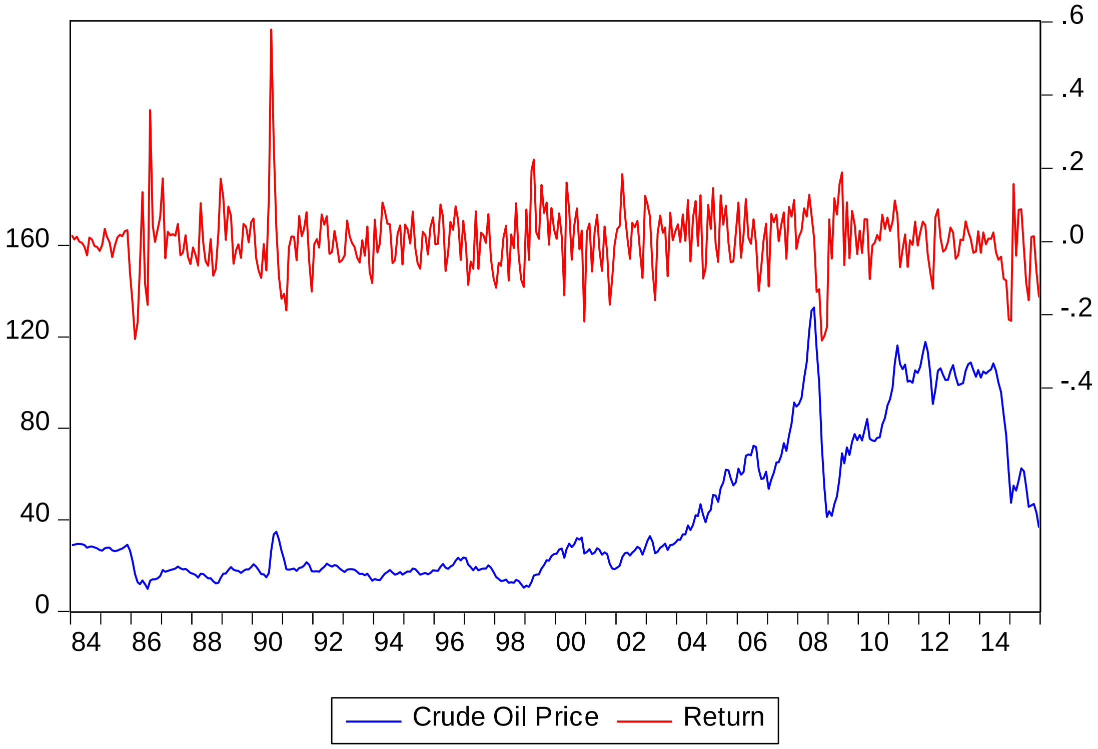
$$\boxed{\begin{aligned} r_t &= E[r_t \mid \Omega_{t-1}] + \xi_t \\ &= \delta_0 + \delta_1 r_{t-1} + \delta_2 \xi_{t-1} + \xi_t \end{aligned}}, \qquad (2.6)$$

given information set at time $t-1$, Ω_{t-1}, $\xi's$ are conditionally heteroscedastic shocks leading to the non-constant and time varying conditional variance $Var[\xi_t \mid \Omega_{t-1}] = \sigma_t^2$. To model such shocks, Engle proposed the autoregressive conditional heteroscedastic (ARCH) model in 1982. Bollerslev (1986) generalized the ARCH model by adding lags of conditional variance, which is called the generalized autoregressive conditional heteroscedastic (GARCH) model. In the literature, researchers use GARCH models to represent volatilities of the rates of returns in financial markets and this study follows this tradition in modelling fluctuations in the crude oil rates of return. We first present the estimates of the mean equation:

$$r_t = -0.004 - 0.099 r_{t-1} + 0.41 \xi_{t-1} + \xi_t, \qquad (2.7)$$

$$(0.003) \quad (0.063) \quad (0.140)$$

where the values in parenthesis represent the standard deviations of the coefficients, and coefficients of r_{t-1} and ξ_{t-1} are statistically significant.



Source: Crude oil prices are obtained from IMF's Primary Commodity Price Database.

Figure 2.6: Crude Oil Prices and Rates of Return on Crude Oil

In modelling volatility of r_t, we use the EGARCH (exponential generalized autoregressive conditional heteroscedastic) model introduced by Nelson (1991) to take into account the leverage and asymmetric effects present in most of the financial rates of return data. Specifically, the time varying conditional variance $Var[\xi_t \mid \Omega_{t-1}] = \sigma_t^2$ of the shocks to the oil rates of return $\xi_t = r_t - E[r_t \mid \Omega_{t-1}]$ are estimated using ARMA(1,1)-EGARCH(1,1) model.

$$\ln(\sigma_t^2) = \gamma_0 + \gamma_1 \left(\frac{\xi_{t-1}}{\sqrt{\sigma_{t-1}^2}} \right) + \eta_1 \left| \frac{\xi_{t-1}}{\sqrt{\sigma_{t-1}^2}} \right| + \theta_1 \ln(\sigma_{t-1}^2), \tag{2.8}$$

where the standardized shocks are independently and identically distributed with constant variance $[\xi_t / \sigma_t] \sim iid(0, \omega)$. The stability condition requires $|\theta_1| < 1$. When $\gamma_1 > 0$, positive shocks enhance volatility but negative shocks reduce volatility. However, when $\gamma_1 < 0$ positive shocks lead to less volatility than negative shocks. This is called the leverage effect. Whenever $\gamma_1 \neq 0$, negative and positive shocks have asymmetric effects on conditional volatility. Only when $\gamma_1 = 0$, both positive and negative shocks have symmetric effects. As the desired feature, EGARCH models also do not require positivity constraints associated with their coefficients.

The estimation results for conditional variance are found as,

$$\ln(\sigma_t^2) = -0.75 + (-0.14)\left(\frac{\xi_{t-1}}{\sqrt{\sigma_{t-1}^2}}\right) + (0.50)\left|\frac{\xi_{t-1}}{\sqrt{\sigma_{t-1}^2}}\right| + (0.92)\ln(\sigma_{t-1}^2), \tag{2.9}$$

(0.15) (0.05) (0.05) (0.02)

where the values in parentheses denote the values of the standard deviations of the coefficients. According to t-tests, all the coefficients are highly significant. Since γ_1 is smaller than zero, a negative shock has a larger effect on the volatility of crude oil rates of returns than a positive shocks. Finally, the conditional variances estimated from the EGARCH model[8] are used to proxy volatility. Figure 2.7 presents volatility series with the U.S. recession band[9].

[8] TGARCH model is also estimated; however, EGARCH is chosen as the most proper model with respect to the Akaike information criterion and the Schwarz information criterion.

[9] It shows U.S. recessions that National Bureau of Economic Research (NBER) reported.

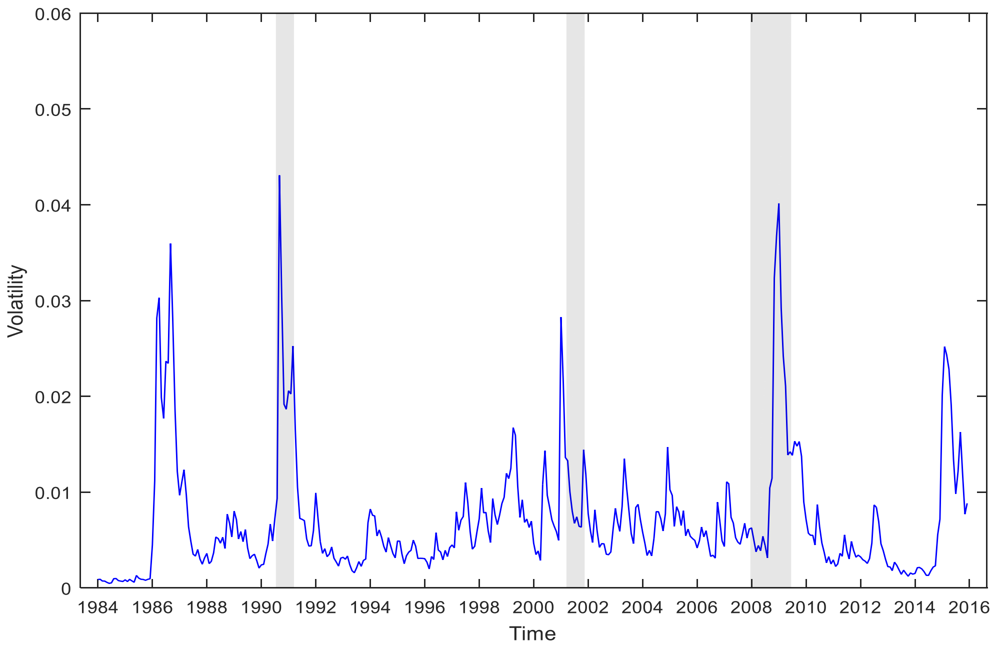


Figure 2.7: ARMA(1,1)-EGARCH(1,1) Model's Volatility Predictions for Rates of Returns of Crude Oil

Besides taking into account the leverage and asymmetric effects, the ARMA (1,1)-EGARCH(1,1) model captures well all the important fluctuations in crude oil rates of returns. In Figure 2.7, it is seen that the predicted volatility levels are clearly very high in some periods such as the 1986 oil price shock, the Iraqi invasion of Kuwait in 1990, the September 11 Attacks in 2001, the 2008 global financial crisis, and the 2014 oil price shock due to the excess oil supply. Also, the extremely high volatility periods, experienced during the global financial crisis in 2008 and the Iraqi intervention in Kuwait in 1990, coincide with the conditional volatility model’s periods characterized with extremely high volatility predictions. Hence, integrating the predicted volatilities of the rates of changes in crude oil price as a time changing variable into the empirical analyses is expected to offer a new dimension in understanding procyclicality of oil producing countries' fiscal policies. It is worthwhile to investigate how a highly volatile environment characterized by explosive fluctuations in rates of changes in prices affect fiscal policy's cyclicality qualitatively and quantitatively.

2.3.2.2. Institutional Quality

In the present chapter, the effect of institutional quality is studied by dividing the whole sample into subsamples. Subsamples are obtained using machine learning clustering methods based on the information provided from institutional quality data sets. Since the countries in the study's sample are not homogenous owing to variation in their institutional and political structure, the effects of institutional quality and oil funds on fiscal policy's procyclicality are likely different.

Kuncic (2014) World Institutional Quality Ranking dataset is used to determine the institutional quality (INQ) level of countries. This data set contains 197 countries over the period of 1990-2010. Kuncic computes the latent INQ in three categories that are economic, legal, and political INQ by using factor analysis. However, only score of economic and political dimensions are used in our clustering analysis due to the data availability.

In clustering algorithms, the aim is to group the data points with certain similarities. Therefore, it is necessary to set some features to create the groups. Although there are different feature selection algorithms used in the literature, there is no definite information about which one is the best (Browniee, 2020). In this study, k-means and agglomerative hierarchical unsupervised learning algorithms are used for clustering (Kuhn and Johnson, 2013).

In the k-means algorithm, it is necessary to set a number k, which shows the centroids' number. A centroid can be defined as an imaginary or real location referring to the cluster's center. Every data point is assigned to the clusters by decreasing the in-cluster sum of squares. It means that the k-means algorithm allocates data points to the cluster nearest to it while trying to keep the centroids as small as possible. There are two widely used ways to set the clusters' number for the k-means model. The elbow method is one of them. Under this method, the sum of the square of each data point distance from the cluster's centroid is calculated. This statistic is called Within Clusters Sum of Square (WCSS). The formula of the WCSS statistic is specified as below,

$$WCSS(k) = \sum_{j=1}^{k} \sum_{x_i \in cluster j} [\![x_i - \overline{x_j}]\!]^2 , \tag{2.10}$$

where $\bar{x}_j$ is sample mean in cluster j.

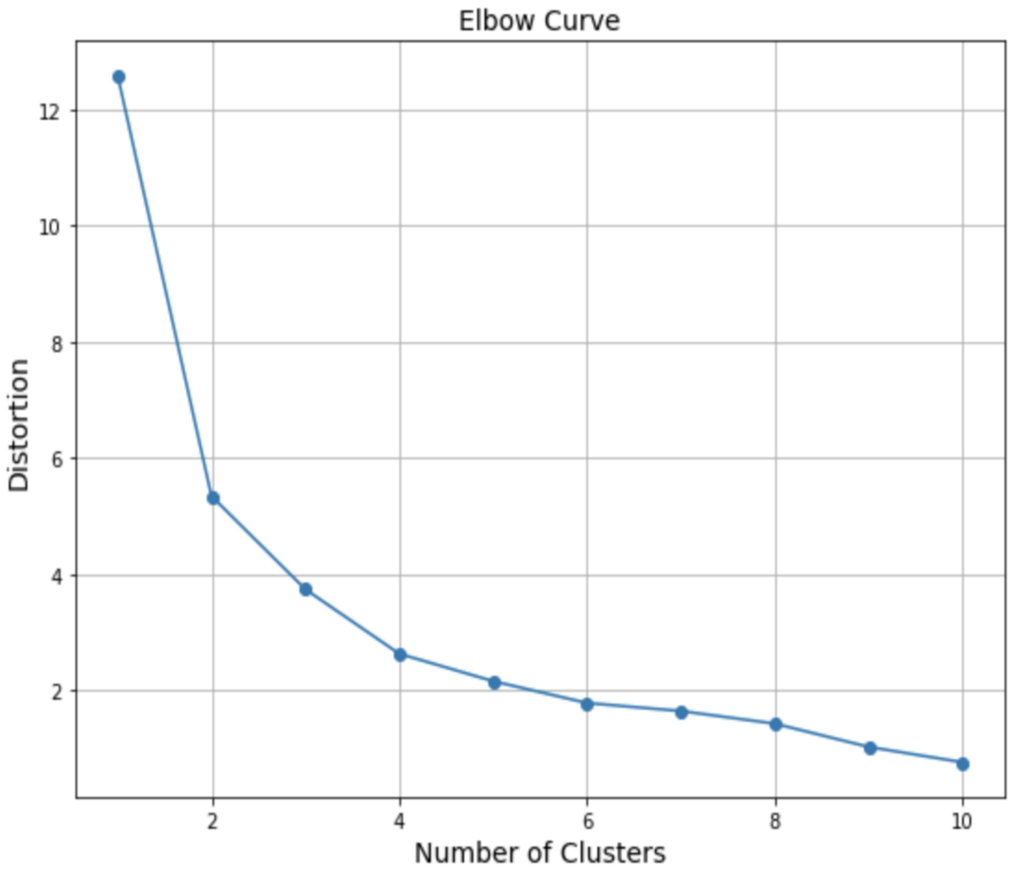


Figure 2.8: Elbow Curve

The WCSS statistic is also called distortion. An elbow curve is provided in the previous page. This graph is called the elbow curve, owing to its shape. In the literature, an optimal clusters' number is specified where the bending of this curve occurs. In Figure 2.8, there are two significant breakpoints. As shown in Figure 2.8, the distortion statistics decrease rapidly until the 2 clusters point. Then, the drop in this statistic is getting slower; however, the distortion falls slightly at 5 clusters point again. Finally, after that point, the elbow curve becomes flatter. Hence, we can decide that our clusters' number is optimal at number 2.

Since the elbow curve analysis is descriptive, it may lead to uncertainty in setting the clusters' number. Hence, the silhouette statistic, which ranges between +1 and -1, is suggested by Kaufman and Rousseeuw (2009) to clarify this uncertainty. This statistic indicates how well data points fit in each cluster. If the statistics are close to +1, it shows that this cluster's data is far away from neighboring clusters. Contrary to this, if the statistic is close to -1, data is more appropriate for neighboring clusters than its own cluster. As a result of this, it is expected that the statistic should be close to +1 to set proper clusters' numbers. The silhouette graph represented for the k-means algorithm is displayed for 2 clusters. Figure 2.9 shows that the silhouette statistic is nearly +1 for each cluster. Therefore, two can be true clusters' number concerning silhouette statistics.

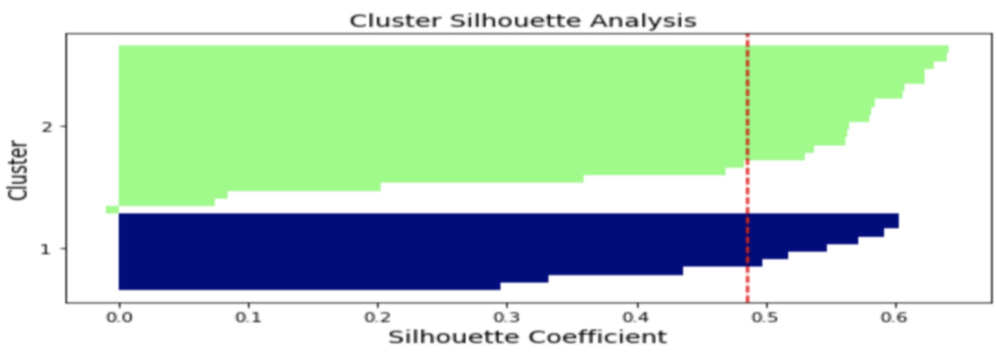


Figure 2.9: Silhouette Coefficients for Each Cluster

The histogram in Figure 2.10 indicates how many countries are chosen for each cluster by the k-means algorithm. As can be easily seen in the histogram below, most countries are assigned to only one cluster.

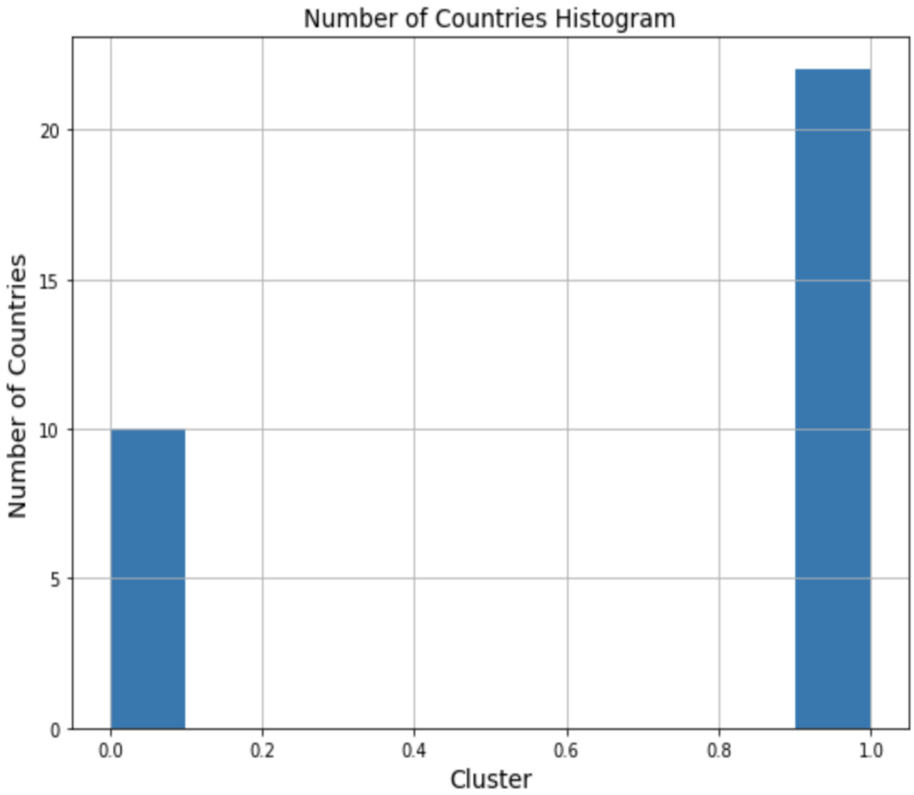


Figure 2.10: Number of Countries for Each Cluster

In this study, so as to confirm the result obtained from the k-means method, it is also used the agglomerative hierarchical clustering algorithm. The hierarchical clustering algorithm has two types: agglomerative clustering (piece-to-whole) and divisive clustering (whole-to-piece) (Johnson, 1967).

In the agglomerative method, at first, each observation is assigned to its own cluster. Then, similarity such as distance between the clusters is calculated, and the two closest clusters are combined (Figure 2.11). Finally, steps 2 and 3 are repeated until a single cluster is left. The related algorithm process is shown below. According to the agglomerative clustering algorithm results, countries that fall into each cluster are the same as the countries in the k-means algorithm; therefore, both methods confirm each other.

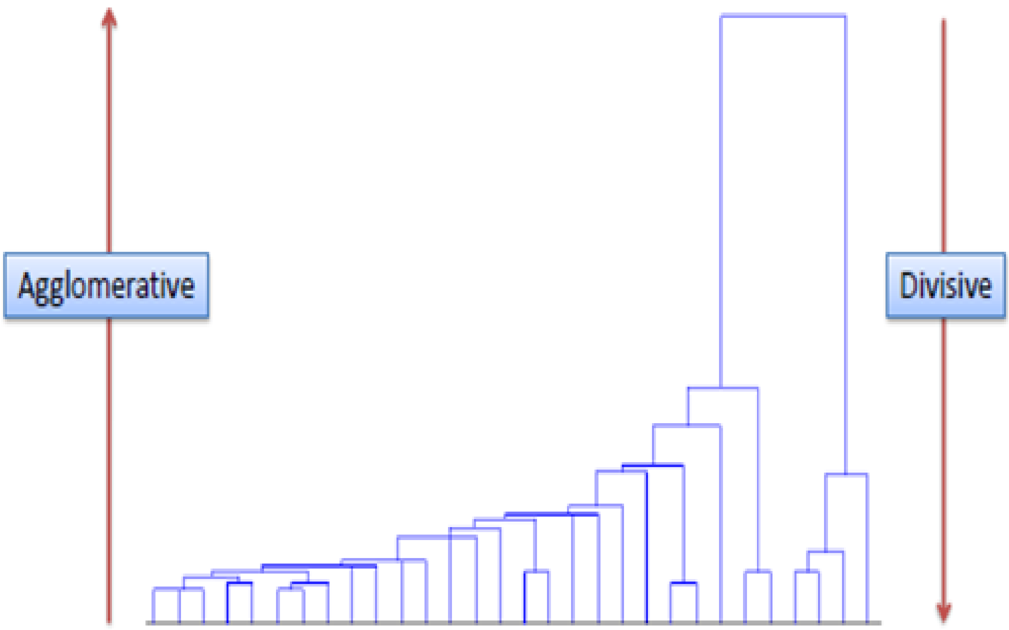


Figure 2.11: Hierarchical Clustering

Table 2.3 presents countries for both clusters and their average (1990-2010) institutional quality scores based on Kuncic (2014) data set.

Table 2.3 Classification of the Selected Resource Rich Countries According to Kuncic (2014) Institutional Quality Scores

High Institutional Quality	
Norway	0.802
Trinidad and Tobago	0.642
Brunei	0.580
Mexico	0.560
Bahrain	0.559
United Arab Emirates	0.546
Oman	0.541
Kuwait	0.548
Ecuador	0.517
Papua New Guinea	0.500

Low Institutional Quality	
Venezuela	0.460
Colombia	0.454
Qatar	0.455
Indonesia	0.443
Saudi Arabia	0.418
Russian Federation	0.404
Yemen	0.399
Gabon	0.393
Kazakhstan	0.367
Iran, Islamic Rep.	0.367
Nigeria	0.357
Cote d'lvoire	0.356
Cameroon	0.349
Vietnam	0.346
Algeria	0.335
Azerbaijan	0.328
Congo, Rep.	0.313
Angola	0.310
Libya	0.291
Syrian Arab Rep.	0.273
Sudan	0.220
Chad	0.217

Source: 1990–2010 average of economic and political institutions, Kuncic (2014).

Notes: Institutional quality scores that are in the parenthesis range from 0 to 1; higher scores show better institutional quality. Due to the lack of data, the 1993-2010 average is presented for Azerbaijan and Kazakhstan.

Besides this, institutional quality is also checked using ICRG data on political risk and its 12 sub measures such as democratic accountability, bureaucratic quality and law and order for full sample, high and low institutional quality groups[10]. Table 2.4 shows countries for both clusters and their average (1984-2015) political risk scores based on the ICRG data set.

[10] Chad is excluded from the sample due to the lack of ICRG data.

Table 2.4: Classification of the Selected Resource Rich Countries According to ICRG Political Risk Scores

High Institutional Quality	
Norway	87.2
Brunei	79.1
Oman	69.9
Mexico	67.7
United Arab Emirates	67.0
Trinidad and Tobago	66.6
Kuwait	65.0
Bahrain	64.9
Ecuador	57.5
Papua New Guinea	59.0

Low Institutional Quality	
Kazakhstan	70.0
Qatar	67.0
Saudi Arabia	63.0
Azerbaijan	61.7
Vietnam	61.0
Gabon	60.1
Russian Federation	59.0
Yemen	57.9
Venezuela	57.7
Colombia	56.8
Libya	56.0
Syrian Arab Rep.	55.0
Cote d’lvoire	54.9
Cameroon	54.5
Algeria	54.4
Iran, Islamic Rep.	53.0
Indonesia	53.0
Congo,Rep.	53.0
Angola	50.0
Nigeria	45.0
Sudan	33.0

Global Median: 63.2

Source: ICRG, 1984–2015 average of 12 political risk components.

Notes: Political risk scores that are in the parenthesis range from 0 to 100; higher scores shows lower risk.

2.4. Estimation Results

2.4.1. Empirical Analyses of Procyclicality

Prior to estimation, summary statistics of variables are listed in Table 2.5. Then, the series are explored with respect to the panel data properties. First, the CD of the data is checked. Furthermore, the stationarity of the series is tested depending on the outcome of the CD test.

Table 2.5: Summary Statistics

Variable	OBS	Mean	Std. Dev.	Min	Max
Growth of Real GDP	976	0.037	0.065	-0.410	0.828
Growth of Real Government Expenditures	943	0.045	0.157	-0.516	0.734
Oil Rent to GDP	975	0.164	0.140	0.000	0.624
Volatility of Rates of Changes in Crude Oil Prices	1024	0.006	0.004	0.000	0.018
External Shock	990	0.013	0.010	-0.022	0.068

The CD test developed by Pesaran (2004) is applied to the data to test cross-section dependence, which uses the correlation coefficients between the time series for each country. Given cross section unit $i \in \{1,\ldots,N\}$ and time $t \in \{1,\ldots,T\}$, the Pesaran CD test statistic for a balanced panel is as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{i,j}\right) \qquad (2.11)$$

where $\hat{\rho}_{i,j}$ is the estimated correlation between time series from country i to j, $i \neq j$, such that the population correlation is $\rho_{i,j} = Cov(u_{i,t}, u_{j,t}) / \sqrt{Var(u_{i,t})Var(u_{j,t})}$ and $u_{i,t}$ is as in (2.1). Under the null hypothesis of no cross sectional dependence, CD is asymptotically standard normally distributed when T is large enough and N goes to infinity. In the case of unbalanced panel, the CD statistic is modified as can be seen in Pesaran (2004).

The results of the CD test are given in Table 2.6. The cross-section independence null hypothesis is rejected at the 1 percent level for all variables; hence, CD is found for all of the variables below.

Table 2.6: CD Test Results

	CD Test
Growth of Real GDP	10.635***
Growth of Real Government Expenditures	10.020***
Oil Rent to GDP	60.462***
External Shock	64.257***

***, **, * denote significance level at the 1%, 5% and 10% respectively.

A variable is stationary (does not have unit root) if its variance and mean do not change systematically over time. The estimators' distributions and test statistics associated with stationary variables may differ from those non-stationary ones. Besides, using standard regression techniques with nonstationary variables can give misleading results (Davidson and MacKinnon, 2003). It is hence crucial to check whether variables have unit roots. In the existence of CD, using some common unit root tests can give spurious results; therefore, Pesaran (2007) second-generation unit root test is employed here beside Maddala and Wu (1999) test for panel unit roots. Pesaran (2007) unit root test allows for heterogeneity in the Dickey Fuller regression's autoregressive coefficient and single unobserved common factors with heterogeneous factor loadings in data. Hence, it takes into account CD (Benos and Karagiannis, 2013). According to both test results in Table 2.7, the unit root null hypothesis is rejected at the 1 percent level for all series.

Table 2.7: Panel Unit Root Test Results

Variable	Madalla and Wu Test	Pesaran (CIPS) Test
Growth of Real GDP	446.270***	-12.466***
Growth of Real Gov. Exp.	765.910***	-18.916***
Oil Rent to GDP	157.970***	-2.841***
External Shock	482.107***	-7.692***
Volatility of Rates of Changes in Crude Oil Prices	476.444***	-

***, **, * indicate significance level at the 1%, 5% and 10% respectively.

Firstly, the degree of fiscal policy procyclicality is checked by using usual OLS estimation techniques (fixed and random effects model) and the one-step system GMM approach. For each specification, three sets of estimations are run. In all these regressions, real government expenditure growth is used as a dependent variable, whereas oil dummy and growth of real GDP are entered into the equations as independent variables. Besides these variables, the ratio of oil rents to GDP and volatility of rates of changes in crude oil prices are included in the second and third set of estimations for controlling oil dependency. To overcome the endogeneity problem, the first and second lags of endogenous variables (real GDP growth and lagged growth of real government expenditure) and contemporaneous and lagged values of external shocks are used to create an instrument set.

Table 2.8: OLS Estimates Results

Independent Variables	Dependent Variable: Growth of Real Government Expenditures								
	(1) Fe	(2) Re	(3) System GMM (One Step)	(4) Fe	(5) Re	(6) System GMM (One Step)	(7) Fe	(8) Re	(9) System GMM (One Step)
Growth of Real GDP	0.903*** (0.138)	0.939*** (0.135)	0.780*** (0.154)	0.889*** (0.142)	0.941*** (0.138)	0.790*** (0.152)	0.892*** (0.141)	0.947*** (0.137)	0.794*** (0.153)
L.Growth Rate of Real Gov. Exp.	-0.019 (0.033)	0.009 (0.032)	0.013 (0.050)	-0.020 (0.033)	0.004 (0.032)	0.0144 (0.048)	-0.030 (0.032)	-0.007 (0.032)	0.000 (0.048)
Fund Dummy*Growth of Real GDP	-0.870*** (0.171)	-0.814*** (0.165)	-0.656** (0.318)	-0.889*** (0.174)	-0.845*** (0.168)	-0.697** (0.305)	-0.847*** (0.172)	-0.807*** (0.167)	-0.656** (0.303)
Fund Dummy	0.058*** (0.015)	0.038*** (0.011)	0.033** (0.015)	0.051*** (0.015)	0.035*** (0.014)	0.029** (0.014)	0.044*** (0.015)	0.030** (0.012)	0.024* (0.013)
Oil Rent to GDP				0.176** (0.069)	0.089** (0.036)	0.091** (0.035)	0.218*** (0.069)	0.101*** (0.036)	0.103*** (0.035)
Volatility Rates of Change in Crude Oil Price							5.73*** (1.260)	5.65 *** (1.255)	5.625*** (1.371)
Constant	0.003 (0.009)	0.009 (0.008)	0.014 (0.010)	-0.021 (0.014)	-0.002 (0.010)	0.002 (0.008)	-0.065 (0.017)	-0.019 (0.024)	-0.037*** (0.012)

***, **, * indicate significance level at the 1%, 5% and 10% respectively.

Table 2.8: (Cont'd) OLS Estimates Results

	Dependent Variable: Growth of Real Government Expenditures								
Independent Variables	(1) Fe	(2) Re	(3) System GMM (One Step)	(4) Fe	(5) Re	(6) System GMM (One Step)	(7) Fe	(8) Re	(9) System GMM (One Step)
Observations	908	908	908	898	898	898	898	898	898
Number of Countries	32	32	32	32	32	32	32	32	32
CD test	7.598***	7.920***	55.120***	7.938***	7.938***	8.000***	6.192***	6.156***	6.256***
AR(1) test-p			0.000			0.000			0.000
AR(2) test-p			0.342			0.307			0.209
Hansen test-p			1.000			1.000			1.000

***, **, * indicate significance level at the 1%, 5% and 10% respectively.

Table 2.8 shows the first set of estimation results. Using One-Step System GMM, random effects and fixed effects estimators, it is found that fiscal policy is, on average, highly procyclical in a panel of 32 oil-rich economies. The coefficients range from 0.780 to 0.947 and are statistically significant in these three specifications. The results also illustrate that the oil dummy and growth of real GDP interaction terms are statistically significant and negative, which means that real government expenditure increases less with GDP rise in these countries where there are oil funds. In other words, fiscal policy is less procyclical with oil funds. Surprisingly, the oil dummy coefficient is positive and statistically significant, indicating that the growth of real government expenditure is higher on average in oil-rich economies having an oil fund. The oppositeness between signs of oil dummy and interaction term coefficients suggests that a large portion of oil revenues that enhanced GDP saved in the oil funds without being used directly in expenditures. The oil revenues accumulated in these funds can be used in government expenditures after being evaluated with different investment instruments. In other words, oil funds contribute to the prevention of fiscal policy procyclicality while improving government expenditures.

Regarding the CD tests statistics in Table 2.8 generated from residuals of all sets of estimations, the null hypothesis is rejected, thereby confirming cross-section dependency in all models. In this case, using these models can lead to serious econometric problems. Therefore, Chudik and Pesaran (2015) DCCE approach with GMM/2SLS is used, including the same instrumental variables as in one step system GMM estimations to obtain more unbiased and robust results. Table 2.9 shows DCCE regressions' results. The DCCE estimations also affirm that fiscal policy is highly procyclical on average in those economies and coefficients of GDP growth is higher (around 1.195-1.685) compared to results in Table 2.8. Also, interaction terms' coefficients are negative and statistically significant (except column for 6 where p-value is 0.11), suggesting that procyclicality degree decreases with oil funds. However, the coefficient on the interaction term is higher and less significant when compared to previous results. Once again, the oil fund dummy's coefficient is positive, indicating that countries with oil funds have higher real expenditure growth on average. With respect to the CD test results in Table 2.9, the null hypothesis cannot be rejected, illustrating that cross-section independence; therefore, DCCE estimations provide more unbiased and robust results compared to previous estimations in Table 2.8.

Table 2.9: CCEM Estimates Results

Dependent Variable: Growth of Real Government Expenditures						
Independent Variables	(1) CCEM/ 2SLS	(2) CCEM / GMM	(3) CCEM/ 2SLS	(4) CCEM/ GMM	(5) CCEM/ 2SLS	(6) CCEM/ GMM
Growth of Real GDP	1.382*** (0.530)	1.195** (0.565)	1.654*** (0.617)	1.585** (0.634)	1.572** (0.673)	1.635* (0.897)
L.Growth rate of Real Gov. Exp.	-0.045 (0.070)	-0.031 (0.072)	-0.088 (0.071)	-0.076 (0.073)	-0.121* (0.073)	-0.107 (0.078)
Fund Dummy*Growth of Real GDP	-0.987* (0.515)	-0.884* (0.546)	-1.340** (0.628)	-1.375** (0.651)	-1.297* (0.789)	-1.419 (0.926)
Fund Dummy	0.053* (0.085)	0.054* (0.033)	0.093*** (0.032)	0.096*** (0.037)	0.099*** (0.020)	0.114** (0.049)
Oil Rent to GDP			0.693* (0.374)	0.706* (0.384)	0.800* (0.487)	0.945* (0.576)
Volatility Rates of Change in Crude Oil Price					2.631* (1.466)	2.800* (1.630)
Constant	0.012 (0.037)	0.014 (0.039)	0.017 (0.045)	0.022 (0.049)	0.012 (0.065)	0.009 (0.078)
Observations	839	839	831	831	831	831
Number of Countries	32	32	32	32	32	32
CD test	-1.585	-1.743	-1.400	-1.447	-1.699	-1.611

***, **, * denote significance level at the 1%, 5% and 10% respectively.

2.4.2. Institutional Quality Effect

Besides full sample estimations, the effect of institutional quality is studied by dividing the whole country sample into subsamples. Subgroups are obtained using machine learning clustering methods based on the information provided from Kuncic (2014) World Institutional Quality Ranking dataset.

Table 2.10: Estimation Results with the Inclusion of INQ

Dependent Variable: Growth of Real Government Expenditures				
	High Quality		**Low Quality**	
Independent Variables	(1) CCEM/2SLS	(2) CCEM/GMM	(3) CCEM/2SLS	(4) CCEM/GMM
Growth of Real GDP	1.067 (0.762)	0.722 (0.602)	1.644^{***} (0.600)	1.700^{***} (0.534)
L.Growth rate of Real Gov. Exp.	-0.048 (0.081)	-0.032 (0.083)	-0.055 (0.093)	-0.054 (0.089)
Fund Dummy*Growth of Real GDP	-1.396^{*} (0.795)	-1.111^{*} (0.616)	-0.766 (0.566)	-0.875 (0.517)
Fund Dummy	-0.004 (0.022)	-0.002 (0.022)	0.070^{*} (0.036)	0.076^{**} (0.034)
Oil Rent to GDP	1.197^{**} (0.581)	1.165^{**} (0.523)	0.337 (0.732)	0.295 (0.755)
Volatility Rates of Change in Crude Oil Price	0.991 (3.022)	0.823 (3.023)	2.773^{*} (1.725)	2.611^{*} (1.533)
Constant	0.025 (0.0771)	0.032 (0.072)	-0.044 (0.061)	-0.048 (0.061)
Observations	272	272	559	559
Number of Countries	10	10	22	22
CD test	-1.578	-1.829	-1.443	-1.579

***, **, * denote significance level at the 1%, 5% and 10% respectively.

Since the countries in the study's sample are not homogenous owing to variation in their institutional and political structure, the effects of institutional quality and oil funds on fiscal policy's procyclicality are likely different. To examine effect of institutional quality, two regressions are run by using CCE with 2SLS and GMM. The rationale is to check whether the procyclicality shows a change when the degree of institutional quality is controlled among the country groups. Estimation results are summarized in Table 2.10. Coefficients of GDP growth and fund dummy are positive and significant, while the interaction term's coefficient is insignificant and negative for the low INQ country group. However, only the coefficient of the interaction term is significant and negative for the high INQ group. Additionally, low INQ country groups have a higher GDP growth coefficient than the high INQ group, whereas the coefficient on the interaction term for high INQ countries is bigger than that for low INQ countries in absolute terms. Hence, it can be summarized that fiscal policy is more procyclical in low INQ countries when compared to high INQ countries. On the other hand, oil funds are effective only in high INQ economies to reduce procyclicality.

