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Effects of Government Interventions on the Economy

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Effects of Government Interventions on the Economy

DISSERTATION

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for the degree of

DOCTOR OF PHILOSOPHY

in Economics

by

Xuejuan Luo

Dissertation Committee:
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DEDICATION

To Kaiya, my daughter, whose smile lights up my universe.

To my mom, who made me the person I am today.

To Chris, my husband, who has never left my side through thick and thin.

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ABSTRACT OF THE DISSERTATION

Effects of Government Interventions on the Economy

By

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Doctor of Philosophy in Economics

University of California, Irvine, 2024

Professor Fabio Milani, Chair

This dissertation is a study of how government actions can impact the macroeconomy under different circumstances. In Chapter 1, I examine the impacts from political conflict and violence in several empirical frameworks. Using generalized least squares, I find that higher levels of magnitude of violence lead to lower growth, investment, and standards of living. This result is further confirmed after running two-stage least squares regressions to address the concern of reverse correlation. I also apply a panel vector-autoregression (VAR) model to study the cross-country economic effects of a shock to the magnitude of political violence in three groups of countries that have had turbulent conflicts in the late 20th century. Findings from the panel VARs show that cross-country effects from a political violence shock are most significant when the countries share characteristics directly related to the cause of the conflict.

In Chapter 2 and 3, I pivot towards studying how the behavioral feature, "myopia", affects government policy in the U.S. economy. Chapter 2 investigates the impact of fiscal policy on economic stimulation within the context of agents who exhibit partial myopia, implying that households and firms are less forward-looking and attentive towards future events. This deviation from perfect rationality impacts the marginal propensity to consume, ultimately challenging the theory of Ricardian Equivalence. To address this, I emphasize the

importance of introducing partially myopic agents into a new Keynesian model with hand-to-mouth consumers. I estimate the model using Bayesian MCMC methods to fit U.S. time series data between 1984-2019 under both determinacy and indeterminacacy. Under determinacy, partially myopic agents may result in higher fiscal multipliers but significantly crowd out private investment. Furthermore, the estimated myopia parameter is 0.86, which is in alignment with Gabaix (2020). However, the data suggets a preference for an indeterminate solution characterized by low degrees of myopia and a passive monetary policy.

Chapter 3 is an examination of how including myopia affects the conditions for a unique and stable equilibrium. I find that the inclusion has substantial effects on the determinacy of the model, where empirically founded values of hand-to-mouth consumers, reasonable degrees of myopia, and active monetary policy cannot all coexist.

Chapter 1

Impacts from Political Conflict and Violence

1.1 Introduction

On December 17th, 2010, a 26-year old Tunisian fruit vendor named Mohamed Bouazizi self-immolated as a protest to the continued abuse by local police officers.[1] His protest sparked a country-wide revolution for human rights and ended the 23-year dictatorship of President Zine el Abidine Ben Ali.[2] In the following months, protests and revolutions that became known as the Arab Spring had spread to Egypt, Libya, Syria, Yemen, and other countries in the Middle East and North Africa (MENA) region, resulting in large scale displacements and only modest amounts of political, social, and economic improvements.[3][4]

While the Arab Spring is a prime example of how civil unrest and its consequences can transmit across the border, it is not the only case in the postwar period. The late 20th

[1] Worth, Robert F. 2011. "How a Single Match Can Ignite a Revolution". The New York Times, January 21. https://www.nytimes.com/2011/01/23/weekinreview/23worth.html

[2] Abouzeid, Rania & Bouzid, Sidi. 2011. "Bouazizi: The Man Who Set Himself and Tunisia on Fire" Time, January 21. https://web.archive.org/web/20110122064850/http://www.time.com/time/world/article/0,8599,2043557,00.html

[3] NPR Staff. 2011. "The Arab Spring: A Year of Revolution". NPR, December 17. https://www.npr.org/2011/12/17/143897126/the-arab-spring-a-year-of-revolution

[4] Robinson, Kali. 2020. "The Arab Spring at Ten Years: What's the Legacy of the Uprisings?" Council on Foreign Affairs, December 3. https://www.cfr.org/article/arab-spring-ten-years-whats-legacy-uprisings

century saw a series of political conflicts with varying degrees of magnitude, ranging from nonviolent protests, such as the Prague Spring, to episodes of mass atrocities, like the Rwandan genocide. On impact, such conflicts would intuitively create a decline in the standard of living, productivity, and investment potential. Yet how do these countries recover over time? Would the political instability and economic wellbeing of neighboring countries and trade partners be impacted as well? Do these effects differ depending on the magnitude of the conflict?

My paper aims to identify the effects of political conflicts with differing degrees of magnitude on the macroeconomy and standards of living and how these conflicts can spillover to neighboring countries and major trade partners. My empirical analysis is based on the total acts of violence variable from the Major Episodes of Political Violence database constructed by the Center for Systematic Peace (CSP) as my political conflict indicator. I combine the total acts of violence indicator with United Nation's Human Development Index, Polity5 Project's Political Regime Characteristics and Transitions, and select macroeconomic indicators (GDP growth and gross fixed capital formation) from the World Bank's World Development Indicators (WDI). From these combined datasets, I proceed to estimate a panel GLS model with 154 countries and 28 years (1990-2018).

To address the issue of endogeneity or reverse causation, I run two-stage least squares regressions with ethnic fractionalization as the instrumental variable. The ethnic fractionalization is often a cause of political instability and conflict, since divisions amongst ethnolinguistic and religious communities lead to competition of power, ideas, and resources. However, it is unclear why it would have a direct causal relationship on macroeconomic variables such as investment and growth, since utility maximizing actors should not be making consumption and investment choices based on polarization of ethnicities. Indeed, existing studies have shown that ethnic fractionalization only indirectly affects growth through directs factors such as political instability, rent-seeking economic policies, and bad institutions.[5]

Moreover, upon examining the conflict list used to compile the Major Episodes of Political Violence database used in this paper, the conflict descriptions largely confirm that a main cause of the intrastate conflicts is disputes amongst ethnic groups rather than discontent with the economic state of the country.

With a panel VAR model that admits cross-sectional heterogeneity and dynamic interdependencies, I can analyze the transmission of idiosyncratic shocks across countries and time, which is particularly useful in an increasingly global economy where the effects of shocks may transmit to other economies in different magnitudes. Using the total acts of violence variable as the political instability indicator for the panel VARs allows me to look at how a shock to the magnitude would affect the magnitudes of political instability, output, and investment of other countries in the region.

Estimates for panel GLS regressions show political violence has a significant negative correlation with economic growth, investment, and HDI. The negative correlation also holds when using a two-stage least squares approach with ethnic fractionalization as the instrumental variable. Results from the impulse response functions looking at effects of political violence shocks to the domestic economy and neighboring economies imply that, while generally an increase in magnitude of political violence has adverse effects on the economies, the context of the conflict must be taken into consideration and results cannot be generalized for all countries and regions.

1.1.1 Literature

This paper builds on past literature related to the effect of political instability on the economy as well as the macroeconomic impacts of political conflict shocks.

[5] Supporting literature will be revisited in detail in the Methodology and Data section.

The literature related to political instability has conceptualized political instability in several ways, but on the whole view political instability as being harmful for the economy. Barro [12] uses number of revolutions and coups, as well as political assassinations in a year to conclude that each of these variables lead to lower growth and investment ratios . Alesina et. al. [6] measure political instability using the propensity of government change, and find that economic growth and instability are jointly determined. Higher instability, particularly in the sense of unconstitutional government change, is a detriment to economic growth, but low economic growth also increases the propensity of coup d'etats [6].

Alesina & Perotti [5] use a socio-political instability index that takes into account assassinations, coups, domestic mass violence, finding that instability reduces growth mainly through the channel of lowering investment. Rodrik [43] also finds that political uncertainty regarding the success of regime reform tends to discourage private investment, which is particularly necessary in developing countries. Other channels through which political instability affect economic growth is in decreasing total factor productivity growth and physical and human capital accumulation (Aisen & Veiga [1]). In short, political instability has unfavorable effects on economic growth, either directly or through necessary channels to growth.

Other forms of political instability that have adverse effects on the economy include regime instability, government repression, and political polarization (Chen & Feng [19]). More recently, Jong-a-Pin [32] uses factor analysis to study the multidimensionality in political instability, finding that the the dimension of instability of the political regime, rather than the instability within the political regime, has a direct causal relationship to low economic growth.

My paper is more in line with literature that focuses on the effects of political conflicts and violence rather than defining measurements of political instability. I believe it is important to study how varying magnitudes of political conflict and violence, which is often a consequence of institutional instability, can impact not only a country's economy but also the standard of living.

My idea most closely mirrors Kent & Phan's [34] working paper that uses a panel VAR with political disruptions, defined as campaigns with the objective of removing existing dictators or military juntas in 157 countries, and the estimated probability of these disruptions . They are able to show that such disruptions do have statistically significant impact on business cycles and countries with higher probability to disruptions are affected even more by the uncertainty factor.

However, there is a gap in existing literature that does not examine the country specific effects from political risk shocks. Moreover, to my knowledge, prior literature has not studied the cross-country effects to a political risk shock, which is crucial in an increasingly globalized world.

The rest of the paper is organized as follows: In section 2, I describe the methodology used in obtaining the necessary results for my research questions and I walk through the data used in the paper. Section 3 presents the results of the GLS fixed effects estimations, the two-stage least square estimations, and the panel VAR impulse response functions.

1.2 Methodology and Data

1.2.1 Methodology

GLS estimation. I use a generalized least squares (GLS) with fixed effects model to estimate the effects of differing magnitudes of political conflicts on the macroeconomy and standards of living. With a panel of 154 countries and 28 years (1990-2018), I use the following specification to implement the regressions:

$$Y_{it} = TAV_{it}\beta_1 + X_{it}'\beta + u_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{1.1}$$

Here, TAV represents the total acts of violence variable, which is my main conflict indicator. i denotes the country unit, where $N = 154$ and t is the year. Y_{it} is the macroeconomic and standard of living variable (i.e. GDP growth, investment, and the Human Development Index), and X_{it} is the vector of control variables.

Since total acts of violence includes summed magnitudes of both intrastate and interstate conflicts, I estimate the following models to see whether intrastate or interstate conflicts have a greater effect on the economy and standards of living:

$$Y_{it} = INTRA_{it}\beta_1 + X_{it}'\beta + u_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{1.2}$$

$$Y_{it} = INTER_{it}\beta_1 + X_{it}'\beta + u_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{1.3}$$

The intrastate conflict variable is represented by INTRA, which includes the magnitudes of all domestic conflicts involving ethnic and civil violence and warfare in a given year. The interstate variable, INTER, is the magnitude of all episodes of international violence and warfare involving the country in a given year. The other variables in the above equations are the same as in (3.1).

Instrumental Variable. Undoubtedly, there are concerns of endogeneity between acts of violence and the economy and standards of living, since economic downturns are a primary cause of conflict, particularly domestic conflict (Londregan & Poole [35]). I use an instrumental variable, ethnic fractionalization, and implement a two-stage least squares approach in order to address this concern.

The rationale behind using ethnic fractionalization as an instrumental variable for political conflict stems from the fact that there is substantial evidence from existing literature suggesting a correlation between ethnic fractionalization and political instability, but no strong evidence of a causal relationship between ethnic fractionalization and growth or investment. For example, Alesina et al. [3] find that, although ethnic and linguistic fractionalization does have a negative impact on economic growth, welfare, and institutions, it is hard to know the extent of explanatory or causal power between the relationship. Alesina & Ferrara [4] look at the link between fractionalization and public good provisions as well as productivity. They conclude that even though there is evidence to support lower public good provisions given higher fractionalization, the impact on productivity is much less clear, where in certain countries, higher fractionalization may actually be positive for growth and productivity.

Karnane & Quinn [33] suggests a direct link between ethnic fractionalization and political instability, but no significant direct correlation between ethnic fractionalization and economic growth. Annett [8] find evidence supporting a causal link between ethnic fractionalization and political instability, where higher fractionalization leads to more societal conflict, which then leads to increased government consumption in attempt to dampen the political instability. Hence, in addition to the robustness tests I conduct for my instrumental variable (described below), empirical evidence seems to confirm that ethnic fractionalization is a suitable for my two-stage least squares estimation.

The specification for estimating the two-stage least squares follows:

$$\widehat{TAV}_{it} = EFI_{it}\gamma + v_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{1.4}$$

$$Y_{it} = \widehat{TAV}_{it}\beta_1 + X'_{it}\beta + u_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{1.5}$$

where in the first stage, I use the ethnic fractionalization index (EFI), to predict TAV, and then use the estimated values of TAV as my explanatory variable in the second stage. Y_{it} here is the two economic variables gross fixed capital formation (as % of GDP) and real

GDP per capita growth. Since the data for ethnic fractionalization ends in 2013, I estimate the two stage least squares with a panel of 144 countries and years 1980-2013.

I use the same specification and instrumental variable to obtain predicted values of intrastate acts of conflict, and use the predicted values in estimating the correlation between intrastate conflicts and the same two economic variables as stated above. I do not perform two-stage least squares regressions on the effects of interstate acts of violence, since ethnic fractionalization is related to domestic conflicts and institutions and thus should not impact state decisions on engaging in international warfare and violence.

To test whether my instrument is valid and an improvement upon the ordinary least squares method, I first use a Hausman test. The p-value from the Hausman test statistic is 0.000, providing strong support for using the two-stage least squares over OLS. Additionally, I compute the Sargan test statistic for the over-identification test in order to see if my instrumental variable is appropriate. The resulting p-value is 0.9999, which does not allow me to reject the null hypothesis that the ethnic fractionalization index is exogenous.

Panel VARs. In order to find if shocks to political instability in one country are propagated to neighboring countries or major trade partners, I use a panel vector-autoregression (VAR) to add a cross-sub-sectional structure to the simple VAR model. As per Canova & Ciccarelli [16], the panel VAR will be represented as

$$Y_{it} = A_{0i}(t) + A_i(l)Y_{t-1} + u_{it} \qquad i = 1, ..., N \quad t = 1, ..., T \tag{1.6}$$

$$u_{it} \sim iid(0, \Sigma_u)$$

where i denotes the country and t is the year. The other elements of the representation have the same structure as basic VAR models: y_{it} is the vector of G endogenous variables for each country, $A_i(l)$ is a polynomial in the lag operator, $A_{0i}(t)$ groups all the deterministic components of the data, and u_{it} is a vector of random disturbances with dimension $G \times 1$.

Since I am looking at the variables TAV, growth, and gross fixed capital formation, it follows that $G = 3$.

In terms of observing how shocks to conflict magnitudes will affect the country's own economy as well as propagating to other countries, I run the panel VARs with countries grouped based on geographical region. Intuitively, the countries most likely to be affected by a shock to political conflict will be countries sharing a border or even in the same geopolitical region as the conflict origin. Hence, I perform panel VARs on the following groups of countries:

1) Rwanda, Burundi, Uganda.

1) Iraq, Iran, Turkey.

3) Colombia, Ecuador, Peru.

These groups of countries were chosen based on two main factors: 1) frequency and magnitude of engaging in political conflict in the late 20th century and 2) availability of data. Group 1 is chosen because of the 1994 Rwandan Genocide, which was one of the most severe cases of ethnic cleansing in the 1990s. Group 2 is selected based the turbulent 1990s and 2000s that has plagued Iraq, including conflicts such as the Gulf War in 1990, ethnic warfare involving the Kurds in 1996, and the Iraq War from 2003 to 2010. Group 3 looks at the the effects from political violence related to Colombia's ongoing drug trafficking.

1.2.2 Data

To estimate the GLS regressions, I use the total acts of violence variable from the Major Episodes of Political Violence (MEPV) database [36] as the political instability variable. Total acts of violence is based on total acts of interstate and intrastate conflict, where each interstate or intrastate conflict is scored on a magnitude between 1 (lowest) to 10 (highest).

Hence, if there are multiple conflicts in a year, the magnitudes of those conflicts are summed to create total acts of violence. If there are no conflicts, then total acts of violence would naturally be coded as zero.

The magnitude score of each conflict is determined by a wide array of factors including: number of fatalities, destruction of resources and infrastructure, population dislocation, and levels of psychological trauma. The minimum number of "directly-related deaths" to qualify as a level 1 conflict is 500, and the conflict is ongoing if there are at least 100 deaths per year. In total, MEPV dataset includes 328 episodes of armed conflict over the years 1946-2018.

Given that political regime characteristics should be be taken into consideration when looking at effects of political instability, I will be including the polity2 score from the Polity5 dataset created by CSP [37]. The polity2 score ranges form -10 to 10, where -10 is strongly autocratic, +10 is strongly democratic, and zero is anarchy. Regime transitional periods are prorated across the span of the transition.

To measure standards of living, I chose to use the Human Development Index (HDI), which scores a country's standard of living on a scale of 0 (lowest standard) to 1 (highest standard). The index assesses three dimensions of quality of life: health (using life expectancy at birth), education (expected and mean years of schooling), and GNI per capita (PPP $). The HDI index is available for years 1990-2020. I multiply the HDI by 100 so that it is scaled as 0 to 100 instead for clearer results.

As the instrumental variable, I use the ethnic fractionalization index from Historical Index of Ethnic Fractionalization dataset (HIEF) [24], which measures the probability that two randomly drawn individuals from a country will be from different ethnic backgrounds . A value of 0 indicates that all individuals in the country belong to the same ethnic group whereas 1 implies every individual belongs to his/her own ethnic group. I scale up this index by 100 so that the regression coefficients are more clear. Compared to existing indices on ethnic fractionalization, this new index focuses less on the ethnic polarization of a country. Rather, it aims to look at how ethnic fractionalization within a country changes over time.

Lastly, the macroeconomic variables, including gross fixed capital formation, real GDP per capita growth, inflation, consumption, foreign direct investment, exports and imports, come from the World Bank's World Development Indicators [10]. After consolidating of all the variables mentioned, I obtain a panel of 154 countries over the years 1990-2018.

1.3 Results

I will first present my results from the GLS fixed effects estimations, followed by two-stage least squares results, and then finally the panel VAR estimates looking at the individual and cross country effects of a shock to political conflict and violence.

1.3.1 GLS estimation results

1.1 reports the estimates of the effect from total acts of violence, interstate and intrastate acts of violence, on real GDP per capita (% change). I chose to look at all three categories of acts of violence since total acts of violence includes both interstate and intrastate acts of violence, so it could include events with high magnitudes of conflict that are taking place in another country with little effects on the domestic country.

After controlling for durability of government, foreign direct investment, inflation, polity score, and gross fixed capital formation, I see that a unit increase in the magnitude of total, interstate, and intrastate violence all have detrimental effects on economic growth. Real GDP per capita growth decreases by 0.414 percent with a unit increase in total acts of violence, and decreases by 0.355 with a unit increase in intrastate acts of violence. However, there seems to be a higher negative impact on real GDP per capita growth, where a one unit increase in magnitude of interstate war now decreases real GDP per capita growth by 1.017 percent.

1.2 presents the results from estimating the effects of total acts of violence, interstate acts of violence, and intrastate acts of violence, on gross fixed capital formation (% of GDP).

Comparing the effects from the three different acts of violence measures, gross fixed capital formation decreases by 0.762 percent from a unit increase in total acts of violence, and by 0.819 percent from intrastate acts of violence. When only looking at the correlation between interstate violence on gross fixed capital formation, the negative effect of 0.0302 percent is no longer robust. This result suggest that when it comes to a country's investment levels, the consequences from political conflict stems from civil violence, while international warfare has no significant impact.

1.3 focuses on the effects of political violence on standards of living. Higher magnitudes of total acts of violence and intrastate acts of violence show similar results, since the coefficient shows a 1.046 decrease in HDI from a unit increase in total acts of violence, and a 1.028 decrease from intrastate acts of violence. The coefficient on HDI still shows a significant decrease of 0.959 with every unit increase in magnitude of interstate violence, although this decrease is less compared to the other two measures of violence.

Figure 1.1: Acts of Violence and Growth

	(1) Real GDP per capita	(2) Real GDP per capita	(3) Real GDP per capita
Total Acts of Violence	-0.414***		
	(0.0846)		
Interstate Acts of Violence		-1.017***	
		(0.292)	
Intrastate Acts of Violence			-0.355***
			(0.0880)
Durability of Government	-0.00634	-0.00528	-0.00572
	(0.00779)	(0.00780)	(0.00780)
Foreign Direct Investment	0.0666***	0.0663***	0.0666***
	(0.0126)	(0.0126)	(0.0126)
Inflation	-0.000950***	-0.000907***	-0.000955***
	(0.000148)	(0.000148)	(0.000148)
Polity Score	0.0900**	0.108***	0.0925**
	(0.0288)	(0.0287)	(0.0289)
Gross fixed capital formation	0.0986***	0.107***	0.0999***
	(0.0141)	(0.0141)	(0.0142)
Constant	-0.288	-0.793*	-0.386
	(0.398)	(0.383)	(0.399)
Observations	3792	3792	3792

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NOTE. Results estimated from GLS fixed effects using a sample of 154 countries between years 1990-2018.

1.3.2 IV estimation results

1.4 displays the results from the two-stage least squares regressions with the ethnic fractionalization index as the instrumental variable.

As 1.4 demonstrates, the effects on gross fixed capital formation from both total acts of violence and intrastate acts of violence are quite substantial. A unit increase in magnitude of total acts of violence and intrastate acts of violence decreases gross fixed capital formation by 3.547 percent and 3.607 percent, respectively. Furthermore, the effect on real GDP per

Figure 1.2: Acts of Violence and Investment

	(1) Gross fixed capital formation	(2) Gross fixed capital formation	(3) Gross fixed capital formation
Total Acts of Violence	-0.762***		
	(0.0983)		
Interstate Acts of Violence		-0.0302	
		(0.345)	
Intrastate Acts of Violence			-0.819***
			(0.102)
Polity Score	0.107**	0.142***	0.104**
	(0.0337)	(0.0337)	(0.0338)
Durability of Government	0.0278**	0.0320***	0.0282**
	(0.00912)	(0.00918)	(0.00911)
Foreign Direct Investment	0.177***	0.180***	0.177***
	(0.0144)	(0.0145)	(0.0144)
Inflation	-0.000411*	-0.000378*	-0.000431*
	(0.000173)	(0.000175)	(0.000173)
Constant	21.15***	20.45***	21.16***
	(0.308)	(0.298)	(0.308)
Observations	3794	3794	3794

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NOTE. Results estimated from GLS fixed effects using a sample of 154 countries between years 1990-2018.

capita from the predicted values of total acts of violence and intrastate acts of violence are -1.509 percent and -1.512 percent, respectively.

Compared to GLS estimates from 1.1 and 1.2, the two-stage least squares results suggest that after accounting for the possibility of endogeneity, the adverse effects of political violence on the economy are even more pronounced.

Figure 1.3: Acts of Violence and HDI

	(1) HDI	(2) HDI	(3) HDI
Total Acts of Violence	-1.046***		
	(0.0766)		
Interstate Acts of Violence		-0.959**	
		(0.309)	
Intrastate Acts of Violence			-1.028***
			(0.0784)
Polity Score	0.470***	0.527***	0.472***
	(0.0266)	(0.0269)	(0.0267)
Durability of Government	0.234***	0.238***	0.235***
	(0.00743)	(0.00761)	(0.00745)
Foreign Direct Investment	0.0348**	0.0337**	0.0345**
	(0.0109)	(0.0112)	(0.0109)
Inflation	-0.000497***	-0.000401**	-0.000514***
	(0.000134)	(0.000137)	(0.000134)
Real GDP per capita	-0.0177	-0.00469	-0.0156
	(0.0148)	(0.0152)	(0.0149)
Gross fixed capital formation	-0.0113	-0.00469	-0.00856
	(0.0211)	(0.0216)	(0.0211)
Exports	-0.0747***	-0.0852***	-0.0743***
	(0.0201)	(0.0206)	(0.0201)
Imports	0.158***	0.165***	0.157***
	(0.0191)	(0.0196)	(0.0192)
Consumption	-0.164***	-0.177***	-0.164***
	(0.0183)	(0.0188)	(0.0184)
Constant	67.92***	68.01***	67.83***
	(1.821)	(1.866)	(1.825)
Observations	3667	3667	3667

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NOTE. Results estimated from GLS fixed effects using a sample of 154 countries between years 1990-2018.

Figure 1.4: Acts of Violence and the Economy

	(1) Gross fixed capital formation	(2) Real GDP per capita	(3) Gross fixed capital formation	(4) Real GDP per capita
Total Acts of Violence	-3.547***	-1.509***		
	(0.554)	(0.361)		
Intrastate Acts of Violence			-3.607***	-1.512***
			(0.547)	(0.356)
Polity Score	-0.187***	-0.0115	-0.176***	-0.00112
	(0.0266)	(0.0195)	(0.0249)	(0.0175)
Durability of Government	0.0152**	-0.00427	0.0127*	-0.00618
	(0.00531)	(0.00320)	(0.00533)	(0.00331)
Foreign Direct Investment	0.162***	0.103***	0.171***	0.109***
	(0.0302)	(0.0193)	(0.0287)	(0.0183)
Inflation	-0.000113	-0.000836***	-0.000160	-0.000855***
	(0.000259)	(0.000170)	(0.000251)	(0.000167)
Constant	24.35***	2.709***	24.20***	2.611***
	(0.553)	(0.363)	(0.516)	(0.336)
Observations	3877	4250	3877	4250

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

NOTE. Results estimated from two-staged least squares using a sample of 144 countries between years 1980-2013. First stage independent variable is the Ethnic Fractionalization Index.