Besides this, institutional quality is also checked using ICRG data on political risk and its 12 sub measures such as democratic accountability, bureaucratic quality, and law and order for full sample, high and low institutional quality groups. The estimation results are presented in Table 2.11. Surprisingly, none of these variables is statistically significant for the full country sample and low INQ country group. Since the low INQ country group forms a large part of the full sample, results for both seem to be similar[11]. On the other hand, the political composite index and its sub-measure, law and order, are statistically significant and negative for the high IQ country group. Higher points of measures in the ICRG dataset show the better outcome. Therefore, the signs of the political composite index and law and order variables suggest that

[11] Most of the political composite index sub-measures are statistically insignificant since they do not show remarkable time and cross-country variation for countries in our sample. Due to the same reason, most of the explanatory variables become insignificant in the inclusion of these sub-political measures to the regression.

better political institutions, that is, lower political risk, are negatively associated with government expenditure.

Table 2.11: Estimation Results for High INQ Countries with the Inclusion of Political Risk

Independent Variables	Dependent Variable: Growth of Real Government Expenditures (1) CCEM/2SLS	(2) CCEM/GMM	(3) CCEM/2SLS	(4) CCEM/GMM
Growth of Real GDP	0.650 (0.890)	0.414 (0.736)	1.713** (0.791)	1.557** (0.741)
L.Growth rate of Real Gov. Exp.	-0.151** (0.066)	-0.134** (0.068)	-0.110 (0.077)	-0.107 (0.076)
Fund Dummy*Growth of Real GDP	-1.028 (0.515)	-0.816 (0.619)	-1.759* (0.961)	-1.599* (0.884)
Fund Dummy	0.011 (0.020)	0.010 (0.019)	0.035* (0.032)	0.030 (0.021)
Oil Rent to GDP	0.028*** (0.006)	0.025*** (0.006)	0.032*** (0.009)	0.030*** (0.010)
Volatility Rates of Change in Crude Oil Price	1.068 (3.273)	0.867 (3.079)	1.490 (3.638)	1.541 (3.519)
Law and Order	-0.026* (0.015)	-0.029** (0.014)		
Political Index			-0.008** (0.004)	-0.009** (0.004)
Constant	-0.227 (0.347)	-0.238 (0.335)	-0.701 (0.472)	-0.637 (0.468)
Observations	272	272	272	272
Number of Countries	10	10	10	10
CD test	-1.566	-1.788*	-1.353	-1.466

***, **, * denote significance level at the 1%, 5% and 10% respectively.

Table 2.12: Estimation Results for Low INQ Countries with the Inclusion of Political Risk

Dependent Variable: Growth of Real Government Expenditures				
Independent Variables	(1) CCEM/2SLS	(2) CCEM/GMM	(3) CCEM/2SLS	(4) CCEM/GMM
Growth of Real GDP	-3.075 (3.035)	-2.712 (2.876)	-4.010 (3.945)	-4.011 (3.960)
L.Growth rate of Real Gov. Exp.	-0.197* (0.120)	-0.191* (0.116)	-0.155 (0.110)	-0.155 (0.111)
Fund Dummy*Growth of Real GDP	2.024 (2.240)	1.873 (2.212)	2.406 (2.729)	2.454 (2.737)
Fund Dummy	-0.016 (0.020)	-0.005 (0.047)	-0.003 (0.043)	-0.008 (0.043)
Oil Rent to GDP	-0.040 (0.717)	-0.118 (0.759)	0.772 (1.664)	0.772 (1.683)
Volatility Rates of Change in Crude Oil Price	1.450 (1.302)	1.093 (1.302)	1.306 (3.148)	1.382 (3.079)
Law and Order	-0.010 (0.044)	-0.011 (0.042)		
Political Index			-0.010 (0.018)	-0.011 (0.019)
Constant	0.821 (0.361)	0.702 (0.333)	0.483 (0.472)	0.508 (0.779)
Observations	527	527	527	527
Number of Countries	21	21	21	21
CD test	-1.662*	-1.773*	-1.019	-0.972

***, **, * denote significance level at the 1%, 5% and 10% respectively.

2.5. Conclusion

Fiscal policy literature suggests that optimal fiscal policy in economies can be either counter-cyclical or acyclical (Ilzetzki and Vègh, 2008). However, oil price volatility causes boom and bust cycles and forces oil-rich countries to implement procyclical fiscal policies. This problem becomes more noticeable in economies where political structure and INQ are weak. In the literature, the suggestion is to establish an oil fund to break the link between government expenditure and volatile oil revenue. These oil funds serve as a tool to compel oil-rich economies to save at the time of high oil prices and use them during the recession, reducing fiscal policy's procyclicality. After the late 1990s, oil funds started to be popular when oil prices were soaring. Nevertheless, the effectiveness of these funds is not apparent. Therefore, it is vital to investigate whether they successfully enforce oil-rich countries to implement less procyclical, cyclical, or counter-cyclical fiscal policies.

There are some challenges in setting a robust relationship between fiscal policy measures and funds, such as cross-sectional dependence, endogeneity, using the proper fiscal policy measure and unobserved heterogeneity. Although there is growing literature on the fiscal policy's cyclicality, few of them pay attention to the effect of the oil funds on the type of cyclicality. This paper analyses the institutional quality and oil funds' effects in mitigating the procyclicality of fiscal policy in 32 oil-exporting economies over the period from 1984 to 2015 using DCCE model, which allows for slope heterogeneity and CD. Besides, some different econometric methods such as system GMM and random-effects (or fixed-effects) are employed to explore whether the results obtained from the main specification hold with different econometric estimation techniques.

The results of usual OLS estimation techniques and one-step system GMM show that fiscal policy is, on average, highly procyclical in a panel of 32 oil-rich economies.

Besides, oil funds have a mitigating effect on fiscal policy's procyclicality while increasing government expenditure on average. These results also suggest that a large portion of oil revenues triggering a GDP rise are transferred to the oil funds without being used directly in expenditures. The accumulated oil revenue in these funds can then be used in government expenditures after being evaluated with different investment instruments. Nevertheless, CD test statistics confirm cross-section dependency in these models, thereby causing serious econometric problems. Hence, Chudik and Pesaran (2015) DCCE approach with GMM/2SLS is applied to get more unbiased and robust results. The DCCE estimation also verified the fiscal policy procyclicality and alleviating effect of oil funds on procyclicality in these countries with higher GDP growth and interaction term's coefficients.

The effect of institutional quality is studied by dividing the whole country sample into two subsamples with respect to information on Kuncic's (2014) World Institutional Quality Ranking data sets. Machine learning methods such as the k-means and agglomerative hierarchical unsupervised learning algorithms are used when classifying the countries. Estimation results using the DCCE approach with GMM/2SLS illustrate that fiscal policy is more procyclical in the low INQ group when compared to high INQ countries. On the other hand, oil funds are effective only in high INQ countries in reducing procyclicality. Also, estimation with the ICRG dataset shows that government expenditure is negatively associated with better political institutions in high INQ while there is no statistically significant relationship between the two variables in low INQ. This finding can result from rent-seeking behavior in low INQ countries, which can sabotage governance and prevent growth-enabling institutions' formation. These findings suggest that an oil fund is an effective policy tool to break away countries from a procyclical fiscal policy and stabilize their economies. Additionally, the results emphasize that institutional quality plays an essential role in implementing the right fiscal policies in conducting volatile oil revenues. Hence, sound fiscal policy should not be replaced by oil funds.

CHAPTER 3

MANAGING RESOURCE WINDFALL ALLOCATION: THE CASE OF REPUBLIC OF AZERBAIJAN

3.1. Introduction

The management of natural resources in resource-rich developing countries is one of the crucial issues that have been argued among policymakers and economists. Despite the potential benefits of natural resource windfalls, managing these windfalls effectively poses severe challenges. Resource-rich developing economies are vulnerable to the *natural resource curse*, fundamentally in the form of inefficient public spending, weak institutions, and poor governance (van der Ploeg, 2011). Also, commodity price and production volatilities create revenue fluctuations and macroeconomic instability, particularly in countries that heavily depend on commodity exports. A large influx of foreign exchange due to resource windfalls could generate a Dutch disease problem, the causal relationship between the contractions in the non-resource traded goods production and the rise in the production of non-traded goods result of real appreciation of the exchange rate. Besides all these, natural resources' exhaustibility creates uncertainty regarding future revenue and makes designing fiscal policy harder.

The conventional advice concerning natural resource management, based on the permanent income hypothesis (PIH), states that natural resource wealth should be saved as financial assets and externally in a natural resource fund (Berg et al., 2012).

According to this advice, the non-resource primary deficit should be limited to resource wealth's perpetuity value to provide fiscal sustainability (Agénor, 2016). However, the relevance of this advice for resource-rich developing economies has been questioned by recent studies since it overlooks that these economies are both credit and capital-constrained. According to these studies (e.g., Takizawa et al. (2004), Venables (2010) and Araujo et al. (2015)), productive government spending can make better off capital scarce and credit constraint economies as an optimal strategy concerning managing resource revenue compared to external saving. Therefore, the main issue is to design more flexible fiscal management rules that let governments allocate adequate resource revenues to meet urgent infrastructure investment, health and education's needs while preserving macroeconomic and fiscal stability (Agénor, 2016).

There are various studies on the management of natural resource revenue in the literature. Some of these studies examine the management of natural resource windfalls in non-stochastic models by using arbitrary allocation rules (Collier et al., 2010; van der Ploeg, 2011 and van der Ploeg and Venables, 2011 and 2013). However, others (Dagher et al., 2012; Richmond et al., 2013 and Berg et al., 2013) investigate resource price shock in stochastic models by focusing on coordination of fiscal and monetary policy to alleviate Dutch disease effects and the impacts of resource revenue allocation for scaling up public investment (Primus, 2016).

Agénor (2016) is the first study to contribute literature on optimal resource revenue allocation using social loss function determined in terms of macroeconomic or fiscal stability and consumption volatility (as a household welfare measure). Agénor developed a model for a resource-rich low-income economy that has insufficient infrastructure. This model incorporates a series of properties, including a direct complementarity effect between private investment and public capital and imperfect access to world capital markets. Also, public capital is subject to congestion and absorption constraints. Dynamic volatility trade-off between saving resource revenue and spending it now is the fundamental point of the Agénor study. This trade-off depends on various factors such as model structure and parameters, the price shock persistence, and the public investment efficiency. According to this dynamic volatility trade-off, a decline in today's spending can reduce volatility for now. However, the more fraction of the revenue is saved, the more interest income earned from the assets in the fund. Hence, rise in the interest income leads to increase spending in time, which raises volatility once again.

Oil has been produced in Azerbaijan's territory since the late nineteenth century. After the breakup of the USSR, oil production in Azerbaijan came to a halt with the economic collapse and the Nagorno-Karabakh war in 1997. Then, Azerbaijan started oil production like a new oil producer by signing the "Contract of Century," including various Production Sharing Agreements, and it established a sovereign wealth fund in 1999. Although deposit rules for sovereign wealth fund are specified, withdrawal rules are unclear, and both types of rules do not take particular issues such as fiscal stability and household welfare into consideration. Additionally, nearly 72 percent of resource revenue inflows to fund have been spent since 2001 (the fund's establishment). Therefore, it is vital for Azerbaijan's policymakers to determine optimal spending and saving of resource revenues. Using a modified version of Agénor's (2016) model, this study aims to investigate macroeconomic effects of energy production and price shocks and to suggest an optimal rule for resource windfalls allocation in the context of Azerbaijan. While Agénor's model examines a hypothetical small low-income country, this study is the first actual developing country application of its model. This research is also the first to assess resource windfalls allocation for savings and consumption in a general equilibrium setting that considers some characteristics of the Azerbaijan's economy.

This research differs from Agénor (2016) in the following ways: the model involves imperfect capital mobility; there is no perfect substitution between tradable and non-tradable products; natural resource products also are consumed domestically;

distribution cost is excluded since completion of pipelines lowers transport of oil and gas in Azerbaijan; there is no complementarity effect between private investment and public capital; the public capital in Azerbaijan is subject to absorption constraint which affects infrastructure spending efficiency. Furthermore, Agénor (2016) assumes that government spending consists of only non-tradable goods, while public investment consists of tradable and non-tradable goods. However, in this study, both government spending and public investment are assumed to consist of tradable and non-tradable goods to be more realistic. Moreover, one of Agénor (2016) assumptions is that there is a positive relationship between a country's risk premium and its ratio of government debt to tradable output ratio. Nevertheless, natural resources are generally seen as a risk by credit rating agencies since they cause a lack of production diversification, increased political risk, and weak institutions in developing countries (van der Ploeg, 2012). Also, van den Bremer and van der Ploeg (2013) state that there is no clear empirical evidence for resource windfall reducing the risk premium on international capital markets. Hence, it is assumed that risk premium is positively related to the ratio of government debt to non-resource output in this study.

The results indicate that if policymaker is equally concerned with fiscal stability and consumption volatility (household welfare), nearly half of the resource revenue should be saved. However, if the policymaker solely focuses on fiscal stability, the optimal value is 0.33, which implies that fiscal policy can contribute to alleviating the effects of price and production shock.

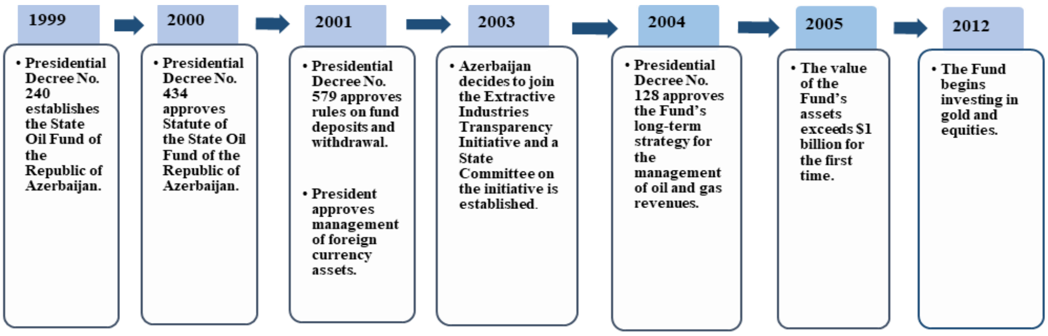
The remainder of this chapter is organized as follows. In the next section, an analysis concerning Azerbaijan's economy and energy sector is presented. In section 3.3, the structure of the model is discussed. In section 3.4, the log-linearized and steady state equations are summarized. In section 3.5, parameterization for the Azerbaijan's economy is presented. In section 3.6, the macroeconomic effects of resource price shock under the two fiscal rules are investigated. In section 3.7, the optimal allocation rule of resource windfalls for the Azerbaijan's economy is discussed. In section 3.8, sensitivity analysis is done. In section 3.9, macroeconomic effects of resource production shock and optimal resource allocation under this shock are examined. In the last section, the key results and their implication for Azerbaijan's economy are outlined.

3.2. Overview of The Azerbaijan's Economy

This section analyses the Azerbaijan's economy and presents a brief overview of the State Oil Fund of the Republic of Azerbaijan (SOFAZ) and characteristics of the Azerbaijan's energy sector.

3.2.1. SOFAZ

The SOFAZ was established by decree of the President in 1999 as a legal entity. President approved statutory regulations of SOFAZ in 2000, and it started to operate as an extra-budgetary fund in 2001. Supervisory Board, comprised of the relevant public and government organizations' representatives, controls fund activities such as accumulation of assets and spending. Executive Director, appointed by President, carries operational management of SOFAZ's activities. As a fund legal representative, Executive Director assures the investment and management of the assets held in SOFAZ with respect to the regulations and rules approved by the President. One of his responsibility is preparing an annual program of SOFAZ on the utilization of its assets and submitting this program to the President of Azerbaijan for approval.



Source: SOFAZ Annual Reports (various years).

Figure 3.1: Timeline of SOFAZ

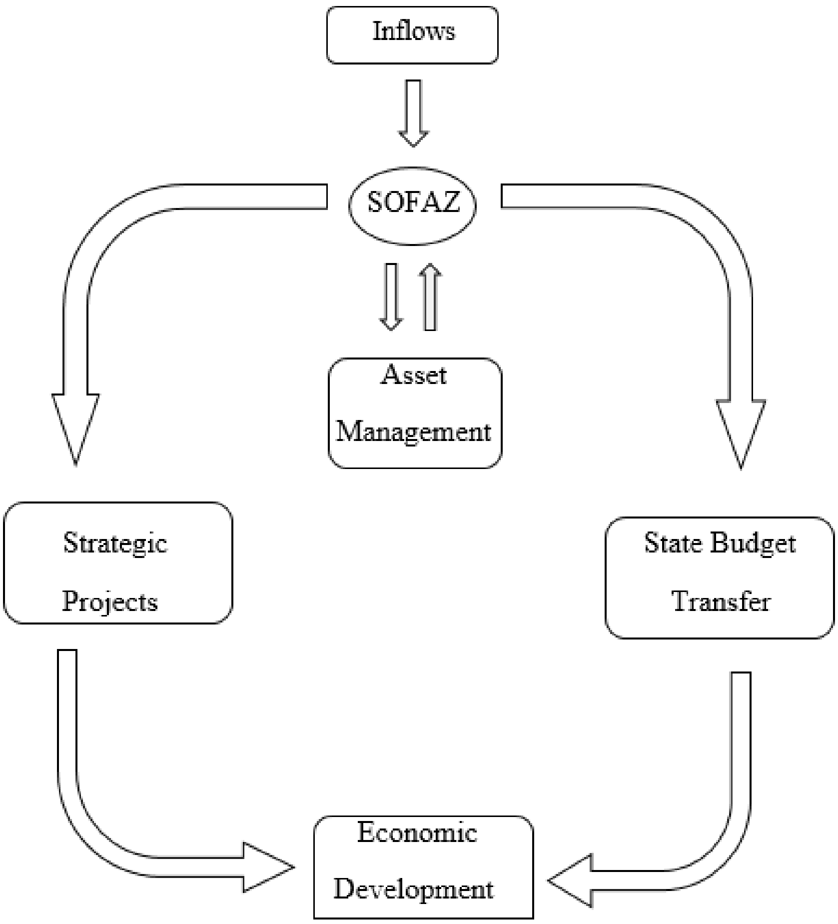


Figure 3.2: Transmission of Resource Windfalls

There are three main objectives of the fund: (1) Sustain macroeconomic stability by reducing the dependence of Azerbaijan on oil income and inducing the non-oil sector development; (2) Save and conserve resource income for future generations; (3) Finance the critical projects to ensure socio-economic development.

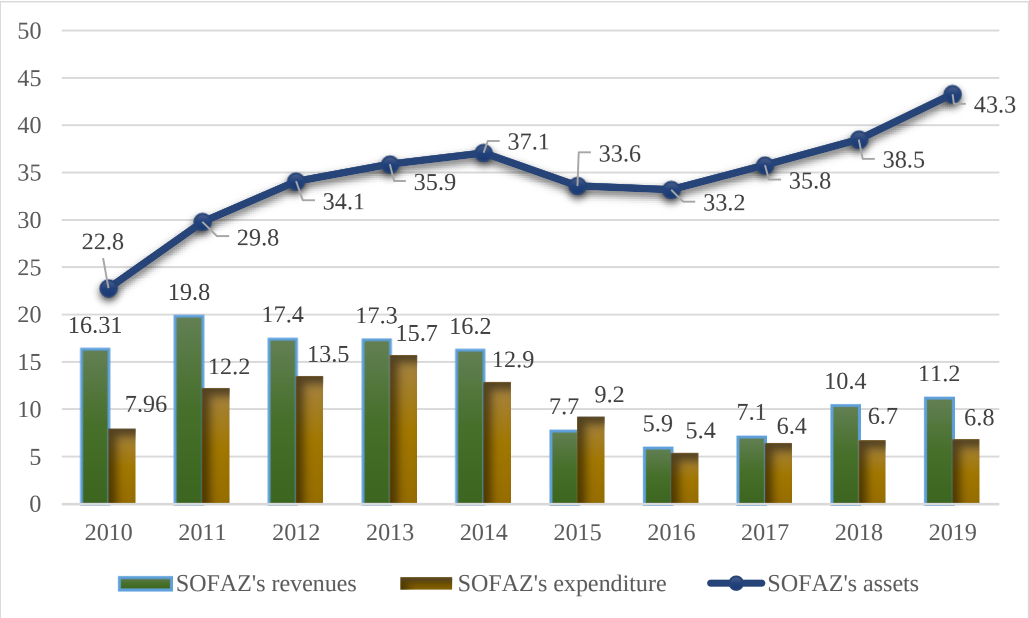
Table 3.1: SOFAZ Revenues and Expenditures (2018, AZN Million)

Indicator	Amount
Revenues	17,614.1
1.Proceeds obtained from the sales of Azerbaijan's hydrocarbons share	16,645.6
2.Bonuses paid by investors when signing and fulfilling oil and gas agreements	765.2
3.Revenues obtained from the management of Fund's assets	181.1
4.Revenues generated from the transit of gas and oil over Azerbaijan's territory	18.1
5.Acreage fees paid by foreign investors for use of the contract areas for the development of hydrocarbon resources	4.1
6.Other Revenues	0.02
Expenditure	11,455.6
1.Transfer to the 2018 state budget	10,959.0
2.The improvement of the socioeconomic conditions of refugees and internally displaced persons	200.0
3.Funding of the new Baku-Tbilisi-Kars Railway construction project	176.1
4.Reconstruction of the Samur-Absheron irrigation system	90.0
5.SOFAZ’s administrative expenses	23.3
6.State Program on the education abroad of the Azerbaijani youth in the years of 2007-2015	7.2

Source: SOFAZ 2018 Annual Report.

Budget revenues of SOFAZ include proceeds obtained from the sales of Azerbaijan's hydrocarbons share, revenues generated from the transit of gas and oil over Azerbaijan's territory, acreage fees, bonus payment, grants, and interest income obtained from Fund's assets (Table 3.1). SOFAZ main expenditures comprise of transfers to the state budget. The funding of human capital, social and infrastructure development programs, and operational expenses such as administrative expenses are the other expenditure areas as detailed for 2018 in Table 3.1 (SOFAZ, 2018). Expenditures of SOFAZ are restrained merely by the decree of the President.

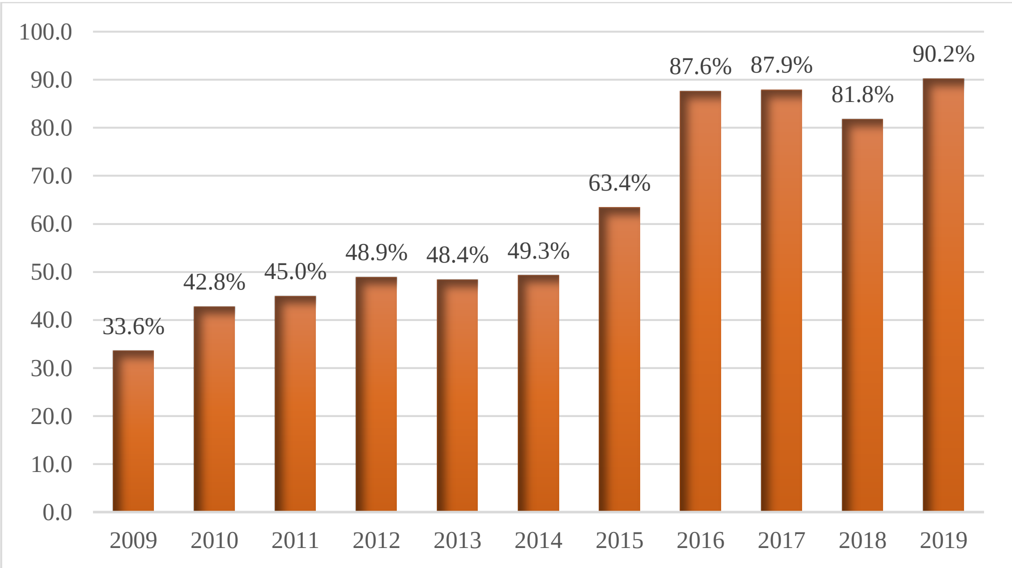
After starting to operate, assets of SOFAZ accumulate slowly, and the value of assets exceeded USD 1 billion in 2005 and reached USD 2 billion in 2007. However, in 2008, its value shot up to USD 11 billion because of the rise in oil price and government share of oil profit. The same year, the government share of oil profit from Azeri-Chirag-Guneshli (ACG) fields rose from 25 percent to 80 percent (Bagirov, 2007). All government oil revenues are transferred to the SOFAZ except the profit taxes paid by foreign oil companies and national oil company (SOCAR) that goes to the state budget. In 2006 and 2007, the shares of government oil revenue transferred to SOFAZ were nearly 39 percent and 46 percent, respectively, and this share increased to 83 percent in 2008.



Source: SOFAZ Annual Reports (2010-2019).

Figure 3.3: SOFAZ's Revenues, Expenditure and Assets (USD, Billion)

From 2008 to 2017, the total budget revenue of SOFAZ contained USD 132.4 billion, with an annual average of USD 13.24 billion. In 2015, because of the declining oil prices and the depreciation of AZN by 34 percent in February 2015 and 48 percent in December 2015, SOFAZ's revenue in dollars decreased from USD 16.2 billion to USD 7.7 billion. The AZN exchange rate dropped to a historic low, and oil price remained the same; therefore, the budget revenue of SOFAZ was USD 5.9 billion in 2016. In 2018 and 2019, SOFAZ budget revenues were USD 10.4 billion and USD 11.2 billion, respectively. During the period 2008-2019, the highest budget revenue of SOFAZ occurred in 2011, with a value of USD 19.8 billion. Moreover, from 2011 to 2019, the value of SOFAZ's assets grew from USD 29.8 billion to USD 43.3 billion (Figure 3.3).



Source: SOFAZ 2019 Annual Report.

Figure 3.4: SOFAZ Assets-to-GDP Ratio

A substantial amount of natural gas and oil rents were saved merely in SOFAZ's first few years; however, the share of the fund's revenues being transferred into the state budget started to increases after 2008. From 2003 to 2018, the transfer from SOFAZ to the state budget totaled USD 93 billion which is 86.9 percent of all fund's budgetary expenditures this far (SOFAZ, 2018). For SOFAZ, there is only one withdrawal rule, which is regulated under the long-term gas and oil management strategy adopted by the President's decree in September 2004. According to this rule, when the gas and oil revenues reach their peak, at least 25 percent of these annual revenues shall be saved[12]. Concerning the annual fund report, generous transfers to the state budget from SOFAZ led to violation of this rule in some years between 2011 and 2015 when peak points in revenues were reached. Seventy-eight percent of revenues were spent in 2012, 90.4 percent in 2013, 79.4 percent in 2014, and 118.9 percent in 2015.

SOFAZ's investment strategy has been conservative, and most of the assets accumulated in SOFAZ were invested in the money market and fixed income instruments such as money market funds, bank deposits and securities, which have very low risk. To illustrate, in 2018, the investment portfolio of SOFAZ consisted of money market instruments and fixed income (76.5 percent), equities (12.8 percent), gold (5.4 percent) and real estate (5.3 percent)[13]. Compared to the investment portfolio in 2018, the share of money market and fixed income instruments in the SOFAZ's investment portfolio decreased to 68.7 percent, whereas the share of gold increased to 11.4 percent in 2019[14].

The investment portfolio of SOFAZ performs worse than sovereign wealth funds of other countries such as the Norwegian Pension Fund, USA Alaska Fund, Canada Alberta Fund, and New Zealand Sovereign Fund, in which the shares of money instruments and fixed income are at most 35 percent. The SOFAZ's average profit was merely 0.35 percent in 2018, while its average annual profit was 1.53 percent between 2010 and 2017. In comparison, in the same period, this value equaled to 15.5 percent

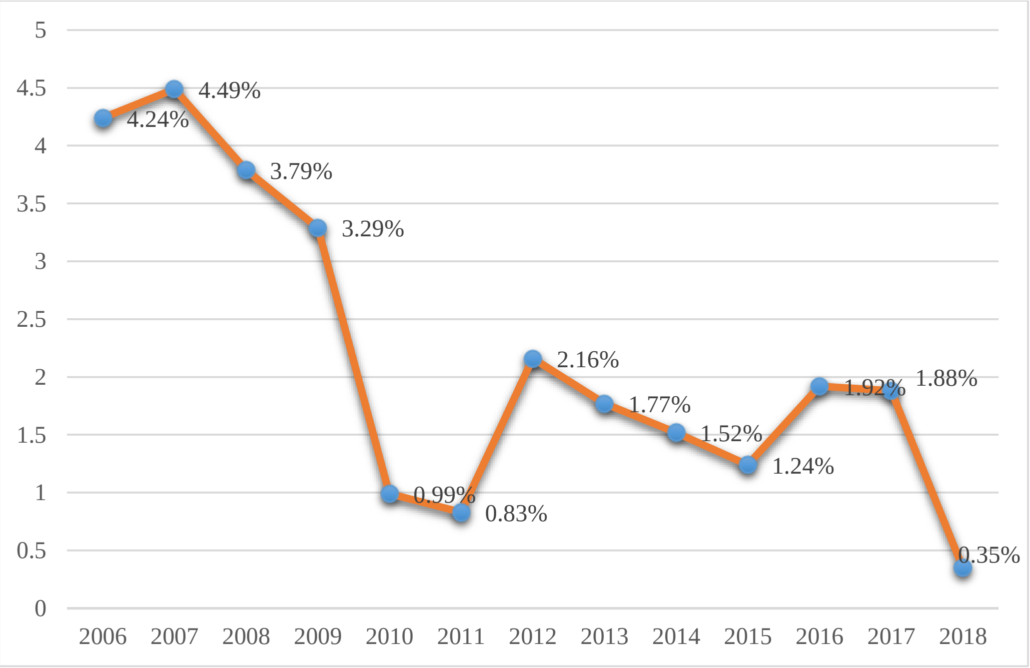
[12] Long-term strategy on the management of oil and gas revenues, approved by Decree of the President of the Republic of Azerbaijan No. 128, 2004.

[13] 2018 SOFAZ Annual Report.

[14] 2019 SOFAZ Annual Report.

for the New Zealand Sovereign Fund, 11.5 percent for Canada Alberta Fund, 9.7 percent for the USA Alaskan Fund, and 7.6 percent for the Norwegian Pension Fund (Ibadoghlu and Crude Accountability, 2020).

Financial flows of SOFAZ are controlled by regular internal audits and independent external audit. Furthermore, SOFAZ joined the Extractive Industries Transparency Initiative (EITI), an international NGO established to enhance transparency in the flow of funds between receipts and extractors (government or oil companies), in 2003, and Azerbaijan became the first country regarding the fulfillment of EITI requirements in 2009 (Aslanli, 2012). In addition, various statistics and quarterly and annual reports, including activities of SOFAZ, are published on the fund website.



Source: SOFAZ 2018 Annual Reports.

Figure 3.5: SOFAZ Investment Portfolio Rate of Return

However, notwithstanding the improvements in transparency and accountability, the governance of SOFAZ is still concentrated on the decisions of the Azerbaijan's President, and fund has no common oversight mechanism (Bacon and Tordo, 2006; Aslanli, 2015). Besides, in 2017, Azerbaijan left EITI after its membership was suspended due to EITI's concerns about limits on civil society freedoms in the Republic of Azerbaijan. In the (2017) Resource Governance Index (RGI), Azerbaijan scored only 47 of 100 points, ranking 47th among 89 countries, which is admitted as a weak score.[15]

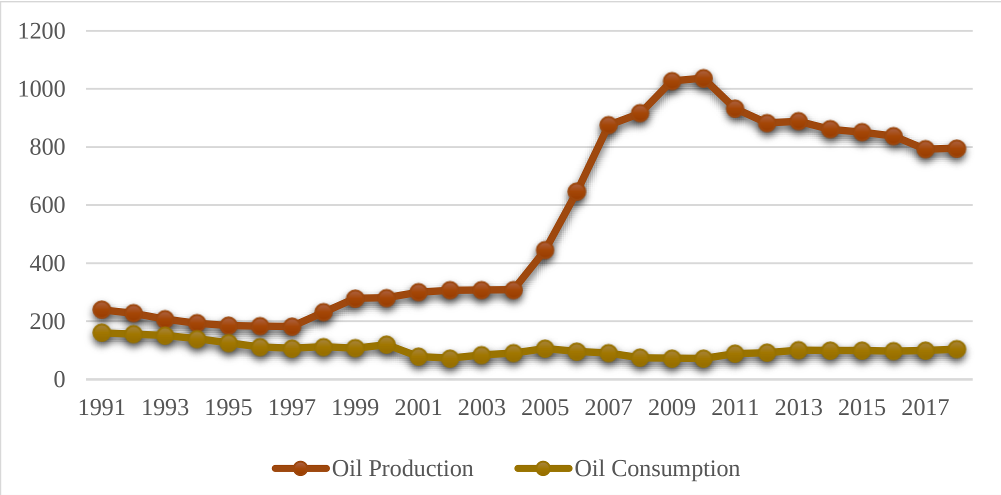
Overall, during the years 2001-2019, inflows to the SOFAZ totaled nearly USD 150 billion, with 28 percent presenting savings and 72 percent spending. According to this information, it may be said that among the fund's objectives, preserving macroeconomic stability and financing the critical national projects to ensure socio-economic development have been roughly met. In contrast, the second objective of securing the fair distribution of resource income across generations has been neglected until now (Tsani et al., 2010). Hence, the essential issue for policymakers in Azerbaijan is to define appropriate deposit and withdrawal rules for the SOFAZ and enhance the performance of its investment portfolio to provide more asset accumulation.

3.2.2. Energy Sector in Azerbaijan

Industrial oil production started on the territory of Azerbaijan in the late nineteenth century. In 1905, Azerbaijan was producing 200,000 barrels per day, equivalent to half of the world's oil production. By 1941, this production had reached a peak of 500,000 barrels per day. After that, it gradually decreased until the end of the 1990s and

[15] The scores of RGI are classified as failing (<30), poor (30-40), weak (45-59), satisfactory (60-74) and, good (>74).

dropped to 200,000 barrels per day (Zotin, 2017). Oil production had become less crucial and less innovative in Azerbaijan when it was part of the USSR between 1921 and 1991 since the industry was monopolized (Gurbanov et al., 2017).



Source: BP Statistical Review of World Energy.

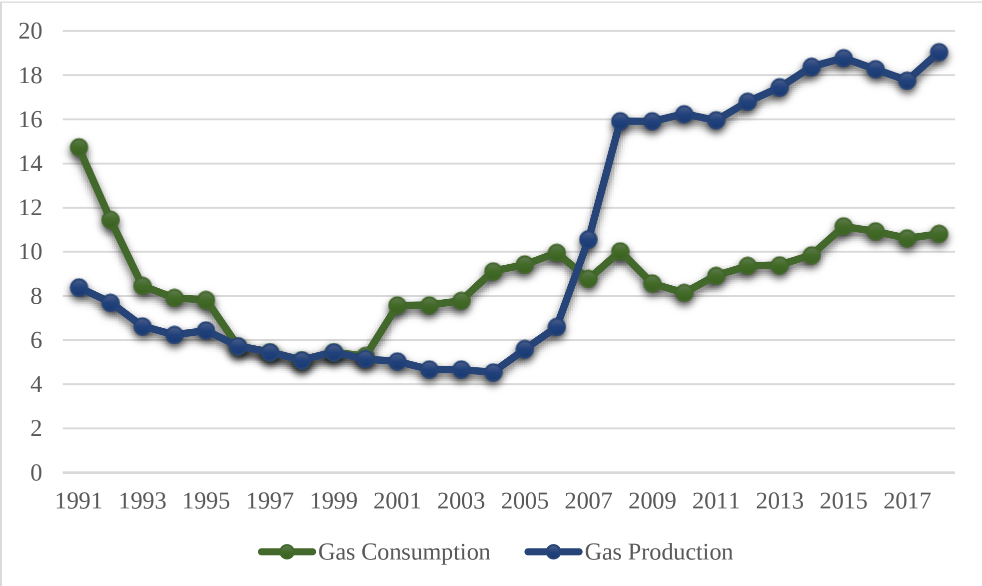
Figure 3.6: Azerbaijan Oil Production and Consumption (Barrels Per Day)

Furthermore, in the same period, oil revenues were received by the USSR. However, after Azerbaijan's independence in 1991, oil revenues started to be accrued to the Azerbaijan state. Azerbaijan made two critical initiatives for the efficient management of its oil revenue. The first initiative was to sign the "Contract of Century" in 1994, including various PSAs with big oil companies[16] for the joint development of Azeri-Chirag-Guneshli oil fields until 2024[17]. This initiative resulted in nearly USD 60 billion FDI inflows and a noticeable increase in oil production of Azerbaijan after 1997. The second was to establish the SOFAZ to accumulate oil revenues in 1999. The

[16] These companies are BP (United Kingdom), Amoco (United States of America (US)), UNOCOL (US), McDermott (US), Pennzoil (US), Statoil (Norway), Lukoil (Russia), TPAO (Turkey), Ramco (Scotland), Delta Nimer (US), SOCAR (Azerbaijan).