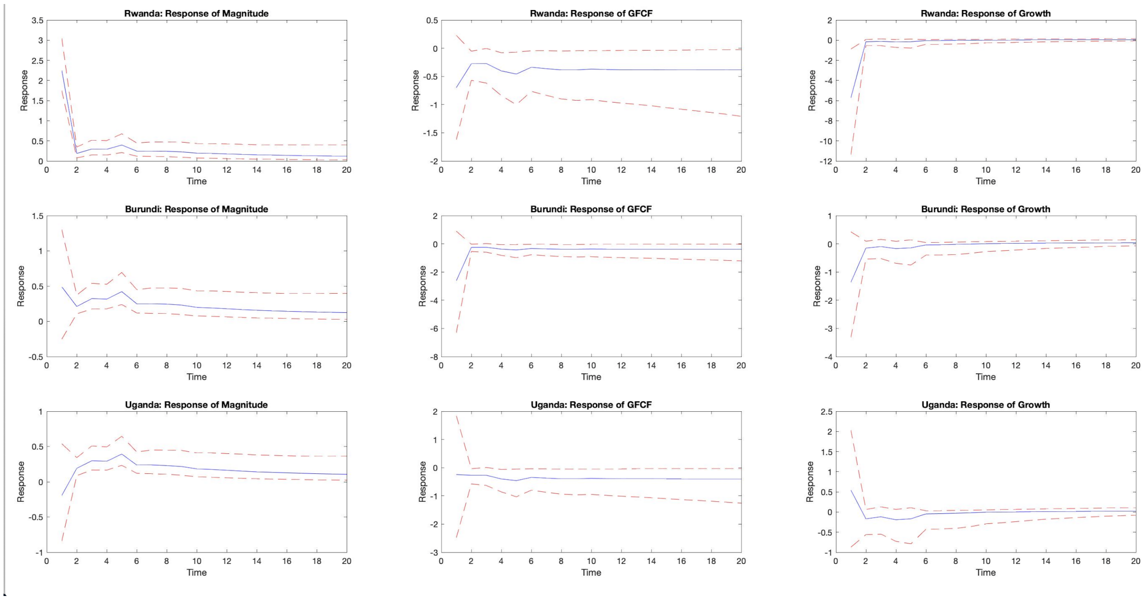
1.3.3 Panel VAR results

1.5 looks at the impulse response functions of a shock to acts of violence in Rwanda. I present the response of magnitudes of political violence, gross fixes capital formation, and growth in Rwanda, Burundi, and Uganda. The confidence bands represents 95% credibility levels.

For Rwanda, a sudden increase in the magnitude of political conflict decreases domestic gross fixed capital formation on impact by 0.5 percentage points. More concerning is the fact that over the 20 year period, the decrease does not seem to recover. The increase in political conflict also drastically decreases growth initially, but the decrease in growth rebounds quickly after a few years.

Interestingly, it seems that the shock of Rwanda's political conflict also spurs a slight increase in magnitude of political conflict in both Burundi and Uganda. Furthermore, the shock also has unfavorable effects on growth and investment of Burundi, albeit the quick recovery after a couple of years. The negative economic effects are less evident in Uganda.

Figure 1.5: Shock to Magnitude of Violence in Rwanda

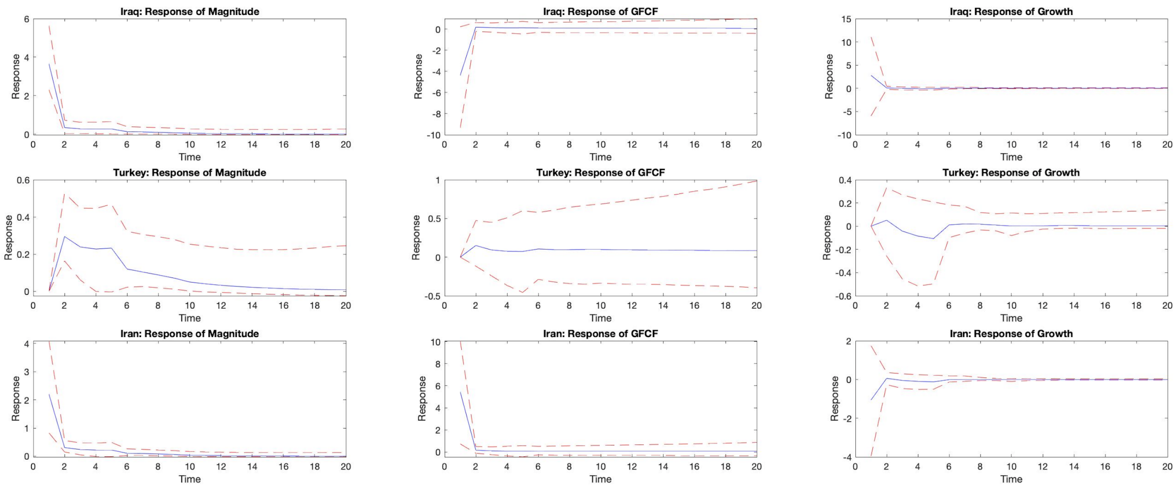


These results are in line with the context of the violence, where the episode of violence with the highest magnitude is the 1994 Rwandan genocide. The conflict mainly involved genocide of the Tutsi ethnic minority group, which has presence in Burundi as well. Therefore, the cross-country effects can be most clearly seen in Burundi but less so in Uganda, where the the Tutsi ethnic group does not exist.

Turning to the Middle East region, I present the IRFs in 1.6 of a shock to magnitude of political conflict in Iraq. The IRFs include responses of Iraq's growth and investment, as well as Iran and Turkey's magnitude of violence, growth, and investment. The results are considerably less clear, as can be seen in the confidence bands. Some more significant results are the increase in magnitude of political conflict in Turkey and Iran. However, the effects on the economies all three countries are puzzling (i.e. the increase in growth in Iraq and the increase in investment in Iran).

These puzzling results could be related to the fact that Iraq has experienced incredibly high magnitudes of political violence since the 1980s, and during episodes of violence, it is hard

Figure 1.6: Shock to Magnitude of Violence in Iraq



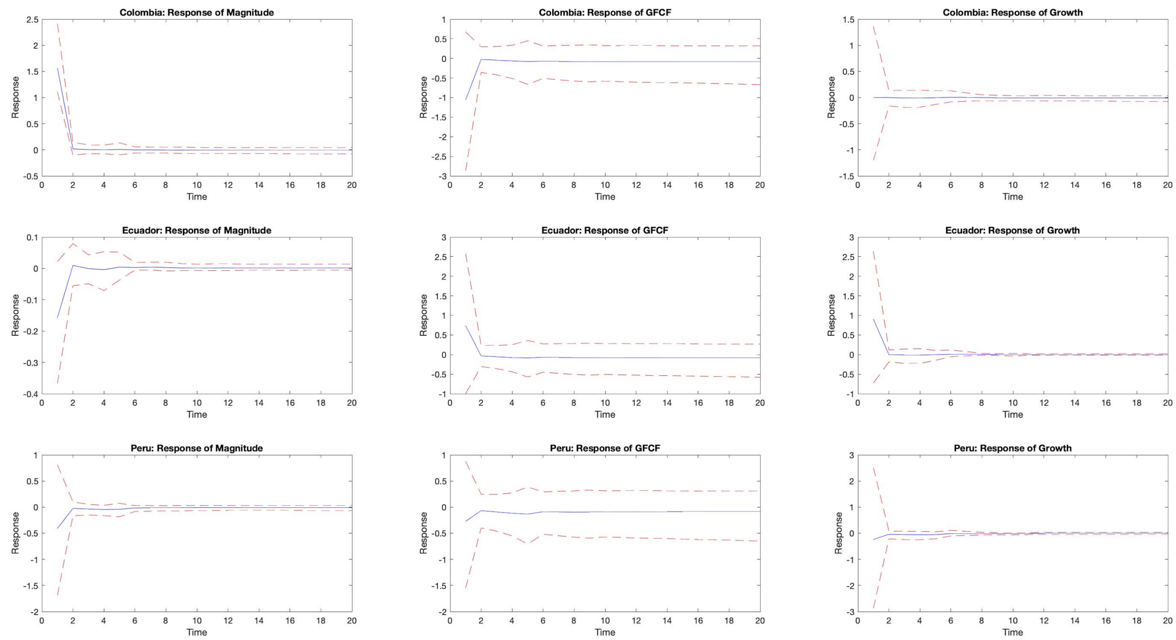
to maintain accurate macroeconomic data.

Finally, I look at the spillover effects of political violence in the South American region. Specifically, 1.7 shows the IRFs of a shock to magnitude of political risk in Colombia, and how the effects of this shock spillover to its neighboring countries, Ecuador and Peru.

The case of a shock to political violence in Colombia presents some interesting results. Firstly, unlike the results above from shocks in the Middle East and East Africa, the magnitudes of political violence decrease on impact in response to a shock in Colombia. With regards to the economy in Colombia, there does not seem to be much impact on growth but it does seem that there are negative effects on investment, but the effects are not persistent. There also does not seem to be robust detrimental effects on the economies of Ecuador and Peru within the 95% credibility level.

A possible explanation for these results could be the fact that political violence in Colombia is very much contained to the violence amongst and related to drug cartels, which may not have much cross-country impacts on neighboring countries.

Figure 1.7: Shock to Magnitude of Violence in Colombia



1.4 Conclusion

To summarize my results, my main findings are: Firstly, political conflicts and episodes of violence have a detrimental effect on economic growth and investment, in the form of gross fixed capital formation, as well as standards of living and these results hold when using ethnic fractionalization as a instrumental variable to address endogeneity concerns.

Secondly, when studying how different economies recover from political conflict shocks and the spillover effects into neighboring countries, the context and nature of the conflict matters. I find the most significant spillover effects in the case of Rwanda, where the conflict was ethnic genocide, and the ethnic group targeted had presence in neighboring countries. with highest magnitude is the 1994 Rwandan genocide. When considering the shock to magnitude of violence in Iraq, which has experienced the highest magnitude of violence in all countries in my dataset, the cross-country effects are not statistically robust. I believe that this may be a result of inaccurate data during times of extreme crisis. Lastly, the economic and spillover effects are least clear when looking at shock to political conflict in Colombia, where the nature of the conflict is a uniquely domestic issue.

Chapter 2

The Effects of Myopia on Fiscal Multipliers

2.1 Introduction

Fiscal policy has taken a more active role in stimulating the economy in recent times. Yet the theory of Ricardian equivalence suggests that individuals, anticipating future tax increases to finance government spending, will increase their savings to offset the expected tax burden, resulting in no expansionary effects on the macroeconomy (Barro [11]). This theory assumes that individuals are able to make rational decisions and ”smooth” their consumption based on foresight of events happening at an indeterminate future date.

The bulk of empirical literature studying the stimulus effects of fiscal policy follow this line of assumption; the models include a representative household that optimize based on perfect rational expectations. Within this strand of literature, fiscal multiplier values range anywhere between 0.8 and 1.5, but values of 0.5 or 2.0 are deemed reasonable as well (Ramey [41]). The difference in multiplier values found depend on the economic environment[1], how

[1]Multipliers are larger when nominal interest rates are close to or constrained at the zero lower bound (Christiano et al. [21]; Eggertsson [25]; Ramey & Zubairy [42]; Woodford [49]; Cogan et al. [22]

the spending is financed[2], or the persistence of the spending[3].

A notable departure away from the representative agent model literature in fiscal policy is Gali et al. [29], where they incorporate rule-of-thumb (referred to in this paper as hand-to-mouth) households that consume all of their income in each period and cannot smooth out consumption. Given that these households have a high marginal propensity to consume than the optimizing households, they find multipliers as high as 2.0 as Ricardian equivalence breaks down. In this paper, I also include hand-to-mouth households but calibrate the share of hand-to-mouth households to a empirically accurate value of 0.35 (Weidner et al. [47]; Correia et al. [23].

This paper not only enriches the standard representative agent model with hand-to-mouth households, but considers the case of behavioral households and firms. Specifically, instead of relying on the strong assumption that optimizing agents form expectations rationally and have full attention of future events, I examine the case where agents are not perfectly rational. To model irrational agents, I use a "cognitive discounting" parameter, myopia, à la Gabaix [27]. Thus, my research question studies how the inclusion of myopic agents who cannot perfectly optimize affects the economic outcomes of an increase in fiscal spending. In particular, I estimate the values of myopia and fiscal multipliers in the US during the years of 1984 to 2019 under both economic determinacy and indeterminacy. To my knowledge, this is the only paper that studies the effects of of irrational agents on fiscal policy.

I find that with the addition of myopic agents, government spending generally yields larger output multipliers with more myopic agents but at a huge cost of private investment. Finally, using US time-series data, I conduct a Bayesian MCMC estimation and conclude that the

[2] Baxter & King [13] find that financing temporary spending through distortionary taxes can generate a multiplier as low as -2.5, whereas financing through deficit spending or current taxes without distortionary taxes will have no differences in effect on the multiplier. Furthermore, disaggregated fiscal spending in the form of military spending generates the largest multipliers (Nakamura & Steisson [40]; Auerback & Gorodnichenko [9]

[3] Aiyagari et al. [2] find that when the government spending is sufficiently persistent, the multiplier can exceed one

value of myopia is 0.86 under determinacy but results show that data prefers an indeterminate non-behavioral equilibrium with low cognitive discounting and active monetary policy.

The paper proceeds as follows. Section 3.2 describes the baseline New Keynesian model used in the paper. Section 2.3 shows the effect of myopia on fiscal multipliers at multiple horizons and its interactions with the share of hand-to-mouth consumers. The paper also conducts a Bayesian estimation of an extended model; this is presented in section 2.4. Section 2.5 concludes.

2.2 Theoretical Model

I use a conventional New Keynesian model adopted from Gali et al. [29], which consists of two types of households, a continuum of differentiated intermediate goods producing firms, a final good producing firm, a central bank that sets the monetary policy, and a fiscal entity that sets the fiscal policy. My contribution to this model is the myopic parameter M, which will enter after I have log-linearized the model. Additionally, I include the monetary policy, preference, technology, and labor supply shocks.

2.2.1 Households

The economy consists of a continuum of households denoted by $j \in [0, 1]$, where a proportion $1 - \lambda$ are optimizing or Ricardian households (o), and the remaining proportion λ are rule-of-thumb households (r). Optimizing households have full access to the capital and asset markets and the rule-of-thumb households fully consume their current period income with no ownership of capital and assets. The distinction between the two types of households is important in this context since the effects of a fiscal stimulus may affect the behavior of rule-of-thumb households more. All households (A) share the same preferences represented by equation:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\log C_t^A(j) - \frac{N_t^A(j)^{1+\kappa}}{1+\kappa} \right] \tag{2.1}$$

where κ is the inverse of the Frisch labor supply elasticity. $C_t^A(j)$ is the consumption of the final good and $N_t^A(j)$ is the amount of labor supplied by household j.

Optimizing households. Optimizing households $j \in (0, 1-\lambda)$ maximize their utility subject to the following budget constraint and capital accumulation equation:

$$P_t(C_t^o + I_t^o) + R_t^{-1} B_{t+1}^o = W_t P_t N_t^o + R_t^k P_t K_t^o + B_t^o + D_t^o - P_t T_t^o \tag{2.2}$$

$$K_{t+1}^o = (1-\delta) K_t^o + \phi(\frac{I_t^o}{K_t^o}) K_t^o. \tag{2.3}$$

In each period, the real consumption (C_t^o) and investment (I_t^o) expenditures, as well as the risk-less nominal government bond (B_t^o) paid out with the nominal gross interest rate R_t^{-1} must equal the total labor income $W_t P_t N_t^o$, capital holdings income $R_t^k P_t K_t^o$, risk-less bonds carried over from the previous period, dividends from firm ownership D_t^o, and lump sum taxes (or transfers) $P_t T_t^o$. Thus, P_t is used to denote the price level, W_t is the real wage, N_t^o is hours worked, and K_t^o is the capital holdings.

In the capital accumulation equation, the $\phi(\frac{I_t^o}{K_t^o})K_t^o$ is the capital adjustment costs, which establishes the change in capital generated by investment spending. Following Gali et al. [29], I assume $\phi' > 0$, and $\phi'' \leq 0$, with $\phi'(\delta) = 1$, and $\phi(\delta) = \delta$.

Wages are set by two different labor market structures: there is a competitive labor market where each household chooses the hours worked given the market wage and an economy-wide union that sets wages in a centralized manner so that firms choose hours supplied instead of the households. In the case of the competitive labor market, the labor supply of optimizing households must follow:

$$W_t = C_t^o (N_t^o)^{\varphi} \zeta_t. \tag{2.4}$$

ζ_t is the labor supply shock that follows the AR(1) process:

$$\zeta_t = \rho_\zeta \zeta_{t-1} + \varepsilon_\zeta. \tag{2.5}$$

A thorough description of the case where the union sets wages can be found in Gali et al. [29], since it does not follow the same condition as in (4).

Rule-of-thumb households. Since rule-of-thumb households can only consume the labor income they receive net of taxes, they face the budget constraint:

$$P_t C_t^r = W_t P_t N_t^r - P_t T_t^r. \tag{2.6}$$

Similar to the optimizing households, rule-of-thumb households also follows two labor market structures. In the case of when the wage is set by the union, I suggest referring to the Appendix in Gali et al. [29] for a detailed description. The case of the competitive labor market must satisfy the condition:

$$W_t = C_t^r (N_t^r)^{\varphi} \zeta_t. \tag{2.7}$$

Aggregation. The aggregated consumption and hours supplied by all households are:

$$C_t^A \equiv \lambda C_t^r + (1 - \lambda) C_t^o \tag{2.8}$$

and

$$N_t^A \equiv \lambda N_t^r + (1-\lambda) N_t^o. \tag{2.9}$$

Since investment and capital stock is only determined by the proportion of optimizing households, the total investment and capital stock is written as:

$$I_t \equiv (1-\lambda) I_t^o \tag{2.10}$$

and

$$K_t \equiv (1-\lambda) K_t^o. \tag{2.11}$$

2.2.2 Firms

The production sector is made up of monopolistically competitive firms that produce differentiated intermediate goods and a representative firm that uses these intermediate goods to produce a single final good.

The intermediate good firm (i) produces a differentiated good $Y_t(i)$ with the Cobb-Douglas production technology:

$$Y_t(i) = A_t(i) K_t(i)^{\alpha} N_t(i)^{1-\alpha}. \tag{2.12}$$

$K_t(i)$ and $N_t(i)$ denote the capital and labor services hired by firm i, and $A_t(i)$ is the total factor productivity. The total factor productivity shock follows the AR(1) process:

$$A_t = \rho_a A_{t-1} + \varepsilon_t^A. \tag{2.13}$$

The intermediate goods firm takes wage and rental costs of capital as given and adjusts prices according to the Calvo pricing mechanism.

The perfectly competitive firm that produces the final good follows the constant returns production function:

$$Y_t = \left[\int_0^1 X_t(i)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} di \right]^{\frac{\varepsilon_p}{\varepsilon_p - 1}}. \tag{2.14}$$

Here, $\varepsilon_p > 1$ and $X_t(i)$ represents the amount of intermediate good i used as inputs. Given the prices for intermediate goods $P_t(i)$ and the price of the final good P_t, the final goods producer's demand function for intermediate inputs is given by

$$X_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\varepsilon_p} Y_t. \tag{2.15}$$

Finally, the final goods firm also faces the zero-profit condition

$$P_t = \left(\int_0^1 P_t(i)^{1-\varepsilon_p} dj \right)^{\frac{1}{1-\varepsilon_p}}. \tag{2.16}$$

2.2.3 Monetary Policy

The central bank sets the nominal interest rate $r_t \equiv R_t - 1$ every period following the interest rate rule

$$r_t = \phi_\pi \pi_t + MP_t, \tag{2.17}$$

with MP_t being monetary policy shock process that follows:

$$MP_t = \rho_{mp} MP_{t-1} + \varepsilon_t^{MP} \tag{2.18}$$

As mentioned in Gali et al. [29], the interest rate rule here satisfies the Taylor principle if and only if $\phi_\pi > 1$, which is also necessary and sufficient to guarantee the uniqueness of equilibrium in the absence of rule-of-thumb consumers.

2.2.4 Fiscal Policy

The government is subject to the budget constraint:

$$P_t T_t + R_t^{-1} B_{t+1} = B_t + P_t G_t, \tag{2.19}$$

where aggregate taxes are calculated from the sum of taxes received from optimizing households and rule-of-thumb households such that $T_t \equiv \lambda T_t^r + (1-\lambda) T_t^o$. By defining $g_t \equiv (G_t - G)/Y$, $t_t \equiv (T_t - T)/Y$, and $b_t \equiv ((B_t/P_{t-1}) - (B/P))/Y$, I can assume a fiscal policy rule as

$$t_t = \phi_b b_t + \phi_g g_t, \tag{2.20}$$

where ϕ_b and ϕ_g are greater than zero.

Government spending follows an AR(1) process:

$$g_t = \rho_g g_{t-1} + \varepsilon_t^g, \tag{2.21}$$

where $0 < \rho_g < 1$ is the persistence parameter and ε_t^g is the i.i.d government spending shock with constant variance σ_ε^2.

2.2.5 Market Clearing

Factor and good markets clear when the following conditions are met for all periods t:

$$N_t = \int_0^1 N_t(i)di, \qquad Y_t(i) = X_t(i) \quad \text{for all} \quad i, \tag{2.22}$$

$$K_t = \int_0^1 K_t(i)di, \qquad Y_t = C_t + I_t + G_t. \tag{2.23}$$

2.2.6 Modeling Myopia

Incorporating myopia into the model is done in line with Gabaix [27]. Under rational expectations, the state vector X_t of the economy evolves according to

$$X_{t+1} = \Gamma X_t + \epsilon_{t+1} \tag{2.24}$$

However, Lemma 1 from Gabaix [27] states that behavioral agents perceive instead the following:

$$X_{t+1} = m(\Gamma X_t + \epsilon_{t+1}) \tag{2.25}$$

where $m \in [0, 1]$ is the myopia parameter.
Thus, agents form expectations *subjectively* by cognitively discounting the future:

$$\mathbb{E}_t^s X_{t+1} = m\mathbb{E}_t X_{t+1} = m\Gamma X_t \tag{2.26}$$

Hence, in my model, the myopic parameter enters a la Gabaix [27] for forward-looking consumers and firms. After log-linearization of the equations describing the optimizing consumers, I have:

$$c_t^o = mE_t c_{t+1}^o - (r_t - E_t \pi_{t+1}) + \chi_t. \tag{2.27}$$

Note that there is no m in front of $E_t \pi_{t+1}$ in the benchmark Gabaix model since only the level of macro attention matters (Ilabaca [31]).

For firms, myopia enters in the log-linearized equation as:

$$\pi_t = m\beta E_t \pi_{t+1} - \frac{(1-\beta\theta)(1-\theta)}{\theta} \mu_t^p. \tag{2.28}$$

$m \in [0, 1]$ is the myopia parameter that represents cognitive discounting for optimizing households and firms. When $m = 1$, agents are fully rational and the model reverts back to the baseline model in Gali et al [29]. With myopia, m is strictly less than one, so that innovations to the economy in the future get heavily discounted. In this case, Ricardian equivalence no longer holds even for optimizing agents. This should mean that any changes in the economy, such as changes in fiscal policy, would have a bigger impact when they happen in the present.

Incorporating myopia specifically in the above forward-looking equations follows Gabaix's baseline new Keynesian model, where not all forward-looking variables are discounted. Additionally, introducing myopia ad hoc after log-linearizing involves simplifications, but the results are equivalent compared to the micro-founded behavioral model (Meggiorini [38]).

Please refer to the Appendix for the full set of log-linearized equations and Gali et al.'s [29] for a more detailed presentation of the model.

2.3 Fiscal Multipliers

For the nuanced empirical analysis pertaining to fiscal multipliers presented in this section as well as the estimation analysis in the following section, the paper utilizes a model that includes several other common frictions and shocks in addition to the features of the base model presented in section 3.2. This is to ensure that the analysis presented here may be comparable to benchmark structural models such as Christiano et al. [20] and Smets and Wouters [45]. To test the importance of myopia on fiscal policy, it is important to first include sources of persistence that are common to most empirical DSGE macro models so that the results are not spuriously attributed to myopia instead of some other source of persistence of friction. The model is expanded to include the following additional features:

- Habit formation
- Wage stickiness (instead of the imperfect labor market)
- Price indexation
- Wage indexation
- Variable capital utilization
- Backward-looking Taylor Rule

The model also has several other AR(1) shocks:

- Monetary policy
- Preference
- Price markup
- Wage markup

- Investment-specific technology

Since these features are standard in the macro literature, I will not discuss them in greater detail here. The full set of log-linearized equilibrium conditions for this version of the model may be found in Appendix B.1.

In this section, I analyze the effect of myopia on the fiscal multiplier. As mentioned in the introduction, in traditional models of the macroeconomy where all agents optimize their future consumption paths with perfect foresight, government stimulus is ineffective as per Ricardian equivalence. The original Gali et. al. [29] paper included HTM agents who violated Ricardian equivalence as they simply consumed all earned income with no ability to offset the stimulus by saving. In this section I investigate if relaxing the assumptions of perfect foresight and rationality on the part of optimizing agents via cognitive discounting can lead to further increases in the effectiveness of fiscal stimulus.

Figure 2.1 plots the fiscal multipliers for the 1-quarter and 4-quarter (1-year) impacts for output (YM_1 and YM_4). The results closely match the multiplier analysis from Gali et. al. [29] except that myopia is able to further raise the YM_1 and YM_4 for the U.S. share of HTM consumers ($\lambda \approx 0.35$). At this value for λ, the multiplier increases with the degree of myopia. As optimizing agents become increasingly myopic, they value current consumption to a greater degree than future consumption via savings (essentially acting more like HTM consumers); this allows them to increasingly violate Ricardian equivalence. Interestingly, the effect of myopia does not remain the same for all levels of λ. At a HTM share of approximately 0.85 and 0.80 for YM_1 and YM_4, respectively, the effect of myopia *inverts* as increased cognitive discounting *decreases* YM_1 and YM_4. The interactions of several variables in this sophisticated model results in a non-linear relationship between λ, M, and the multiplier.

Figure 2.2 plots the fiscal multipliers for 8 and 20 quarters (two and five years) after impact

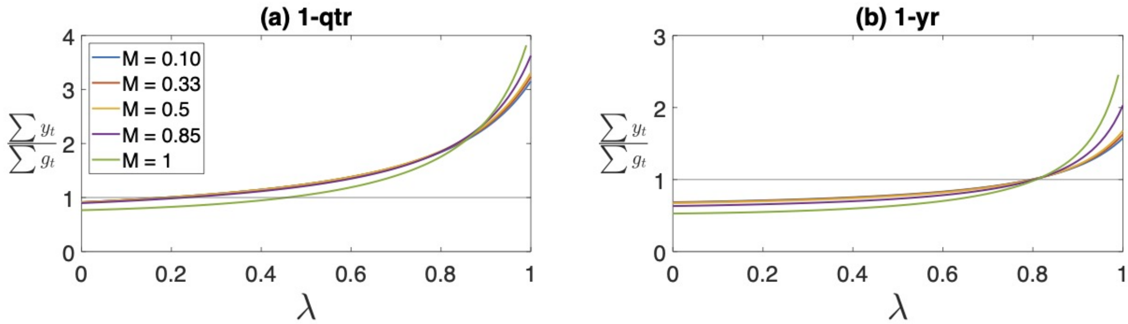


Figure 2.1: Fiscal Multipliers for Output, Short Run

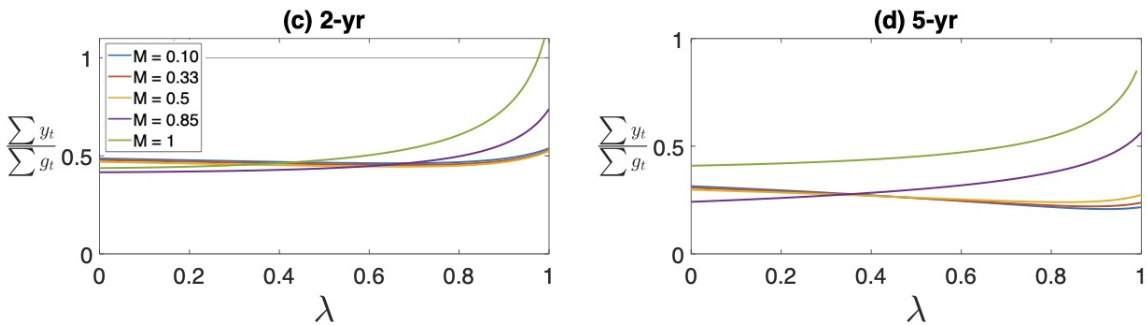


Figure 2.2: Fiscal Multipliers for Output, Long Run

for output (YM_8 and $YM_2 0$). As can be seen, output multipliers diminish at longer horizons and only extremely high values of λ can push the multiplier above 1 in YM_8. The excess increases in output in the short-run are now paid off in the longer horizons with no myopia leading to highest YM at distant horizons. At the 5-yr horizon the results are stark; YM_{20} is significantly larger under no myopia as compared to high degrees of discounting.