[17] "Contract of Century" was extended until 2050 by a new agreement signed in 2017.

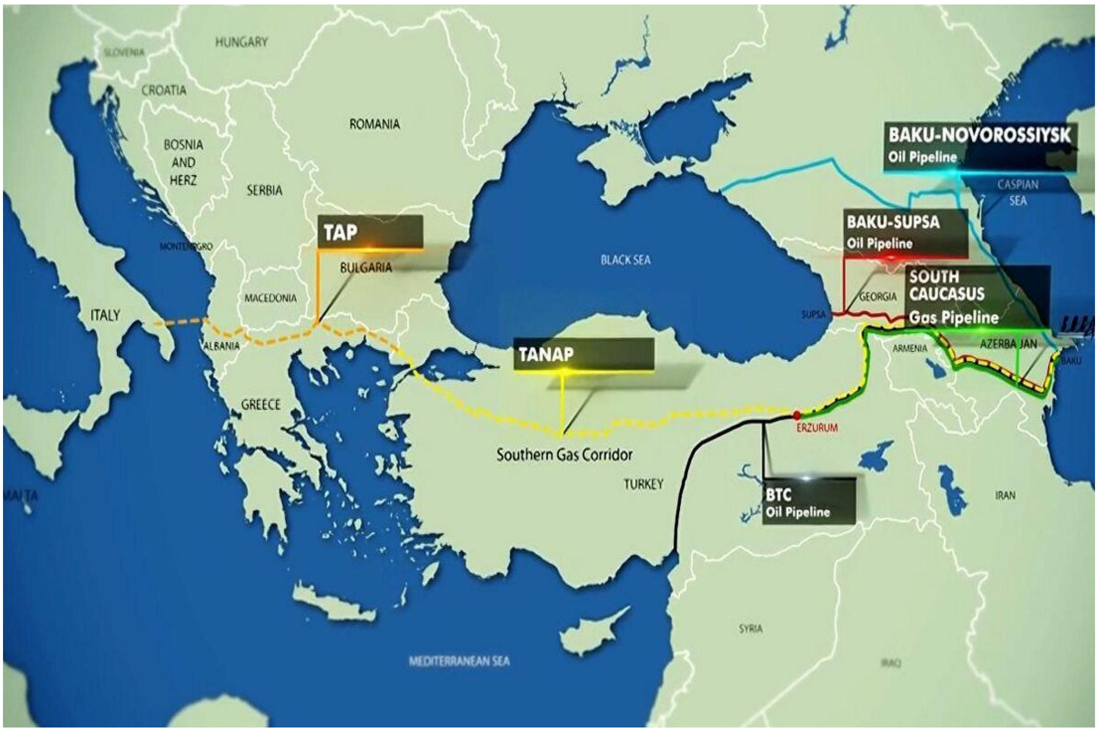
first oil production in the Azeri and Chirag oil fields started in 2005, while it took place in the Guneshli oil field in 2007. As a result of this, Azerbaijan's oil production rose 300,000 barrels per day in 2005 and reached more than one million barrels per day in 2010, breaking a record. After 2010, oil production declined slowly, declining to 764,000 barrels per day by 2019. According to the 2018 BP World Energy Review report, Azerbaijan oil reserves are 7 billion barrels, equal to 0.4 percent of global reserves at the end of 2017, and these reserves were estimated to last nearly 23 years.



Source: BP Statistical Review of World Energy, 2018.

Figure 3.7: Azerbaijan Gas Production and Consumption (Million Cubic Meters)

Natural gas production on the territory of Azerbaijan started in 1901 and reached the highest production level with 17 billion cubic meters (bcm) in 1981 since the beginning of production. During the time of the USSR, the natural gas industry lagged behind the oil sector (Aras et al., 2013). After 1991, the production started to decline sharply, dropping to 5.6 bcm by 2005. Until 2007, Azerbaijan could meet only 40 percent of its natural gas consumption with its own production. After the beginning of the Shah-Deniz field's exploitation in 2006, the natural gas production of Azerbaijan rose from 5.6 bcm in 2005 to 19.0 bcm in 2018. Between 2007 and 2018, natural gas consumption and production of Azerbaijan were 9.7 bcm and 16.8 bcm on average, respectively, indicating that Azerbaijan has been a net exporter of natural gas since 2007. According to the 2018 BP World Energy Review report, Azerbaijan's natural gas reserves are estimated to 46.6 trillion cubic feet, equal to 0.7 percent of global reserves at the end of 2017.



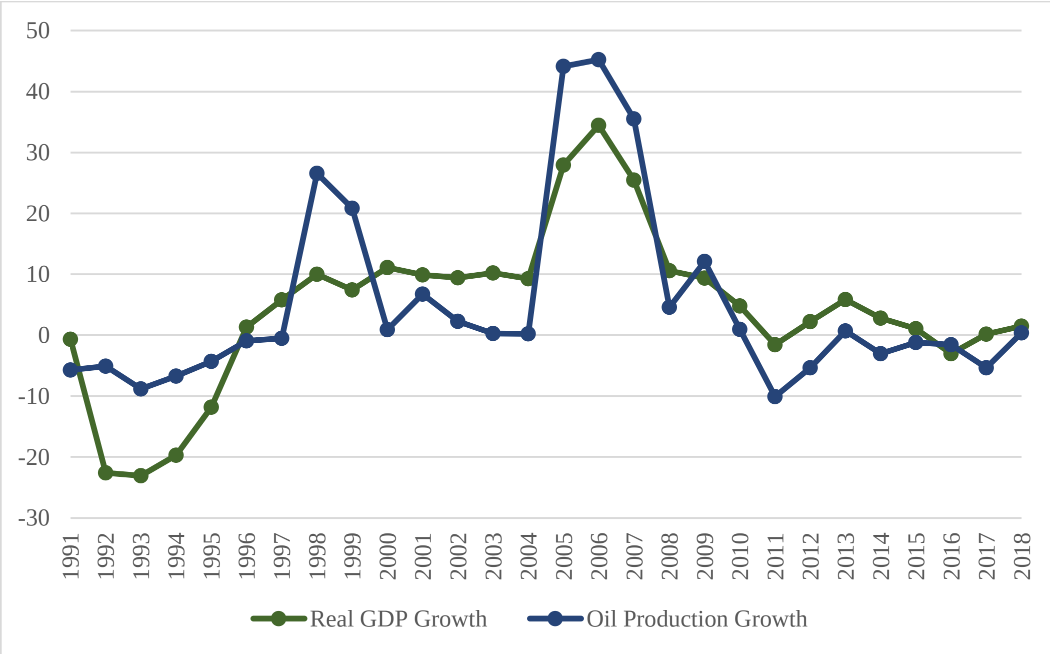
Source: Trans Anatolian Natural Pipeline (TANAP).

Figure 3.8: Azerbaijan Natural Gas and Oil Pipelines

As part of PSAs, various pipelines were built for exporting gas and oil, including the Baku-Tbilisi-Ceyhan (BTC) oil pipeline (2005) and the Baku-Tbilisi-Erzurum (BTE) gas pipeline (2006). The BTC is the main pipeline for exporting Azerbaijan's oil to the world. In 2006, more than 9 million tons of oil was exported by the BTC pipeline, whereas it increased to 50 million tons in 2009. However, the oil export by the BTC pipeline started to decrease in 2011. Most of the natural gas exports of Azerbaijan are transmitted through Georgia to Turkey by the BTE pipeline (Figure 3.8). Currently, natural gas supply to Turkey, Georgia and Greece by BTE in a year reached to 8.4 million cubic meters. Besides this, the Natural gas export plans of Azerbaijan are now focused on TANAP and Trans Adriatic Pipeline (TAP), on which constructions are completed in 2018 and 2020, respectively. Azerbaijan aims to supply nearly 2 percent of the European Union's gas needs (Zotin, 2017). By building TAP and TANAP, Azerbaijan and Turkey became transit countries for Central Asia's oil and natural gas being exported to European and World markets.

3.2.3. Characteristics of Azerbaijan's Economy

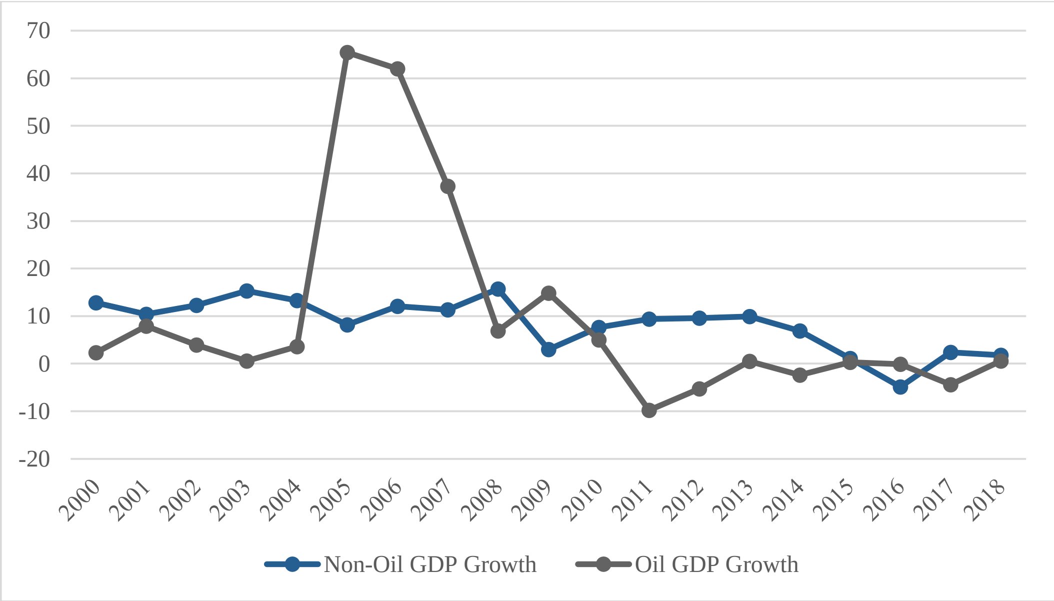
Azerbaijan has experienced remarkable economic transformation and development after gaining its independence in 1991. Before 1991, Azerbaijan's economy developed industry, agriculture and service sectors. However, this diversified economy collapsed after the breakup of the USSR, and GDP fell sharply until 1996 due to the decrease in oil production, loss of financing support from the USSR, and transition to a free market economy (ADB, 2014). From 1991 to 1995, the growth of Azerbaijan's real GDP was negative, and real GDP declined by nearly 58 percent. The war with Armenia on Nagorno-Karabakh also worsened economic recovery in the same period. After signing the “Contract of Century” in 1994, FDI started to flow into Azerbaijan's economy, thereby enabling economic growth to turn positive. In addition, Azerbaijan's structural and stabilization reforms that lead to financial and macroeconomic stability started in 1995. The real GDP growth of Azerbaijan was 7 percent on average over the period 1996–2000. After 2000, oil production increased noticeably due to substantial infrastructural investments. Besides production, rise in the oil price and the completion of the BTC pipeline led to real GDP growth of 9.2 percent in 2004, 28 percent in 2005, 34.4 percent in 2006, and 25.4 percent in 2007 before falling to growth levels of 10 percent in the last years of the decade. This clearly shows a close relation between overall economy and oil (Hasanov and Huseynov, 2013). The vulnerability of Azerbaijan's economy to the fluctuation of oil production and oil price was also seen in 2011, when real GDP growth dropped sharply to -1.5 percent, owing to the decline in oil production. After 2011, the oil production continued to fall gradually until 2017, and real GDP growth fluctuated with changes in oil price (Figure 3.9).



Source: BP Statistical Review of World Energy and the State Statistical Committee of the Azerbaijan Republic (SSCAR) Database.

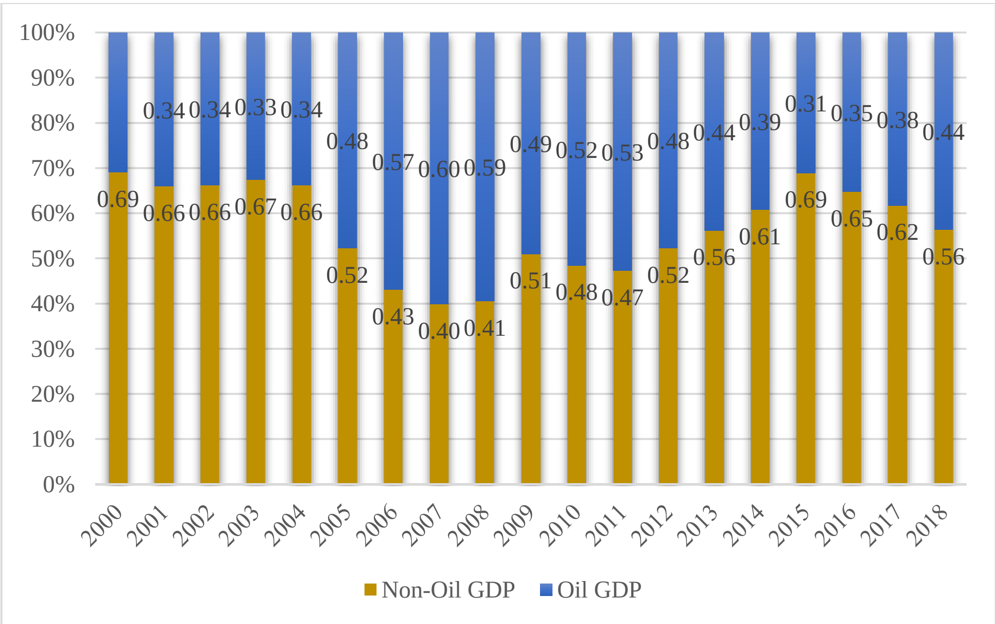
Figure 3.9: Real GDP Growth (Percent)

The real growth rates of non-oil sector have been more stable and fluctuating less than real growth rates of oil sector since 2000, ranging from 7 percent to 15 percent between 2000 and 2014. The non-oil sector growth has been positive since 2000 with the exception of 2016 (Figure 3.10).



Source: IMF Article IV Consultation: Azerbaijan (various years).

Figure 3.10: Real Non-Oil and Oil GDP Growth (Percent)



Source: Author's calculations based on the SSCAR Database.

Figure 3.11: Oil and Non-Oil Share of GDP

In Azerbaijan, oil accounted for more than half of the GDP between 2005 and 2010, and this share even exceeded 60 percent in oil boom times (Figure 3.11). The sector composition of Azerbaijan's GDP has not shown noticeable change regarding the diversifying away from oil. Although Azerbaijan's GDP and oil production growth have diminished since 2007, the oil sector share in GDP remained high (nearly 40 percent on average) since the ratio of oil rents to GDP and hydrocarbon (natural gas and oil) exports in total exports remained high (Gurbanov et al., 2017).

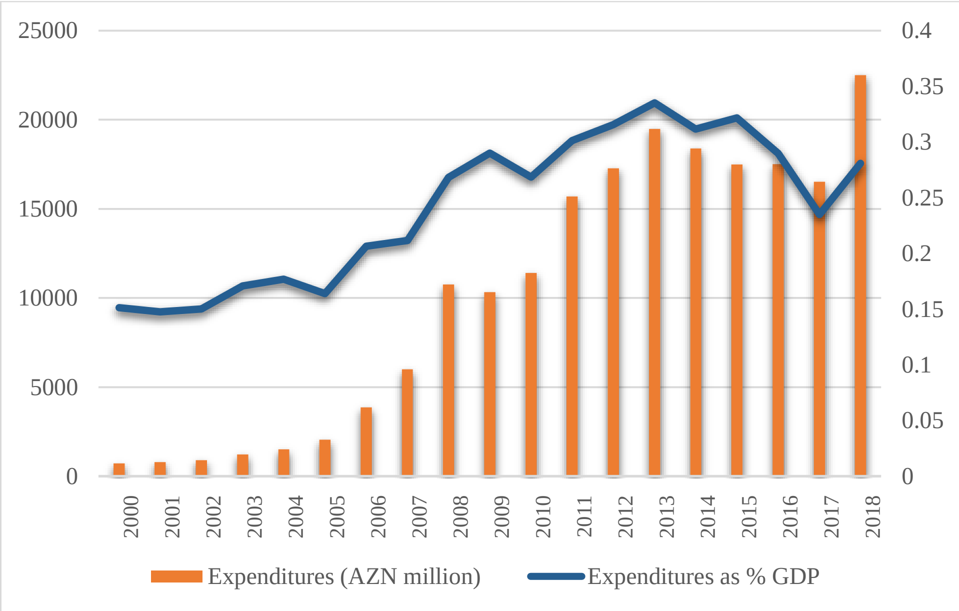
As stated in the Dutch Disease theory, the non-oil sector in Azerbaijan can be divided into two sectors to be analyzed: non-tradable and non-oil tradable sectors. The non-tradable sector includes transport, communication, construction, hotels and service sectors, while the non-oil tradable sector is the summation of agriculture and non-oil industry sectors (Hasanov, 2013). In his study Hasanov (2013) showed that the increase in oil GDP created a gap between non-tradable and non-oil tradable sectors in Azerbaijan; therefore, the non-tradable and non-oil tradable sectors grew 13 and 7 percent on average between 2000 and 2007, respectively regarding his calculation. In Azerbaijan, agriculture and manufacturing were the two main sectors in the non-oil tradable sector in the 1990s. However, their shares have shrunk over time as Azerbaijan's economy became highly dependent on oil. Once an essential part of the economy, the share of the agriculture in GDP was 30 percent on average in the first half 1990s, but it fell to merely 5.5 percent by 2012. The share of manufacturing sector in GDP was 17 percent on average between 1991 and 1995, and it declined sharply to 5 percent in 2007. In terms of employment, the agriculture sector's development is essential for the Azerbaijan economy since the share of this sector employment in total employment is nearly 40 percent compared to the oil sector, which employs nearly 1 percent of the labor force (Guliyev, 2013).

Table 3.2: Sectoral Shares in GDP (Percent)

Year	Mining	Agriculture	Manufact.	Construction	Trade, Transportation, Accommodation and Food	Others
2005	45.7	9.9	7.1	9.8	12.9	14.6
2006	55.3	7.5	6.0	8.2	11.2	11.8
2007	57.1	7.0	5.1	6.9	11.7	12.2
2008	56.0	6.0	5.0	7.4	12.0	13.6
2009	46.4	6.6	6.0	7.9	15.6	17.5
2010	49.2	5.9	5.0	8.7	14.0	17.2
2011	50.9	5.4	4.2	8.4	13.7	17.4
2012	45.9	5.5	4.5	10.7	14.1	19.3
2013	42.8	5.7	4.5	12.4	14.3	20.3
2014	37.0	5.7	5.1	13.6	15.7	22.9
2015	28.8	6.8	5.8	13.2	19.8	25.6
2016	33.4	6.1	5.3	11.4	21.1	21.1
2017	36.7	6.0	5.0	10.3	20.9	21.1
2018	42.0	5.6	5.0	8.3	19.5	19.6

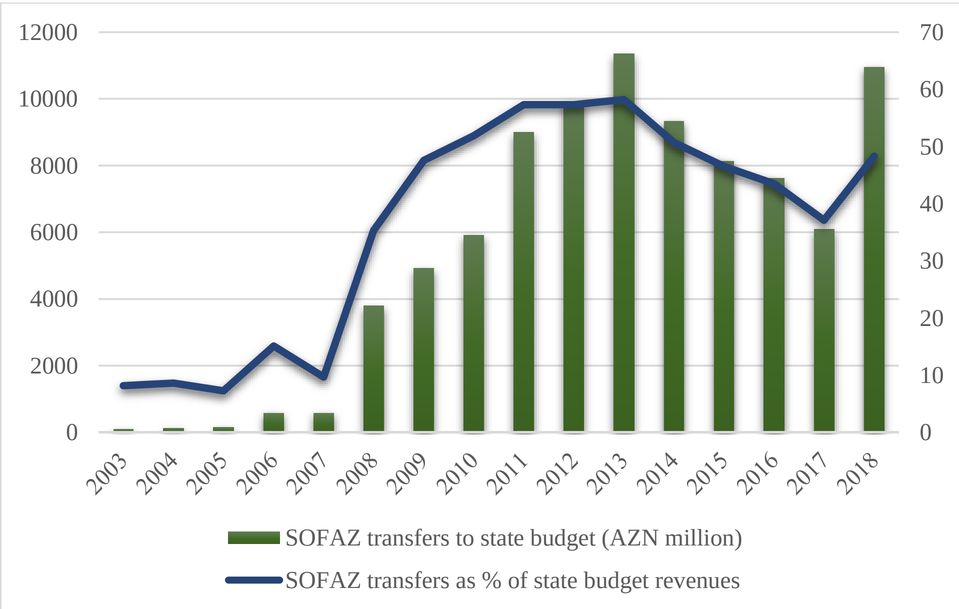
Source: SSCAR Database and author's calculations.

The oil windfalls caused a noticeable increase in Azerbaijan's government expenditures, which stimulated aggregate demand. Despite the fiscal rule and SOFAZ, these expenditures rose more than eight-fold between 2005 (before the oil boom) and 2013 (Figure 3.12). Since 2005, the remarkable increase in government expenditures has been made possible by transfers from the SOFAZ. While in 2005, SOFAZ transfers constituted merely 7 percent of state budget revenues, it increased to an average of more than 50 percent between 2009 and 2015. Additionally, the share of SOFAZ transfers to the Azerbaijan State Budget exceeded 100 percent of SOFAZ revenues in 2015 (Figure 3.13).



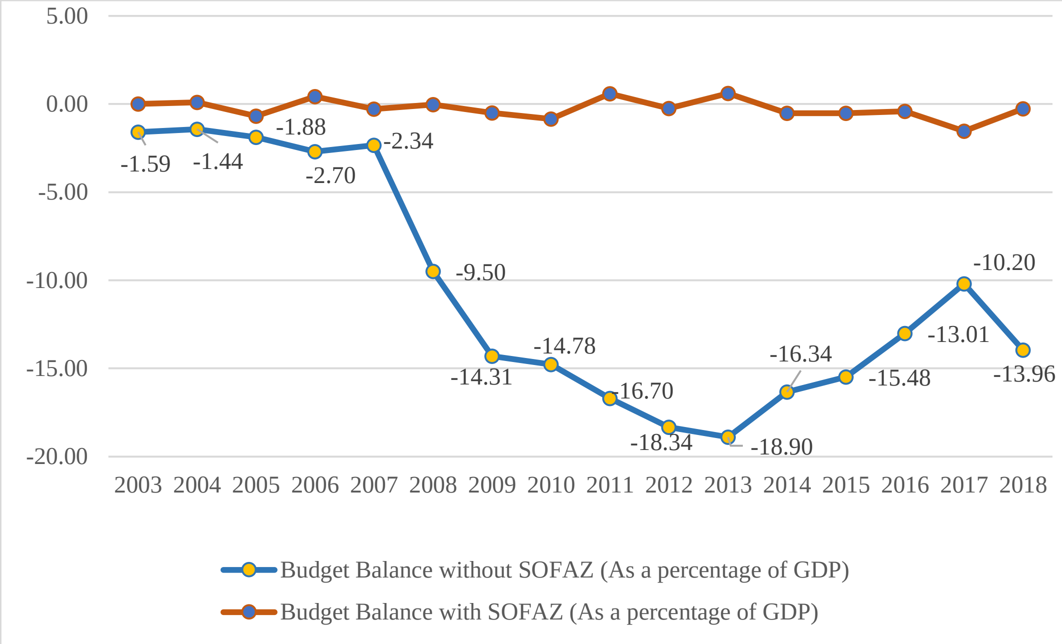
Source: SSCAR Database and author's calculations based on this database.

Figure 3.12: Budget Expenditures, 2000-2018



Source: SOFAZ Annual Reports (various years), SSCAR Database and author's calculations.

Figure 3.13: SOFAZ Transfers to State Budget, 2003-2018



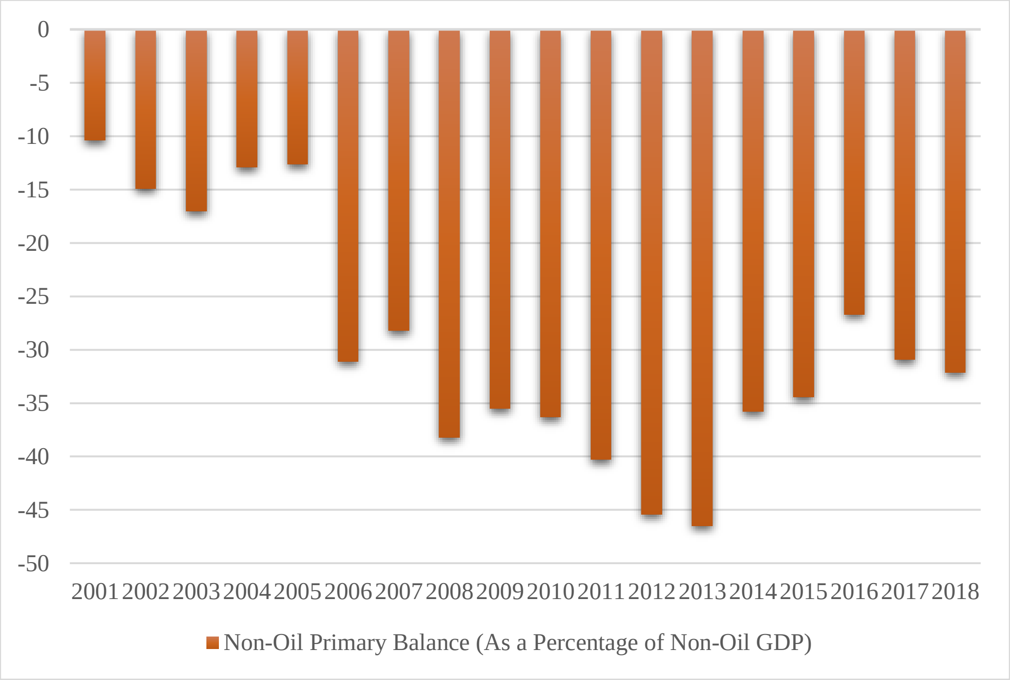
Source: SSCAR Database and author's calculations based on SOFAZ Annual Reports (various years).

Figure 3.14: Budget Balance with and without SOFAZ Transfers, 2003-2018

In Azerbaijan, government expenditures have mirrored government revenues, which causes the state budget has had small deficits or surpluses of around 1 percent of GDP since 2001. However, this deficit would be significant without SOFAZ transfers (Figure 3.14). To illustrate, the budget deficit without SOFAZ transfers was merely AZN 235 million in 2005 compared to AZN 11 billion in 2013. After 2013, state budget expenditure and the SOFAZ transfers to state budget started to decrease until 2018 due to policy measures adopted to decrease budget oil dependency (ADB, 2014).

The public investment programs of Azerbaijan crowded out non-oil sector's private investment, thereby causing a decline in private investment and FDI in that sector. Private investment in the non-oil sector as a percentage of GDP fell by more than 50 percent between 2005 and 2008 (ADB, 2014).

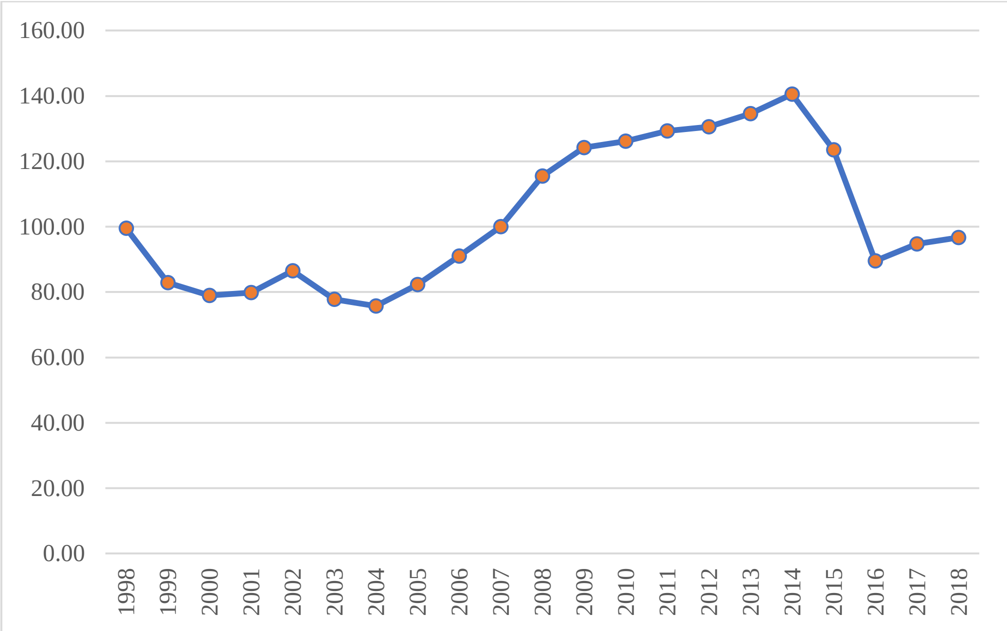
Moreover, the non-oil sector contribution to the state budget of Azerbaijan is not enough to decrease the non-oil primary balance (as a percentage of non-oil GDP) under 30 percent since 2006; therefore, the country's expenditure on non-oil services and goods have been financed by gas and oil revenues (Gurbanov et al., 2017).



Source: IMF Article IV Consultation: Azerbaijan (various years).

Figure 3.15: Non-Oil Primary Balance, 2001-2018

In Azerbaijan, the AZN had appreciated since 2006, causing the currency exchange rate to decline from 0.92 to 0.78. The main reason for these appreciations was large foreign currency influx due to the FDIs to the oil sector, foreign currency revenues of SOCAR and SOFAZ transfers to Azerbaijan Treasury. The strengthening of the national currency affected Azerbaijan's competitiveness, making it difficult for the country to diversify into manufacturing and agriculture exports (ADB, 2014). The Global Competitiveness Index (GCI) prepared by the World Economic Forum (WEF) shows that Azerbaijan's international competitiveness deteriorates when its economy becomes more oil-dependent. In the 2007-2008 report, Azerbaijan was ranked 66 among the 131 countries with a score of 4.0 (on a 1-to-7 scale), while it had a ranking of 46 with a score of 4.4 in the 2012-2013 report when oil production dropped sharply. After 2014, due to a sharp decrease in oil price, Azerbaijan carried out two devaluations, a fixed AZN at 1.55 to the dollar (Zotin, 2017).



Source: Darvas, Z. (2012). Real effective exchange rates for 178 countries: a new database, Bruegel Working Paper No.2012/06.

Note: The rise in index denotes an appreciation.

Figure 3.16: Azerbaijan's Real Effective Exchange Rate, 1998-2018

After 2005, Azerbaijan's current account balance (CAB) started to have a large surplus due to the sudden increase in hydrocarbon production and export after completing BTC and BTE pipelines, and surpluses reached the peak at 34 percent of GDP in 2008. However, large CAB surplus started to decrease gradually after 2008 due to the global economic crises and decline in the oil productions, and it became negative with the sharp drop in oil price in 2014. The large CAB surpluses were generated by high hydrocarbon exports. The share of hydrocarbon export in total export was 65 percent in 1996, whereas it increased to nearly 97 percent in 2008. In addition, hydrocarbon exports accounted for 94.5 percent of total exports between 2006 and 2012.

To summarize, the non-oil sector in Azerbaijan remains underdeveloped. Manufacturing value added, an economic growth engine, constitutes 5 percent of GDP throughout 2005-2018. The agriculture share also remained low. Although the non-resource sector's development is defined as one of the essential goals in the long-term gas and oil revenue management strategy, Azerbaijan economy remains highly dependent on oil. Additionally, it faces some challenges since non-renewable resource revenue is volatile, uncertain and exhaustible. The resource exhaustibility raises intergenerational resource and sustainability issues, whereas the uncertainty and volatility of resource revenue make macroeconomic management and fiscal planning difficult. Therefore, it is crucial to diversify Azerbaijan's economy outside of the non-renewable resource sector and reduce resource revenue dependency.

3.3. Model

In this open economy DSGE model, there are three sectors: non-resource tradable (T), non-tradable (N) and resource (R) sectors. Resource output, (Y_t^R), which consists of crude oil and natural gas production, is a flow endowment and owned by the government. While some amount of this production is consumed domestically by households, the rest of it is exported. The output of tradable (Y_t^T) and non-tradable (Y_t^N) sectors are produced competitively. Non-resource tradable good is either consumed or used for investment; however, non-tradable goods are only consumption goods. Besides, the household can buy and consume both of these goods. The government also can purchase and buy both goods. The public investment comprises of both non-tradables and tradables, while private investment comprises just tradables.

The model assumes that there is imperfect capital mobility across the tradable and non-tradable sectors, which means capital is not freely mobile between these two sectors. The other assumption of the model is that both households and government have the opportunity to borrow from world capital markets by paying a risk premium.

The final assumption of the model is that for tradable goods, since there is no distribution cost, purchasing power parity holds at both retail and wholesale level and the world price of it for a unit is unity. The world resource price is exogenous, and prices are flexible.

3.3.1. Total Output

$$Y_t = Y_t^T + z_t^{-1} Y_t^N + p_t^R Y_t^R \tag{3.1}$$

Y_t is the total output which is measured in foreign currency, and Y_t^R, Y_t^T, Y_t^N represent resource output, non-resource tradable output and non-tradable output, respectively. z_t denotes real exchange rate. p_t^R is the exogenous world price of the resource.

3.3.2. Tradable Production

Public capital, K^G, labor, L^T and private capital, K^T are used in order to produce tradable goods at time t. Its production function which is in the Cobb-Douglass form, is given by,

$$Y_t^T = (L_t^T)^{\beta}(K_t^T)^{1-\beta}(K_t^G)^{\omega_T}, \tag{3.2}$$

where $\omega_T > 0$ and $\beta \in (0,1)$. Firms maximize profits, which is defined as $\Pi_t^T = Y_t^T - w_t L_t^T - r_t^{K,T} K_t^T$, where w_t is the wage rate (economy-wide) and $r_t^{K,T}$ denotes a tradable sector rental rate of capital. This maximization yields below first-order conditions:

$$w_t = \beta\left(\frac{Y_t^T}{L_t^T}\right), \tag{3.3}$$

$$r_t^{K,T} = (1-\beta)\left(\frac{Y_t^T}{K_t^T}\right). \tag{3.4}$$

3.3.3. Non-tradable Production

A firm produces non-tradable goods using public capital, K^G, private capital, K^N, labor, L^N inputs with the same production function at time t as the non-resource tradable output. This function is given by,

$$Y_t^N = (L_t^N)^{\eta}(K_t^N)^{1-\eta}(K_t^G)^{\omega_N}, \tag{3.5}$$

where $\omega_N > 0$ and $\eta \in (0,1)$.

Producer of non-tradable good chooses K_t^N and L_t^N by solving the maximization of profit $\Pi_t^N = p_t^N Y_t^N - w_t L_t^N - r_t^{K,N} K_t^N$ subject to the production function in (3.5). This results in

$$z_t w_t = \eta \left(\frac{Y_t^N}{L_t^N} \right), \tag{3.6}$$

$$z_t r_t^{K,N} = (1-\eta)\left(\frac{Y_t^N}{K_t^N} \right), \tag{3.7}$$

where, $r_t^{K,N}$ denotes non-tradable sector rental rate of capital. In both non-resource tradable and tradable sectors, it is assumed that the elasticity of output with respect to public capital is the same.

3.3.4. Production and Price of Resource

Resource price, p_t^R, is exogenously determined, and it follows an exogenous process which is given by,

$$\left(p_t^R \right) = \left(p_{t-1}^R \right)^{\rho^{p^R}} \exp(\in_t^{p^R}). \tag{3.8}$$

Here, $\rho^{P^R} \in (0,1)$ is the autoregressive coefficient, which represents the degree of persistence, and random shock $\in_t^{P^R}$ is normally distributed with a constant variance and zero mean.

$$\left(Y_t^R\right) = \left(Y_{t-1}^R\right)^{\rho^{Y^R}} \exp(\in_t^{Y^R}) \tag{3.9}$$

Resource output, Y_t^R, also follows an exogenous process. Here, $\rho^{Y^R} \in (0,1)$ is the autoregressive coefficient, and it measures degree of persistence. Random shock $\in_t^{Y^R}$ is normally distributed with a constant variance and zero mean.

3.3.5. Households

There is two-step process in the household consumption decision. In the first one, the optimal consumption level is determined. Household allocates consumption specified in the first stage between consumption of non-tradable and tradable goods in the second stage. The representative household aims to maximize the below infinite lifetime utility function,

$$U_t = E_t \sum_{s=0}^{\infty} \Lambda^s \left\{ \frac{\left(C_{t+s}\right)^{1-\varsigma^{-1}}}{1-\varsigma^{-1}} - \frac{\eta_L}{1+\psi} L_{t+s}^{1+\psi} \right\}, \tag{3.10}$$

where $\Lambda \in (0,1)$ represents the discount factor. E_t denotes expectations operator, whereas ς is the intertemporal elasticity of substitution. ψ denotes the inverse of Frisch elasticity of labor supply, and $\eta_L > 0$ represents preference parameter.

The stock of private capital evolves according to,

$$K_t^p = \left(1-\delta^p\right)K_{t-1}^p + \left(I_t^p\right) - \Gamma\left(K_t^p, K_{t-1}^p\right), \tag{3.11}$$

where $\delta^P \in (0,1)$ denotes a constant depreciation rate, I_t^p represents private investment, and $\Gamma(\ )$ gives a function of capital adjustment cost, which have the following quadratic form,

$$\Gamma\left(K_t^p, K_{t-1}^p\right) = 0.5\kappa\left(\frac{K_t^p}{K_{t-1}^p} - 1\right)^2 K_{t-1}^p, \tag{3.12}$$

where, $\kappa > 0$ denotes an adjustment cost parameter.

Households own both types of firms. Since these companies operate in a perfectly competitive market, their profits are equal to zero. Therefore, households' net income comprises only after-tax non-resource income. The flow budget constraint (end-of-period) of household is specified as,

$$D_{t+1}^{p} = \left(1 + r_t^{w}\right) D_t^{p} - \left(1 - \tau\right)\left(Y_t^{T} + z_t^{-1} Y_t^{N}\right) + p_t C_t + I_t^{p} + T_t^{L}, \qquad (3.13)$$

where D_t^p is the foreign currency debt, T_t^L is the lump-sum taxes, r_t^w denotes world interest rate, p_t is the price of non-tradable and tradable good's basket, and $\tau \in \left(0,1\right)$ represents the non-resource tax rate.

Households maximize utility function in equation (3.10) subject to constraints in equations (3.11) to (3.13). First-order conditions, which maximization gives, are as below,

$$\frac{C_t^{-\varsigma^{-1}}}{p_t} = \Lambda\left(1 + r_t^{w}\right)\frac{E_t\left(C_{t+1}^{-\varsigma^{-1}}\right)}{p_{t+1}}, \qquad (3.14)$$

$$L_t = \left[\frac{\left(1-\tau\right) w_t}{\eta_L C_t^{\varsigma^{-1}} p_t}\right]^{\frac{1}{\psi}}, \qquad (3.15)$$

$$\left\{\left[\kappa\left(\frac{K_{t+1}^{P}}{K_t^{P}} - 1\right) + 1\right]^{-1}\left[\left(1-\tau\right) r_{t+1}^{K} + \left(1 - \delta^{P}\right) + \frac{\kappa}{2}\left(\frac{\Delta\left(K_{t+2}^{P}\right)^{2}}{\left(K_{t+1}^{P}\right)}\right)\right]\right\} = 1 + r_t^{w}, \qquad (3.16)$$

where $\Delta(K_{t+2}^P)^2 = \left(K_{t+2}^P\right)^2 - \left(K_{t+1}^P\right)^2$. Equation (3.14) is the Euler equation, (3.15) describes labor supply, and (3.16) denotes arbitrage condition, which specifies private capital demand.

Private consumption is specified as a constant elasticity of substitution (CES) aggregator of tradable and non-tradable goods consumptions, C_t^T and C_t^N :

$$C_t = \left[\theta^{\frac{1}{\alpha}} \left(C_t^N \right)^{\frac{\alpha-1}{\alpha}} + (1-\theta)^{\frac{1}{\alpha}} \left(C_t^T \right)^{\frac{\alpha-1}{\alpha}} \right]^{\frac{\alpha}{\alpha-1}}, \tag{3.17}$$

$$p_t = \left[\theta \left(p_t^N \right)^{1-\alpha} + (1-\theta) \right]^{\frac{1}{1-\alpha}}, \tag{3.18}$$

$$p_t C_t = C_t^T + p_t^N C_t^N, \tag{3.19}$$

where $\theta \in (0,1)$ indicates the weight of non-tradable goods in the total private consumption and, α denotes the elasticity of substitution between tradable and non-tradable consumption. Since the tradable good's price is set to unity it disappears in the equation (3.18). Subject to (3.17), representative household minimizes expenditure function and obtains the following first-order conditions:

$$C_t^N = \theta \left(\frac{p_t^N}{p_t} \right)^{-\alpha} C_t, \qquad (3.20)^{18}$$

[18] First order condition in equation 3.20 can be written as $C_t^N = \theta \left(\frac{p_t}{z_t} \right)^{\alpha} C_t$, since $z_t = 1/ p_t^N$,

$$C_t^T = (1-\theta)\left(\frac{1}{p_t}\right)^{-\alpha} C_t \,. \tag{3.21}$$

Following Primus (2016), tradable consumption comprises a bundle of non-resource related goods, C_t^{TNR}, and resource products, C_t^{TR},

$$C_t^T = \left(C_t^{TR}\right)^{\theta^T} \left(C_t^{TNR}\right)^{1-\theta^T} , \tag{3.22}$$

where $\theta^T \in (0,1)$, budget constraint is,

$$C_t^T = C_t^{TNR} + p_t^R C_t^{TR} \,. \tag{3.23}$$

Household maximizes (3.22) subject to (3.23) and this maximization yields the following solutions:

$$C_t^{TR} = \theta^T \left(p_t^R\right)^{-1} C_t^T , \tag{3.24}$$

$$C_t^{TNR} = \left(1-\theta^T\right) C_t^T \,. \tag{3.25}$$

3.3.6. Government

The government gains resource revenue, T_t^R, lump-sum taxes, T_t^L and non-resource revenue, T_t^{NR}. Besides these revenues, it also gains interest income on the stock of assets, F_t, which is held as foreign currency in a sovereign wealth fund, at the interest rate, r_t^F. Total government revenue is thus given by,

$$T_t = T_t^R + T_t^{NR} + T_t^L + r_t^F F_t, \tag{3.26}$$

or equivalently,

$$T_t = p_t^R Y_t^R + \tau\left(Y_t^T + z_t^{-1} Y_t^N\right) + T_t^L + r_t^F F_t. \tag{3.27}$$

G_t is the CES basket of tradable and non-tradable goods purchased by the government:

$$G_t = \left[\upsilon^{\frac{1}{\alpha}}\left(G_t^N\right)^{\frac{\alpha-1}{\alpha}} + \left(1-\upsilon\right)^{\frac{1}{\alpha}}\left(G_t^T\right)^{\frac{\alpha-1}{\alpha}}\right]^{\frac{\alpha}{\alpha-1}}, \tag{3.28}$$

where $\upsilon \in (0,1)$ denotes the weight of non-tradable goods in the total government spending. The elasticity of substitution between non-tradable and tradable goods, which is given by α, is assumed to be the same value as that for private consumption.

The price of tradable and non-tradable goods' basket purchased by government is given by,

$$p_t^G = \left[\upsilon \left(p_t^N \right)^{1-\alpha} + (1-\upsilon) \right]^{\frac{1}{1-\alpha}}. \tag{3.29}$$

Minimizing total government expenditures $p_t^G G_t = G_t^T + p_t^N G_t^N$ subject to the consumption basket of government (3.28) yields the following optimal public demand for tradable and non-tradable goods:

$$G_t^N = \upsilon \left(\frac{p_t^N}{p_t^G} \right)^{-\alpha} G_t, \tag{3.30}$$

$$G_t^T = (1-\upsilon) \left(\frac{1}{p_t^G} \right)^{-\alpha} G_t. \tag{3.31}$$

Government spending, G_t, is apportioned in fixed shares to government consumption, C_t^G and investment, I_t^G,

$$I_t^G = \upsilon^G G_t, \tag{3.32}$$

$$C_t^G = \left(1-\upsilon^G\right) G_t, \tag{3.33}$$

where, $\upsilon^G \in (0,1)$. Government consumes its purchases of non-tradable and tradable goods in investment and consumption:

$$p_t^G(I_t^G + C_t^G) = G_t^T + p_t^N G_t^N . \tag{3.34}$$

Government spending is specified as a fixed proportion, $\psi^G \in (0,1)$ of output in steady state; however, in the log-linearized equations system, the determination of it relies on the fiscal rule (as it states in Appendix 2.A.3) in place.

The public capital stock accumulates in accordance with,

$$K_t^G = \left(1-\delta^G\right) K_{t-1}^G + \varphi_t I_t^G , \tag{3.35}$$

where φ_t denotes efficiency parameter of government spending on infrastructure, which is firstly proposed in Agénor (2010). Additionally, it is assumed that there is inverse relation between this parameter and the ratio of public investment to public capital for capturing absorption capacity constraint. $\delta^G \in (0,1)$ represents the depreciation rate,

$$\varphi_t = \varphi_0 \left(\frac{I_t^G}{K_t^G} \right)^{-\varphi_1} , \tag{3.36}$$

where $\varphi_0, \varphi_1 > 0$.

The flow budget constraint of government is specified as,

$$D_{t+1}^{G} = \left(1 + r_t^{w}\right) D_t^{G} + p_t^{G} G_t - T_t \, , \tag{3.37}$$

where D_{t+1}^{G} represents the government's debt, which is foreign-currency denominated.[19]

The government's non-resource primary balance, $NRPB_t$, is specified as,

$$NRPB_t = T_t^{NR} + T_t^{L} - p_t^{G} G_t \, . \tag{3.38}$$

3.3.7. Risk Premium and World Interest Rate

The market cost of external borrowing, r_t^{w}, relies on a risk premium, PR_t, and the risk free rate of world, $r^{W,R}$,

$$r_t^{w} = \left(1 + r^{W,R}\right)\left(1 + PR_t\right) - 1 \, . \tag{3.39}$$

[19] In the calibration, it is assumed that the government in Azerbaijan does not issue additional debt so as to finance its deficit.

Unlike Agénor (2016), there is positive relation between country's risk premium and the government debt to non-resource output ratio,

$$PR_t = \left(\frac{D_t^G}{Y_t^T + z_t^{-1} Y_t^N} \right)^{pr_1}, \tag{3.40}$$

where, $pr1 > 0$. Hence, a non-resource output rise causes a decrease in risk premium of country.

3.3.8. Market-Clearing Conditions

For non-tradable sector, the market clearing condition is specified as,

$$Y_t^N = C_t^N + G_t^N . \tag{3.41}$$

In the model, it is assumed that the workforce is employed in only non-tradable and non-resource tradable sectors since the production of the resource, especially oil and natural gases, is capital intensive. Thus, the equilibrium condition for the labor market is[20],

$$L_t = L_t^N + L_t^T . \tag{3.42}$$

[20] The resource sector is capital intensive, and employment in this sector is small compared to the other sectors. Therefore, total labor is assumed to be allocated only between the non-tradable and non-resource tradable production sectors.

The CES aggregator of private capital is specified as,

$$K_{t-1}^{P}=\left[\varsigma_K\left(K_t^T\right)^{(\eta_K-1)/\eta_K}+\left(1-\varsigma_K\right)\left(K_t^N\right)^{(\eta_K-1)/\eta_K}\right]^{\eta_K/\eta_K-1}, \qquad (3.43)$$

where, η_K represents the elasticity of substitution between K_t^T and K_t^N. The determination of rental rate of capital (aggregate) is as follows,

$$r_t^K=\left[\left(\varsigma_K\right)^{\eta_K}\left(r_t^{K,T}\right)^{(1-\eta_K)}+\left(1-\varsigma_K\right)^{\eta_K}\left(r_t^{K,N}\right)^{(1-\eta_K)}\right]^{1/1-\eta_K} . \qquad (3.44)$$

The accumulation of asset in sovereign wealth fund evolves according to,

$$F_{t+1}=(1-\phi^F)F_t+\chi T_t^R, \qquad (3.45)$$

where, $\phi^F\in\left(0,1\right)$ denotes management fee, which is excised on the stock of sovereign wealth fund's assets. $\chi>0$ represents the fraction of resource revenue saved in the country's fund. The saving-investment balance is defines as,

$$D_{t+1}-F_{t+1}=\left(1+r_t^w\right)D_t-\left(1+r_t^F\right)F_t \qquad (3.46)$$
$$+C_t^T+G_t^T+I_t^P-Y_t^T-p_t^RY_t^R,$$

where, $D_t = D_t^P + D_t^G$ represents the total debt.

As in Agenor (2016), the competitive equilibrium comprises sequences of allocations $\left\{C_t^N, C_t^T, I_t^P, D_t, F_t, L_t^N, L_t^T, K_t^P, K_t^N, K_t^T, G_t, G_t^N, G_t^T\right\}_{t=0}^{\infty}$, factor prices, $\left\{p_t, p_t^G, p_t^N, p_t^T, w_t, r_t^K, r_t^{K,T}, r_t^{K,N}\right\}_{t=0}^{\infty}$ and final goods, such that, taking as given, $K_{-1}^P, K_{-1}^G, D_{-1}, F_{-1}$, the exogenous process $\left\{p_t^R, Y_t^R\right\}_{t=0}^{\infty}$, constant policy parameters χ, τ, υ^G and υ, and constant public debt,

a) $\left\{C_t, C_t^N, C_t^T, L_t, I_t^P, D_t^P, K_t^P\right\}_{t=0}^{\infty}$ solve optimization problem of households;

b) $\left\{L_t^N, K_t^N\right\}$ solve the optimization problem of firm, which produces non-tradable goods;

c) $\left\{L_t^T, K_t^T\right\}$ solve the optimization problem of firm, which produces non-resource tradable goods;

d) a sequence of lump-sum taxes $\left\{T_t^L\right\}_{t=0}^{\infty}$, a sequence of spending $\left\{G_t\right\}_{t=0}^{\infty}$ and components of this spending $\left\{C_t^G, I_t^G\right\}_{t=0}^{\infty}$ are set by government; therefore, lifetime and flow budget constraints of government are satisfied;

e) for non-resource tradable goods, private capital, non-tradable goods and labor, market clearing conditions are satisfied.

3.4. Log-Linearization and Steady State Equations of The Model

Summary of log-linearized and steady state[21] equations of the model is presented in this section of the study. However, derivations of these equations are described in

[21] Steady state of variables are represented by subscript "ss".

detail in Appendix 2.A.2 and 2.A.3, respectively. From (3.16), the steady state rental rate of capital (economy wide) is equal to:

$$r_{ss}^{K} = \frac{1}{(1-\tau)}\left(r_{ss}^{w} + \delta^{P}\right).$$

From the Euler equation (3.14), the world interest rate in steady state is given by,

$$r_{ss}^{w} = \frac{1}{\Lambda} - 1.$$

In the steady state, from the equations (3.32) and (3.35), the stock of public capital is equal to:

$$K_{ss}^{G} = \varphi \upsilon^{G} G_{ss} / \delta^{G} \quad .$$

And, from the market cost of external borrowing equation (3.39), risk premium in steady state is,

$$\left(1 + PR_{ss}\right)\left(1 + r^{W,R}\right) = 1 + r_{ss}^{w}.$$

Log-linearized equations are obtained by deriving log deviations of variables around their steady state values[22]. Log linear form of total output is identified by,

$$\hat{Y}_t = \frac{1}{Y_{ss}}\left[Y_{ss}^T \hat{Y}_t^T + z_{ss}^{-1} Y_{ss}^N \left(\hat{Y}_t^N - \hat{z}_t\right) + p_{ss}^R Y_{ss}^R \left(\hat{p}_t^R + \hat{Y}_t^R\right)\right].$$

Total consumption in log-linear form is calculated as,

$$E_t \hat{C}_{t+1} + \varsigma \hat{p}_{t+1} = \hat{C}_t + \varsigma (\hat{r}_t^w + \hat{p}_t).$$

Log-linearizing risk premium gives,

$$P\hat{R}_t = -\left[\frac{Y_{ss}^T \hat{Y}^T - z_{ss}^{-1} Y_{ss}^N \left(\hat{z}_t - \hat{Y}_t^N\right)}{Y_{ss}^T (z_{ss}^{-1} + Y_{ss}^N)}\right] pr_1 .$$

The non-resource primary balance denotes non-resource revenue of government less its non-interest spending,

$$NR\hat{P}B_t = \frac{1}{NRPB_{ss}}\left[T_{ss}^{NO} \hat{T}_t^{NO} + T_{ss}^L \hat{T}_t^L - p_{ss}^G G_{ss} (\hat{G}_t + \hat{p}_t^G)\right].$$

[22] Log deviation of a variable around its steady state is identified with a hat above this variable; however, for interest rate, hat denotes percentage point deviation from its steady state.

And, public capital is,

$$\hat{K}_t^G = \left(1-\delta^G\right)\hat{K}_{t-1}^G + \frac{\varphi_{ss} I_{ss}^G}{K_{ss}^G}\left(\hat{\varphi}_t + \hat{I}_t^G\right).$$

3.5. Calibration

The model is calibrated to Azerbaijan on annual data using several data sources, including the SSCAR Database, the Ministry of Finance of the Republic of Azerbaijan, the Central Bank of the Republic of Azerbaijan, the Ministry of Economic Development of the Republic of Azerbaijan, the SOFAZ annual and quarterly reports, the BP Statistical Review of World Energy and WEO, as well as parameters found in the literature. The values of the benchmark parameter are presented in Table 3.3.

The intertemporal discount factor[23], Λ, is calibrated at 0.969 for households using the real interest rates[24] provided below. As in Agénor (2016), the preference parameter, η_L, is set to 0.12, which is low value. The Frisch elasticity of labor supply is specified at 0.125 $(\psi = 8)$ in order to have an inelastic labor supply. The intertemporal elasticity of substitution, ς, is specified as 0.2, as in Agénor and Montiel (2015). The share of non-tradable goods in total consumption, θ, is calculated as 0.54 using Household Budget Survey (HBS) data (2012-2015) for the Republic of Azerbaijan. This is close to the value, 0.55, reported in Agénor (2016) and Pieschacón (2012), and the methodology used to determine the tradable and non-tradable goods in line with the

[23]The discount factor is derived by using the following steady state equation, $r^W=\Lambda^{-1}-1$, which defines the relationship between discount factor and real interest rate.

[24] The real interest rate (world), r^W, is 3.18 percent, and detailed calculation is explained later.

method used in U.S. Bureau of Labor Statistic (BLS) (2017)[25]. In addition, using HBS data, the share of household oil and gas consumption in tradable consumption, θ^T, is computed as 0.076. Following Berg et al. (2013), the substitution elasticity between consumption of non-traded and traded goods is set at 0.44.

The parameter of adjustment cost for private investment is specified at 25 as one in Berg et al. (2013), while the depreciation rate of private capital is set at 0.068, obtained from Penn World Table[26]. The parameter, which indicates the capital share of the non-resource tradable sector, is set at 0.6 in order to capture that this sector is more capital-intensive than the non-tradable sector. The parameter, η_K, indicative of elasticity of substitution between K_t^N and K_t^T, is calibrated at 0.5 following Primus (2016).

The resource sector's size is computed using statistics published in the State Statistical Committee Database. This sector's size as a share of total GDP for the 2012-2015 period is 39.75 percent. In the Azerbaijan Republic, gas and oil productions constitute a majority of the resource sector. Therefore, the degree of persistence in production is calculated in line with Agénor (2016). Since proven natural gas and oil reserves are assumed to last about 20 years[27], ρ^{Y^R} is computed as 0.932, which indicates a high

[25]U.S. BLS (2017) assumes that the non-tradable sector includes transport, communication, construction, hotels and service sectors, while the tradable sector is the summation of oil, agriculture and non-oil industry sectors.

[26] In Penn World Table, the depreciation rate is estimated for the whole economy; however, it is used as a proxy for private capital in our study.

[27] Azerbaijan proven oil reserves are predicted to be depleted within 22 years, concerning the BP 2015 Statistical Review of World Energy report. Additionally, the proven natural gas reserves in Azerbaijan were predicted to run out in 60 years in the same report. However, the depletion period of natural gas reserves constantly changes due to discovering new reserves and fluctuations in production. Therefore, it assumed that energy reserves would last 20 years in Azerbaijan (by considering the depletion times of oil reserves only), and the formula yields $(\rho^{Y^R})^{7.5} = 0.5$; hence, $\rho^{Y^R} = 0.932$. In the sensitivity analysis, the effect of changing period is also examined.

persistence. Due to the fact that there is strong co-movements between natural gas and oil price, the degree of persistence for resource price, ρ^{P^R}, is 0.93, as reported in Maliszewski(2009), where he focused on oil prices.

Besides, the elasticity of production with respect to labor for non-tradable and tradable sector are calibrated at 0.70 and 0.60, respectively so as to reflect the fact that the non-tradable sector production is more labor intensive than the tradable sector production. Following Agénor (2016), the elasticity of production with respect to public capital, ω_T and ω_N, are assumed to be equal to 0.17 for tradable and non-tradable sectors, which means that the productivity of public infrastructure are same in both sectors.

When it comes to government, based on IMF Article IV and the State Statistical Committee data for the period 2012-2015, the non-resource tax rate is computed at 12 percent. Moreover, using same databases for the same period, the ratio of government spending (non-interest) in GDP, ψ^G, is calculated as 32 percent. According to the Ministry of Finance information, the parameter, υ^G, which indicates the ratio of government infrastructure investment to its total spending is also computed at 32 percent. The parameter, υ, that reflects the share of non-tradable goods in government spending, is calibrated at 0.54, which means that these shares are same in both government spending and private consumption.

Furthermore, the efficiency parameter for public investment, φ, is 0.382, as reported in Dabla-Norris et al. (2012) for the Republic of Azerbaijan, while the parameter, φ_1, is specified as 0.05 following the Agénor (2016).The depreciation rate of public capital, δ^G, is set at 0.325 in line with the estimation of Gupta et al. (2014) for middle-income countries.

Table 3.3: Baseline Parameter Calibration

Parameters	Description	Values
Households		
Λ	Discount factor	0.969
ς	Intertemporal elasticity of substitution	0.2
η_L	Preference parameter, labor in utility function	0.12
ψ	Inverse of Frisch elasticity of labor supply	8
θ	Share of non-tradables in private consumption	0.54
θ^T	Share of energy products in total tradable consumption	0.076
κ	Adjustment cost parameter, private investment	25
δ^P	Depreciation rate, private capital	0.068
ζ_K	Share of capital in the traded sector	0.6
η_K	Elasticity of substitution between K_t^N and K_t^T	0.5
α	Elasticity of substitution between traded and non-traded good	0.44
Resource sector		
ρ^{P^R}	Persistence parameter, world resource price	0.93
ρ^{Y^R}	Persistence parameter, oil output	0.932
Non-resource production		
β, η	Labor shares, tradable and non-tradable sectors	0.6,0.70
$\omega_T = \omega_N$	Elasticity of output wrt public capital	0.17
Government		
τ	Effective tax rate on non-resource income	0.12
ψ^G	Share of total government spending in output	0.32
υ^G	Share of spending on infrastructure investment	0.32
υ	Share of non-tradables in government spending	0.54
φ	Investment efficiency parameter	0.382
φ_1	Absorption constraint parameter, public investment	0.05
δ^G	Depreciation rate, public capital	0.325
ϕ_F	Management fee on sovereign assets	0.001
μ	Weight of consumption volatility in government loss function	0.0-1.0
Risk Premium		
p_1	Elasticity wrt the debt–non-resource tradable and non-tradable output ratio	0.8
World interest rate	World risk-free interest rate	0.017

The annual reports of the State Oil Fund[28] are used to compute the average rate of return earned on the assets of fund, r^F, for the period 2012-2015, that is 1.67 percent. These reports also reveal that the average management fee as a fraction of the stock of sovereign wealth fund's assets, ϕ^F, is 0.1 percent for the same period. Also, sovereign wealth fund's assets are assumed to be initially at 30 percent of GDP, nearly equal to assets to GDP ratio in 2009.

The risk-free world interest rate is calculated as a value of 1.7 percent, equal to average real returns on 30-year bonds of the U.S. Treasury issued in 2015. To compute the world interest rate, r^W, recent averages on nominal returns on sovereign bonds issued by Azerbaijan on the international financial market in 2013 and the average inflation rate of the U.S. for the same year were used. Given that these values are 4.68 and 1.5 percent, respectively, r^W is equal to 3.18 percent. Hence, the risk premium (in foreign currency terms) is computed as 1.45 percent using equation (3.39). The elasticity of the risk premium with respect to the debt to non-resource output ratio, $pr1$, is calibrated as 0.8, and sensitivity analysis is done.

The ratio of non-tradable output-total output is calculated as 49.45 percent, while non-resource tradable output-total output is computed at 10.8 percent using State Statistical Committee data to coincide with the composition of Azerbaijan's output for the periods 2012-2015. The steady state value of the private investment and private consumption (as a percentage of total output) over the same period are 14 percent and 53 percent, respectively. The average stock of private capital flight (as a share of GDP) is calculated as 18.6 percent over the period 2012-2015. Using data for the same period, the total government debt is set at 18.9 percent. Hence, the external debt stock of the economy (as a percentage of GDP) is calculated as 0.3 percent.

[28] See the SOFAZ annual reports (various years)

3.6. Macroeconomic Effects of Resource Windfall

In this section, the macroeconomic effects of resource windfall under two different fiscal rules were analyzed, these are “full spending rule” and “full saving rule”. To do this, equations of the model are log-linearized and a temporary unanticipated shock to resource prices by 10 percent is supposed. While rental rate of capital and risk premium are indicated in percentage point deviation from their steady states, other variables of model are expressed in percent deviation from their steady state by simulations of model. Following Agénor (2016), it is assumed that there is constant government debt and lump-sum taxes adjust in order to balance the government budget under both rules.

3.6.1. Full Spending of Resource Revenues

Under the full spending rule (χ=0), there is no asset accumulation and the government entirely spends resource revenues on investment and consumption needs. The full spending experiment is mostly seen in resource-rich developing countries that do not have any mechanisms such as sovereign wealth funds and have development needs in areas such as health, education and infrastructure. Also, this experiment is supported by some views in the literature for these countries. Formally,

$$\hat{F}_t = 0 \tag{3.47}$$

$$p_{ss}^G G_{ss} (\hat{G}_t + \hat{p}_t^G) = T_{ss}^R \hat{T}_t^R \tag{3.48}$$

Lump-sum taxes, $\hat{T}_t^L$, are solved residually from government budget constraint, (3.37), with using (3.26),

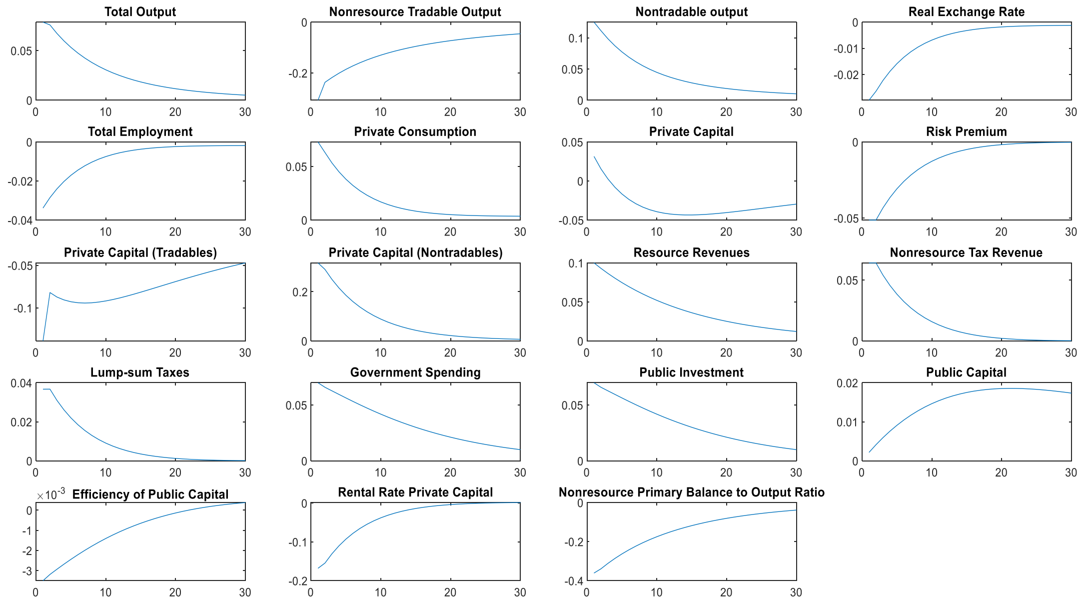
$$T_{ss}^L \hat{T}_t^L = -T_{ss}^{NR} \hat{T}_t^{NR} - T_{ss}^R \hat{T}_t^R - \left(1 + r_{ss}^F\right) F_{ss} \left(\hat{r}_t^F + \hat{F}_t\right) + F_{ss} \hat{F}_t + p_{ss}^G G_{ss} (\hat{G}_t + \hat{p}_t^G) + \left(1 + r_{ss}^w\right) D_{ss}^G \hat{r}_t^w .$$

Using (3.48), and with $\hat{F}_t = \hat{r}_t^F = 0$, lump-sum taxes are specified as,

$$T_{ss}^L \hat{T}_t^L = -T_{ss}^{NR} \hat{T}_t^{NR} + \left(1 + r_{ss}^w\right) D_{ss}^G \hat{r}_t^w . \qquad (3.49)$$

The macroeconomic effects of a 10 percent temporary positive shock in resource price under the full spending rule are presented in Figure 3.17. On the fiscal side, there is a direct windfall effect that increases government revenues. Since this increase is allocated to all government expenditure components, the public investment and consumption grow in the same proportion. However, the positive effect of an increase in public investment on the public capital stock is alleviated by a decrease in investment efficiency due to the absorption constraint.

The other direct windfall effect of an increase in resource price is a positive temporary wealth effect for households generated by the rise of their income. In turn, households increase their current consumption, leading to an increase in household demand for leisure and reduced labor supply. Therefore, employment in both non-tradable and tradable sectors falls. The increase in demand for non-tradable goods causes a real appreciation and leads to a rise in this sector's product wage. The non-resource tradable sector narrows due to the resource movement effect and real appreciation, which weakens its goods' competitiveness. The increase in demand for non-tradable goods raises these goods' production, and this expansion exceeds the contraction in the non-resource tradable sector, which implies growth of non-resource outputs and non-resource revenues. A rise in non-resource revenues results in a growth of non-resource tax revenues. However, the increase in government spending is large enough to reduce the overall primary balance and non-resource primary balance despite the rise in non-resource tax revenues and resource revenues.



Note: The values on figure are absolute deviations from baseline, unless otherwise indicated.

Figure 3.17: Full Spending of Resource Revenues

Since the government debt is assumed to be constant, the increase in total non-resource output lowers the debt-to-non-resource output ratio, which means lowering the risk premium and world interest rate. The decrease in the world interest rate magnifies the increase in today's private consumption through the intertemporal effect and also puts downward pressure on capital's aggregate rental rate. Therefore, private investment and capital stock increase. Due to the the real appreciation and decrease in the rental rate of capital in the non-tradable sector, the capital shifts from the tradable sector toward the non-tradable sectors, generating a rise in the capital stock of that sector.

On the whole, under the full spending experiment, the resource windfall brings about the Dutch disease effects. Over time, these effects are softened by the expansion of public capital, which benefits the supply side.

3.6.2. Full Saving of Resource Revenues

The all resource revenues is completely accumulated in the sovereign wealth fund under the full saving experiment $\left(F_{t+1} = \left(1-\phi^F\right)F_t + T_t^R, \chi = 1\right)$, and merely the interest income earned from the fund's assets is transferred to the government budget so as to finance public investment and consumption. The log-linearized form of the accumulation rule for the stock of sovereign wealth fund's assets under the full saving experiment is specified as,

$$F_{ss}\hat{F}_{t+1} = \left(1-\phi^F\right)F_{ss}\hat{F}_t + T_{ss}^R\hat{T}_t^R \, . \tag{3.50}$$

And the government spending is,

$$p_{ss}^G G_{ss}(\hat{G}_t + \hat{p}_t^G) = \left(1+r_{ss}^F\right)F_{ss}\left(\hat{r}_t^F + \hat{F}_t\right) - F_{ss}\hat{F}_t \, . \tag{3.51}$$

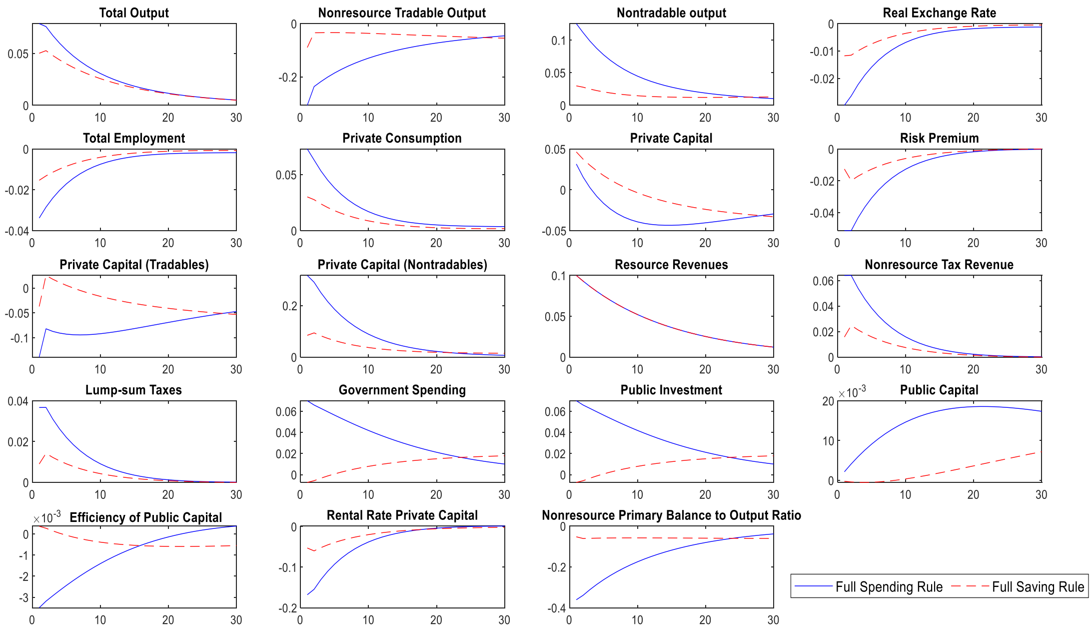
Since the resource revenues are not a direct resource for the government under this experiment, the lump-sum taxes is identified by,

$$T_{ss}^{L}\hat{T}_{t}^{L} = -T_{ss}^{NR}\hat{T}_{t}^{NR} - \left(1+r_{ss}^{F}\right)F_{ss}\left(\hat{r}_{t}^{F} + \hat{F}_{t}\right) + F_{ss}\hat{F}_{t} + p_{ss}^{G}G_{ss}(\hat{G}_{t} + \hat{p}_{t}^{G}) + \left(1+r_{ss}^{w}\right)D_{ss}^{G}\hat{r}_{t}^{w}. \quad (3.52)$$

If we substitute (3.51) into (3.52), the equation of lump-sum taxes will be again specified by (3.49).

Under full saving rule, the macroeconomic effects of a 10 percent temporary positive shock in resource price are presented in Figure 3.18. Accumulation of assets in fund suppresses the Dutch disease effects while reducing the volatility in fiscal variables. Assets in sovereign wealth fund as a share of output grow swiftly and stabilize at nearly 200 percent of GDP. On the fiscal side, comparing with the full spending experiment, government spending increase gradually; hence, public investment and consumption rise less rapidly. Since public investment grows gradually, public investment efficiency goes down less than in the full spending experiment. Additionally, the overall primary balance shows a surplus and the fall in the non-resource primary balance is eliminated by comparison with the full spending case.