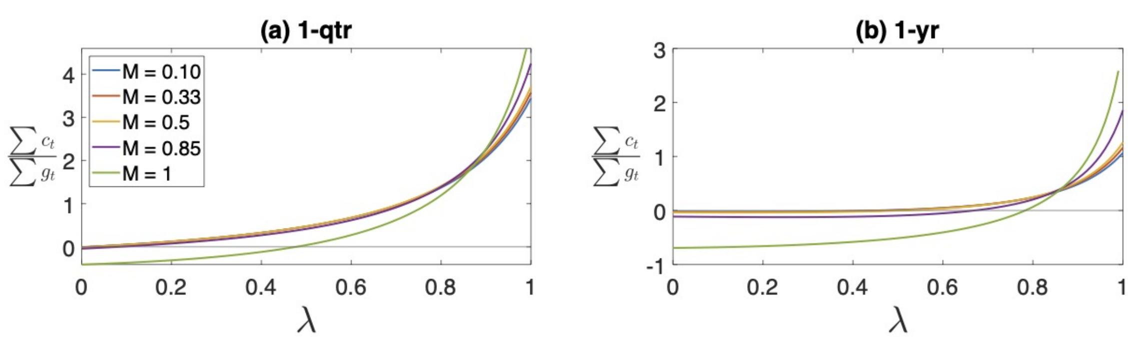


Figure 2.3: Fiscal Multipliers for Consumption, Short Run

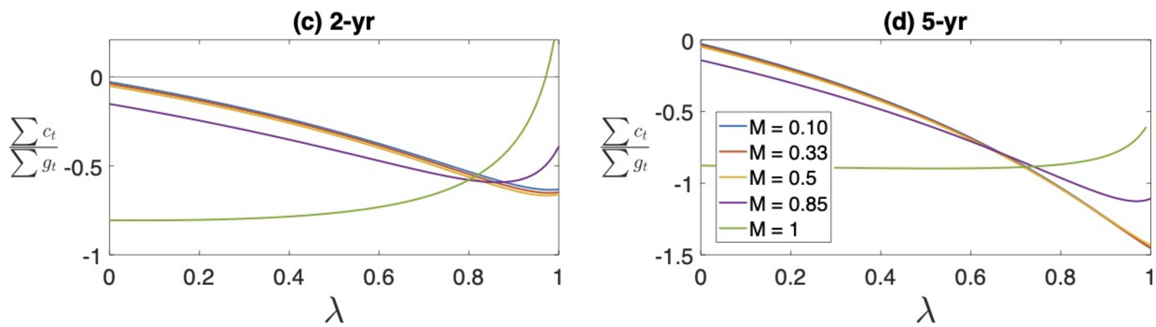


Figure 2.4: Fiscal Multipliers for Consumption, Long Run

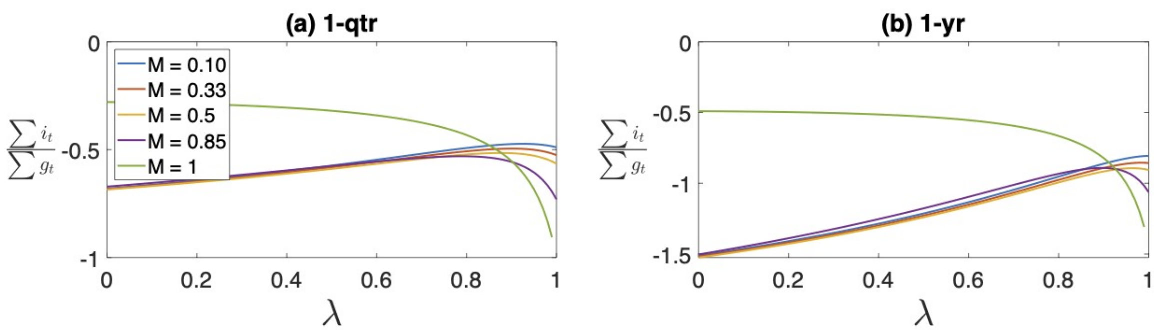


Figure 2.5: Fiscal Multipliers for Investment, Short Run

Figure 2.3 shows that CM_1 and CM_4 follows in a similar manner to output and is almost always positive. Generally, the degree of myopia does not seem to have a large effect on the multiplier as much as the presence of multiplier. When λ is below 0.85, any degree of myopia raises the multiplier of consumption higher than the baseline model with no myopia. At the 1-year horizon, private consumption is crowded out for most values of λ unless there is myopia. Both CM_8 and CM_{20} are below zero as agents have been over-consuming in the immediate aftermath of stimulus and must now revert to reducing consumption. However, private consumption is crowded-out to a significantly lesser extent when agents are highly myopic.

The higher multipliers from output and consumption with myopia in the short run is not without consequence. For investment multipliers, higher myopia is accompanied by a stronger crowding-out effect, as can be seen in 2.5. At λ = 0.35, IM_1 is around -0.36

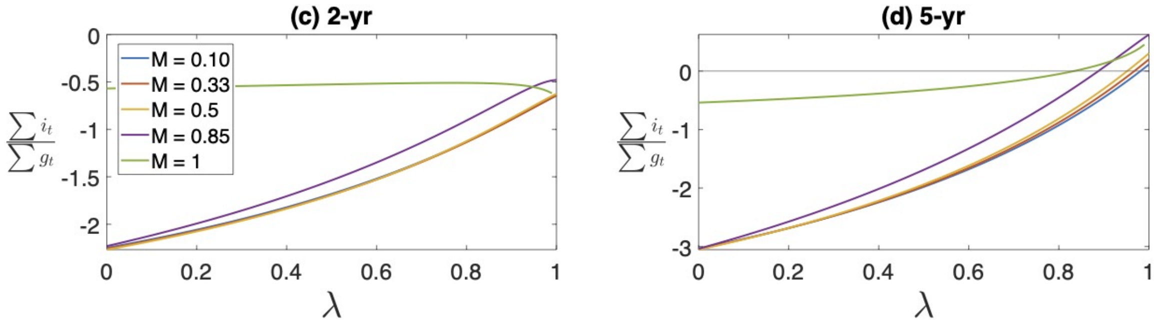


Figure 2.6: Fiscal Multipliers for Investment, Long Run

without myopia but falls drastically to -0.65 for $M = 0.85$. These results clearly indicate that fiscal stimulus is much more effective at impact for U.S. consumers, keeping output multipliers higher than 1 without significantly crowding-out private consumption. However, the investment sector suffers a significantly sharper decline than suggested in Gali et. al. [29]. As with the immediate quarter, IM_4 stays well below zero and the crowding-out effect is even stronger than IM_1. Any degree of myopia severely exacerbates this phenomenon; the results are similar for M ranging from 0.10 to 0.85. Only under the absence of myopia entirely is IM_4 higher as agents trade-off increases government spending with decreases in both consumption and investment.

Figure 2.6 plots the fiscal multipliers for two and five years after impact for investment (IM_5 and IM_{20}). Short-run trends for investment continue into the longer horizons with massive crowding-out at virtually every level of myopia. Only in the case of no myopia does the model exhibit IM_8 and IM_{20} that are above -1. For the U.S. HTM share of 0.35 with the Gabaix (2020) value of $M = 0.85$, crowding-out is very large with $IM_8 \approx -1.8$ and $IM_{20} \approx -2$.

2.4 Bayesian Estimation

2.4.1 Data and Methodology

The extended model presented in appendix B.1 is estimated via Bayesian MCMC techniques[4] to fit data for six quarterly macroeconomic U.S. time series: log difference of real GDP, log difference of consumption, log difference of investment, log difference of wages, log difference of labor supply, inflation (log difference of GDP deflator), and the federal funds rate. Data on these variables were obtained fromt he Bureau of Economic Analysis. Additionally, as discussed in the introduction, prior empirical approaches in this area of study have largely ignored expectations data. Since the primary innovation of this paper is the inclusion of a parameter that discounts expectations, it is important to include expectations data in the data series that is to be fitted. Data on expectations of inflation were collected from the Michigan Survey of Consumers for the 1-year horizon.

The final dataset spans Q1 1984 through Q4 2019: roughly corresponding to the start of the post-Volcker monetary era and proceeding until the start of the COVID-19 pandemic; this period also roughly corresponds to the modern U.S. macroeconomy with active monetary policy. The measurement equation used in the estimation procedure for the standard non-

[4]See An and Schorfheide [7], Fernández-Villaverde [26], and Herbst and Schorfheide [30] for an overview of Bayesian MCMC estimation methods pertaining to DSGE models.

expectations macro data is given by:

$$OBS_t = \begin{bmatrix} dlY_t \\ dlC_t \\ dlI_t \\ dlW_t \\ dlN_t \\ dlP_t \\ FFR_t \end{bmatrix} = \begin{bmatrix} \bar{\chi} \\ \bar{\chi} \\ \bar{\chi} \\ \bar{\chi} \\ \bar{\chi} \\ \bar{\pi} \\ \bar{r} \end{bmatrix} + \begin{bmatrix} \log Y_t/Y_{t-1} \\ \log C_t/C_{t-1} \\ \log I_t/I_{t-1} \\ \log W_t/W_{t-1} \\ logN_t - N_{t-1} \\ \log P_t/P_{t-1} \\ r_t \end{bmatrix} \tag{2.29}$$

where dl represents 100 times the log difference, $\bar{\chi}$ is the quarterly trend growth rate common to Y_t, C_t, I_t and W_t, $\bar{\pi}$ is the steady-state quarterly inflation rate, and $\bar{r}$ is the steady-state quarterly interest rate.

Parameter	Value	Details
β	0.99	Discount rate
δ	0.025	Depreciation rate
α	0.33	Effective share of capital
μ_p	1.20	Steady state price markup
γ_z	0.75	Capital utilization share
γ_c	0.6	Consumption share
γ_i	0.2	Investment share

Table 2.1: Calibrated Parameters: Bayesian Estimation

Some structural parameters are calibrated; these parameters are presented in Table 2.1. The remaining parameters are estimated using a standard Bayesian MCMC procedure. First, the mode of the posterior distribution is estimated by maximizing the log of the posterior function; the posterior is computed as the product of the prior information of non-calibrated parameters and the likelihood of the data described above. The priors for the selected parameters are set based on standard choices in the empirical macro literature and may be found in Tables B.5 and 2.3. Secondly, a Metropolis-Hastings computational algorithm comprising two MCMC chains and enough draws to achieve convergence is utilized to map a complete posterior distribution for all estimated parameters. Note that all estimated parameters are identified from the data. The estimated posterior means are used to compute IRFs to the various shocks within the model. The results from these analyses are presented in the following section.

2.4.2 Posterior Estimates

Estimates Under Determinacy

I begin the results discussion with the key parameters of this model under determinacy. With λ fixed at 0.35, the posterior mean for M is 0.86, which is in line with Gabaix's suggested value of 0.85. This value implies that agents in the economy are half as attentive towards events one year in the future as compared to today. The data also prefers an extremely high monetary response to inflation with χ_π estimated to be 2.75.

Parameter	Description	Prior	Posterior Means	
			Determinacy	Indeterminacy
φ	Inverse Frisch elas.	$\mathbf{N}$(4.00, 1.50)	6.84	2.72
h	Habit formation	$\mathbf{B}$(0.70, 0.10)	0.60	0.31
θ_p	Calvo prices	$\mathbf{B}$(0.50, 0.10)	0.70	0.71
θ_w	Calvo wages	$\mathbf{B}$(0.50, 0.10)	0.55	0.48
ι_p	Price indexation	$\mathbf{B}$(0.50, 0.15)	0.44	0.09
ι_w	Wage indexation	$\mathbf{B}$(0.50, 0.15)	0.39	0.97
σ_l	Labor supply elas.	$\mathbf{N}$(2.00, 0.75)	2.01	1.59
ψ	Capital util. elas.	$\mathbf{B}$(0.50, 0.15)	0.56	0.88
α	Capital share	$\mathbf{N}$(0.30, 0.05)	0.28	0.22
M	Myopia	$\mathbf{B}$(0.85, 0.10)	0.86	0.97
χ_π	MP inflation	$\mathbf{N}$(1.50, 0.25)	2.75	0.19
χ_y	MP output	$\mathbf{N}$(0.12, 0.05)	0.04	0.11
ϕ_g	FP govt. spending	$\mathbf{N}$(0.10, 0.05)	0.02	0.13
ϕ_b	FP debt	$\mathbf{N}$(0.33, 0.10)	0.41	0.41
y^*	Trend	$\mathbf{N}$(0.40, 0.10)	0.81	0.59
π^*	Trend	$\mathbf{N}$(0.60, 0.10)	0.40	0.59
i^*	Trend	$\mathbf{N}$(0.75, 0.10)	0.71	0.55
	Marginal likelihood		-1266.2	-1021.6

Table 2.2: Posterior Estimates: Structural Parameters with $\lambda = 0.35$

Contrary to Milani [39], mechanical sources of persistence uphold their importance in fitting the sluggishness of macro variables, even in the presence of behavioral features . For the rest of this discussion, I will highlight any cases where there is significant disagreement between my parameter estimates and those of Smets and Wouters [45] ("SW2007") as that provides a valuable benchmark for comparison. If a SW2007 value is not provided, it is because my estimates are similar. Habit formation (h) is moderate at 0.60 which is within the range of standard studies. The parameter for sticky wages (θ_w) is 0.55, lower than SW2007 (0.73). This suggests that the data favors a higher degree of sluggishness in price adjustments instead

Parameter	Description	Prior	Posterior Determinacy	Posterior Indeterminacy
Persistence				
ρ_χ	Preference	$\mathbf{B}(0.50, 0.20)$	0.80	0.93
ρ_w	Wage markup	$\mathbf{B}(0.50, 0.20)$	0.96	0.98
ρ_p	Price markup	$\mathbf{B}(0.50, 0.20)$	0.99	0.98
ρ_a	Technology	$\mathbf{B}(0.50, 0.20)$	0.97	1.00
ρ_g	Govt. Spending	$\mathbf{B}(0.50, 0.20)$	0.98	0.95
ρ_i	Investment specific	$\mathbf{B}(0.50, 0.20)$	0.61	0.95
ρ_r	Monetary Policy	$\mathbf{B}(0.50, 0.20)$	0.85	0.98
Deviation				
σ_χ	Preference	$\Gamma^{-1}(0.30, 1.00)$	0.92	0.21
σ_w	Wage markup	$\Gamma^{-1}(0.30, 1.00)$	0.70	0.77
σ_p	Price markup	$\Gamma^{-1}(0.30, 1.00)$	0.15	0.19
σ_a	Technology	$\Gamma^{-1}(0.30, 1.00)$	0.53	0.47
σ_g	Govt. Spending	$\Gamma^{-1}(0.30, 1.00)$	0.45	0.44
σ_i	Investment specific	$\Gamma^{-1}(0.30, 1.00)$	0.84	0.35
σ_r	Monetary Policy	$\Gamma^{-1}(0.30, 1.00)$	0.15	0.14

Table 2.3: Posterior Estimates: Shock Processes with $\lambda = 0.35$

of wage adjustments. Price indexation (ι_p) and wage indexation (ι_w) have posterior means of 0.44 and 0.39 respectively, indicating a higher $iota_p$ but a lower $iota_w$ compared to their SW2007 counterparts: 0.22 and 0.59. Price stickiness and price indexation are both more important than wage stickiness and wage indexation in fitting the data under this model.

Next I discuss the estimates of standard macro parameters. There is a wide range of estimated values for the inverse Frisch elasticity (φ); my estimated mean is 6.84 which is higher than the SW2007 value of 5.74. The Fed response to output (χ_y) is expectedly low at 0.04. The trend coefficients, y^*, π^*, and i^*, are along expected values at 0.81, 0.40, and 0.71 respectively. Inflation and interest rate trends are lower than SW2007, which intuitively corroborates the low interest rate, low inflation period following the sample used in SW2007.

Table 2.3 shows the posterior estimates of the shock processes. Preference shocks have a high degree of persistence and deviation of 0.80 and 0.92, respectively. Both markup shocks, wage and price, have high persistence (similar to SW2007) of 0.96 and 0.99 but price markup shocks have a low deviation of 0.15. Wage markups are persistent and large with a deviation of 0.70.

Technology shocks are very persistent with an AR parameter value of 0.97, again similar to its value from SW2007; it has a moderate deviation with a value of 0.53. Government spending shocks are highly persistent (0.98), which is in line with SW2007 (0.97). It is also volatile with a deviation of 0.45. Investment-specific shocks are moderately persistent (0.61) and highly volatile (0.84). Monetary policy exhibits a high degree of smoothing with an AR coefficient of 0.85 but is mildly volatile with a 0.15 mean deviation.

Estimation Under Indeterminacy

Here, I focus on the estimation results under indeterminacy that differ from the results under determinacy. Most notably, the posterior mean for M is 0.97, indicating that under indeterminacy, agents exhibit very low degrees of myopia. Furthermore, the data now prefers a very passive monetary response to inflation where $\chi_\pi = 0.19$. Fiscal policy coefficients (ϕ_g and ϕ_b) estimates now stay closer to their prior means at 0.13 and 0.41 respectively.

Although price stickiness and wage stickiness remain fairly in line with the values under determinacy (0.71 and 0.48), it is interesting to note that values for price and wage indexation have drastically changed. With $\iota_p = 0.09$ and $\iota_w = 0.97$, the data under indeterminacy strongly prefers wage indexation over price indexation in fitting the data.

As for the posterior estimates of the shock processes, results show that shocks are generally more persistent under indeterminacy. Investment-specific shocks are now highly persistent (0.95) but not as volatile (0.35). Similarly, preferences shocks are also slightly more persistent (0.93) and much less volatile (0.21) compared to the case under determinacy.

Through comparing the values of the marginal likelihood between the estimation under determinacy and indeterminacy, it is evident the the data prefers the indeterminate solution far more. This indicates that between the period of Q1 1984 to Q4 2019, the US economy has trended towards a more indeterminate state.

2.5 Concluding Remarks

This paper includes cognitive discounting of expectations in a medium-scale monetary DSGE model of the macroeconomy that is typically used for fiscal policy analysis. Myopia causes a larger deviation from the Ricardian equivalence equilibrium so that fiscal multipliers are larger at multiple horizons. However, the larger multipliers are accompanied by significantly larger crowding out of private investment. Additionally, the effects of myopia on fiscal multipliers are non-linear and reverse after crossing a particular threshold of the ratio of hand-to-mouth consumers. Finally, a Bayesian MCMC estimation reveals that under determinacy, agents in the economy are fairly myopic, with $M = 0.86$. However, the data indicates that the economy has been more indeterminate in the period that I have estimated.

This paper raises many more questions and research avenues that may be addressed in future iterations or other papers altogether. Myopia is just one potential form of behavioral bias, and a stylized one at that. It is also used in a reduced-form context. It may be interesting to apply other behavioral factors such as sentiment, anchoring, etc. and check if my results still hold.

Chapter 3

Myopia, Hand-to-Mouth Agents, and Determinacy

3.1 Introduction

In considering the implementation of monetary or fiscal policy interventions, policymakers must ensure the effectiveness and credibility of the new policies. One of the factors to guarantee policy effectiveness is economic determinacy, which is whether the model describing the economy has a unique, well-defined equilibrium solution. In other words, a model is said to be determinate if given a set of initial conditions, it predicts a single path for the variables of interest over time. Conversely, when the economy is indeterminate, the model has infinite equilibria and will fail to converge to a stable solution (Benhabib Farmer 1999).

Literature that has centered on assessing the implications of determinacy for monetary policy focuses on identifying policy mechanisms aimed at mitigating the risk of inducing indeterminacy. In a seminal paper, Sargent & Wallace [44] advocate for money-supply rules over interest-rate rules to avoid indeterminacy. Alternatively, Bernanke & Woodford [14] suggest that it is the reliance on private-sector inflation forecasts that lead to indeterminacy. However, it may be that purely forward-looking approaches, as opposed to backward-looking rules, is credited as a cause of indeterminacy (Carlstrom & Fuerst [17]; Woodford [48]; Svensson & Woodford [46]. Timing is also a consideration, as concluded by Carlstrom & Fuerst [18], where seemingly minor model features (i.e. cash-when-I'm-done rather than cash-in-advance), could be the determining factor in the determinacy of the economy.

Rather than examining factors that could lead to indeterminacy, I study the interactions between non-Ricardian agents and monetary policy and how they affect determinacy. Specifically, the non-Ricardian agents included in my model are hand-to-mouth agents, which are consumers that do not optimize period-to-period and consume all their income contemporaneously, as well as myopic agents, or agents that exhibit short-sighted behavior by focusing on immediate consequences rather than long term objectives. To model myopic agents, I use Gabaix's [27] microfounded "cognitive discounting" parameter, myopia, and incorporate it into Gali et al.'s [29] new-Keynesian model with optimizing and non-Ricardian consumers.

In the style popularized by Bullard and Mitra [15], I exhibit three pairwise determinacy plots for the degree of myopia, share of hand-to-mouth agents, and the response of monetary policy to inflation. Gali et al. ([28]; [29]) similarly use pairwise determinacy plots to show that by including hand-to-mouth agents, the equilbrium conditions for determinacy are drastically altered. However, in this paper, I argue the necessity of further including an additional behavioral component of myopia, since it is natural to assume that not all optimizing agents in the economy have perfect foresight and optimize their income completely.

I find that with the addition of myopic agents, the regions of indeterminacy are much larger, thus necessitating an analysis of the effects of myopia under indeterminacy. Furthermore, I uncover a determinacy trilemma where only two of the following three are possible: reasonable myopia, realistic hand-to-mouth share, and active monetary policy. To my knowledge, there is no prior literature on the consequences of adding a "cognitive discounting" parameter in the study of economic determinacy.

The remainder of the paper continues with section 3.2 describes the New Keynesian model adapted from Gali et al. [29] and lists the data used for analysis. Section 3.3 presents the determinacy plots and highlights the determinacy trilemma. Section 3.4 concludes.

3.2 Theoretical Model

In order to draw comparisons to Gali et al.'s [29] conclusions on regions of indeterminacy with hand-to-mouth agents, I adopt the new Keynesian model from their paper. The model includes two types of households, a continuum of differentiated intermediate goods producing firms, a final good producing firm, monetary authority, and a fiscal authority that determined government spending. A feature I add to the model is the myopic parameter M, which appears in the forward-looking log-linearized consumer and firm equations. I also include monetary policy, preference, technology, and labor supply shocks.

3.2.1 Households

There is a continuum of $j \in [0, 1]$ households in the economy, and a proportion $1 - \lambda$ of these households are optimizing households. Proportion λ are rule-of-thumb households, or otherwise known as hand-to-mouth households in this paper. Optimizing households have complete access to capital and asset markets, while hand-to-mouth households spend their entire current period income without the ability to own capital. Optimizing households are denoted by superscript o, while hand-to-mouth households are denoted by superscript h. All households (A) have the same preferences equation of:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\log C_t^A(j) - \frac{N_t^A(j)^{1+\kappa}}{1+\kappa} \right] \tag{3.1}$$

κ is the inverse of the Frisch labor supply elasticity, $C_t^A(j)$ is the final good consumption and $N_t^A(j)$ is labor supply of household j.

Optimizing households. The budget constraint and capital accumulation equation for optimizing households $j \in (0, 1-\lambda)$ are:

$$P_t(C_t^o + I_t^o) + R_t^{-1} B_{t+1}^o = W_t P_t N_t^o + R_t^k P_t K_t^o + B_t^o + D_t^o - P_t T_t^o \tag{3.2}$$

$$K_{t+1}^o = (1-\delta) K_t^o + \phi(\frac{I_t^o}{K_t^o}) K_t^o. \tag{3.3}$$

The sum of real consumption (C_t^o), investment expenditures (I_t^o), and risk-less nominal government bond (B_t^o) paid out with the nominal gross interest rate R_t^{-1} is equal to the total labor income $W_t P_t N_t^o$, capital holdings income $R_t^k P_t K_t^o$, risk-less bonds carried over from the previous period, dividends from firm ownership D_t^o, and lump sum taxes (or transfers) $P_t T_t^o$ in every period. P_t is the price level, w_t denotes the real wage, N_t^o represents hours worked, and K_t^o symbolizes capital holding.

In equation 3.3, $\phi(\frac{I_t^o}{K_t^o}) K_t^o$ is the capital adjustment costs, which determines period-to-period capital changes from investment spending. I assume $\phi' > 0$, and $\phi'' \leq 0$, with $\phi'(\delta) = 1$, and $\phi(\delta) = \delta$.

Although in Gali et al. [29], there are two different labor market structures that set the wages, I only consider the case with the competitive labor market. In this labor market, every household determines their hours worked taking into account the market wage. In this case, the labor supply of optimizing households is:

$$W_t = C_t^o (N_t^o)^{\varphi} \zeta_t. \tag{3.4}$$

ζ_t is the labor supply shock that follows the AR(1) process:

$$\zeta_t = \rho_\zeta \zeta_{t-1} + \varepsilon_\zeta. \tag{3.5}$$

Hand-to-mouth households. The budget constraint of hand-to-mouth households is:

$$P_t C_t^h = W_t P_t N_t^h - P_t T_t^h. \tag{3.6}$$

From this budget constraint, it is clear that hand-to-mouth households can only consume the income they receive each period.