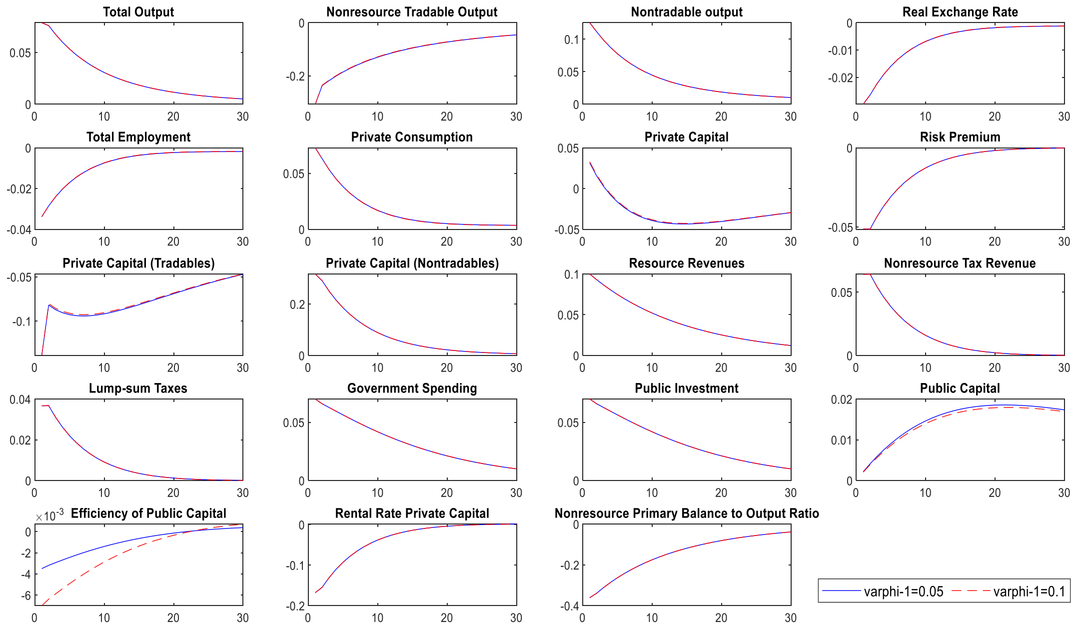
Moreover, under the full saving experiment, the non-resource output also increases, and this increase causes a decline in the risk premium, thereby increasing today's consumption, leading to expansion in demand for leisure and reduction in labor supply. However, compared to full spending experiment, since the non-resource output increases less, reduction in risk premium and rise in consumption are less than the first experiment. One of the key differences with full spending experiment is that the fall in the tradable output is eliminated while the increase in the non-tradable output reduces substantially. Additionally, the drop in non-tradable capital and employment lead to the contraction of non-tradable goods production, thereby lowering product wage in that sector. This substantial contraction causes the rise in the non-resource tax revenues and output to diminish.



Note: The values on figure are absolute deviations from baseline, unless otherwise indicated.

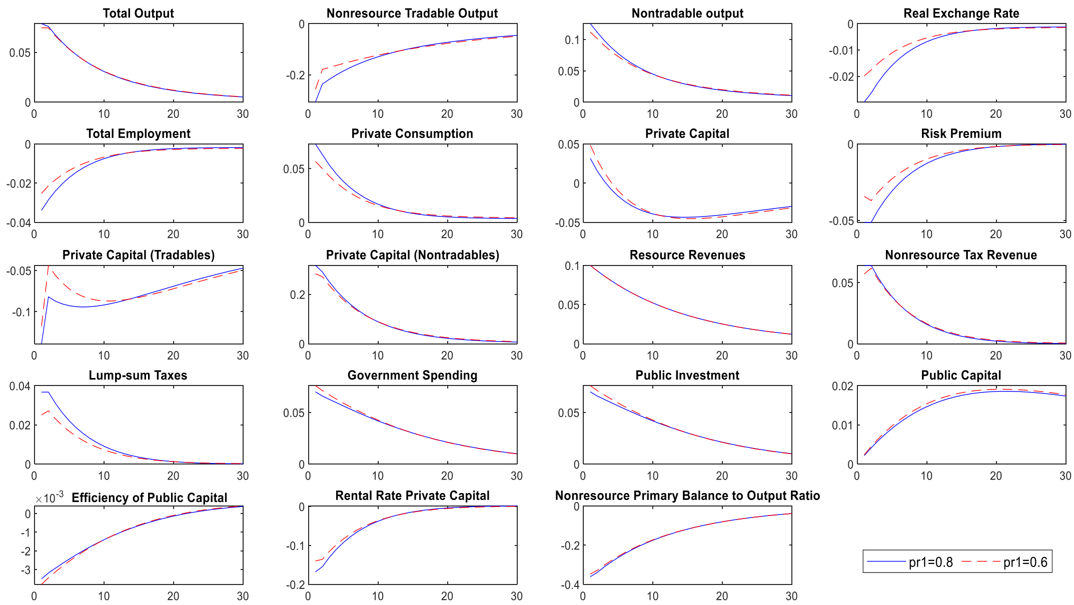
Figure 3.18: Full Spending to Full Saving of Resource Windfall

Two sensitivity analyses are conducted under the resource price shock to show how parameters affect the dynamic of price shock. In the first analysis, the parameter which is an indicator of absorption constraint, φ_1, increases from 0.05 to 0.1. The Figure 3.19 shows the results for both values of φ_1, which are similar in most variables except public capital. Since tighter absorption constraint causes public capital efficiency to fall, the accumulation speed of public capital decreases, thereby negatively influencing the output of both tradable and non-tradable sectors. In the second experiment, the elasticity of the risk premium to public debt-tradable output ratio, *pr1*, decreases from 0.8 to 0.6, reflecting the lower sensitivity of world capital markets to the external debt position of the domestic country. The Figure 3.20 illustrates results calculated with lower *pr1*. Compared to results obtained by a value of 0.8, the initial fall in risk premium is less now, thereby implying less increase in private consumption but more rise in private capital. Also, the real exchange rate appreciates less significantly, which causes a decrease in the contraction of production of the non-resource tradable sector compared to values obtained with benchmark parameter.



Note: The values on figure are absolute deviations from baseline, unless otherwise indicated.

Figure 3.19: Full Spending: Higher φ_1 from 0.05 to 0.1



Note: The values on figure are absolute deviations from baseline, unless otherwise indicated.

Figure 3.20: Full Spending: Lower *pr1* from 0.8 to 0.6

3.7. Optimal Resource Revenue Allocation

The previous chapter states that most resource-rich economies raise government spending with a resource revenue growth and cut down on expenditures with a decrease in resource revenue that results from a decline in resource price. Therefore, these economies are substantially vulnerable to resource revenue shocks. In order to reduce this fiscal procyclicality by overcoming the resource revenue volatility, resource-rich economies establish a sovereign wealth funds and start to accumulate their resource revenues in these funds. Comparing the macroeconomic effects of the full saving experiment with the full spending experiment analyzed in the previous part, it is showed that the accumulation of assets in fund eliminates the Dutch disease effects while reducing the volatility in variables, especially in fiscal ones. Hence, establishing funds and accumulating resource windfall in these funds serve as a precautionary buffer for resource-rich countries. However, as these economies have development needs such as infrastructure, health and education, it is necessary to transfer some part of their resource revenues to their government budgets to satisfy these needs. Here, the one important policy question that arises is what should be the optimal transfer of resource revenues to government budget with concerning household welfare and economic volatility.

In order to answer this critical question for Azerbaijan, as a resource-rich developing country, a fiscal experiment is defined. Under this experiment, a fraction of resource windfalls, χ, is saved in a sovereign wealth fund, when there is a temporary price shock (10 percent increase in resource price). Indeed, $1-\chi$ fraction of resource windfall is used for government spending. Formally, log-linearized asset accumulation rule is now identified by,

$$F_{ss}\hat{F}_{t+1} = \left(1-\phi^{F}\right)F_{ss}\hat{F}_{t} + \chi T_{ss}^{R}\hat{T}_{t}^{R} . \tag{3.53}$$

While the government spending rule is,

$$p_{ss}^{G}G_{ss}(\hat{p}_{t}^{G}+\hat{G}_{t})=\left[(1-\chi)T_{ss}^{R}\hat{T}_{t}^{R}+(1+r_{ss}^{F})F_{ss}(\hat{F}_{t}+\hat{r}_{t}^{F})-F_{ss}\hat{F}_{t}\right]. \tag{3.54}$$

The lump-sum taxes equation is specified as,

$$T_{ss}^{L}\hat{T}_{t}^{L}=-T_{ss}^{NR}\hat{T}_{t}^{NR}-(1-\chi)T_{ss}^{R}\hat{T}_{t}^{R}-(1+r_{ss}^{F})F_{ss}(\hat{F}_{t}+\hat{r}_{t}^{F})+F_{ss}\hat{F}$$
$$+p_{ss}^{G}G_{ss}(\hat{p}_{t}^{G}+\hat{G}_{t})_{t}+\left(1+r_{ss}^{w}\right)D_{ss}^{G}\hat{r}_{t}^{w}. \tag{3.55}$$

Besides partial spending fiscal experiment, the objective function of the policymaker should be specified. In order to set the optimal saving level of resource revenue and define a loss function, the volatility of four key variables are assessed: the ratio of non-resource fiscal balances to output $\left(\sigma_{NRPBY}^{\chi}\right)$, private consumption $\left(\sigma_{C}^{\chi}\right)$, total employment $\left(\sigma_{L}^{\chi}\right)$ and real exchange rate $\left(\sigma_{Z}^{\chi}\right)$.

Conceptually, using a similar method to Agénor (2016), a criterion is proposed that is to set χ in order to minimize loss function defined as the weighted geometric average of a fiscal/macroeconomic stability measure and welfare measure. The welfare measure is represented by the volatility[29] of private consumption or by an equally weighted geometric average of the volatility of total employment and private consumption. Similarly, the measure of fiscal stability is denoted by the volatility of non-resource primary balance to output ratio, while the measure of macroeconomic stability is specified by an equally weighted geometric average of the volatility of real

[29] Volatilities are calculated by the model's simulated path for all cases.

exchange rate and that of the non-resource primary balance to output ratio. In this study, the following three loss functions are considered:

$$\mathcal{L}_t^{S_1}(\chi) = \left(\sigma_C^{\chi}\right)^{\mu} \left(\sigma^{\chi}{}_{NRPBY}\right)^{1-\mu}, \tag{3.56}$$

$$\mathcal{L}_t^{S_2}(\chi) = \left[\left(\sigma_C^{\chi}\right)^{0.5} \left(\sigma_L^{\chi}\right)^{0.5}\right]^{\mu} \left(\sigma^{\chi}{}_{NRPBY}\right)^{1-\mu}, \tag{3.57}$$

$$\mathcal{L}_t^{G}(\chi) = \left(\sigma_C^{\chi}\right)^{\mu} \left[\left(\sigma^{\chi}{}_{NRPBY}\right)^{0.5} \left(\sigma_Z^{\chi}\right)^{0.5}\right]^{1-\mu}, \tag{3.58}$$

where parameter, $\mu \in (0,1)$ denotes relative weight that is attached to the welfare of the household. Hence, if the policy maker specifies a policy merely on the basis of household welfare then $\mu = 1$; while if the policy maker is solely concerned with fiscal or macroeconomic stability, $\mu = 0$. In order to calculate loss function, χ parameter and μ parameter are changed between 0 and 1 with a grid of 0.1. The equations (3.56) and (3.57) defined in the previous section are called "social loss functions." Tables 3.4 and 3.5, in which optimum values are shown in bold, present calculations for social loss functions. The results show that if the policy maker is solely concerned with fiscal stability $(\mu = 0)$, then $\chi = 0.3$, which shows that 30 percent of resource revenue should be saved in the fund. By contrast, if the policy maker is merely concerned with the household welfare $(\mu = 1)$, then $\chi = 0.8$. In reality, one would expect the government to be concerned with both types of volatility. Hence, if the policy maker is equally concerned with fiscal volatility and household welfare, then $\chi = 0.4$.

Table 3.4: Optimal Allocation of Resource Revenue under Social Loss Function (C, NRPB)

		μ										
Variable	Standard Deviation (SD)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
χ=0.0												
C	0.1414	0.9451	0.7816	0.6464	0.5345	0.4420	0.3656	0.3023	0.2500	0.2068	0.1710	0.1414
NRPB/Y	0.9451											
χ=0.1												
C	0.1341	0.8902	0.7367	0.6096	0.5045	0.4175	0.3455	0.2859	0.2366	0.1958	0.1620	0.1341
NRPB/Y	0.8902											
χ=0.2												
C	0.1276	0.8569	0.7083	0.5855	0.4840	0.4000	0.3307	0.2733	0.2259	0.1868	0.1544	0.1276
NRPB/Y	0.8569											
χ=0.3												
C	0.1218	**0.8476**	**0.6981**	**0.5750**	**0.4736**	0.3901	0.3213	0.2646	0.2180	0.1795	0.1479	0.1218
NRPB/Y	0.8476											
χ=0.4												
C	0.1170	0.8632	0.7068	0.5788	0.4740	**0.3881**	**0.3178**	0.2602	0.2131	0.1745	0.1429	0.1170
NRPB/Y	0.8632											
χ=0.5												
C	0.1132	0.9023	0.7332	0.5957	0.4841	0.3933	0.3196	**0.2597**	**0.2110**	0.1715	0.1393	0.1132
NRPB/Y	0.9023											

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 3.4: (Cont'd) Optimal Allocation of Resource Revenue under Social Loss Function (C, NRPB)

		μ										
Variable	SD	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
χ=0.6												
C	0.1106	0.9621	0.7750	0.6242	0.5028	0.4050	0.3262	0.2627	0.2116	**0.1705**	0.1373	0.1106
NRPB/Y	0.9621											
χ=0.7												
C	0.1092	1.039	0.8294	0.6621	0.5286	0.4219	0.3368	0.2689	0.2147	0.1714	**0.1368**	0.1092
NRPB/Y	1.0390											
χ=0.8												
C	0.1091	1.1295	0.8941	0.7077	0.5602	0.4435	0.3510	0.2779	0.2200	0.1741	0.1378	**0.1091**
NRPB/Y	1.1295											
χ=0.9												
C	0.1103	1.2307	0.9669	0.7597	0.5969	0.4689	0.3684	0.2895	0.2274	0.1787	0.1404	0.1103
NRPB/Y	1.2307											
χ=1.0												
C	0.1127	1.3401	1.0462	0.8168	0.6376	0.4978	0.3886	0.3034	0.2369	0.1849	0.1444	0.1127
NRPB/Y	1.3401											
Optimum χ		0.33	0.33	0.33	0.35	0.39	0.41	0.47	0.54	0.60	0.71	0.79

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 3.5: Optimal Allocation of Resource Revenues under Social Loss Function (C, L, NRPB)

		μ										
Variable	SD	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
χ=0.0												
C	0.1414	0.9451	0.7514	0.5974	0.4749	0.3776	0.3002	0.2387	0.1897	0.1509	0.1199	0.0954
L	0.0643											
NRPB/Y	0.9451											
χ=0.1												
C	0.1341	0.8902	0.7084	0.5637	0.4486	0.3570	0.2841	0.2261	0.1799	0.1432	0.1139	0.0907
L	0.0613											
NRPB/Y	0.8902											
χ=0.2												
C	0.1276	0.8569	0.6813	0.5417	0.4306	0.3424	0.2722	0.2164	0.1721	0.1368	0.1088	0.0865
L	0.0586											
NRPB/Y	0.8569											
χ=0.3												
C	0.1218	**0.8476**	**0.6717**	**0.5323**	**0.4218**	0.3343	0.2649	0.2100	0.1664	0.1319	0.1045	0.0828
L	0.0563											
NRPB/Y	0.8476											
χ=0.4												
C	0.1170	0.8632	0.6803	0.5362	0.4226	**0.3331**	**0.2625**	**0.2069**	0.1631	0.1285	0.1013	0.0799
L	0.0545											
NRPB/Y	0.8632											
χ=0.5												
C	0.1132	0.9023	0.7060	0.5524	0.4322	0.3382	0.2646	0.2070	**0.1620**	0.1268	0.0992	0.0776
L	0.0532											
NRPB/Y	0.9023											

Note: NRPB/Y, C and L represent the ratio of non-resource primary balance to output, consumption and labor, respectively.

Table 3.5: (Cont'd) Optimal Allocation of Resource Revenues under Social Loss Function (C, L, NRPB)

						μ						
Variable	SD	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
χ=0.6												
C	0.1106	0.9621	0.7466	0.5794	0.4496	0.3489	0.2708	0.2101	0.1631	**0.1265**	0.0982	0.0762
L	0.0525											
NRPB/Y	0.9621											
χ=0.7												
C	0.1092	1.0390	0.7995	0.6152	0.4734	0.3643	0.2803	0.2157	0.1660	0.1277	**0.0983**	0.0756
L	0.0524											
NRPB/Y	1.0390											
χ=0.8												
C	0.1091	1.1295	0.8623	0.6583	0.5026	0.3837	0.2929	0.2236	0.1707	0.1303	0.0995	**0.0760**
L	0.0529											
NRPB/Y	1.1295											
χ=0.9												
C	0.1103	1.2307	0.9330	0.7073	0.5362	0.4065	0.3082	0.2336	0.1771	0.1343	0.1018	0.0772
L	0.0540											
NRPB/Y	1.2307											
χ=1.0												
C	0.1127	1.3401	1.0099	0.7610	0.5735	0.4322	0.3257	0.2454	0.1850	0.1394	0.1050	0.0792
L	0.0556											
NRPB/Y	1.3401											
Optimum χ		0.29	0.30	0.32	0.35	0.38	0.39	0.44	0.50	0.56	0.65	0.71

Source: Model simulation results and author's calculations.

Note: NRPB/Y, C and L represent the ratio of non-resource primary balance to output, consumption and labor, respectively.

Table 3.6: Optimal Allocation of Resource Revenue under Generalized Loss Function (C, NRPB, Z)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.1414	0.2345	0.2230	0.2120	0.2015	0.1916	0.1821	0.1731	0.1646	0.1565	0.1487	0.1414
Z	0.0582											
NRPB/Y	0.9451											
χ=0.1												
C	0.1341	0.2215	0.2106	0.2003	0.1905	0.1812	0.1723	0.1639	0.1559	0.1483	0.1410	0.1341
Z	0.0551											
NRPB/Y	0.8902											
χ=0.2												
C	0.1276	0.2115	0.2011	0.1912	0.1817	0.1728	0.1643	0.1562	0.1485	0.1412	0.1342	0.1276
Z	0.0522											
NRPB/Y	0.8569											
χ=0.3												
C	0.1218	0.2048	0.1945	0.1846	0.1753	0.1664	0.1580	0.1500	0.1424	0.1351	0.1283	0.1218
Z	0.0495											
NRPB/Y	0.8476											
χ=0.4												
C	0.1170	0.2016	0.1910	0.1808	0.1713	0.1622	0.1536	0.1455	0.1378	0.1305	0.1235	0.1170
Z	0.0471											
NRPB/Y	0.8632											
χ=0.5												
C	0.1132	**0.2013**	**0.1900**	**0.1794**	**0.1694**	0.1599	0.1509	0.1425	0.1345	0.1270	0.1199	0.1132
Z	0.0449											
NRPB/Y	0.9023											

Note: NRPB/Y, C and Z represent the ratio of non-resource primary balance to output, consumption and real exchange rate, respectively.

Table 3.6: (Cont'd) Optimal Allocation of Resource Revenue under Generalized Loss Function (C, NRPB, Z)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.6												
C	0.1106	0.2036	0.1916	0.1802	0.1696	**0.1595**	**0.1501**	0.1412	0.1328	0.1250	0.1176	0.1106
Z	0.0431											
NRPB/Y	0.9621											
χ=0.7												
C	0.1092	0.2081	0.1951	0.1830	0.1715	0.1608	0.1508	**0.1413**	**0.1325**	**0.1242**	**0.1165**	0.1092
Z	0.0417											
NRPB/Y	1.0390											
χ=0.8												
C	0.1091	0.2144	0.2004	0.1873	0.1751	0.1636	0.1529	0.1430	0.1336	0.1249	0.1167	**0.1091**
Z	0.0407											
NRPB/Y	1.1295											
χ=0.9												
C	0.1103	0.2222	0.2071	0.1931	0.1801	0.1679	0.1565	0.1460	0.1361	0.1269	0.1183	0.1103
Z	0.0401											
NRPB/Y	1.2307											
χ=1.0												
C	0.1127	0.2315	0.2154	0.2005	0.1866	0.1736	0.1615	0.1503	0.1399	0.1302	0.1211	0.1127
Z	0.0400											
NRPB/Y	1.3401											
Optimum χ		0.45	0.47	0.51	0.54	0.58	0.61	0.65	0.67	0.71	0.73	0.79

Source: Model simulation results and author's calculations.

Note: NRPB/Y, C and Z represent the ratio of non-resource primary balance to output, consumption and real exchange rate, respectively.

With intervals of 0.1, both social functions give nearly same optimum values since volatility of private consumption and total employment follow similar path. Social loss functions are also computed using finer grid search with intervals of 0.01. The last lines of Table 3.4 and 3.5 present the results of finer grid search. The optimal values for the first and second social loss functions are 0.71 and 0.79 in the case of $(\mu = 1)$, 0.33 and 0.29 in the case of $(\mu = 0)$ and 0.41 and 0.39 in the case of $(\mu = 0.5)$.

Table 3.6 shows the generalized loss function calculations, using equal weight on the real exchange rate and fiscal indicator. The findings illustrate that values of χ are higher than values in benchmark case in general since volatility of real exchange rate reduces with a higher value of χ. If the policy maker is only concerned with macroeconomic stability $(\mu = 0)$, then $\chi = 0.5$, while the government is merely concerned with volatility of private consumption $(\mu = 1)$, then $\chi = 0.8$. However, if the government is equally concerned with macroeconomic stability and volatility of private consumption $(\mu = 0.5)$, then $\chi = 0.6$. In order to get more precise optimum values, generalized loss functions are computed using a finer grid. Optimal values of χ for the cases $(\mu = 0), (\mu = 0.5)$ and $(\mu = 1)$ are 0.45, 0.61 and 0.79, respectively.

Figure 3.21 illustrates the graphs of our three loss functions where the policy maker gives equal importance on fiscal stability (macroeconomic stability) and households' welfare. The first and second social loss functions decrease until the value of χ (saving fraction of resource revenues) reaches 0.4, whereas this value is 0.6 for the generalized loss function. However, after these values of χ, the loss functions start to increase, which shows that they have convex shape. The convex shape of the loss functions means that they are minimized for a value of χ. The reason for these loss functions' behavior is that both volatilities of non-resource primary balance to output and consumption also have convex shapes. That is to say, a decline in today's spending can reduce volatility for now. However, the more revenue is saved, the more interest income earned from the assets of the fund, which tends to increase spending in time, thereby raising volatility once again. Since the shock is temporary, this effect is not symmetric.

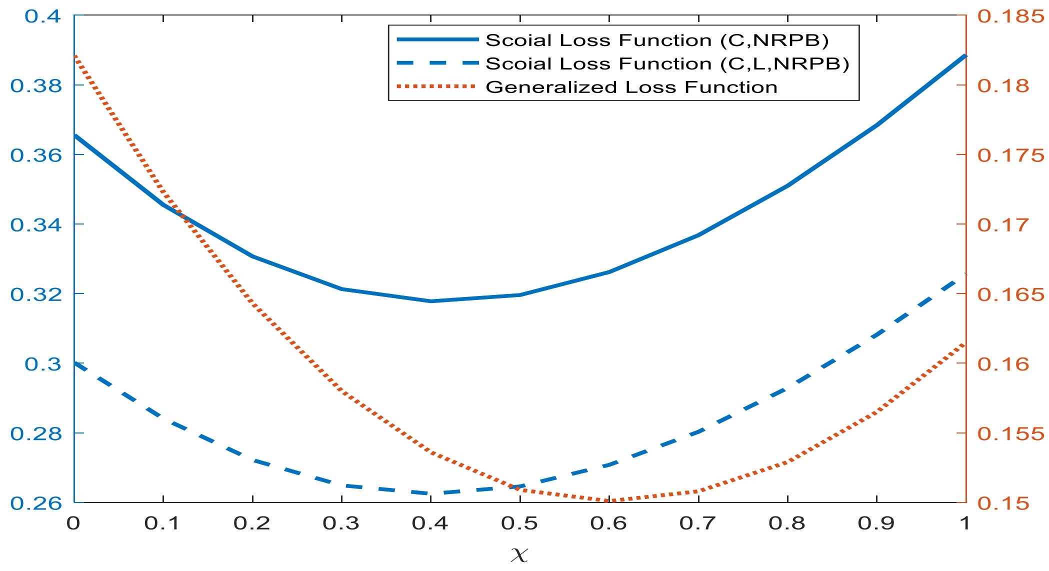


Figure 3.21: Loss Functions $\mathcal{L}_t^{S_1}, \mathcal{L}_t^{S_2}, \mathcal{L}_t^{G}$ (μ=0.5)

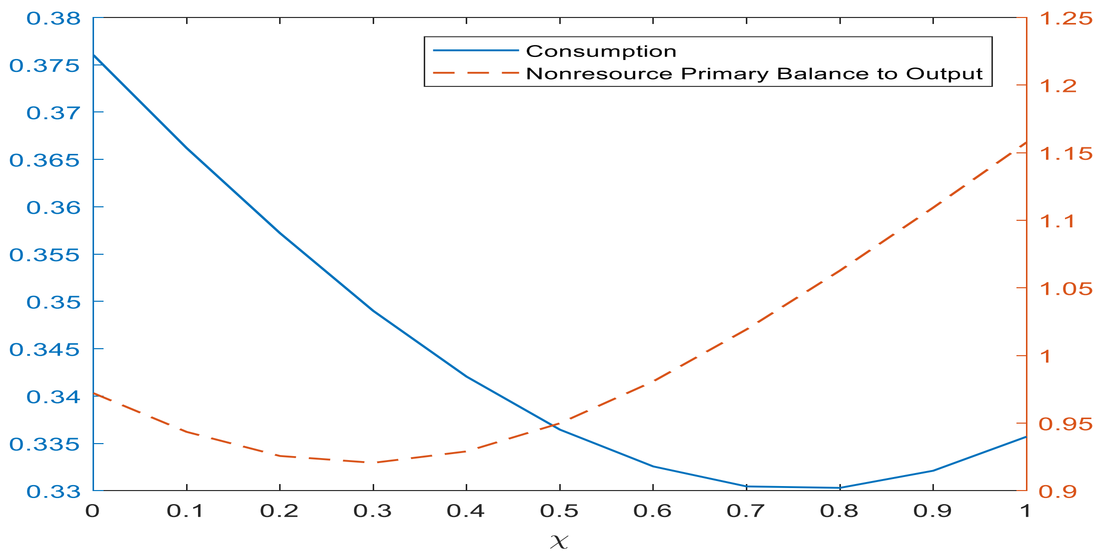


Figure 3.22: Volatility of Non-Resource Primary Balance to Output and Consumption

Figure 3.22 illustrates the volatility of non-resource primary balance to output ratio and private consumption with χ changing between 0 and 1 for the case where government gives same importance on fiscal stability and household welfare $(\mu = 0.5)$. Also, the shape of these volatilities can change with variations of the model parameters and the degree of persistence of shock.

3.8. Sensitivity Analysis of The Model

This section checks the robustness of the results obtained in the last part for the optimal χ values computed using the first social function (3.56), which is assumed as a benchmark case. Following changes in some parameters are analyzed: tighter absorption constraints; alternative risk premium measure; a higher share of government spending allocated to government infrastructure investment; a higher elasticity of output with respect to public capital.

3.8.1. Absorption Constraints

Owing to absorption constraint, a rise in public capital leads to a decrease in efficiency, thereby diminishing the increase in the stock of public capital for developing countries. This drop in the fluctuations in the public capital causes volatilities of other variables to decrease and require a lower optimal value of χ. The calculations of this experiment presented in Table 2.A.1 (it is reported in the Appendix) indicate that when φ_1 goes up from 0.05 to 0.07, the optimum values for χ are the same as the benchmark case values (Table 3.4). However, finer grid search is done in order to obtain more clear results. The results illustrate that with $\mu = 0$ and $\mu = 0.1$, the optimum values for χ are 0.29 and 0.32, respectively, whereas they are both 0.33 in the benchmark case (Table

3.4). Therefore, if the absorption constraint increases, the optimal value of χ will reduce, which means a fall in saving.

3.8.2. Government Spending Rule (Investment-Biased)

In the benchmark experiment, it is assumed that the government spends the transfer of resource revenues on consumption and investment. This section analyzes the investment-biased rule under which there is rise in the share of government spending allocated to government infrastructure investment, υ^G. As stated in Agénor(2016), the investment-biased rule is more realistic since developing countries need some development needs such as human development besides infrastructure needs. Under this experiment, it is expected that the increase in parameter υ^G causes public capital to increase, thereby implying a decrease in the volatility of macroeconomic variables such as real exchange rate and consumption. Table 2.A.2 presents the results where the value of υ^G rises from 0.32 (benchmark case) to 0.40 (investment-biased rule). Comparing Table 2.A.2 with Table 3.4 indicates that the χ value is generally lower. To illustrate, for $\mu = 0.6$ and $\mu = 0.8$, the optimal χ value is 0.4 and 0.5, respectively compared with 0.5 and 0.6 in Table 3.4.

3.8.3. Elasticity of Output with Respect to Public Capital

The Table 2.A.3 illustrates optimal χ values when the value of 0.22 is used instead of the value of 0.17 (benchmark case) for the elasticity of output in both non-tradable and tradable sectors with respect to public capital, ω_T and ω_N **.** Under this experiment, the optimal value of χ is expected to increase compared to the value in the benchmark case in line with Agénor and Neanidis (2015). The results in the Table 3.9 indicate that the optimum values for χ are lower compared with the values in the benchmark case (Table

3.4). To illustrate, for $\mu = 0.7$, the optimal χ value is 0.4 but 0.5 for benchmark case (Table 3.4).

3.8.4. Alternative Risk Premium Measure

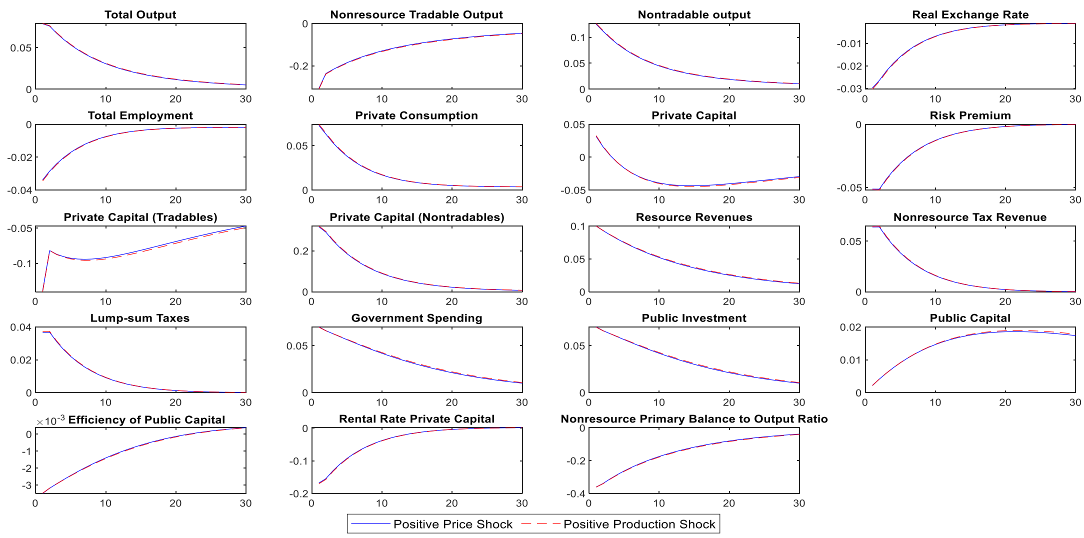
This section examines variations in the optimal value of χ when the different measure of risk premium is used in the model. Now, it is assumed that there is positive relation between country's risk premium and the government debt-total output ratio instead of government debt to non-resource output ratio. Therefore, the equation (3.40) will be changed as;

$$PR_t = \left(\frac{D_t^G}{Y_t} \right)^{pr1}. \tag{3.59}$$

Natural resources are generally seen as a risk by credit rating agencies since their volatility are very high and they cause a lack of production diversification, increased political risk, and weak institutions in especially developing country. Hence, using equation (3.59) instead of the equation (3.40) will increase the volatility of risk premium and the world interest rate which results in a rise in the volatility of output and consumption. In this case, the values of χ are expected to be higher comparing with the benchmark experiment. The Table 3.A.4 illustrates that if the policymaker focuses on households' welfare $(\mu = 0.9)$ and $(\mu = 1)$, the optimal values of χ are 0.9 and 1, respectively, which are higher than the optimal values (0.70 and 0.80) in the benchmark case.

3.9. Production Shock

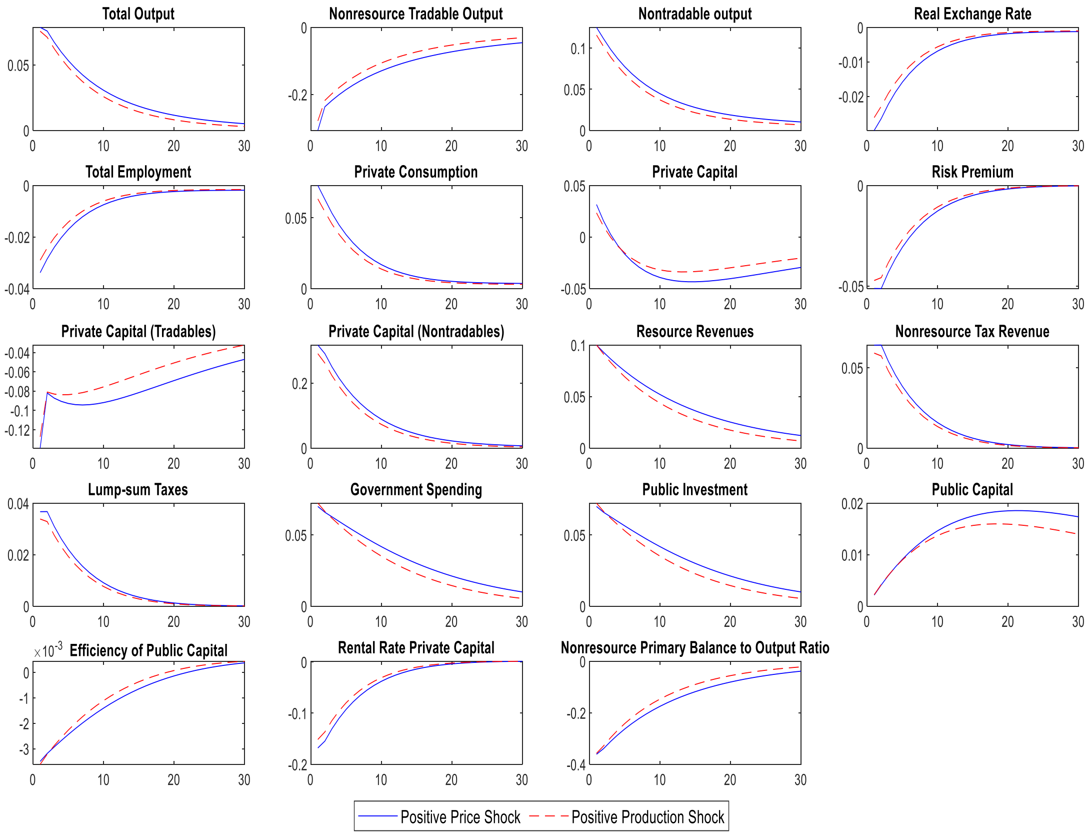
In resource-rich countries, the resource windfall effect can also be seen when resource production goes up. In this analysis, proven natural gas and oil reserves in Azerbaijan are assumed to last about 20 years; therefore, the degree of persistence in resource production is computed as 0.932, indicating a high persistence. This section investigates the macroeconomic effects of a 10 percent temporary positive shock in resource production under full spending and full saving experiment as well as the optimal transfer of resource revenues to government budget. To check the robustness of the results, the analysis is also done with a lower degree of persistence, 0.912, where proven natural gas and oil reserves in Azerbaijan are assumed to last about 15 years.



Note: The values on figure are absolute deviations from baseline.

Figure 3.23: Full Spending: Price Shock versus Production Shock ρ^{YO}= 0.932

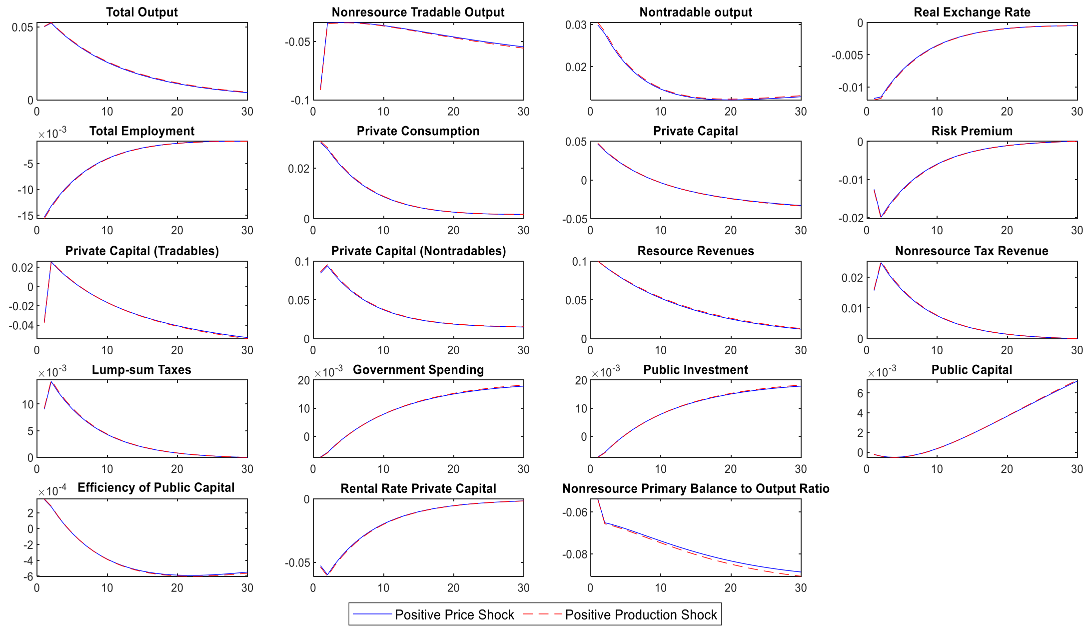
The Figure 3.23 illustrates results for a 10 percent temporary positive shock in resource production compared to the simulations from 10 percent price shock under the full spending rule. The results indicate that both price and production shock dynamics are the same for most variables since the degree of persistence for both price and production shocks is nearly the same. The analysis is repeated using a lower degree of persistence, 0.912 for the production shock. In comparison to the resource price shock, Figure 3.24 shows that the fiscal variable's volatility is lightly lower, while the movements in private capital are more noticeable under the production shock. Moreover, the exchange rate's appreciation considerably diminishes, thereby alleviating output and private consumption volatility compared to resource price shock. As a side note, the rental rate of capital in the non-tradable sector declines, causing a drop in the increase of total output and capital in that sector when there is a rise in resource production.