As with optimizing households, hand-to-mouth households follows the competitive labor market structure, which must satisfy the condition:

$$W_t = C_t^h (N_t^h)^{\varphi} \zeta_t. \tag{3.7}$$

Aggregation. Aggregating the consumption and labor hours of all households, I have:

$$C_t^A \equiv \lambda C_t^r + (1 - \lambda) C_t^o \tag{3.8}$$

and

$$N_t^A \equiv \lambda N_t^r + (1 - \lambda) N_t^o. \tag{3.9}$$

Since only the optimizing households determines the investment and capital stock, the total investment and capital stock is as follows:

$$I_t \equiv (1-\lambda)I_t^o \tag{3.10}$$

and

$$K_t \equiv (1-\lambda)K_t^o. \tag{3.11}$$

3.2.2 Firms

The production sector includes a variety of firms in monopolistic competition, each creating unique intermediate goods, and a central firm that utilizes these intermediate goods to manufacture a single final product.

The intermediate good firm (i) produces a differentiated good $Y_t(i)$ using the Cobb-Douglas production technology:

$$Y_t(i) = A_t(i)K_t(i)^{\alpha}N_t(i)^{1-\alpha}. \tag{3.12}$$

$K_t(i)$ and $N_t(i)$ denote the capital and labor services hired by firm i, and $A_t(i)$ is the total factor productivity. The total factor productivity shock follows the AR(1) process:

$$A_t = \rho_a A_{t-1} + \varepsilon_t^A. \tag{3.13}$$

The intermediate goods firm accepts the prevailing wage and capital rental costs and adjusts its prices using the Calvo pricing mechanism..

The final good producing firm has the following the constant returns production function:

$$Y_t = \left[\int_0^1 X_t(i)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} di \right]^{\frac{\varepsilon_p}{\varepsilon_p - 1}}. \tag{3.14}$$

In the above equation, $\varepsilon_p > 1$ and $X_t(i)$ are the quantities of intermediate good i used as inputs. The final good producer's demand function for intermediate inputs is established using the prices for intermediate goods $P_t(i)$ and the price of the final good P_t:

$$X_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\varepsilon_p} Y_t. \tag{3.15}$$

The zero-profit condition for the final goods firm is:

$$P_t = \left(\int_0^1 P_t(i)^{1-\varepsilon_p} dj \right)^{\frac{1}{1-\varepsilon_p}}. \tag{3.16}$$

3.2.3 Monetary Policy

The monetary authority sets the nominal interest rate $r_t \equiv R_t - 1$ every period according to the interest rate rule

$$r_t = \phi_\pi \pi_t + MP_t, \tag{3.17}$$

with MP_t being monetary policy shock process that follows:

$$MP_t = \rho_{mp} MP_{t-1} + \varepsilon_t^{MP} \tag{3.18}$$

The Taylor principle is satisfied if and only if $\phi_\pi > 1$ in the interest rate rule, which is also necessary and sufficient to guarantee the determinacy in the absence of hnd-to-mouth consumers.

3.2.4 Fiscal Policy

The government is subject to the budget constraint:

$$P_t T_t + R_t^{-1} B_{t+1} = B_t + P_t G_t, \tag{3.19}$$

By summing taxes received from optimizing households and hand-to-mouth consumers, I can aggregate taxes such that $T_t \equiv \lambda T_t^r + (1-\lambda) T_t^o$.

Since I have defined $g_t \equiv (G_t - G)/Y$, $t_t \equiv (T_t - T)/Y$, and $b_t \equiv ((B_t/P_{t-1}) - (B/P))/Y$, I am able to assume a fiscal policy rule as

$$t_t = \phi_b b_t + \phi_g g_t, \tag{3.20}$$

where ϕ_b and ϕ_g are greater than zero.

Government spending follows an AR(1) process:

$$g_t = \rho_g g_{t-1} + \varepsilon_t^g, \tag{3.21}$$

where $0 < \rho_g < 1$ is the persistence parameter and ε_t^g is the i.i.d government spending shock with constant variance σ_ε^2.

3.2.5 Market Clearing

The following conditions must be met for factor and good markets to clear in all periods t:

$$N_t = \int_0^1 N_t(i)di, \qquad Y_t(i) = X_t(i) \quad \text{for all} \quad i, \tag{3.22}$$

$$K_t = \int_0^1 K_t(i)di, \qquad Y_t = C_t + I_t + G_t. \tag{3.23}$$

3.2.6 Modeling Myopia

Incorporating myopia into the model is done in the same way as in Chapter 2 of this dissertation. In short, in this model, the myopic parameter enters for the log-linearized forward-looking consumer and firm equations:

$$c_t^o = mE_t c_{t+1}^o - (r_t - E_t \pi_{t+1}) + \chi_t. \tag{3.24}$$

For firms, myopia enters in the log-linearized equation as:

$$\pi_t = m\beta E_t \pi_{t+1} - \frac{(1-\beta\theta)(1-\theta)}{\theta}\mu_t^p. \tag{3.25}$$

Again, $m \in [0, 1]$ is the myopia parameter such that when $m = 1$, there is perfect foresight and agents are completely rational. The model then becomes the same as in Gali et al. [29]. When m is strictly less than one, innovations to the economy in the future get heavily discounted.

For a more detailed explanation of how myopia is modelled, please refer to Chapter 2. Appendix C for the full set of log-linearized equations and Gali et al, [29] for a more detailed presentation of the model.

3.3 Results

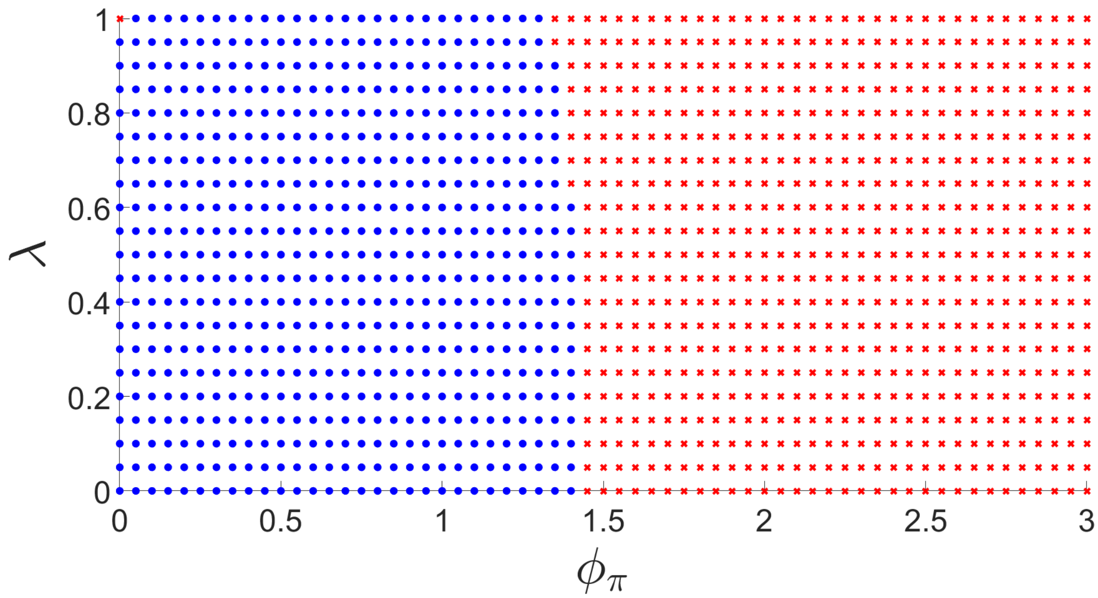


Figure 3.1: Determinacy Region: ϕ_π v. λ, $M = 0.85$

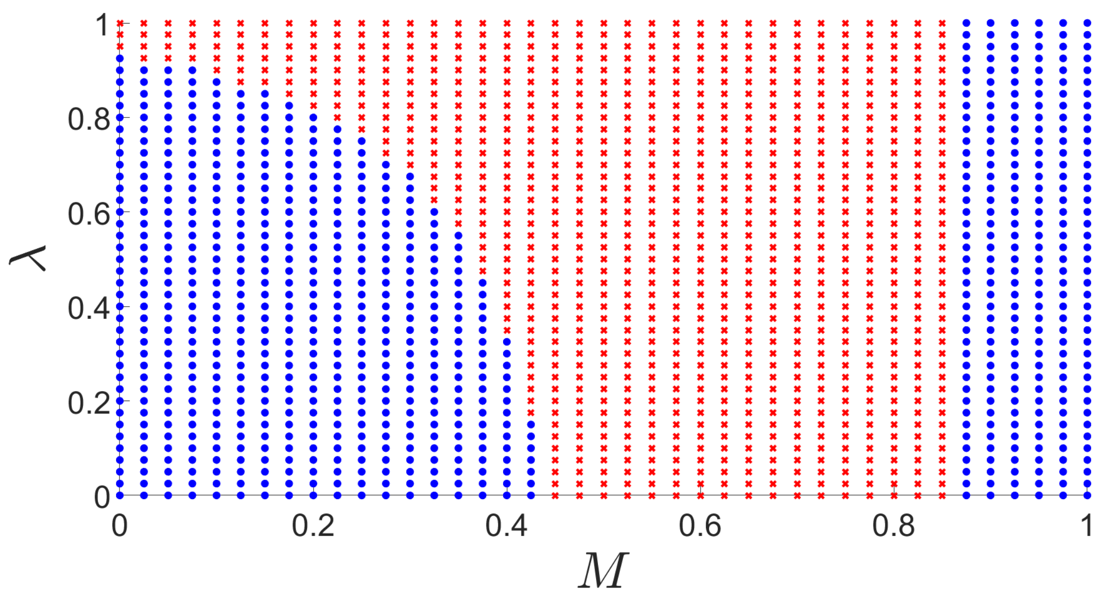


Figure 3.2: Determinacy Region: M v. λ, $\phi_\pi = 1.5$

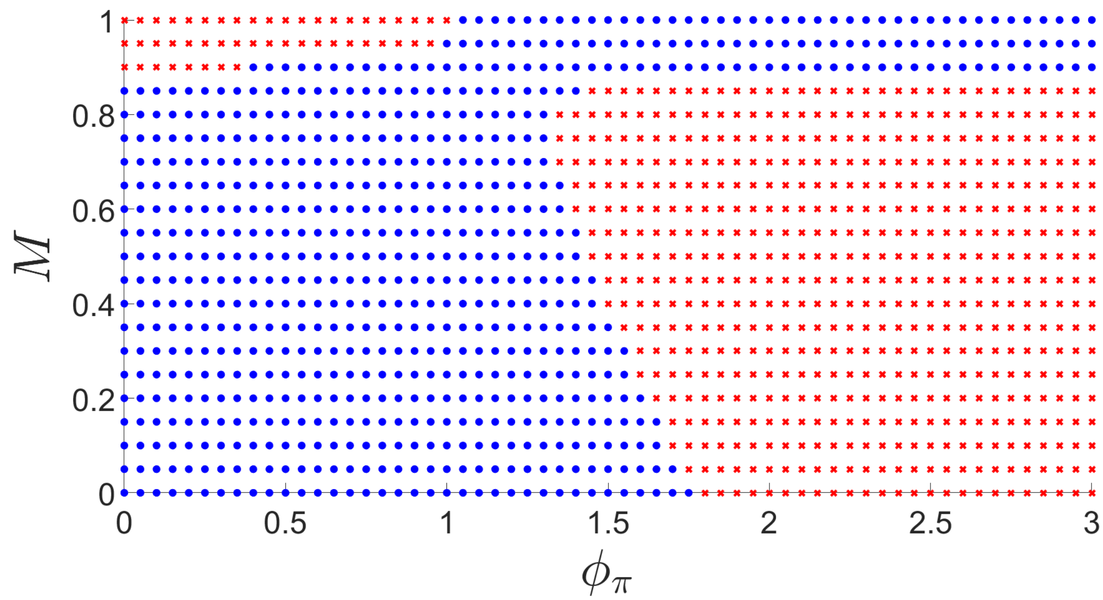


Figure 3.3: Determinacy Region: ϕ_π v. M, $\lambda = 0.35$

I now present the implications of including the degree of myopia in the analysis of determinacy. I show three pairwise determinacy plots for the degree of myopia (M), share of HTM agents (λ), and response of monetary policy to inflation (ϕ_π). Unlike Gali et al. (2007), the results are presented for the version of the model that includes imperfect labor markets which increases the regions of indeterminacy altogether although the overall implications remain similar under both perfectly and imperfectly competitive labor markets. In all graphs, regions of indeterminacy are demarcated by red dots. Blue-dotted regions represent parameter combinations that lead to model determinacy. Similar to Gali et al. (2007), model determinacy is established via a numerical method utilizing the *gensys* tool from Sims (2002). Given the multitude of model equations, it is difficult to analytically compute explicit algebraic determinacy conditions such as the Taylor Principle computed in Bullard and Mitra (2002). The key finding from this analysis is the presence of a *determinacy trilemma*: reasonable values (for the U.S. macroeconomy) for M, λ, and ϕ_π cannot simultaneously co-exist while having a determinate model solution. One of these three must be calibrated to a value that sharply differs from existing literature for the model to be determinate.

Figure 3.1 shows the pairwise effect of λ and ϕ_π with M calibrated at its value of 0.85 from Gabaix (2020). As mentioned in the introduction, roughly 1/3 of the U.S. population is HTM. Notice from the graph that for λ values around 33%, FED response to inflation must actually be relatively *passive* for model determinacy; this in stark contrast to the Taylor Principle where $\phi_\pi > 1$ ensures determinacy. Values marginally over one are still determinate but any deviation towards stronger inflation responses may trigger indeterminacy. Estimates of ϕ_π are usually significantly higher than unity; for instance Smets and Wouters (2007) estimate an inflation response of 2.04 for the U.S. economy. The conviction that inflation responses are well above one is so strong that most empirical literature in macroeconomics that utilize Bayesian methods to estimate inflation responses usually utilize a prior mean of 1.5 for ϕ_π. Under Smets and Wouters (2007), both prior and posterior means for ϕ_π would result in indeterminacy if M is calibrated at 0.85.