Note: The values on figure are absolute deviations from baseline.

Figure 3.24: Full Spending: Price Shock versus Production Shock ρ^{YO}= 0.912

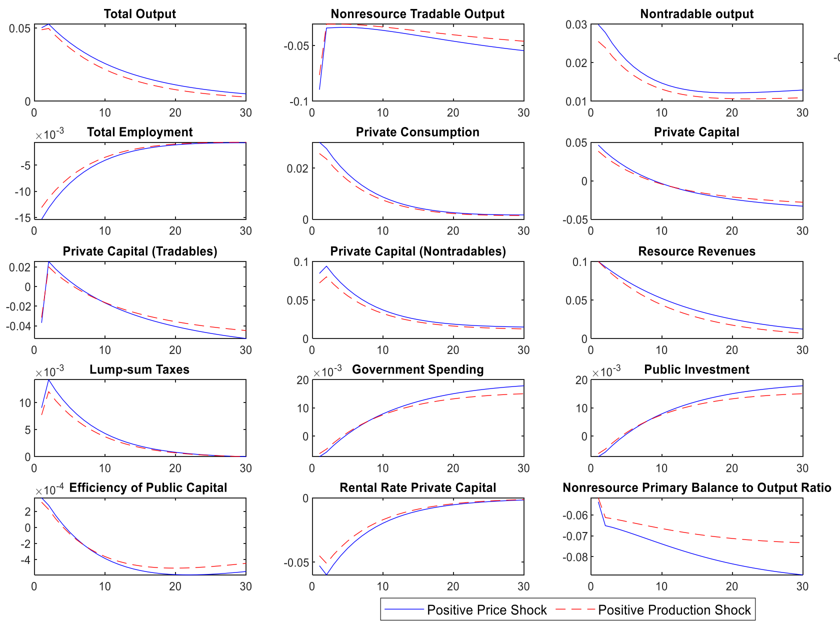
The Figure 3.25 and 3.26 show the results for a 10 percent temporary positive shock in resource production with 0.932 and 0.912 degrees of persistence under the full saving rule, respectively (compared to the simulations from 10 percent price shock). The dynamics of production shock with 0.932 degree of persistence and price shock are the same; however, this uniformity starts to differentiate when the degree of persistence decreases from 0.932 to 0.912.



Note: The values on figure are absolute deviations from baseline.

Figure 3.25: Full Saving: Price Shock versus Production Shock ρ^{YO}= 0.932

Compared to price shock, due to the fact that the decrease in the non-resource output is less, the volatilities in the risk premium and world interest rate diminish, thereby mitigating the fluctuation in the private capital and consumption under the production shock. In addition, the increases in the fiscal variables fall slightly when resource production rises.



Note: The values on figure are absolute deviations from baseline.

Figure 3.26: Full Saving: Price Shock versus Production Shock $\rho^{YO} = 0.912$

The optimal χ values are computed using the social loss function (benchmark case) under the production shock. The results in the Table 2.A.1.5 illustrate that, under production shock, optimal values are generally the same as the values obtained under the price shock when the degree of persistence for production shock is calculated as 0.932. The experiment is repeated with using the lower degree of persistence for production shock which is 0.912. The results in Table 2.A.1.6 indicate that the optimal values of χ appear higher for most of values of μ compared to values under the price shock. For instance, when government are equally concerned about volatility of consumption and fiscal stability, the optimal χ value is 0.50 but 0.40 for benchmark case (Table 3.4).

3.10. Conclusion

The chapter aims to develop a three-sector DSGE model to investigate the macroeconomic effects of temporary resource production and price shocks under two alternative fiscal rules; these are full saving and full spending rules. The model is parameterized for the Republic of Azerbaijan. Also, this chapter examines the optimal spending and saving of resource revenues. The optimal allocation rule is determined to minimize the social loss function expressed in terms of fiscal stability and household welfare[30].

The study's main findings indicate that spending all resource revenues generates high volatility and causes an appreciation of real exchange rate and non-resource tradable sector contraction, called the Dutch disease effect. Contrary to this, the Dutch disease effect is alleviated if all the revenue is saved. The reason is that the full saving of resource revenue reduces government spending, which lowers aggregate demand pressures, thereby causing a fall in non-tradable production. Moreover, social loss function results show a volatility trade-off (dynamic) between spending today and saving. Furthermore, this trade-off is clearer for fiscal and consumption volatility. Hence, as the share of resource revenues saved in the fund goes up, the volatilities of the non-resource primary balance to output ratio and consumption fall until $\chi = 0.3$ and $\chi = 0.8$, respectively. However, these volatilities start to increase for the higher value of χ and takes a convex shape. As the non-resource balance to output ratio equation includes output, government spending, lump-sum taxes and world interest rates (therefore indirectly debt to non-resource output ratio and risk premium), the volatilities of these variables have an impact on the formation of this convex shape. Additionally, spending all assets held in the fund on consumption and investment generates high volatility in the non-resource primary balance to output ratio and consumption. Besides, resource production shock may have similar effects as resource

[30] As an indicator of household welfare, employment is also used besides private consumption. However, it does not create a big difference.

price increase since both types of shock generate a higher resource revenue for the government.

According to the optimal allocation of resource revenues under the resource price shock, if the Azerbaijan government is solely concerned with fiscal stability, then 33 percent of resource revenues should be saved in SOFAZ. By contrast, if the government is merely concerned with consumption volatility, this proportion is 79 percent. In reality, one would expect the government to be concerned with both types of volatility. Hence, if the policy maker gives equal importance on fiscal stability and household welfare, the optimal allocation rule suggests that at least 41 percent of resource revenues should be saved.

Contrary to these findings, nearly 72 percent of resource revenue inflows to fund have been spent from the establishment of SOFAZ to 2019, which is higher than the optimal values explained above. Additionally, there is only one withdrawal rule for SOFAZ, which remarks that when the gas and oil revenues reach their peak, at least 25 percent of these annual resource revenues shall be saved in SOFAZ. This rule also does not take particular issues such as fiscal stability and household welfare into consideration. Hence, these results show that the Azerbaijan government should reassess its policy concerning saving and spending so that the amount of resource revenue transferred from fund to the state budget declines, thereby providing more asset accumulation in SOFAZ. Similarly, the IMF (2012) recommended that developing resource-rich economies increase value of assets in their sovereign wealth fund to break the link between government spending and resource revenue dynamics.

The other way to raise the size of the fund is to enhance its investment portfolio performance. SOFAZ's investment strategy has been conservative, and most of the assets accumulated in it was invested in the money market and fixed income instruments, which have very low risk. The investment portfolio of SOFAZ performs worse than sovereign wealth funds of other countries such as the Norwegian Pension Fund and USA Alaska Fund since the shares of money instruments and fixed income are at most 35 percent in these funds. While the SOFAZ's average profit was merely 1.53 percent, it was equaled 9.7 percent for the USA Alaska Fund and 7.6 percent for the Norwegian Pension Fund between 2010 and 2017. Hence, policymakers in Azerbaijan can increase the fund's real return by changing the composition of the investment portfolio, thereby providing more asset accumulation in SOFAZ.

Moreover, the Azerbaijan government should apply policies that reduce resource dependency since the increase in non-renewable resource reserves and price are temporary. Otherwise, Azerbaijan may have to follow a procyclical fiscal policy. The contribution of non-resource industrial sectors to the Azerbaijan state budget is not enough to reduce the non-oil primary balance (as a percentage of non-oil GDP) below 30 percent. Therefore, the state budget dependency on resource revenues is very high in Azerbaijan and, the volatility and uncertainty of resource revenue make harder fiscal planning and macroeconomic management. Azerbaijan should apply policies to promote non-resource exports and GDP to develop a strong non-resource tax base, reducing oil dependency on the state budget.

Besides, the public investment efficiency in Azerbaijan was calculated to be 38.2 percent by Dabla-Norris et al. (2012), which denotes that government investment spending has low quality. Additionally, Aliyev and Mikayilov (2016) present evidence that social and capital spending efficiency fell noticeable in the oil-boom period, and capital expenditures are not productive enough for non-oil sector development. In light of these findings, eliminating unnecessary government expenditure should be a priority for Azerbaijan while building a new expenditure allocation strategy to increase public investment efficiency. Moreover, accumulating a more significant proportion of resource revenues in sovereign wealth fund until government spending efficiency improves can reduce the waste of Azerbaijan's natural resource wealth.

In the literature, there have been various studies on natural resource wealth management that examine the optimal allocation of natural resource windfalls in non-stochastic models by using arbitrary allocation rules. Since this research applies DSGE methodology, it differs from those in the literature. However, the main findings of this research show similarities with some of them. Collier et al. (2010) and van der Ploeg (2012) indicate that if an economy spends all of their natural resource windfalls, this can cause a Dutch disease effect, which confirms our study's finding. Contrary to this, van der Ploeg and Venables (2011) show that if natural resource windfall is not spent on non-tradable goods, the Dutch disease effects can be avoided. Additionally, Ibadoglu et al. (2013) and Ahmadov et al. (2010) suggest that a fiscal rule may be adopted that at most 30 percent of SOFAZ assets can be transferred to the state budget, which is close to value calculated in this research.

CHAPTER 4

CONCLUSION

Commodity prices and productions have fluctuated continuously throughout history. These fluctuations cause procyclical fiscal behavior in most resource-rich countries, as commodity exports constitute a large part of their total exports. A procyclicality of fiscal policy can be defined as governments choosing to raise spending with a resource revenue growth but reduce spending during the resource revenues fall. Countries can adopt fiscal rules and fiscal institutions to manage income volatility resulted from a high resource revenue dependency. In this context, a common and crucial feature is establishing NRFs, which can accumulate resource revenues. NRFs have become common among economies with vast natural resource endowments since they can contribute to cope with volatile resource prices and productions. Studies in the literature have shown that the effectiveness of NRFs in mitigating fiscal procyclicality varies from one country to another. Nonetheless, these existing studies are plagued with some problems. They do not choose the appropriate fiscal variable that fiscal authorities can directly control, do not carefully overcome the endogeneity problem, and do not take into consideration slope heterogeneity and cross-section dependence. Hence, this subject needs further investigation to obtain more precise results.

Besides, the success of NRFs depends on various factors such as clearly defining deposit and withdrawal rules which are prepared in line with the countries' long-term development plan and transparency in the management of the fund. As a resource-rich developing country, Azerbaijan established SOFAZ in 1999 to save revenues from oil and natural gas exports. Even though, Azerbaijan became the first country to fulfill EITI requirements in 2009, its membership was suspended due to EITI's concerns about limits on civil society freedoms in 2017. Additionally, while deposit rules are clearly defined, there is only one withdrawal rule for SOFAZ, which remarks that when the gas and oil revenues reach their peak, at least of 25 percent of these annual revenues shall be saved in the SOFAZ. Azerbaijan's large government expenditures financed by transfers from the SOFAZ are not sustainable and can entail serious risk for the economy. In the last decade, Azerbaijan received enormous fiscal revenues from its oil and natural gas resources; however, future fiscal revenues from exports of these resources can be lower than expected due to fluctuations in global market prices and declining production. Therefore, sound management of resource revenues requires a strong fiscal framework to smooth government expenditure in Azerbaijan's economy. The issue that needs to be analyzed here is how much of the resource windfalls should be saved in the fund and how much should be transferred to the state budget or consumed.

In the context of the points mentioned above, this dissertation, consisting of two essays, attempts to find an answer for two crucial questions that policymakers in resource-rich countries have been working on for decades. The first question is whether oil funds and institutional quality help countries implement less procyclical fiscal policy, which is closer to an optimal fiscal policy defined by the theory. The first essay of the dissertation examines the institutional quality and oil funds' effect in mitigating the procyclicality of fiscal policy in 32 oil-rich economies over the period from 1984 to 2015. Chudik and Pesaran (2015) DCCE model, which allows for slope heterogeneity and CD, is used in this analysis. Also, countries are classified into subgroups based on Kuncic (2014) World Institutional Quality data sets using machine learning methods such as the k-means and agglomerative hierarchical unsupervised learning algorithms to assess institutional quality.

The results show that fiscal policy is, on average, highly procyclical in a panel of 32 oil-rich economies. Besides this, estimation results give an evidence that oil funds reduce fiscal policy's procyclicality while increasing government expenditure on average. In other words, a large share of oil income which ensures a GDP rise is transferred to the oil funds to be saved, and some amount of these accumulated assets are then used in government expenditures after being evaluated with different investment instruments. According to institutional quality, it is found that fiscal policy is more procyclical in the low INQ group when compared to high INQ countries. On the other hand, oil funds are effective only in high INQ countries in reducing procyclicality. Also, estimation with the ICRG dataset shows that there is an inverse relation between better political institutions and government expenditure in high INQ while there is no statistically significant relationship between the two variables in low INQ.

The second question taken as one of the central issues of this dissertation is which resource windfalls allocation rule is optimal for resource-rich developing economies. In the second essay, a three-sector open economy DSGE model was applied to Azerbaijan to examine the macroeconomic effects of temporary resource production and price shocks and the optimal spending and saving of resource revenues. This optimality is determined to minimize the social loss function expressed in terms of fiscal stability and household welfare. The analysis conducted in this essay yielded several essential policy lessons. Firstly, it is found that spending all resource revenues leads to the Dutch disease effect. In other words, appreciation of the real exchange rate causes contraction in non-resource tradable sector production. By contrast, this effect is mitigated by saving all resource revenues. However, considering that resource-rich developing countries are credit and capital-constrained, both full saving and full spending of resource revenues are not the optimal policy response to the production and price shocks.

Next, it is also found that there is a volatility trade-off (dynamic) between spending and saving. Moreover, this trade-off is clearer for fiscal and consumption volatility. As the share of the assets transferred to the state budget increases, the volatilities of the non-resource primary balance to output ratio and consumption falls until χ= 0.3

and χ= 0.8, respectively. However, these volatilities starts to increase for the higher value of χ and takes a convex shape. Besides, spending all resource revenues generates high volatility in the non-resource primary balance to output ratio and consumption. Resource production shock may also have similar effects as resource price increase since both types of shock generate a higher resource revenue for the government. Further, results of social loss function indicate that if the policy maker in Azerbaijan is more concerned about household welfare than fiscal stability, then a higher proportion of resource revenue should be saved. Nevertheless, if the policy maker gives equal importance on fiscal stability and household welfare, the optimal allocation rule suggests that at least 41 percent of resource revenues should be saved. Overall, this evidence shows that fiscal policy can contribute to alleviating the impact of energy production and price shocks on developing countries with vast natural resource endowments.

Finally, almost three-quarters of the Azerbaijan resource income have been spent since the SOFAZ was established according to the SOFAZ's annual reports. This value is higher than the optimal values found in this analysis. Additionally, government expenditure has low efficiency. Hence, the Azerbaijan government should reassess its policy concerning saving and spending to prompt more asset accumulation in SOFAZ and reduce the amount of resource revenue transferred from the fund to the state budget.

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APPENDICES

APPENDIX A: DERIVATIONS, FIGURES AND TABLES

APPENDIX 1.A LIST OF COUNTRIES AND SEVERAL OIL-DEPENDENCY MEASURES

Table 1.A.1: List of Countries

Country	Name	Fund Inception Year	Natural Resource
Algeria	Revenue Regulation Fund	2000	Oil
Angola	Fundo Soberano Angolano	2012	Oil
Azerbaijan	State Oil Fund of the Republic of Azerbaijan	1999	Oil
Bahrain	Bahrain Mumtalakat Holding Company	2000	Oil
Brunei	Brunei Investment Agency	1983	Oil
Cameroon	Stabilization Fund for Hydrocarbon Prices	1974	Hydrocarbon
Chad	Revenue Management Plan	1999-2006	Oil
Colombia	Colombia Oil Stabilization Fund	1995	Hydrocarbon
Congo, Rep.	-		Oil
Cote d'ivoire	-		Oil
Ecuador	Oil Stabilization Fund	1999-2007	Hydrocarbon
Gabon	Gabon Fund for Future Generation	1998	Oil
Indonesia	-		Oil
Iran	Iran Oil Stabilization Fund	2000	Oil
Kazakhstan	National Fund of the Republic of Kazakhstan	2000	Oil

Table 1.A.1: (Cont'd) List of Countries

Country	Name	Fund Inception Year	Natural Resource
Kuwait	Reserve Fund for Future Generations of Kuwait	1953	Oil
Libya	Libyan Investment Authority	1995 (Replaced in 2006)	Oil
Mexico	Mexico Stabilization Fund	2000	Oil
Nigeria	Nigerian Sovereign Investment Authority	2004	Oil
Norway	Government Pension Fund	1990	Hydrocarbon
Oman	State General Reserve Fund	1980	Hydrocarbon
Papua New Guinea	Papua New Guinea Sovereign Wealth Fund	2011	Oil
Qatar	Qatar Investment Authority	2000 (Replaced in 2005)	Oil
Russia	National Welfare Fund	2004 (Replaced in 2008)	Hydrocarbon
Saudi Arabia	SAMA Foreign Holding	1952	Oil
Sudan	Oil Revenue Stabilization Account	2002	Oil
Syria	-		Oil
Trinidad and Tobago	Heritage and Stabilization Fund	2000 (Replaced in 2007)	Hydrocarbon
UAE	Abu Dhabi Investment Authority	1976	Oil
Venezuela, RB	Macroeconomic Stabilization Fund (FIEM)	1998	Hydrocarbon
Vietnam	-		Oil
Yemen, Rep.	-		Oil

Table 1.A.2: Oil Indicators

Oil Producing Country	Group[a]	Oil[b] Exports % Total Exports	Oil[c] Exports % GDP	Oil[d] Revenue/Total Gov. Revenue
Algeria	UM	92.5	37.9	72.1
Angola	UM	93.0	69.2	77.8
Azerbaijan	UM	82.7	44.7	47.0
Bahrain	H	59.7	54.1	76.1
Brunei	H	85.5	62.3	82.4
Cameroon	LM	35.9	9.8	28.5
Chad	L	78.3	37.5	52.5*
Columbia	UM	28.1	4.8	n.a.
Congo	LM	83.8	67.5	76.3
Cote d lvoire	LM	20.0	9.0	n.a.
Ecuador	UM	46.2	13.5	22.2
Gabon	UM	79.9	46.8	59.4
Indonesia	LM	9.7	3.0	21.7
Iran, Islamic Rep.	UM	85.0	22.0	67.4
Kazakhstan	UM	52.4	26.1	32.2
Kuwait	H	81.5	49.6	75.5
Libya	UM	100.0	59.4	83.5
Mexico	UM	12.4	3.5	31.5
Nigeria	LM	97.7	38.5	77.9
Norway	H	30.6	13.2	24.9
Oman	H	81.0	45.4	82.6
Papua New Guinea	LM	22.4	12.5	n.a.
Qatar	H	87.4	53.6	61.1
Russian Federation	UM	41.0	13.5	23.4
Saudi Arabia	H	83.9	42.9	85.0
Sudan	LM	79.8	13.8	51.6
Syrian Arab Rep.	LM	34.4	12.5	34.5
Trinidad Tobago	H	32.7	21.6	45.7
UAE	H	40.6	27.8	73.3
Venezuela, RB	UM	82.7	25.0	51.7
Vietnam	LM	15.3	10.3	25.7
Yemen	LM	83.4	28.8	70.1

Source: a) Based on 2015 World Bank country classification (nominal GNI per capita), GDP from World Bank WDI; b) and c) Oil exports from IMF WEO; total exports and GDP from World Bank WDI; 2000–2012 average. n.a. denotes not available. d) Author calculations on Villafuerte and Lopez-Murphy (2010); 2000–2010 average.* shows that 2004-2010 data is used for Chad.

APPENDIX 2.A SENSITIVITY ANALYSIS, STEADY STATE AND LOG-LINEARIZED EQUATIONS

Appendix 2.A.1 Results of Sensitivity Analysis.

Table 2.A.1.1: Social Loss Function: Tighter Absorption Constraints (φ_1 from 0.05 to 0.07)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.1412	0.9451	0.7815	0.6462	0.5343	0.4418	0.3653	0.3021	0.2498	0.2065	0.1708	0.1412
NRPB/Y	0.9451											
χ=0.1												
C	0.1340	0.8903	0.7367	0.6096	0.5044	0.4174	0.3454	0.2858	0.2365	0.1957	0.1619	0.1340
NRPB/Y	0.8903											
χ=0.2												
C	0.1275	0.8569	0.7083	0.5854	0.4838	0.3999	0.3305	0.2732	0.2258	0.1866	0.1543	0.1275
NRPB/Y	0.8569											
χ=0.3												
C	0.1217	**0.8477**	**0.6981**	**0.5750**	**0.4735**	0.3900	0.3212	0.2645	0.2179	0.1794	0.1478	0.1217
NRPB/Y	0.8477											

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.1: (Cont'd) Social Loss Function: Tighter Absorption Constraints (φ_1 from 0.05 to 0.07)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.4												
C	0.1169	0.8632	0.7068	0.5787	0.4738	**0.3880**	**0.3177**	0.2601	0.2130	0.1744	0.1428	0.1169
NRPB/Y	0.8632											
χ=0.5												
C	0.1132	0.9023	0.7332	0.5957	0.4841	0.3933	0.3196	**0.2597**	**0.2110**	0.1715	0.1393	0.1132
NRPB/Y	0.9023											
χ=0.6												
C	0.1106	0.9621	0.7750	0.6242	0.5028	0.4050	0.3262	0.2627	0.2116	**0.1705**	0.1373	0.1106
NRPB/Y	0.9621											
χ=0.7												
C	0.1092	1.0390	0.8294	0.6621	0.5286	0.4219	0.3368	0.2689	0.2147	0.1714	**0.1368**	0.1092
NRPB/Y	1.0390											
χ=0.8												
C	0.1091	1.1296	0.8942	0.7078	0.5603	0.4435	0.3511	0.2779	0.2200	0.1741	0.1378	**0.1091**
NRPB/Y	1.1296											
χ=0.9												
C	0.1102	1.2307	0.9668	0.7596	0.5967	0.4688	0.3683	0.2893	0.2273	0.1786	0.1403	0.1102
NRPB/Y	1.2307											
χ=1.0												
C	0.1126	1.3401	1.0461	0.8166	0.6375	0.4976	0.3885	0.3032	0.2367	0.1848	0.1442	0.1126
NRPB/Y	1.3401											

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.2: Social Loss Function: Investment-Biased (υ^G from 0.32 to 40)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.1102	0.9105	0.7372	0.5968	0.4832	0.3912	0.3168	0.2565	0.2076	0.1681	0.1361	0.1102
NRPB/Y	0.9105											
χ=0.1												
C	0.1074	0.8580	0.6970	0.5662	0.4600	0.3737	0.3036	0.2466	0.2003	0.1627	0.1322	0.1074
NRPB/Y	0.8580											
χ=0.2												
C	0.1023	0.8270	0.6710	0.5445	0.4418	0.3585	0.2909	0.2360	0.1915	0.1554	0.1261	0.1023
NRPB/Y	0.8270											
χ=0.3												
C	0.0980	**0.8199**	**0.6630**	**0.5361**	**0.4335**	0.3505	0.2835	0.2292	0.1853	0.1499	0.1212	0.098
NRPB/Y	0.8199											
χ=0.4												
C	0.0948	0.8375	0.6735	0.5417	0.4356	**0.3504**	**0.2818**	**0.2266**	0.1822	0.1466	0.1179	0.0948
NRPB/Y	0.8375											
χ=0.5												
C	0.0927	0.8781	0.7013	0.5601	0.4473	0.3572	0.2853	0.2279	**0.1820**	**0.1453**	0.1161	0.0927
NRPB/Y	0.8781											

Note: NOPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.2: (Cont'd) Social Loss Function: Investment-Biased (υ^G from 0.32 to 40)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.6												
C	0.0918	0.9389	0.7441	0.5897	0.4674	0.3704	0.2936	0.2327	0.1844	0.1461	**0.1158**	**0.0918**
NRPB/Y	0.9389											
χ=0.7												
C	0.0921	1.0162	0.7993	0.6287	0.4945	0.3889	0.3059	0.2406	0.1893	0.1489	0.1171	0.0921
NRPB/Y	1.0162											
χ=0.8												
C	0.0937	1.1066	0.8645	0.6754	0.5276	0.4122	0.3220	0.2516	0.1965	0.1535	0.1199	0.0937
NRPB/Y	1.1066											
χ=0.9												
C	0.0963	1.207	0.9373	0.7279	0.5653	0.4390	0.3409	0.2648	0.2056	0.1597	0.1240	0.0963
NRPB/Y	1.2070											
χ=1.0												
C	0.1001	1.3153	1.0166	0.7858	0.6074	0.4694	0.3629	0.2805	0.2168	0.1676	0.1295	0.1001
NRPB/Y	1.3153											

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.3: Social Loss Function: A Higher Elasticity of Output with Respect to Public Capital (ω_T = ω_N = 0.22)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.1466	0.944	0.7836	0.6504	0.5399	0.4482	0.3720	0.3088	0.2563	0.2128	0.1766	0.1466
NRPB/Y	0.9440											
χ=0.1												
C	0.1394	0.8893	0.7389	0.6139	0.5100	0.4238	0.3521	0.2925	0.2431	0.2019	0.1678	0.1394
NRPB/Y	0.8893											
χ=0.2												
C	0.1334	0.8561	0.7109	0.5903	0.4901	0.4070	0.3379	0.2806	0.2330	0.1935	0.1607	0.1334
NRPB/Y	0.8561											
χ=0.3												
C	0.1289	**0.8470**	**0.7016**	**0.5812**	**0.4815**	**0.3989**	0.3304	0.2737	0.2267	0.1878	0.1556	0.1289
NRPB/Y	0.8470											
χ=0.4												
C	0.1259	0.8627	0.7117	0.5871	0.4843	0.3995	**0.3296**	**0.2719**	**0.2243**	**0.1850**	0.1526	0.1259
NRPB/Y	0.8627											
χ=0.5												
C	0.1247	0.902	0.7401	0.6072	0.4982	0.4088	0.3354	0.2752	0.2258	0.1852	**0.1520**	**0.1247**
NRPB/Y	0.9020											

Note: C and NRPB/Y represent consumption and the ratio of non-resource primary balance to output, respectively.

Table 2.A.1.3: (Cont'd) Social Loss Function: A Higher Elasticity of Output with Respect to Public Capital (ω_T = ω_N = 0.22)

		µ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.6												
C	0.1251	0.9619	0.7844	0.6397	0.5216	0.4254	0.3469	0.2829	0.2307	0.1881	0.1534	0.1251
NRPB/Y	0.9619											
χ=0.7												
C	0.1273	1.0389	0.8422	0.6827	0.5534	0.4486	0.3637	0.2948	0.2390	0.1937	0.1570	0.1273
NRPB/Y	1.0389											
χ=0.8												
C	0.1311	1.1295	0.9107	0.7342	0.5920	0.4773	0.3848	0.3103	0.2501	0.2017	0.1626	0.1311
NRPB/Y	1.1295											
χ=0.9												
C	0.1364	1.2307	0.9877	0.7927	0.6361	0.5105	0.4097	0.3288	0.2639	0.2118	0.1700	0.1364
NRPB/Y	1.2307											
χ=1.0												
C	0.1430	1.3401	1.0714	0.8566	0.6849	0.5475	0.4378	0.3500	0.2798	0.2237	0.1789	0.1430
NRPB/Y	1.3401											

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.4: Social Loss Function: Alternative Risk Measure

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.2189	0.9801	0.8437	0.7262	0.6251	0.5381	0.4632	0.3987	0.3432	0.2954	0.2543	0.2189
NRPB/Y	0.9801											
χ=0.1												
C	0.2127	0.9222	0.7964	0.6877	0.5939	0.5129	0.4429	0.3825	0.3303	0.2852	0.2463	0.2127
NRPB/Y	0.9222											
χ=0.2												
C	0.2069	0.8852	0.7654	0.6619	0.5723	0.4949	0.4280	0.3701	0.3200	0.2767	0.2393	0.2069
NRPB/Y	0.8852											
χ=0.3												
C	0.2016	**0.8717**	**0.7530**	**0.6504**	**0.5618**	0.4853	0.4192	0.3621	0.3128	0.2702	0.2334	0.2016
NRPB/Y	0.8717											
χ=0.4												
C	0.1968	0.8828	0.7598	0.6539	0.5627	**0.4843**	**0.4168**	0.3597	0.3087	0.2657	0.2287	0.1968
NRPB/Y	0.8828											
χ=0.5												
C	0.1924	0.9176	0.7849	0.6714	0.5743	0.4912	0.4202	**0.3594**	**0.3074**	0.2630	0.2249	0.1924
NRPB/Y	0.9176											

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.4: (Cont'd) Social Loss Function: Alternative Risk Measure

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.6												
C	0.1886	0.9736	0.8262	0.7012	0.5950	0.5049	0.4285	0.3636	0.3086	**0.2619**	0.2222	0.1886
NRPB/Y	0.9736											
χ=0.7												
C	0.1854	1.0473	0.8808	0.7408	0.6230	0.5239	0.4406	0.3706	0.3117	0.2621	0.2204	0.1854
NRPB/Y	1.0473											
χ=0.8												
C	0.1828	1.1354	0.9459	0.7880	0.6564	0.5469	0.4556	0.3795	0.3162	0.2634	0.2194	0.1828
NRPB/Y	1.1354											
χ=0.9												
C	0.1809	1.2347	1.0189	0.8409	0.6939	0.5727	0.4726	0.3900	0.3219	0.2656	**0.2192**	0.1809
NRPB/Y	1.2347											
χ=1.0												
C	0.1769	1.3428	1.0981	0.8980	0.7343	0.6005	0.4911	0.4016	0.3284	0.2686	0.2196	**0.1796**
NRPB/Y	1.3428											

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.5: Social Loss Function: Production Shock (ρ^{YO} = 0.932)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.1441	0.9580	0.7927	0.6559	0.5427	0.4490	0.3715	0.3074	0.2544	0.2105	0.1742	0.1441
NRPB/Y	0.9580											
χ=0.1												
C	0.1368	0.9032	0.7478	0.6192	0.5127	0.4245	0.3515	0.2910	0.2410	0.1995	0.1652	0.1368
NRPB/Y	0.9032											
χ=0.2												
C	0.1301	0.8707	0.7200	0.5953	0.4923	0.4070	0.3366	0.2783	0.2301	0.1903	0.1573	0.1301
NRPB/Y	0.8707											
χ=0.3												
C	0.1243	**0.8633**	**0.7112**	**0.5859**	**0.4827**	0.3976	0.3276	0.2699	0.2223	0.1832	0.1509	0.1243
NRPB/Y	0.8633											
χ=0.4												
C	0.1194	0.8813	0.7216	0.5909	0.4838	**0.3962**	**0.3244**	0.2656	0.2175	0.1781	0.1458	0.1194
NRPB/Y	0.8813											
χ=0.5												
C	0.1157	0.9235	0.7503	0.6096	0.4952	0.4023	0.3269	**0.2656**	**0.2158**	0.1753	0.1424	0.1157
NRPB/Y	0.9235											

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.5: (Cont'd) Social Loss Function: Production Shock (ρ^{YO} = 0.932)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.6												
C	0.1131	0.9867	0.7945	0.6398	0.5152	0.4149	0.3341	0.2690	0.2166	**0.1744**	0.1405	0.1131
NRPB/Y	0.9867											
χ=0.7												
C	0.1117	1.0671	0.8515	0.6795	0.5422	0.4327	0.3452	0.2755	0.2198	0.1754	**0.1400**	0.1117
NRPB/Y	1.0671											
χ=0.8												
C	0.1117	1.1612	0.9188	0.7270	0.5752	0.4552	0.3601	0.2850	0.2255	0.1784	0.1412	**0.1117**
NRPB/Y	1.1612											
χ=0.9												
C	0.1130	1.2659	0.9942	0.7808	0.6132	0.4816	0.3782	0.2970	0.2333	0.1832	0.1439	0.1130
NRPB/Y	1.2659											
χ=1.0												
C	0.1156	1.3789	1.0762	0.8399	0.6555	0.5116	0.3993	0.3116	0.2432	0.1898	0.1481	0.1156
NRPB/Y	1.3789											

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.6: Social Loss Function: Production Shock (ρ^{YO} = 0.912)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.0												
C	0.1204	0.8489	0.6983	0.5744	0.4725	0.3887	0.3197	0.2630	0.2163	0.1779	0.1464	0.1204
NRPB/Y	0.8489											
χ=0.1												
C	0.1141	0.7948	0.6546	0.5391	0.4440	0.3657	0.3011	0.2480	0.2043	0.1682	0.1385	0.1141
NRPB/Y	0.7948											
χ=0.2												
C	0.1084	0.7563	0.6228	0.5128	0.4223	0.3477	0.2863	0.2358	0.1941	0.1599	0.1316	0.1084
NRPB/Y	0.7563											
χ=0.3												
C	0.1033	0.7358	0.6046	0.4969	0.4083	0.3355	0.2757	0.2266	0.1862	0.1530	0.1257	0.1033
NRPB/Y	0.7358											
χ=0.4												
C	0.0989	**0.7349**	**0.6013**	**0.4921**	**0.4026**	0.3295	0.2696	0.2206	0.1805	0.1477	0.1209	0.0989
NRPB/Y	0.7349											
χ=0.5												
C	0.0953	0.7535	0.6128	0.4983	0.4052	**0.3295**	**0.2680**	**0.2179**	0.1772	0.1441	0.1172	0.0953
NRPB/Y	0.7535											

Note: NPPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Table 2.A.1.6: (Cont'd) Social Loss Function: Production Shock (ρ^{YO} = 0.912)

		μ										
Variable	SD	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
χ=0.6												
C	0.0926	0.7904	0.6379	0.5148	0.4154	0.3352	0.2705	0.2183	**0.1762**	0.1422	0.1147	0.0926
NRPB/Y	0.7904											
χ=0.7												
C	0.0909	0.8432	0.6748	0.5401	0.4322	0.3459	0.2769	0.2216	0.1773	**0.1419**	0.1136	0.0909
NRPB/Y	0.8432											
χ=0.8												
C	0.0901	0.9090	0.7214	0.5725	0.4544	0.3606	0.2862	0.2271	0.1803	0.1431	**0.1135**	**0.0901**
NRPB/Y	0.9090											
χ=0.9												
C	0.0905	0.9852	0.7760	0.6112	0.4814	0.3791	0.2986	0.2352	0.1852	0.1459	0.1149	0.0905
NRPB/Y	0.9852											
χ=1.0												
C	0.0918	1.0698	0.8369	0.6547	0.5121	0.4006	0.3134	0.2451	0.1918	0.1500	0.1174	0.0918
NOPB/Y	1.0698											

Source: Model simulation results and author's calculations.

Note: NRPB/Y and C represent the ratio of non-resource primary balance to output and consumption, respectively.

Appendix 2.A.2 Steady State Equations of Model

In this section, the steady state values for model's variables are presented. The steady state variables are obtained by leaving time subscripts from variables.

The steady state value of resource production, Y_{ss}^{R}, is specified as a portion of output. For resource price, the steady state value, p_{ss}^{R}, is set to unity.

From (3.1), total domestic output is,

$$Y_{ss} = Y_{ss}^{T} + z_{ss}^{-1} Y_{ss}^{N} + p_{ss}^{R} Y_{ss}^{R} . \qquad (2.A.2.1)$$

From (3.2) and (3.5), tradable and non-tradable goods' productions are,

$$Y_{ss}^{T} = (L_{ss}^{T})^{\beta} (K_{ss}^{T})^{1-\beta} (K_{ss}^{G})^{\omega_T} , \qquad (2.A.2.2)$$

$$Y_{ss}^{N} = (L_{ss}^{N})^{\eta} (K_{ss}^{N})^{1-\eta} (K_{ss}^{G})^{\omega_N} . \qquad (2.A.2.3)$$

From (3.3), the real wage is given by,

$$w_{ss} = \beta(\frac{Y_{ss}^{T}}{L_{ss}^{T}}) . \tag{2.A.2.4}$$

Using (3.15), labor supply is specified by,

$$L_{ss} = \left[\frac{(1-\tau) w_{ss}}{\eta_L p_{ss} C_{ss}^{\varsigma^{-1}}} \right]^{\frac{1}{\psi}} . \tag{2.A.2.5}$$

Using equations (3.6) and (3.42), labor demands in tradable and non-tradable sector are defined as,

$$L_{ss}^{T} = L_{ss} - L_{ss}^{N} , \tag{2.A.2.6}$$

$$L_{ss}^{N} = \eta(\frac{Y_{ss}^{N}}{w_{ss} z_{ss}}) . \tag{2.A.2.7}$$

From (3.16), the rental rate of capital is,

$$r_{ss}^{K} = \frac{1}{(1-\tau)} \left(r_{ss}^{w} + \delta^{P} \right) . \tag{2.A.2.8}$$

In the traded and non-traded sectors, the rental rate of capital is assumed to be equal. Hence, $r_{ss}^{K} = r_{ss}^{K,N} = r_{ss}^{K,T}$.

From equation (3.43), total stock of private capital is given by,

$$K_{ss}^{P} = \left[\varsigma_K \left(K_{ss}^{T}\right)^{(\eta_K - 1)/\eta_K} + \left(1 - \varsigma_K\right)\left(K_{ss}^{N}\right)^{(\eta_K - 1)/\eta_K} \right]^{\eta_K/\eta_K - 1}. \qquad (2.A.2.9)$$

In non-tradable and tradable sector, capital from equations (3.4) and (3.7) is,

$$K_{ss}^{T} = \left(1 - \beta\right)\left(\frac{Y_{ss}^{T}}{r_{ss}^{K,T}}\right) , \qquad (2.A.2.10)$$

$$K_{ss}^{N} = (1 - \eta)\left(\frac{Y_{ss}^{N}}{z_{ss} r_{ss}^{K}}\right) . \qquad (2.A.2.11)$$

Total investment is given by,

$$I_{ss} = I_{ss}^{G} + I_{ss}^{P} . \qquad (2.A.2.12)$$

From equations (3.32) and (3.11), government investment and private investment are,

$$I_{ss}^{G} = \upsilon^{G} G_{ss} , \qquad (2.A.2.13)$$

$$I_{ss}^{P} = \delta^{P} K_{ss}^{P} \ . \qquad (2.A.2.14)$$

From (3.30) and (3.31), government spending on non-traded goods and traded goods is,

$$G_{ss}^{T} = \left(1-\upsilon\right)\left(\frac{1}{p_{ss}^{G}}\right)^{-\alpha} G_{ss} , \qquad (2.A.2.15)$$

$$G_{ss}^{N} = \upsilon\left(\frac{p_{ss}^{N}}{p_{ss}^{G}}\right)^{-\alpha} G_{ss} . \qquad (2.A.2.16)$$

Total consumption from equation (3.46) is,

$$C_{ss} = \frac{1}{p_{ss}^{\alpha}(1-\theta)}\left[Y_{ss}^{T} - r_{ss}^{w} D_{ss} - I_{ss}^{P} - G_{ss}^{T} + r_{ss}^{F} F_{ss} - \phi^{F} F_{ss} + p_{ss}^{R} Y_{ss}^{R}\right]. \qquad (2.A.2.17)$$

From equation (3.20) and (3.21), consumption in the non-tradable sector and tradable sector is,

$$C_{ss}^{N}=\theta\left(\frac{p_{ss}^{N}}{p_{ss}}\right)^{-\alpha}C_{ss}\ , \qquad (2.A.2.18)$$

$$C_{ss}^{T}=\left(1-\theta\right)\left(\frac{1}{p_{ss}}\right)^{-\alpha}C_{ss}\ . \qquad (2.A.2.19)$$

From equations (3.24) and (3.25), tradable consumption of non-resource products and natural resource products is,

$$C_{ss}^{TNR}=\left(1-\theta^{T}\right)C_{ss}^{T}\ , \qquad (2.A.2.20)$$

$$C_{ss}^{TR}=\theta^{T}\left(p_{ss}^{R}\right)^{-1}C_{ss}^{T}\ . \qquad (2.A.2.21)$$

The real exchange rate from equation (3.41) is,

$$z_{ss}=\frac{1}{p_{ss}}\left[\frac{1}{\theta C_{ss}}\left(Y_{ss}^{N}-C_{ss}^{G}-I_{ss}^{G,N}\right)\right]^{1/\alpha}\ . \qquad (2.A.2.22)$$

From equation (3.27), the lump-sum taxes are,

$$T_{ss}^{L} = T_{ss} - p_{ss}^{R} Y_{ss}^{R} - \tau \left(Y_{ss}^{T} + z_{ss}^{-1} Y_{ss}^{N} \right) - r_{ss}^{F} F_{ss} . \qquad (2.A.2.23)$$

From equation (3.37), total revenue is,

$$T_{ss} = r_{ss}^{w} D_{ss}^{G} + p_{ss}^{G} G_{ss} . \qquad (2.A.2.24)$$

Total revenue obtained from production is given by,

$$T_{ss}^{R} = p_{ss}^{R} Y_{ss}^{R} . \qquad (2.A.2.25)$$

Non-resource revenue is specified by,

$$T_{ss}^{NR} = \tau \left(Y_{ss}^{T} + z_{ss}^{-1} Y_{ss}^{N} \right) . \qquad (2.A.2.26)$$

Government spending is set as,

$$G_{ss} = \psi^{G} Y_{ss} . \qquad (2.A.2.27)$$

From equation (3.33), government consumption is given by,

$$C_{ss}^{G} = \left(1-\upsilon^{G}\right)G_{ss}\,. \qquad (2.A.2.28)$$

From equation (3.35), public capital is,

$$K_{ss}^{G} = \frac{\varphi_{ss}}{\delta^{G}}I_{ss}^{G}\,. \qquad (2.A.2.29)$$

From equation (3.40), government debt is given by,

$$D_{ss}^{G} = PR_{ss}^{\frac{1}{pr1}}\left(Y_{ss}^{T} + z_{ss}^{-1}Y_{ss}^{N}\right). \qquad (2.A.2.30)$$

From equation (3.13), foreign currency debt of household is given by,

$$D_{ss}^{p} = \frac{1}{r_{ss}^{w}}\left\{\left(1-\tau\right)\left(Y_{ss}^{T} + z_{ss}^{-1}Y_{ss}^{N}\right) - p_{ss}C_{ss} - I_{ss}^{p} - T_{ss}^{L}\right\}. \qquad (2.A.2.31)$$

Total debt is given by,

$$D_{ss} = D_{ss}^{P} + D_{ss}^{G}\,. \qquad (2.A.2.32)$$

From equation (3.14), the world interest rate is,

$$r_{ss}^{w} = \Lambda^{-1} - 1. \qquad (2.A.2.33)$$

From equation (3.39), the risk premium is,

$$PR_{ss} = \frac{1 + r_{ss}^{W}}{1 + r^{W,R}} - 1. \qquad (2.A.2.34)$$

From equation (3.38), government's non-resource primary balance is given by,

$$NRPB_{ss} = T_{ss}^{NR} + T_{ss}^{L} - p_{ss}^{G} G_{ss}. \qquad (2.A.2.35)$$

From equation (3.29), the price of tradable and non-tradable goods' basket purchased by government is given by,

$$p_{ss}^{G} = \left[\upsilon \left(p_{ss}^{N} \right)^{1-\alpha} + (1-\upsilon) \right]^{1/1-\alpha}. \qquad (2.A.2.36)$$

From equation (3.18), p_t is the price of tradable and non-tradable goods' basket purchased by household,

$$p_{ss} = \left[\theta \left(p_{ss}^{N} \right)^{1-\alpha} + (1-\theta) \right]^{1/1-\alpha} . \qquad (2.A.2.37)$$

Appendix 2.A.3 Log-Linearized Equations of the Model

The log-linearized equations are introduced in this section. Log-linearized equations are obtained by deriving log deviations of variables around their steady state values. Log deviation of a variable around its steady state is identified with a hat above this variable; however, for interest rate, hat denotes percentage point deviation from its steady state.

From (3.1), log linear form of total output is identified by

$$\hat{Y}_t = \frac{1}{Y_{ss}} \left[Y_{ss}^{T} \hat{Y}_t^{T} + z_{ss}^{-1} Y_{ss}^{N} \left(\hat{Y}_t^{N} - \hat{z}_t \right) + p_{ss}^{R} Y_{ss}^{R} \left(\hat{p}_t^{R} + \hat{Y}_t^{R} \right) \right] . \qquad (2.A.3.1)$$

From equations (3.2) and (3.5), output in non-tradable sector and non-resource tradable sector is,

$$\hat{Y}_t^{N} = \eta \hat{L}_t^{N} + \left(1-\eta\right) \hat{K}_t^{N} + \omega_N \hat{K}_t^{G} , \qquad (2.A.3.2)$$

$$\hat{Y}_t^T = \beta \hat{L}_t^T + (1-\beta)\hat{K}_t^T + \omega_T \hat{K}_t^G \ . \tag{2.A.3.3}$$

From equations (3.3) and (3.42), the real wage (economy wide) is given by,

$$\hat{w}_t = \hat{Y}_t^T \left(\frac{L_{ss}^T}{L_{ss}}\right) + \left(\frac{L_{ss}^N}{L_{ss}}\right)\left(\hat{Y}_t^N - \hat{z}_t\right) - \hat{L}_t \ . \tag{2.A.3.4}$$

From equations (3.15), labor supply is given by,

$$\hat{L}_t = \frac{1}{\psi}\left[\hat{w}_t - \frac{1}{\varsigma}\hat{C}_t - \hat{p}_t\right]. \tag{2.A.3.5}$$

From equations (3.6) and (3.42), labor demand in the non-tradable sector and tradable sector is,

$$\hat{L}_t^N = \hat{Y}_t^N - \hat{z}_t - \hat{w}_t \ , \tag{2.A.3.6}$$

$$\hat{L}_t^T = \hat{Y}_t^T - \hat{w}_t \ . \tag{2.A.3.7}$$

From equation (3.16), the rental rate of capital is,

$$\hat{r}_{t+1}^{K} = \frac{\left(1+r_{ss}^{w}\right)}{\left(1-\tau\right)\left(1+r_{ss}^{K}\right)}\left[\kappa\left(\hat{K}_{t+1}^{P}-\hat{K}_{t}^{P}\right)+\hat{r}_{t}^{w}\right]-\frac{\kappa}{\left(1-\tau\right)\left(1+r_{ss}^{K}\right)}\left(\hat{K}_{t+2}^{P}-\hat{K}_{t+1}^{P}\right). \quad (2.A.3.8)$$

In the non-tradable sector and tradable sector, the rental rate of capital from equations (3.4) and (3.44) is,

$$\hat{r}_{t}^{K,T} = \left(\hat{Y}_{t}^{T}-\hat{K}_{t}^{T}\right), \quad (2.A.3.9)$$

$$\hat{r}_{t}^{K} = \left[\left(\varsigma_{K}\right)^{\eta_{K}}\left(\frac{1+r_{ss}^{K,T}}{1+r_{ss}^{K}}\right)^{(1-\eta_{K})}\hat{r}_{t}^{K,T}+\left(1-\varsigma_{K}\right)^{\eta_{K}}\left(\frac{1+r_{ss}^{K,N}}{1+r_{ss}^{K}}\right)^{(1-\eta_{K})}\right]^{1/1-\eta_{K}}\hat{r}_{t}^{K,N}. \quad (2.A.3.10)$$

Private capital from equation (3.11) is given by,

$$\hat{K}_{t}^{P} = \left(1-\delta^{P}\right)\hat{K}_{t-1}^{P}+\left(\frac{I_{ss}^{P}}{K_{ss}^{P}}\right)\hat{I}_{t}^{P}. \quad (2.A.3.11)$$

From equations (3.7) and (3.43), the capital in non-tradable and tradable sector is given by,

$$\hat{K}_{t-1}^{P} = \varsigma_K \left(\frac{K_{ss}^{T}}{K_{ss}^{P}} \right)^{(\eta_K - 1)/\eta_K} \hat{K}_t^{T} + \left(1 - \varsigma_K\right) \left(\frac{K_{ss}^{N}}{K_{ss}^{P}} \right)^{(\eta_K - 1)/\eta_K} \hat{K}_t^{N}, \qquad (2.A.3.12)$$

$$\hat{K}_t^{N} = \hat{Y}_t^{N} - \hat{z}_t - \hat{r}_t^{K,N}. \qquad (2.A.3.13)$$

Total investment is given by,

$$\hat{I}_t = \frac{1}{I_{ss}} \left[I_{ss}^{G} \hat{I}_t^{G} + I_{ss}^{P} \hat{I}_t^{P} \right]. \qquad (2.A.3.14)$$

From equation (2.43), private investment is,

$$I_{ss}^{P} \hat{I}_t^{P} = D_{ss}^{P} \hat{D}_{t+1}^{P} - F_{ss} \hat{F}_{t+1} - \left(1 + r_{ss}^{w}\right) D_{ss}^{P} \left(\hat{r}_t^{w} + \hat{D}_t^{P} \right) - C_{ss}^{T} \hat{C}_t^{T} - G_{ss}^{T} \hat{G}_t^{T}, \qquad (2.A.3.15)$$

$$+ Y_{ss}^{T} \hat{Y}_t^{T} + \left(1 + r_{ss}^{F} - \phi^{F}\right) F_{ss} \left(\hat{r}_t^{F} + \hat{F}_t \right) + p_{ss}^{R} Y_{ss}^{R} \left(\hat{p}_t^{R} + \hat{Y}_t^{R} \right).$$

From equation (3.32), total government investment spending is given by,

$$\hat{I}_t^{G} = \hat{G}_t. \qquad (2.A.3.16)$$

From equations (3.30) and (3.31), government investment spending on non-traded and traded goods is,

$$\hat{G}_t^N = \alpha(\hat{z}_t + \hat{p}_t^G) + \hat{G}_t \ , \tag{2.A.3.17}$$

$$\hat{G}_t^T = \alpha(\hat{p}_t^G) + \hat{G}_t \ . \tag{2.A.3.18}$$

Total consumption from equation (3.14) is given by,

$$E_t\hat{C}_{t+1} + \varsigma\hat{p}_{t+1} = \hat{C}_t + \varsigma(\hat{r}_t^w + \hat{p}_t) \ . \tag{2.A.3.19}$$

From equations (3.20) and (3.21), consumption in non-tradable and tradable sector is,

$$\hat{C}_t^N = \alpha(\hat{z}_t + \hat{p}_t) + \hat{C}_t, \tag{2.A.3.20}$$

$$\hat{C}_t^T = \alpha\hat{p}_t + \hat{C}_t \, . \tag{2.A.3.21}$$

Tradable consumption of non-resource products and natural resource products from equations (3.24) and (3.25) is,

$$\hat{C}_t^{TNR} = \hat{C}_t^{\,T} \, , \tag{2.A.3.22}$$

$$\hat{C}_t^{TR} = \hat{C}_t^T - \hat{P}_t^R . \tag{2.A.3.23}$$

From equation (3.41), the real exchange rate is,

$$\hat{z}_t = \frac{1}{\alpha\theta p_{ss} z_{ss}^{\alpha} C_{ss}} \left[Y_{ss}^N \hat{Y}_t^N - G_{ss}^N \hat{G}_t^N \right] - \frac{\hat{C}_t}{\alpha} - \hat{p}_t . \tag{2.A.3.24}$$

From equation (3.15), the foreign currency debt of household is,

$$\hat{D}_t^P = \frac{1}{D_{ss}^P} \left[\left(1 + r_{ss}^w\right) D_{ss}^P \left(\hat{r}_{t-1}^w + \hat{D}_{t-1}^P \right) \right] \tag{2.A.3.25}$$

$$-\left(1-\tau\right)\left\{ Y_{ss}^T \hat{Y}_{t-1}^T - z_{ss}^{-1} Y_{ss}^N \left(\hat{Y}_{t-1}^N - \hat{z}_{t-1} \right) + p_{ss} C_{ss} (\hat{C}_{t-1} + \hat{p}_{t-1}) + I_{ss}^P \hat{I}_{t-1}^P + T_{ss}^L \hat{T}_{t-1}^L \right\}.$$

In this study, public debt is assumed to be constant $\left(\hat{D}_t^G\right)$. However, for lump-sum taxes, $\hat{T}_t^L$, stock of fund's assets, $\hat{F}_t$ and total government spending, $\hat{G}_t$, log-linearized equations vary according the alternative fiscal rules.

In the *Full spending case*, since $\hat{r}_t^F = 0$, log-linearized equations for these variables are given by,

$$p_{ss}^G G_{ss} (\hat{G}_t + \hat{p}_t^G) = T_{ss}^R \hat{T}_t^R , \tag{2.A.3.26}$$

$$T_{ss}^{L}\hat{T}_{t}^{L} = -T_{ss}^{NR}\hat{T}_{t}^{NR} + \left(1+r_{ss}^{W}\right)D_{ss}^{G}\hat{r}_{t}^{w}, \quad (2.A.3.27)$$

$$\hat{F}_{t} = 0. \quad (2.A.3.28)$$

In the *Full saving case*, since $F_{t+1} = \left(1-\phi^{F}\right)F_{t} + T_{t}^{R}$, total government spending, assets in fund and lump-sum tax are given by,

$$p_{ss}^{G}G_{ss}(\hat{G}_{t} + \hat{p}_{t}^{G}) = \left(1+r_{ss}^{F}\right)F_{ss}\left(\hat{r}_{t}^{F} + \hat{F}_{t}\right) - F_{ss}\hat{F}_{t}, \quad (2.A.3.29)$$

$$F_{ss}\hat{F}_{t} = \left(1-\phi^{F}\right)F_{ss}\hat{F}_{t-1} + T_{ss}^{R}\hat{T}_{t-1}^{R}, \quad (2.A.3.30)$$

$$T_{ss}^{L}\hat{T}_{t}^{L} = -T_{ss}^{NR}\hat{T}_{t}^{NR} + \left(1+r_{ss}^{w}\right)D_{ss}^{G}\hat{r}_{t}^{w}. \quad (2.A.3.31)$$

In the partial spending case, where the optimum allocation of assets held in the fund is determined, total government spending, assets in fund and lump-sum tax are given by,

$$p_{ss}^{G}G_{ss}(\hat{p}_{t}^{G} + \hat{G}_{t}) = \left[(1-\chi)T_{ss}^{R}\hat{T}_{t}^{R} + (1+r_{ss}^{F})F_{ss}(\hat{F}_{t} + \hat{r}_{t}^{F}) - F_{ss}\hat{F}_{t}\right], \quad (2.A.3.32)$$

$$F_{ss}\hat{F}_{t+1} = \left(1-\phi^{F}\right)F_{ss}\hat{F}_{t} + \chi T_{ss}^{R}\hat{T}_{t}^{R}, \quad (2.A.3.33)$$

$$T^{L}_{ss}\hat{T}^{L}_{t} = -T^{NR}_{ss}\hat{T}^{NR}_{t} - \chi\left[\left(1+r^{F}_{ss}\right)F_{ss}\left(\hat{r}^{F}_{t}+\hat{F}_{t}\right)+F_{ss}\hat{F}_{t}\right]+G_{ss}\hat{G}_{t}+\left(1+r^{w}_{ss}\right)D^{G}_{ss}\hat{r}^{w}_{t}\,. \quad (2.A.3.34)$$

From equation (3.37), total revenue is,

$$T_{ss}\hat{T}_{t} = p^{G}_{ss}G_{ss}(\hat{G}_{t}+\hat{p}^{G}_{t})+\left(1+r^{w}_{ss}\right)D^{G}_{ss}\hat{r}^{w}_{t}\,. \quad (2.A.3.35)$$

Revenue received from resource production is,

$$\hat{T}^{R}_{t} = \hat{p}^{R}_{t}+\hat{Y}^{R}_{t}\,. \quad (2.A.3.36)$$

Non-resource revenue is given by,

$$\hat{T}^{NR}_{t} = \frac{1}{T^{NR}_{ss}}\left[\tau Y^{T}_{ss}\hat{Y}^{T}_{t}+\tau z^{-1}_{ss}Y^{N}_{ss}\left(\hat{Y}^{N}_{t}-\hat{z}_{t}\right)\right]. \quad (2.A.3.37)$$

Government consumption from equation (3.33) is,

$$\hat{C}^{G}_{t} = \hat{G}_{t}\,. \quad (2.A.3.38)$$

From equation (3.38), the non-resource primary balance is given by,

$$NRPB_{ss} NR\hat{P}B_t = T_{ss}^L \hat{T}_t^L + T_{ss}^{NR} \hat{T}_t^{NR} - p_{ss}^G G_{ss} (\hat{G}_t + \hat{p}_t^G). \qquad (2.A.3.39)$$

Using equation (3.35), the public capital is computed as,

$$\hat{K}_t^G = \left(1-\delta^G\right)\hat{K}_{t-1}^G + \frac{\varphi_{ss} I_{ss}^G}{K_{ss}^G}\left(\hat{\varphi}_t + \hat{I}_t^G\right). \qquad (2.A.3.40)$$

From equation (3.36), the public capital efficiency is calculated as,

$$\hat{\varphi}_t = \varphi_1 \left(\hat{K}_{t-1}^G - \hat{I}_t^G\right). \qquad (2.A.3.41)$$

Using equation (3.9), the resource production is given by,

$$\hat{Y}_t^R = \rho^{YR} \hat{Y}_{t-1}^R + \in_t^{YR}. \qquad (2.A.3.42)$$

From equation (3.8), the resource price is,

$$\hat{P}_t^R = \rho^{PR} \hat{P}_{t-1}^R + \in_t^{PR}. \qquad (2.A.3.43)$$

Using equation (3.40), the risk premium is specified as,

$$P\hat{R}_t = -\left[\frac{Y_{ss}^T \hat{Y}^T - z_{ss}^{-1} Y_{ss}^N \left(\hat{z}_t - \hat{Y}_t^N\right)}{Y_{ss}^T (z_{ss}^{-1} + Y_{ss}^N)}\right] pr_1 . \qquad (2.A.3.44)$$

Using equation (3.39), the foreign barrowing's market cost is,

$$\hat{r}_t^w = P\hat{R}_t . \qquad (2.A.3.45)$$

Using equation (3.29) and (3.18), the price of tradable and non-tradable goods' basket purchased by government and household are,

$$\hat{p}_t^G ((p_{ss}^G)^{1-\alpha}) = -\upsilon (z_{ss}^{\alpha-1}) \hat{z}_t \ , \qquad (2.A.3.46)$$

$$\hat{p}_t ((p_{ss})^{1-\alpha}) = -\theta (z_{ss}^{\alpha-1}) \hat{z}_t . \qquad (2.A.3.47)$$

APPENDIX B: CURRICULUM VITAE

PERSONAL INFORMATION

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EDUCATION

Degree	**Institution**	**Subject**	**Year of Graduation**
PhD	Middle East Technical University	Economics	2021
MS	Barcelona Graduate School of Economics	Macroeconomic Policy and Financial Markets	2020
MS	Ankara University	Economics	2010
BA	Ege University	Economics	2007

WORK EXPERIENCE

Year	**Place**	**Enrollment**
07-2018-Present	Ministry of Treasury and Finance	Expert
11.2011-07-2018	Turkish Treasury	Treasury Expert
03.2010-11.2011	Eastern Mediterranean Development Agency	Development Expert

INTEREST AREAS

Computable Macroeconomics, Macroeconometrics and Time Series Analysis.

SKILLS

Microsoft Offices, MATLAB, Dynare, Stata and Eviews

FOREIGN LANGUAGES

Advanced English

APPENDIX C: TURKISH SUMMARY/TÜRKÇE ÖZET

Kaynak zengini ülkelerde, petrol, doğal gaz ve mineral gibi emtiaların ihracatından elde edilen gelirler, ülkeleri bu gelire bağımlı hale getirmektedir. Bu bağımlılık, ülkelerin gelir oynaklığı ve ülke parasının değerlenmesi ile ticarete konu olan sektörlerin daralması ve diğer sektörlerde üretim artışının olması olarak literatüre geçen "Hollanda hastalığı" gibi bazı sorunlar ile karşı karşıya kalmasına neden olmaktadır. İhracat gelirlerindeki artış nedeniyle ülkelere ciddi bir döviz girişi olmakta ve bu döviz girişi ülke parasının değerlenmesi ile sonuçlanmaktadır. Diğer yandan, petrol ve doğal gaz üretimi ve fiyatları dünyada meydana gelen savaşlar ve ekonomik krizler gibi birçok etkenden etkilenmekte olup, sürekli değişkenlik göstermektedir. Kaynak zengini ülkelerde, emtia ihracat gelirleri kamu gelirlerinin büyük bir kısmını oluşturması nedeniyle petrol ve doğal gaz fiyat ve üretimindeki değişkenlik kamu gelirlerinde ciddi dalgalanmalara yol açmaktadır. Bunun yanında, gelirlerdeki dalgalanmalar sonucunda da kamu harcamaları oynaklığı ve dolayısıyla maliye politikasının konjonktürel yanlılığı artmaktadır. Maliye politikasının konjonktürel yanlılığı kaynak zengini ülkeler için ciddi ekonomik sorunlara neden olmaktadır. Bu ülkeler, kaynak gelirleri artınca hükümet harcamalarını artırmakta; ancak kaynak gelirlerindeki düşüşle kamu harcamalarını kısmaktadır. Bu durumda, emtia fiyatlarında küçük bir düşüş, yabancı sermaye girişlerinin de azalması ile birlikte ciddi finansman açıkları yaratmaktadır. Bu ülkeler, iç finansal piyasalarının gelişmemiş olması ve dış finansmana erişimlerinin kısıtlı olması nedenleriyle kamu harcamalarını, özellikle de sermaye harcamalarını azaltmak zorunda kalmaktadır. Sermaye yatırımlarındaki azalma uzun dönemde ekonomik büyümeyi olumsuz etkilemektedir.

Keynesyen ekonomi en uygun maliye politikasını konjonktür karşıtı bir politika olarak tanımlarken, Neoklasik teori konjonktür yanlısı veya karşıtı olmayan tarafsız bir maliye politikasını desteklemektedir (Ilzetzki ve Vègh, 2008). Literatürde yer alan ampirik çalışmaların bir çoğu, petrol zengini gelişmekte olan ülkelerde maliye politikasının aslında oldukça konjonktür yanlısı olduğunu ortaya koymaktadır. Petrol gelirindeki oynaklık ve bu gelire bağımlılık nedeniyle oluşan maliye politikasındaki yanlılığı kırmak için petrol zengini ülkeler, 1990'ların sonlarına doğru popüler olmaya başlayan petrol istikrar fonları kurmuşlardır.

İstikrar fonları, makroekonomik hedefler için hükümetler tarafından kurulan mekanizma ve düzenlemeleri içeren yapılardır. Bu fonlar, ekonomileri büyük bir gelir akışından izole etmek için emtia ihracatı ve özelleştirme gibi işlemlerden elde edilen varlıkları yönetirler. Devlet varlık fonları, tasarruf fonları ve mali istikrar fonları istikrar fonunun örnekleridir. Petrol istikrar fonları, devlet varlık fonlarının kapsamına girer. Devlet Varlık Enstitüsü verilerine göre, devlet varlık fonlarının toplam büyüklüğü Mart 2018 itibarıyla yaklaşık 7,45 milyar ABD dolarıdır ve bu fonların yarısından fazlasını petrol ve doğal gaz fonları oluşturmaktadır. Petrol istikrar fonları, genellikle gelecek için tasarruf sağlamak (nesiller arası eşitlik ve mali sürdürülebilirlik) veya mali harcamaların dönemler arasında çok değişkenlik göstermesini engellemek için oluşturulmuştur. Petrol fiyat ve üretiminde artış yaşandığı dönemlerde hükümetler, petrol gelirlerinin bir kısmını fona aktararak kriz dönemlerinde fonlarda biriken bu varlıklar ile bütçe açıklarını finanse edebilmektedir.

Literatürde, maliye politikasının konjonktürel yanlılığı ile gelirlerde oluşan dalgalanmalar arasındaki ilişki farklı ülke gruplarında incelenmiş ve gelişmekte olan ülkeler için maliye politikasının konjonktürel yanlılığını destekleyici sonuçlar bulunmuştur. Bu çalışmaların bazıları (Gavin ve Perotti, 1997; Akitoby ve diğerleri, 2004; Kaminsky ve diğerleri, 2004 ve Alessina ve Tabellini, 2008) daha çok gelişmekte olan ve endüstriyel ülke gruplarına odaklanırken, diğerleri ülke örneklemlerini petrol ihraç eden (Villafuerte ve Lopez-Murphy, 2010 ve Erbil, 2011) veya kaynak zengini ülkeler (Bova ve diğerleri, 2016) olarak daraltmıştır.

Politik ekonomi bağlamında, Arezki ve diğerleri (2011), yüksek kaliteli siyasi kurumların varlığının, hükümet harcamalarının konjonktürel yanlılığını azaltmaya yardımcı olduğunu göstermektedir. Daha genel olarak, gelişmiş ve gelişmekte olan ülkeleri kapsayan çalışmalarında Frankel ve diğerleri (2013), gelişmekte olan ülkelerin üçte birinin mali davranışlarının konjonktürel yanlı olmaktan çıkarak konjonktür karşıtına dönüştüğünü bulmuşlardır. Söz konusu çalışmadaki örneklemin yarısını petrol ihracat eden ülkelerin oluşturması ve ülkelerin mali davranışlarında yaşanan dönüşümün petrol fonlarının yaygınlaşmaya başladığı zamana denk gelmesi oldukça dikkat çekmektedir. Yazarlar ayrıca kurumsal kalitenin bu süreçte çok önemli bir rol oynadığını ortaya koymuştur.

Doğal kaynak fonlarının yaygınlaşması ile birlikte, bu fonların maliye politikasının yönetimi üzerindeki etkisini araştıran çalışmaların sayısı da artış göstermiştir. Ancak bu etkiyi nicel olarak analiz eden çok az akademik çalışma vardır ve bu analizlerden elde edilen sonuçlar farklılık göstermektedir. Bu çalışmalardan bazıları tek bir ülke üzerine odaklanırken veya birden fazla ülkeyi ayrı ayrı incelerken diğerleri fonların etkisini birçok ülkeyi kapsayan panel veri setleri ile araştırmaktadır.

İlk grupta Fasano (2000), örnek olay incelemesinde Şili (bakır)'de, Kuveyt'te, Umman'da, Venezuela'da ve Alaska Eyaleti'nde tasarruf fonlarını incelemiştir. Bu çalışma, fonların bazı ülkelerde (Norveç, Alaska Eyaleti ve Şili) kamu geliri ile kamu harcamaları arasındaki bağı ortadan kaldırarak mali yönetimin etkinliğini artırmaya yardımcı olduğunu; ancak diğer ülkelerde önceden konan fon hedeflerine sadık kalınmaması ve sürekli değişen fon kuralları nedeni ile bu etkinin görülmediğini ortaya koymuştur. Ayrıca yazar, doğal kaynak fonlarının başarısının, güçlü mali disiplin ve hükümetlerin doğru makroekonomik yönetimlerinin bir sonucu olduğunu vurgulamıştır.

İkinci grupta, 1970-2000 dönemi için 71 doğal kaynak zengini ülkeyi kapsayan panel veri setini kullanarak Crain ve Devlin (2003), fonların mali oynaklık üzerindeki etkisini araştırmıştır. Söz konusu çalışmada; özellikle petrol zengini ülkelerde bu fonların hükümet harcamalarının oynaklığında bir artışa neden olduğu sonucuna ulaşılmıştır. Öte yandan, örneklem Norveç, Şili ve Umman ülkelerini kapsayacak şekilde daraltıldığında Norveç ve Şili'deki fonların harcama oynaklığını azalttığı öne sürülmüştür. Yazarlar, fonların etkilerinde görülen farklılıkların ülkelerin mali ve fon yönetimlerindeki görülen farklılıkların bir sonucu olabileceğini vurgulamışlardır.

Bagattini (2011) kamu mali dengesini, kaynak dışı kamu mali dengesini, kaynak dışı kamu gelirlerini ve kamu borçlarını içeren yeni bir gösterge oluşturarak, 1992-2007 dönemi için petrol üreten 12 ülkede, doğal kaynak fonlarının ülkelerin mali performansları üzerindeki etkisini incelemiştir. Elde edilen sonuçlar, örneklemdeki ülkelerden yalnızca birinde (Çad) fon kurulduktan sonra mali performansın düştüğünü, ancak diğer ülkelerde fon varlığının daha iyi kaynak dışı mali denge ve daha düşük kamu borcu ile ilişkili olduğunu göstermiştir. Çalışma ayrıca, siyasi istikrar ve fon yapısının daha iyi mali performans için etkili faktörler olduğunu doğrulamıştır.

Tsani (2013) quantile regresyon yöntemini kullanarak 1996-2007 döneminde iki ülke grubunda (27 kaynak zengini ülke ve 81 ülke) kaynak fonları, kurumların kalitesi ve yönetişim arasındaki ilişkiyi araştırmıştır. Analiz sonuçlarına göre, kaynak fonlarının kurulması ülkedeki yönetişim ve kurumların kalitesinin artmasına katkıda bulunmuştur. Çalışmada ayrıca, ortaya konan bu olumlu ilişkinin ülkelerin yönetişim ve kurumsal kalite sıralamasında üst veya alt sıralarda yer almalarına bağlı olmaksızın tüm ülkeler için geçerli olduğu vurgulanmıştır.

Coutinho ve diğerleri (2013), panel en küçük kareler ve araç değişkenleri yöntemini kullanarak, 1962-2011 dönemi için 84 kaynak zengini ülkeyi incelemiştir. Bu çalışmada, maliye politikası değişkeni olarak kamu harcamalarındaki büyüme ve bu büyümenin gayrisafi yurtiçi hasılaya oranı kullanılmıştır. Tahmin sonuçları, örneklemde yer alan ülkelerde maliye politikasının son derece konjonktürel yanlı olduğunu göstermiştir. Ayrıca elde edilen bulgulara göre, ülkelerdeki demokrasi seviyesi ile yönetim organlarının kalitesinin yüksek olması ve ülkelerde fonların kurulmuş olması maliye politikasının yanlılığını azaltırken, mali kuralların bu yanlılık üzerinde herhangi bir etkisi yoktur.

Sugawara (2014), 1988-2012 döneminde 68 doğal kaynak zengini ülke için, doğal kaynak fonlarının hükümet harcamalarındaki dalgalanmayı azaltıcı etkisi olup olmadığını araştırmıştır. Tahmin sonuçları, fonun kamu harcamalarındaki oynaklığı azaltmada başarılı bir araç olduğu, ayrıca mali kuralların ve siyasi kurumların kalitesinin de bu oynaklığı azaltmada belirleyici rol oynadığını ortaya koymuştur. Çalışma aynı zamanda ekonomik büyüklüğün, iyi yapılandırılmış reel sektörün ve ihracatta ve finansal piyasalardaki çeşitlenmenin harcama oynaklığını azaltmaya katkıda bulunduğuna dair kanıtlar sunmuştur.

Koh (2016), panel VAR modelini kullanarak 1960-2014 dönemini kapsayan ve 42 petrol ihraç eden ülke için bir çalışma yapmıştır. Yazar, çalışma dönemini petrol fonları kurulmadan önce ve kurulduktan sonra olmak üzere ikiye ayırmıştır. Tahmin sonuçları, yüksek kaliteli kurumlara sahip ülkelerde, petrol fonlarının kamu harcamalarındaki konjonktürel yanlılığı ortadan kaldırarak konjonktüre karşı duruma getirdiğini göstermiştir. Buna ilaveten çalışmada, düşük kaliteli kurumlara sahip ülkelerde de fonlar kurulduktan sonra maliye politikasının konjonktürel yanlılığının azaldığı; ancak elde edilen sonuçların istatistiksel olarak anlamlı olmadığı belirtilmiştir.

Özetle, doğal kaynak zengini ülkelerde maliye politikalarının konjonktürel yanlılığını inceleyen birçok çalışma olsa da çok azı doğal kaynak fonlarının ve kurumsal kalitenin bu yanlılık üzerindeki etkisini araştırmıştır. Ayrıca, bu çalışmalar maliye politikasını temsilen uygun değişkenleri seçmezken içsellik sorununu tam olarak incelememiş ve eğim heterojenliğini ile kesit bağımlılığını dikkate almamışlardır. Bu tez iki makaleden oluşmaktadır. Bu makalelerden ilkinde, petrol fonlarının ve kurumsal kalitenin maliye politikasının konjonktürel yanlılığı üzerindeki etkisi incelenmiş olup, yukarıda belirtilen sorunlar dikkate alınarak söz konusu çalışmada istatistiki olarak daha doğru sonuçlar elde edilmesi amaçlanmıştır.

Bu çalışma ile birkaç açıdan literatüre katkı sağlanmıştır. İlk olarak, maliye politikasının konjonktürel yanlılığı ve fonların bu yanlılık üzerindeki etkisi, Chudik ve Pesaran (2015) Dinamik Ortak İlişkili Etkiler Panel yöntemi kullanılarak test edilmiştir. Bu nedenle, aynı tahminde içsellik, eğim heterojenliği ve kesit bağımlılığı dikkate alınmıştır. Ayrıca, rastgele etkiler (veya sabit etkiler) ve sistem GMM gibi farklı ekonometrik yöntemler kullanılarak elde edilen tahmin sonuçları karşılaştırılmıştır. İkinci olarak, tüm ülke örneklemi Kuncic kurumsal kalite veri setlerine ilişkin bilgiler ışığında makine öğrenmesi kümeleme yöntemleri kullanılarak alt gruplara ayrılmış ve kurumsal kalitenin etkisi incelenmiştir. Çalışmanın örneklemini oluşturan ülkeler kurumsal ve siyasi yapılar açısından homojen olmadığından, kurumsal kalitenin maliye politikasının konjonktürel yanlılığı üzerindeki etkisi ülke gruplarına göre değişiklik göstermiştir. Son olarak, literatürde yalnızca birkaç çalışma, regresyonlarındaki ülkelerin petrol fiyatı dalgalanmalarına duyarlılıklarını kontrol etmek için bir değişken kullanmışlardır ve bu değişken genellikle petrol fiyatıdır. Buna karşılık, bu çalışmada petrol fiyatındaki dalgalanmayı daha sağlıklı şekilde kontrol etmek için petrol fiyatı oynaklığı kullanılmıştır.

Bu çalışmanın örneklemi Cezayir, Angola, Azerbaycan, Bahreyn, Brunei, Kamerun, Çad, Kolombiya, Fildişi Sahili, Kongo Cumhuriyeti, Ekvador, Gabon, Endonezya, İran İslam Cumhuriyeti, Kazakistan, Kuveyt, Libya, Meksika, Nijerya, Norveç, Umman, Katar, Papua Yeni Gine, Rusya Federasyonu, Suudi Arabistan, Suriye Arap Cumhuriyeti, Sudan, Trinidad ve Tobago, Birleşik Arap Emirlikleri, Venezuela, Vietnam ve Yemen’i kapsamaktadır. Bu ülkeler, iki kriterden en az birini sağladıkları için seçilmiştir. Bu kriterler, petrol ihracatının toplam ihracata veya gayrisafi yurtiçi hasılaya oranı veya kamunun petrol gelirlerinin toplam gelirlerine oranı en az yüzde 20 olmasıdır. Çalışma dönemi olarak ise 1984-2015 dönemi seçilmiştir.

Çalışmada, en küçük kareler ve tek adımlı sistem GMM yöntemleri kullanılarak elde edilen tahmin sonuçları, petrol zengini 32 ülkeden oluşan bir örneklemde maliye politikanın oldukça konjonktürel yanlı olduğunu göstermektedir. Bunun yanı sıra, petrol fonları bu yanlılığı azaltıcı bir etkiye sahipken devlet harcamalarını ortalama olarak artırdığı elde edilen bir diğer bulgudur. Bir başka deyişle, gayrisafi yurtiçi hasıla artışını tetikleyen petrol gelirlerinin büyük bir kısmının, doğrudan harcamalarda kullanılmadan petrol fonlarına aktarıldığı ve fonlarda biriken petrol gelirlerinin, farklı yatırım araçlarıyla değerlendirildikten sonra devlet harcamalarında kullanıldığı görülmektedir. Bununla birlikte, kesit bağımlılığı test istatistikleri bu modellerde ciddi ekonomik sorunlara neden olan yatay kesit bağımlılığının varlığını ortaya koymuştur. Bu nedenle, Chudik ve Pesaran (2015) Dinamik Ortak İlişkili Etkiler Panel yöntemi daha tarafsız ve sağlam sonuçlar elde etmek için kullanılmıştır. Bu model ile elde edilen tahmin sonuçları maliye politikasının konjonktürel yanlılığını ve petrol fonlarının bu yanlılığı azaltıcı etkilerini doğrulamaktadır. Bu modeller ile elde edilen tahmin sonuçları en küçük kareler ve tek adımlı sistem GMM yöntemleri kullanılarak elde edilen tahmin sonuçları ile karşılaştırıldığında, fon ile ekonomik büyüme etkileşim katsayısının daha büyük olduğu yani; petrol fonlarının yanlılığı azaltıcı etkilerinin daha büyük olduğu sonucuna ulaşılmıştır. Ayrıca, dinamik ortak ilişkili etkiler panel yöntemi ile elde edilen sonuçlara yatay kesit bağımlılık testi uygulanmış ve testler bu tahmin sonuçlarında herhangi bir yatay kesit bağımlılığı bulunmadığını ortaya koymuştur.

Çalışmada, kurumsal kalitenin etkisi, Kuncic (2014) kurumsal kalite veri setleri ışığında tüm ülke örneklemi iki alt gruba ayrılarak incelenmiştir. Ülkeler kümelere ayrılırken k-means ve hiyerarşik denetimsiz öğrenme algoritmaları gibi makine öğrenme metotları kullanılmıştır. Dinamik ortak ilişkili etkiler panel yöntemi ile elde edilen sonuçlara göre, yüksek kurumsal kaliteye sahip ülke grubuna kıyasla düşük kurumsal kaliteye sahip ülke grubunda maliye politikası daha konjonktürel yanlıdır. Elde edilen bulgular, petrol fonlarının yanlılığı azaltmada yalnızca yüksek kurumsal kaliteye sahip ülkelerde etkili olduğunu ortaya koymaktadır. Ayrıca, Uluslararası Ülkeler Risk Rehberi veri setiyle yapılan analiz sonuçları, siyasi kurumların kalitesinin yüksek oluşunun yüksek kurumsal kaliteye sahip ülkelerde kamu harcamalarının azalmasına katkı sağladığını; ancak düşük kurumsal kaliteye sahip ülkelerde bu ilişkinin görülmediğini göstermiştir. Bu bulgunun nedeni düşük kurumsal kaliteye sahip ülkelerde devlet yönetimini sabote eden ve büyümeyi sağlayan kurumların oluşumunu engelleyen rant davranışı olabilmektedir. İlk çalışmada elde edilen bütün bu sonuçlar, bir petrol fonunun ülkelerinin konjonktürel yanlı maliye politikası uygulamalarını engellemek ve ekonomilerini istikrara kavuşturmak için etkili bir politika aracı olduğunu göstermektedir. Ayrıca, kurumsal kalitenin, yüksek oynaklığa sahip petrol gelirlerinin yönetilmesi için, ihtiyaç duyulan doğru mali politikaların uygulanmasında önemli bir rol oynadığını sonucuna ulaşılmıştır. Bu nedenle petrol fonları sağlam maliye politikasının ikamesi değil, tamamlayıcısı olarak düşünülmelidir.

Kaynak zengini gelişmekte olan ülkelerde doğal kaynakların yönetimi, politika yapıcılar ve ekonomistler arasında tartışılan önemli konulardan biridir. Kalıcı Gelir Hipotezi 'ne dayanan doğal kaynak yönetimi ile ilgili geleneksel görüş, doğal kaynak zenginliğinin finansal varlıklar olarak harici bir fonda saklanmasıdır (Berg ve diğerleri, 2012). Bu görüşe göre, mali sürdürülebilirliği sağlamak için kaynak dışı birincil açık, fonda biriken kaynak gelirinden elde edilen faiz geliri ile sınırlandırılmalıdır (Agénor 2016). Ancak, kaynak zengini gelişmekte olan ülkelerde hem krediye hem de sermayeye erişimde kısıtların olması nedeniyle kalıcı gelir hipotezinin bu ekonomiler için uygunluğu literatürdeki birçok çalışma tarafından sorgulanmaktadır. Bu çalışmalara göre, (örneğin, Takizawa ve diğerleri (2004), Venables (2010) ve Araujo ve diğerleri (2015)), söz konusu gelişmekte olan ülkelerde kaynak gelirleri kullanılarak yapılan verimli hükümet harcamalarının ekonomi üzerindeki olumlu etkileri kaynak gelirlerinin tümünün tasarruf edildiği duruma göre daha büyüktür. Bu nedenle, bu ülkeler için maliye politikaları, bir taraftan makroekonomik ve mali istikrarı korumalı diğer taraftan da altyapı yatırımlarında ve sağlık ile eğitim gibi kamu harcamalarını karşılamak için hükümetlerin yeterli kaynak gelirlerini tahsis etmesine izin veren daha esnek mali yönetim kurallarını içermelidir.

Literatürde doğal kaynak gelirlerinin yönetimi ile ilgili çeşitli çalışmalar bulunmaktadır. Bu çalışmalardan bazıları, rastgele tahsis kurallarını kullanarak stokastik olmayan modeller ile doğal kaynak gelirlerinin optimal tahsisini incelerken, diğerleri, petrol veya doğalgaz gibi emtialarına fiyatlarında meydana gelen artış sonucu oluşan Hollanda hastalığını ve bu hastalığın etkilerini hafifletmek için gerekli olan maliye ve para politikasının koordinasyonuna odaklanmıştır.

Agénor (2016), optimal kaynak gelir dağılımını makroekonomik veya mali istikrar ve tüketim oynaklığı (hanehalkı refah ölçüsü olarak) kullanılarak oluşturulan sosyal kayıp fonksiyonu ve dinamik stokastik genel denge modeli ile analiz ederek literatüre katkıda bulunan ilk çalışmadır. Agénor'un altyapı kapasite ve erişimi yeterli olmayan, kaynak açısından zengin, düşük gelirli bir ülke için geliştirdiği bu model, özel yatırım ve kamu sermayesi arasında doğrudan tamamlayıcılık etkisi ve dünya sermaye piyasalarına tam erişimin olmaması gibi bir dizi özelliği içermektedir. Ayrıca modelde kamu sermayesinin yığılma ve emilme kısıtlamalarına tabi olduğu varsayılmaktadır. Agénor'un çalışmasının temel noktası, model yapısı ve parametreleri, fiyat şokunun kalıcılığı, devlet fonunda biriken varlıkların reel getirisi ve kamu harcamalarının etkinliği gibi çeşitli faktörlere bağlı olan kaynak gelirlerinin şimdi harcanması ile tasarruf edilerek daha sonra harcanması arasındaki dinamik oynaklık değiş tokuşudur. Söz konusu dinamik oynaklık değiş tokuşuna göre, bugünün harcamalarındaki bir düşüş oynaklığı azaltabilir. Ancak, gelirin ne kadar büyük bir kısmı tasarruf edilirse devlet fonundaki varlıklardan o kadar fazla faiz geliri elde edilir ve bu artış zaman içinde harcamaları dolayısıyla da oynaklığı artırır.

Azerbaycan topraklarında on dokuzuncu yüzyılın sonlarından beri petrol üretilmektedir. Sovyet Sosyalist Cumhuriyetler Birliği'nin dağılmasından sonra, yaşanan ekonomik çöküş ve 1997 yılında meydana gelen Dağlık Karabağ Savaşı ile Azerbaycan'da petrol üretimi durma noktasına gelmiştir. Azerbaycan, 1994 yılında önde gelen petrol üretici ülke şirketleri ile bir dizi üretim paylaşım anlaşmalarını içeren "Yüzyılın Sözleşmesi" imzalamış ve 1999 yılında devlet petrol fonunu kurmuştur. Bu iki gelişme ile birlikte ülkede petrol ve doğal gaz alanında kamu yatırımlarının ve doğrudan yabancı yatırımların artması ile birlikte durma noktasına gelen petrol ve doğal gaz üretimi ve ihracatı artış göstermeye başlamıştır. Zamanla kurulan petrol ve doğal gaz iletim boruları ile birlikte Azerbaycan, petrol ve doğal gaz piyasasında önemli bir oyuncu konumuna gelmiştir.

Azerbaycan Devlet Petrol Fonu 1999 yılında Cumhurbaşkanı kararıyla tüzel kişilik olarak kurulmuştur. Yasal düzenlemesi 2000 yılında Cumhurbaşkanı tarafından onaylanan Azerbaycan Devlet Petrol Fonu 2001 yılında bütçe dışı fon olarak faaliyet göstermeye başlamıştır. İlgili kamu kuruluşlarının temsilcilerinden oluşan denetim kurulu, fonun varlık biriktirme ve harcama gibi faaliyetlerini kontrol etmektedir. Cumhurbaşkanı tarafından atanan icra direktörü, fon faaliyetlerinin operasyonel yönetimini üstlenmektedir. İcra direktörü ayrıca, varlıklarının kullanımına ilişkin yıllık bir fon programı hazırlayarak Azerbaycan Cumhurbaşkanı'nın onayına sunmaktadır. Azerbaycan Devlet Petrol Fonu'nun üç ana hedefi vardır: (1) Azerbaycan'ın petrol gelirine olan bağımlılığını azaltıp petrol dışı sektör gelişimini teşvik ederek makroekonomik istikrarı sürdürmek; (2) Gelecek nesiller için kaynak gelirlerini biriktirmek ve korumak; (3) Sosyo-ekonomik kalkınmayı sağlamak için kritik ulusal projeleri finanse etmek. Azerbaycan Devlet Petrol Fonu bütçe gelirleri, Azerbaycan'ın hidrokarbon payının satışından elde edilen gelirleri, gaz ve petrolün Azerbaycan toprakları üzerinden transit geçişinden elde edilen gelirleri, ikramiye ödemelerini ve fon varlıklarının yönetiminden elde edilen gelirleri içermektedir. Fonun harcamaları ise ağırlıklı olarak devlet bütçesine yapılan transferlerden oluşmaktadır. Diğer harcama alanları, insan sermayesinin finansmanı, sosyal ve altyapı geliştirme programları ve idari harcamalar gibi operasyonel harcamalardır. Fonun harcamaları yalnızca cumhurbaşkanı kararı ile sınırlandırılmaktadır.

2001 yılında fonun faaliyete geçmesiyle birlikte, petrol gelirleri fonda birikmeye başlamış ve varlıklarının değeri 2005 yılında 1 milyar ABD dolarına ulaşmıştır. 2007 yılına gelindiğinde 2 milyar ABD dolarını aşan varlıkların değeri, 2008 yılında artan petrol fiyatlarının da etkisi birlikte büyük bir yükseliş göstererek 11 milyar ABD doları olmuştur. Aynı yıl, Azeri-Çırak-Güneşli sahalarından elde edilen petrol karındaki devlet payı yüzde 25'ten yüzde 80'e yükselmiştir (Bagirov, 2007). Devlet bütçesine giden yabancı petrol şirketleri ve ulusal petrol şirketi SOCAR tarafından ödenen kâr vergileri dışındaki tüm devlet petrol gelirleri, Azerbaycan Petrol Fonu'na aktarılmaktadır. 2006 ve 2007 yıllarında fona aktarılan devlet petrol gelirlerinin payları sırasıyla yaklaşık yüzde 39 ve yüzde 46 iken, 2008 yılında bu pay yüzde 83'e yükselmiştir.

2008 yılından 2017'ye kadar fonun toplam bütçe geliri 132,4 milyar ABD doları (yıllık ortalama 13,24 milyar ABD doları) olmuştur. 2015 yılında petrol fiyatlarındaki düşüş ve AZN'nin Şubat 2015'te yüzde 34, Aralık 2015'te yüzde 48 değer kaybetmesi nedeniyle Azerbaycan Petrol Fonu'nun dolar bazındaki geliri 16,2 milyar ABD dolarından 7,7 milyar ABD dolarına gerilemiştir. 2016 yılında AZN döviz kurunun tarihi bir düşüş göstererek gerilemesi ve petrol fiyatının değişmemesi nedeniyle fonun bütçe geliri gerileyerek 5,9 milyar ABD doları olmuştur. Ancak 2018 ve 2019 yıllarında fonun bütçe gelirleri artarak sırasıyla 10,4 milyar ABD doları ve 11,2 milyar ABD doları seviyelerine ulaşmıştır. 2008-2019 döneminde fonun en yüksek bütçe geliri 19,8 milyar ABD doları ile 2011 yılında gerçekleşmiştir. Ayrıca, 2011'den 2019'a kadar, fon varlıkları 29,8 milyar ABD dolarından 43,3 milyar ABD dolarına yükselmiştir.

Azerbaycan Petrol Fonu'nun faaliyete başladığı ilk yıllarda petrol ve doğal gaz gelirlerinden önemli miktarda tasarrufu sağlanmıştır. Ancak, fon gelirlerinin devlet bütçesine aktarılan payı 2008 yılından sonra artmaya başlamıştır. 2003 yılından 2018 yılına kadar fondan devlet bütçesine yapılan aktarım toplam 93 milyar ABD doları olup, bu değer bugüne kadarki tüm fon harcamalarının yüzde 86,9'una denk gelmektedir (SOFAZ, 2018). Fon için, Eylül 2004'te Cumhurbaşkanı Kararnamesi ile kabul edilen uzun vadeli gaz ve petrol yönetimi stratejisi kapsamında düzenlenen tek bir çekilme kuralı vardır. Bu kurala göre, gaz ve petrol gelirleri zirveye ulaştığında, yıllık gelirlerin yüzde 25'inin tasarruf edilmesi gerekmektedir. Ancak Azerbaycan Petrol Fonu'nun yıllık raporlarına göre, fondan devlet bütçesine yapılan cömert transferler, gelirlerin en yüksek seviyeye ulaştığı 2011-2015 yılları arasında bu kuralın ihlal edilmesine yol açmıştır. Petrol ve doğal gaz gelirlerinin 2012 yılında yüzde 78'i, 2013 yılında yüzde 90,4'ü, 2014 yılında yüzde 79,4'ü ve 2015 yılında yüzde 118,9'u harcanmıştır.

Petrol ve doğal gazdan elde edilen gelirler ile birlikte fonda biriken varlıklar artış göstermiştir. Azerbaycan Petrol Fonu için mevduat kuralları belirlenmiş olmasına rağmen, kaynak harcama kuralları belirsizdir ve her iki tür kural da mali istikrar ve hanehalkı refahı gibi belirli konuları dikkate almamaktadır. Ayrıca, 2001 yılından beri petrol fonuna aktarılan petrol ve doğal gaz gelirlerinin yaklaşık yüzde 72'si harcanmıştır. Bu nedenle, Azerbaycan politika yapıcılarının fondaki varlıkların harcama ile tasarrufu arasında optimal kaynak tahsisini belirlemesi hayati önem taşımaktadır.

Agénor (2016) modelinin geliştirilmiş bir versiyonunun kullanıldığı tezin ikinci makalesinde, enerji üretimi ve fiyat şoklarının makroekonomik etkileri ve kaynak gelirlerinin harcama ile tasarruf arasındaki optimal tahsisi Azerbaycan bağlamında belirlenmeye çalışılmıştır. Agenor'un modeli varsayımsal düşük gelirli bir ülkeyi incelerken, bu çalışma modelin ilk gerçek gelişmekte olan ülke uygulamasıdır. Bu araştırma aynı zamanda, Azerbaycan ekonomisinin bazı özelliklerini göz önünde bulunduran, genel bir denge ortamında tasarruf ve tüketim arasında kaynak gelirleri tahsisini inceleyen ilk çalışmadır.

Bu araştırma, Agénor'dan (2016) şu açılardan farklıdır: model, tam sermaye hareketliliğinin olmadığı durumu içerir; ticarete konu olan ve olmayan ürünler arasında tam bir ikame yoktur; doğal kaynak ürünleri yurt içinde de tüketilmektedir; boru hatlarının tamamlanması Azerbaycan'da petrol ve gaz iletim maliyetlerini azalttığı için dağıtım maliyeti hariç tutulmuştur; özel yatırım ve kamu sermayesi arasında tamamlayıcılık etkisi yoktur; kamu sermayesi altyapı harcama verimliliğini etkileyen emilim kısıtlamasına tabidir. Bunun yanında, Agénor (2016) modelinde kamu harcamalarının yalnız ticarete konu olmayan ürünleri içerdiği varsayılırken bu modelde, söz konusu harcamaların ticarete konu olmayan ürünlerin yanı sıra ticarete konu olan ürünleri de kapsadığı varsayılmıştır. Agenor'un (2016) varsayımlarından biri, bir ülkenin risk primi ile devlet borcunun ticarete konu olan çıktı oranı arasında pozitif bir ilişki olduğudur. Ancak doğal kaynaklar, gelişmekte olan ülkelerde üretimde kaynak dışı sektörlerin gelişmemesine, politik riskin artmasına ve kurumların kalitesinin azalmasına neden olduğu için kredi derecelendirme kuruluşları tarafından genellikle bir risk olarak görülmektedir (van der Ploeg, 2012). Ayrıca, van den Bremer ve van der Ploeg (2013), uluslararası sermaye piyasalarındaki risk primini azaltan, beklenmedik kaynaklara dair net bir ampirik kanıt bulunmadığını belirtmektedir. Dolayısıyla bu çalışmada risk priminin devlet borcunun kaynak dışı çıktıya oranı ile pozitif ilişkili olduğu varsayılmaktadır.

Bu çalışma, geçici kaynak üretimi ve fiyat şoklarının makroekonomik etkilerini iki alternatif mali kural olan tam tasarruf ve tam harcama kuralları altında incelemek için üç sektörlü bir dinamik stokastik genel denge modeli geliştirmeyi amaçlamaktadır. Modelde, optimal tahsis kuralı, sosyal kayıp fonksiyonunu en aza indirecek şekilde belirlenmektedir. Kavramsal olarak Agénor'a (2016) benzer bir yönteme başvurularak bir mali/makroekonomik istikrar ölçüsünün ağırlıklı geometrik ortalaması kullanılarak elde edilen kayıp fonksiyonunu en aza indirmek için bir kriter önerilmiştir. Hanehalkı refah ölçüsü, özel tüketimin oynaklığı veya toplam istihdam ve özel tüketimin oynaklığının eşit ağırlıklı geometrik ortalaması ile temsil edilir. Benzer şekilde, mali istikrarın ölçüsü, kaynak dışı birincil dengenin çıktıya oranının oynaklığı ile gösterilirken makroekonomik istikrarın ölçüsü, reel döviz kuru oynaklığı ve kaynak dışı birincil dengenin çıktıya oranının eşit ağırlıklı geometrik ortalaması ile belirlenmektedir.

Çalışmanın ana bulguları, tüm kaynak gelirlerinin harcanmasının yüksek oynaklığa ve Hollanda hastalığı etkisi olarak adlandırılan reel döviz kurunun değerlenmesi ve kaynak dışı ticarete konu olan sektörün daralmasına neden olduğunu göstermektedir. Bunun aksine, tüm gelirlerim tasarruf edildiği durumda Hollanda hastalığı etkisinin hafiflediği belirlenmiştir. Bu durumun nedeni, kaynak gelirinin tam tasarrufunun devlet harcamalarını dolayısıyla da toplam talep baskılarını azaltması ve ticarete konu olmayan üretimde düşüşe neden olmasıdır.

Bunun yanında, optimal kaynak tahsisine ilişkin sosyal kayıp fonksiyonlarından (3.56, 3.57) elde edilen sonuçlar, harcama ile tasarruf arasında mali oynaklık ve tüketim oynaklığı için açık bir oynaklık değiş tokuşu (dinamik) olduğunu göstermektedir. Bir başka deyişle devlet bütçesine aktarılan varlıkların payı arttıkça, kaynak dışı birincil dengenin çıktıya oranının oynaklığı ve tüketimin oynaklığı belli bir düzeye (χ= 0,3 ve χ=0,8) kadar düşmektedir. Ancak bu oynaklık bu noktalardan sonra artmaya başlayarak dışbükey bir şekil almaktadır. Bu dışbükey şekil kayıp fonksiyonunu minimize eden bir χ değerinin olduğunu göstermektedir. Hükümet harcamaları, götürü vergiler ve dünya faiz oranları (dolaylı olarak borç-ticarete konu çıktı oranı ve risk primi) gibi değişkenlerin oynaklıkları, model parametreleri ve şokların kalıcılığı bu dışbükey şeklin oluşumunda bir etkiye sahiptir. Ayrıca, kaynak üretim artışı da fiyat artışında olduğu gibi devlet için daha yüksek bir kaynak geliri oluşturduğundan, bu iki şokta makroekonomi değişkenleri üzerinde benzer etkiler göstermektedir. Kaynak fiyat şoku altında Azerbaycan Petrol Fonu’nda bulunan varlıkların tasarruf ve harcama arasında optimal dağılımı ile ilgili olarak elde edilen sonuçlara göre, Azerbaycan hükümeti yalnızca mali istikrarla ilgilendiği durumda, fonda tutulan varlıkların yüzde 30'unu fona aktararak tasarruf etmelidir. Buna karşılık, hükümet yalnızca tüketim oynaklığı (hanehalkı refahı) ile ilgileniyorsa, bu oran yüzde 80'dir. Gerçekte, hükümetlerin her iki oynaklık türüyle de ilgilenmesi beklenir. Çalışmada elde edilen bulgulara göre, hükümet mali istikrar ve hanehalkı refahı ile eşit derecede ilgileniyorsa optimal tahsis kuralı elde edilen petrol ve doğal gaz gelirlerinin yüzde 40'ının Azerbaycan Petrol Fonu'nda tasarruf edilmesini önermektedir.

Sosyal kayıp fonksiyonları ile 0,1'lik bir aralık kullanılarak elde edilen hesaplamalar bazen kesin sonuçlar vermemektedir. Bu nedenle alternatif olarak 0,01'lik aralıklarla daha hassas sonuçlar elde edilmeye çalışılmıştır. Tablo 3.4 ve 3.5'in son satırlarında, bu sonuçlar sunulmaktadır. Birinci sosyal kayıp fonksiyonu için optimal değerler $(\mu = 0)$ ve $(\mu = 1)$ durumları için 0,33 ve 0,79 iken, ikinci kayıp fonksiyonu için bu değerler sırasıyla 0,29 ve 0,71'dir. Bununla birlikte, hükümet her iki oynaklık türü ile eşit olarak ilgilendiğinde, optimal değerler birinci ve ikinci sosyal kayıp fonksiyonu için sırasıyla 0,33 ve 0,41'dir.

Agénor (2016)'da belirtildiği gibi reel döviz kurundaki dalgalanmalar, ekonomilerin rekabet edebilirliğinin incelenmesi ve dolayısıyla makroekonomik istikrar için oldukça önemli olan nispi fiyatların oynaklığını yansıtmaktadır. Bu kapsamda, kaynak dışı birincil denge oynaklığının yanı sıra reel döviz kuru oynaklığını da içeren denklem, makroekonomik oynaklık için daha genel bir endeksi temsil etmekte ve Agénor (2016)'da olduğu gibi genelleştirilmiş kayıp fonksiyonu olarak adlandırılmaktadır. Tablo 3.6, reel döviz kuru ve mali gösterge üzerinde eşit ağırlık kullanılarak genelleştirilmiş kayıp fonksiyonu hesaplamalarını göstermektedir. Bulgular, χ değerlerinin sosyal kayıp fonksiyonunda elde edilen değerler ile karşılaştırıldığında genel olarak daha yüksek olduğunu göstermektedir. Hükümet yalnızca makroekonomik istikrarla ilgilendiği durumda optimal χ değeri 0,5, yalnızca özel tüketimin oynaklığıyla ilgilendiği durumda ise 0,80'dir. Ancak hükümet, makroekonomik istikrar ve özel tüketimin oynaklığı ile eşit derecede ilgilendiği durum için, optimal χ değeri 0,6 olarak hesaplanmıştır. Daha kesin optimal değerler elde etmek için, 0,01 hassas aralıklar kullanılarak genelleştirilmiş kayıp fonksiyonları hesaplanmıştır. Devlet petrol fonunda tutulan varlıkların devlet bütçesine optimal transferleri $(\mu = 0), (\mu = 0,5)$ ve $(\mu = 1)$ durumları için sırasıyla 0,45, 0,61 ve 0,79 olarak hesaplanmıştır.

Çalışmada ayrıca birinci sosyal kayıp fonksiyon (3.56) kullanılarak hesaplanan, kaynak gelirlerinin optimal tasarruf oranı değerlerinin duyarlılık analizi bazı parametre değişiklikleri ve model spesifikasyonları kullanılarak yapılmıştır. Bu değişiklikler daha sıkı emilim kısıtını, devlet altyapı yatırımlarına ayrılan devlet harcamalarının daha yüksek bir paya sahip olmasını, kamu sermayesine göre daha yüksek bir çıktı esnekliğini ve alternatif risk primi ölçüsünü içermektedir. Emilim kısıtı nedeniyle kamu sermayesindeki bir artış, verimlilikte bir azalmaya yol açmakta ve bu durum gelişmekte olan ülkelerde kamu sermayesi stokundaki artışı azaltmaktadır. Kamu sermayesi oynaklığında görülen bu düşüş, diğer değişkenlerin oynaklıklarının azalmasına neden olurken daha düşük bir optimal tasarruf düzeyini gerektirmektedir. Çalışmada φ_1 parametresi 0,05 değerinden 0,07 değerine yükseltildiğinde politika yapıcılarının yalnızca mali istikrara önem verdiği durumlarda optimal tasarruf düzeyinin ilk duruma göre azaldığı görülmüştür. Örneğin, politika yapıcının yalnızca mali istikrara önem verdiği durumda φ_1 parametresinin 0,05 değeri için optimal tasarruf oranı 0,33 iken, φ_1 parametresi 0,07 değerine yükseltildiği ikinci durumda optimal tasarruf değeri 0,29 olarak bulunmuştur.

Agénor (2016)'da belirtildiği gibi, gelişmekte olan ülkelerinin altyapının yanı sıra insani gelişme gibi bazı kalkınma ihtiyaçları çok büyük kamu yatırımlarının yapılmasını gerektirmektedir. Kamu yatırımlarına ayrılan payın artması durumunda, modelde bulunan υ^G parametresinde artış olmakta ve bu artış kamu sermayesini artırmaktadır. Bunun sonucu olarak da reel döviz kuru ve tüketim gibi makroekonomik değişkenlerin oynaklığında bir azalma meydana gelmektedir. Çalışmada υ^G

parametresinin 0,32’den 0,40’a yükselmesi durumunda optimal tasarrufların ilk duruma göre azaldığı görülmektedir. Örneğin, politika yapıcının mali istikrara ve hanehalkı refahına önem verdiği durumda ($\mu = 0,6$) υ^G parametresi 0,32 değeri için optimal tasarruf oranı 0,50 iken, υ^G parametresinin değeri 0,40’a çıkarıldığı ikinci durumda optimal değer 0,40 olmaktadır.

Bir diğer duyarlılık analizi de farklı bir risk primi eşitliği tanımlanarak yapılmıştır. İlk durumda risk priminin kamu borcunun kaynak dışı çıktıya oranı ile doğru orantılı olduğu varsayılmıştır. Duyarlılık analizinde bu oran yerine, kamu borcunun toplam çıktıya oranı kullanılmıştır. Kaynak gelirleri kaynak fiyat ve üretimlerinden dolayı oldukça oynaktır. Toplam gelirin kaynak dışı gelirlerin yanı sıra kaynak gelirlerini de içermesi nedeniyle ikinci durumda risk primi ve dünya faiz oranı ilk duruma göre daha oynak olmaktadır. Bu ise toplam gelir ve tüketim oynaklığını artırmakta ve ilk duruma göre daha yüksek tasarruf oranlarını gerektirmektedir. Örneğin, modelde yer alan risk primi denkleminde kamu borcunun kaynak çıktısına oranının kullanıldığı ve politika yapıcının yalnızca hanehalkı refahına önem verdiği durumda kaynak gelirinin optimal tasarruf oranı yüzde 80 iken, bu oran kamu borcunun toplam gelire oranının kullanıldığı ikinci durumda yüzde 100 olarak bulunmuştur.

Bu bulguların aksine, Azerbaycan Petrol Fonu’nun kuruluşundan 2019 yılına kadar fona aktarılan kaynak gelirlerinin yaklaşık yüzde 72’si harcanmış olup bu değer, çalışmada elde edilen optimal değerlerin üzerindedir. Ayrıca fona ilişkin tek bir harcama kuralı vardır ve bu kural doğal gaz ve petrol gelirleri zirveye ulaştığında, söz konusu yıllık gelirlerin en az yüzde 25’inin fona aktarılması şeklindedir. Bu kural aynı zamanda mali istikrar ve hanehalkı refahı gibi hususları da dikkate almamaktadır. Dolayısıyla bu sonuçlar, Azerbaycan hükümetinin tasarruf ve harcama ile ilgili politikasını yeniden değerlendirmesinin ve fondan devlet bütçesine aktarılan kaynak geliri miktarının azaltılarak daha fazla varlık birikiminin sağlanması gerektiğini göstermektedir. Benzer şekilde, Uluslararası Para Fonu (2012) kaynak zengini gelişmekte olan ülkelerin, devlet harcamalarının kaynak gelirlerine olan bağımlılığı azaltarak varlık fonu büyüklüklerini artırmalarını tavsiye etmektedir.

Fon büyüklüğünü artırmanın diğer bir yolu da yatırım portföyü performansını artırmaktır. Azerbaycan Petrol Fonu varlıkların büyük bir kısmı çok düşük riskli para piyasası ve sabit getirili enstrümanlara yatırılmıştır. Söz konusu fonun yatırım portföyü, Norveç Emeklilik Fonu ve Amerika Birleşik Devletleri Alaska Fonu gibi diğer ülkelerin devlet varlık fonları ile karşılaştırıldığında daha düşük bir performans sergilemektedir. Çünkü bu fonların portföyleri incelendiğinde Azerbaycan Petrol Fonu'nun aksine para enstrümanları ve sabit gelirlerin paylarının en fazla yüzde 35 olduğu görülmektedir. Ayrıca, Azerbaycan Petrol Fonu'nun 2010-2017 yılları arasındaki ortalama kârı yüzde 1,53 iken, bu oran Amerika Birleşik Devletleri Alaska Fonu için yüzde 9,7 ve Norveç Emeklilik Fonu için ise yüzde 7,6'dır. Dolayısıyla, Azerbaycan'daki politika yapıcılar fonun kompozisyonunu değiştirerek reel getirisini artırıp, fonda daha fazla varlık birikimi sağlayabilirler.

Ayrıca, yenilenemeyen kaynak rezervlerindeki ve fiyatlarındaki artış geçici olduğu için Azerbaycan hükümeti kaynak bağımlılığını azaltan politikalar uygulamalıdır. Aksi takdirde konjonktürel yanlı bir maliye politikası izlemek zorunda kalabilir. Kaynak dışı sanayi sektörlerinin Azerbaycan devlet bütçesine katkısı, petrol dışı birincil dengeyi (petrol dışı gayrisafi yurtiçi hasılanın yüzdesi olarak) yüzde 30'un altına düşürmek için yeterli değildir. Azerbaycan'da devlet bütçesinin kaynak gelirlerine bağımlılığı çok yüksektir ve kaynak gelirlerinin oynaklığı ve belirsizliği mali planlamayı ve makroekonomik yönetimi zorlaştırmaktadır. Azerbaycan, devlet bütçesinin petrol bağımlılığını azaltarak güçlü bir kaynak dışı vergi tabanı geliştirmek için kaynak dışı ihracatı ve kaynak dışı gayrisafi yurtiçi hasılayı artırmayı teşvik eden politikalar uygulamalıdır.

Ayrıca, Dabla-Norris ve diğerleri (2012) tarafından yapılan çalışmada Azerbaycan'da kamu yatırımlarının verimliliği yüzde 38,2 olarak hesaplanmıştır ve bu değer kamu yatırım harcamalarının kalitesinin düşük olduğunu göstermektedir. Bunun yanında, Aliyev ve Mikayilov (2016), petrol gelirlerinin arttığı dönemde sosyal ve sermaye harcama verimliliğinin gözle görülür şekilde düştüğüne ve bu dönemde sermaye harcamalarının petrol dışı sektörlerin gelişimi için yeterince üretken olmadığına dair kanıtlar sunmaktadır. Bu bulgular ışığında, kamu yatırım verimliliğini artırmak için yeni bir harcama stratejisi oluştururken, gereksiz devlet harcamalarının ortadan kaldırılması Azerbaycan için bir öncelik olmalıdır. Dahası, kamu harcama verimliliği artıncaya kadar, kaynak gelirlerinin daha büyük bir kısmının petrol fonunda biriktirilmesi, Azerbaycan'ın doğal kaynak zenginliğinin israfını azaltabileceği öngörülmektedir.

Literatürde, doğal kaynak zenginliği yönetimi üzerine çeşitli çalışmalar yapılmıştır. Bu çalışma, dinamik stokastik genel denge modeli kullanması nedeniyle literatürdeki çalışmalardan farklılaşırken elde edilen ana bulgularıyla literatürdeki bazı çalışmalar ile benzerlikler göstermektedir. Collier ve diğerleri (2010) ve van der Ploeg (2012), bir ekonominin tüm doğal kaynak gelirlerinin harcanmasının Hollanda hastalığı etkisine neden olabileceğini belirterek çalışmamızın bulgusunu doğrulamaktadır. Bunun aksine, van der Ploeg ve Venables (2011), doğal kaynak gelirinin ticarete konu olmayan mallara harcanmaması durumunda Hollanda hastalığının etkilerinden kaçınılabileceğini göstermektedir. Ayrıca, İbadoğlu ve diğerleri (2013) ile Ahmadov ve diğerleri (2010), Azerbaycan Devlet Petrol Fonu varlıklarının en fazla yüzde 30'unun bu araştırmada hesaplandığı gibi devlet bütçesine aktarıldığı bir mali kuralın kabul edilebileceğini öne sürmektedir.

APPENDIX D: TEZ İZİN FORMU / THESIS PERMISSION FORM

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YAZARIN / AUTHOR

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Adı / Name : Cumhur

Bölümü / Department : İktisat

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English) :

ESSAYS ON PROCYCLICALITY OF FISCAL POLICY AND NATURAL RESOURCE FUNDS

....

....

TEZİN TÜRÜ / DEGREE**:** **Yüksek Lisans** / Master ☐ **Doktora** / PhD ■

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