Figure 3.2 shows the pairwise effect of λ and M with ϕ_π calibrated to 1.5. Again, within the context of the U.S. with a roughly 33% HTM ratio, only strong (< 0.40) or weak (> 0.85) degrees of myopia are able to achieve determinacy. Note that for values between these two points, the region that corresponds with reasonable values for cognitive discounting as described in Gabaix (2020), the model is indeterminate. A likely explanation is that for strong degrees of myopia, optimizing agents tend to mimic HTM agents, effectively increasing the share of rule-of-thumb consumers. As this share increases, active monetary policy begins to help rather than hurt model determinacy as shown in the prior graph.

Finally, Figure 3.3 shows the pairwise effect of ϕ_π and M, with λ calibrated to a value of 0.35 to accurately capture the share of U.S. consumers that are HTM. Once again, the determinacy dilemma is presented where strong responses of monetary policy to inflation can only lead to determinate outcomes only when the optimizing agents barely exhibit any cognitive discounting or a high degree of discounting. For values of M around 0.85, the FED should either be passive or barely active ($\phi_\pi < 1.3$). As the degree of myopia increases (i.e. M decreases) the monetary authority can correspondingly react more aggressively to inflation but still in a manner that is more restricted than indicated by prior macro literature.

Thus, I have demonstrated the existence of a "determinacy trilemma", where active monetary policy and empirically founded values of HTM and myopia cannot all coexist. However, the more important takeaway from this section is that adding myopia increases the regions of indeterminacy significantly when compared to the baseline Bullard and Mitra (2002) and GLV2007 determinacy analysis. Consequently, an estimation of the model under indeterminacy is necessary present a full picture of the parameter values.

3.4 Conclusion

This paper considers the impact of including myopic and hand-to-mouth agents on determinacy. Given that Gali et al. (2007) found large implications on determinacy after adding hand-to-mouth agents, it should follow that further adding myopic agents would generate additional conditions to guarantee the uniqueness of equilibrium. As predicted, such deviation from rational expectations has drastic effects on the determinacy of the model. The analysis unveils a *determinacy trilemma*: the model can only select 2 of 3 reasonable values for myopia, share of hand-to-mouth consumers, and active monetary policy.

This result poses a compelling policy implication, given that with the inclusion of behavioral features, the conditions of attaining determinacy under active monetary policy become much more stringent. Perhaps an estimation of the myopia parameter given current economic data should be done to determine the level of myopia in the economy before carrying out policy decisions.

Another thought-provoking topic of research would be to include fiscal policy in a similar determinacy analysis. Most studies of determinacy focus on the Taylor Principle, yet few look at the implications of active or fiscal policy. Furthermore, there has not been a study done with incorporating behavioral features into a model when studying the conditions that lead to a unique equilibrium with active fiscal policy.

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Appendix A

Supplementary material to Chapter 1

Table A1. List of Countries in the Sample for GLS estimation

	Years			
Country	Total	With Interstate Conflict	With Intrastate Conflict	With All Conflicts
Afghanistan	29	0	29	29
Albania	29	0	1	1
Algeria	29	0	14	14
Angola	29	0	16	16
Argentina	29	0	0	0
Armenia	29	4	1	5
Australia	29	0	0	0
Austria	29	0	0	0
Azerbaijan	29	4	8	8
Bahrain	29	0	0	0
Bangladesh	29	0	3	3
Belarus	29	0	1	1
Belgium	29	0	0	0
Benin	29	0	0	0
Bhutan	29	0	3	3

Table A1 Continued

Bolivia	29	0	0	0
Bosnia	29	0	5	5
Botswana	29	0	0	0
Brazil	29	0	0	0
Bulgaria	29	0	0	0
Burkina Faso	29	0	0	0
Burundi	29	0	18	18
Cambodia	29	0	8	8
Cameroon	29	0	4	4
Canada	29	0	0	0
Cape Verde	29	0	0	0
Central African Republic	29	0	17	17
Chad	29	0	11	11
Chile	29	0	0	0
China	29	0	16	16
Colombia	29	0	27	27
Comoros	29	0	0	0
Costa Rica	29	0	0	0
Croatia	29	1	4	5
Czech Republic	29	0	0	0
Democratic Republic of the Congo	29	0	27	27
Denmark	29	0	0	0
Djibouti	29	0	4	4
Dominican Republic	29	0	0	0
Ecuador	29	1	0	1
Egypt	29	0	15	15
El Salvador	29	0	3	3
Equatorial Guinea	29	0	0	0

Table A1 Continued

Eritrea	29	3	0	3
Estonia	29	0	1	1
Ethiopia	29	0	2	2
Fiji	29	0	0	0
Finland	29	0	0	0
France	29	0	0	0
Gabon	29	0	0	0
Gambia	29	0	0	0
Georgia	29	1	5	6
Germany	29	0	0	0
Ghana	29	0	1	1
Greece	29	0	0	0
Guatemala	29	0	7	7
Guinea	29	0	2	2
Guinea-Bissau	29	0	2	2
Guyana	29	0	0	0
Haiti	29	0	5	5
Honduras	29	0	1	1
Hungary	29	0	0	0
India	29	1	29	29
Indonesia	29	0	13	13
Iran	29	0	4	4
Iraq	29	15	17	29
Ireland	29	0	0	0
Israel	29	2	29	29
Italy	29	0	0	0
Ivory Coast	29	0	7	7
Jamaica	29	0	0	0
Japan	29	0	0	0
Jordan	29	0	0	0
Kazakhstan	29	0	1	1

Table A1 Continued

Kenya	29	0	7	7
Korea	29	0	0	0
Kuwait	29	2	0	2
Kyrgyzstan	29	0	2	2
Laos	29	0	1	1
Latvia	29	0	1	1
Lebanon	29	2	4	5
Lesotho	29	0	0	0
Liberia	29	0	12	12
Libya	29	0	6	6
Lithuania	29	0	1	1
Luxembourg	29	0	0	0
Malawi	29	0	0	0
Malaysia	29	0	0	0
Mali	29	0	13	13
Mauritania	29	0	0	0
Mauritius	29	0	0	0
Mexico	29	0	17	17
Moldova	29	0	8	8
Mongolia	29	0	0	0
Morocco	29	0	0	0
Mozambique	29	0	3	3
Myanmar	29	0	29	29
Namibia	29	0	0	0
Nepal	29	0	11	11
Netherlands	29	0	0	0
New Zealand	29	0	0	0
Nicaragua	29	0	1	1
Niger	29	0	9	9
Nigeria	29	0	26	26
Norway	29	0	0	0

Table A1 Continued

Oman	29	0	0	0
Pakistan	29	1	27	28
Panama	29	0	0	0
Papua New Guinea	29	0	8	8
Paraguay	29	0	0	0
Peru	29	1	8	8
Philippines	29	0	29	29
Poland	29	0	0	0
Portugal	29	0	0	0
Qatar	29	0	0	0
Republic of Congo	29	0	6	6
Romania	29	0	0	0
Russia	29	1	22	22
Rwanda	29	7	10	13
Saudi Arabia	29	0	5	5
Senegal	29	0	8	8
Sierra Leone	29	0	11	11
Singapore	29	0	0	0
Slovakia	29	0	0	0
Solomon Islands	29	0	6	6
South Africa	29	0	7	7
South Sudan	29	0	29	29
Spain	29	0	0	0
Sri Lanka	29	0	20	20
Sudan	29	0	29	29
Suriname	29	0	0	0
Sweden	29	0	0	0
Switzerland	29	0	0	0
Syria	29	0	8	8
Tajikistan	29	0	8	8
Tanzania	29	0	0	0

Table A1 Continued

Thailand	29	0	16	16
Togo	29	0	0	0
Trinidad and Tobago	29	0	0	0
Tunisia	29	0	0	0
Turkey	29	0	25	25
Turkmenistan	29	0	1	1
Uganda	29	7	17	17
Ukraine	29	0	6	6
United Arab Emirates	29	0	0	0
United Kingdom	29	0	5	5
United States	29	13	0	13
Uruguay	29	0	0	0
Uzbekistan	29	0	1	1
Venezuela	29	0	4	4
Vietnam	29	0	0	0
Yemen	29	0	0	0
Zambia	29	0	0	0
Zimbabwe	29	0	0	0
Total	4466	66	828	870

Table A2. List of Countries in the Sample for 2SLS estimation

	Years			
Country	Total	With Interstate Conflict	With Intrastate Conflict	With All Conflicts
Afghanistan	34	0	34	34
Albania	34	0	1	1
Algeria	34	0	14	14
Angola	34	0	26	26
Argentina	34	1	1	2
Armenia	34	13	1	14
Australia	34	0	0	0
Austria	34	0	0	0
Azerbaijan	34	13	8	17
Bahrain	34	0	0	0
Bangladesh	34	0	13	13
Belarus	34	9	1	10
Belgium	34	0	0	0
Benin	34	0	0	0
Bhutan	34	0	3	3
Bolivia	34	0	0	0
Bosnia	34	9	5	14
Botswana	34	0	0	0
Brazil	34	0	1	1
Bulgaria	34	0	0	0
Burkina Faso	34	0	0	0
Burundi	34	0	15	15
Cambodia	34	10	8	18
Canada	34	0	0	0
Cape Verde	34	0	0	0
Central African Republic	34	0	12	12

Table A2 Continued

Chad	34	0	21	21
Chile	34	0	1	1
China	34	3	24	24
Colombia	34	0	34	34
Comoros	34	0	0	0
Costa Rica	34	0	0	0
Croatia	34	1	4	5
Czech Republic	34	0	0	0
Democratic Republic of the Congo	34	0	0	0
Denmark	34	0	0	0
Djibouti	34	0	4	4
Dominican Republic	34	0	0	0
Ecuador	34	1	0	1
Egypt	34	0	10	10
El Salvador	34	0	13	13
Eritrea	34	3	0	3
Estonia	34	9	1	10
Ethiopia	34	3	21	22
Fiji	34	0	0	0
Finland	34	0	0	0
Gabon	34	0	0	0
Gambia	34	0	1	1
Georgia	34	10	5	15
Germany	34	0	0	0
Ghana	34	0	2	2
Greece	34	0	0	0
Guatemala	34	0	17	17
Guinea	34	0	2	2
Guinea-Bissau	34	0	2	2

Table A2 Continued

Guyana	34	0	0	0
Haiti	34	0	5	5
Honduras	34	6	11	11
Hungary	34	0	0	0
Indonesia	34	0	23	23
Iran	34	9	14	14
Iraq	34	24	22	34
Ireland	34	0	0	0
Israel	34	10	34	34
Italy	34	0	3	3
Ivory Coast	34	0	7	7
Jamaica	34	0	1	1
Japan	34	0	0	0
Jordan	34	0	0	0
Kazakhstan	34	9	1	10
Kenya	34	0	7	7
Korea	34	0	1	1
Kuwait	34	2	0	2
Kyrgyzstan	34	9	2	11
Laos	34	0	11	11
Latvia	34	9	1	10
Lebanon	34	10	14	15
Lesotho	34	0	0	0
Liberia	34	0	13	13
Libya	34	0	1	1
Lithuania	34	9	1	10
Malawi	34	0	0	0
Malaysia	34	0	0	0
Mali	34	0	8	8
Mauritania	34	1	0	1
Mauritius	34	0	0	0

Table A2 Continued

Mexico	34	0	12	12
Moldova	34	9	8	17
Mongolia	34	0	0	0
Morocco	34	0	10	10
Myanmar	34	0	34	34
Namibia	34	0	0	10
Nepal	34	0	11	11
Netherlands	34	0	0	0
New Zealand	34	0	0	0
Nicaragua	34	6	10	10
Niger	34	0	8	8
Nigeria	34	0	31	31
Norway	34	0	0	0
Oman	34	0	0	0
Pakistan	34	1	29	30
Panama	34	1	0	1
Paraguay	34	0	0	0
Peru	34	1	16	16
Philippines	34	0	34	34
Poland	34	0	0	0
Portugal	34	0	0	0
Qatar	34	0	0	0
Republic of Congo	34	0	6	6
Romania	34	0	1	1
Russia	34	10	18	27
Rwanda	34	7	10	13
Saudi Arabia	34	0	5	5
Senegal	34	1	8	9
Sierra Leone	34	0	11	11
Singapore	34	0	0	0
Slovakia	34	0	0	0

Table A2 Continued

Solomon Islands	34	0	6	6
South Africa	34	0	14	14
Spain	34	0	0	0
Sri Lanka	34	0	27	27
Sudan	34	0	31	31
Sweden	34	0	0	0
Switzerland	34	0	0	0
Syria	34	1	6	6
Tajikistan	34	9	8	17
Tanzania	34	0	0	0
Thailand	34	8	15	19
Togo	34	0	0	0
Trinidad and Tobago	34	0	0	0
Tunisia	34	0	0	0
Turkey	34	0	30	30
Turkmenistan	34	9	1	10
Uganda	34	7	26	26
Ukraine	34	9	1	10
United Arab Emirates	34	0	0	0
United Kingdom	34	1	15	15
United States	34	13	0	13
Uruguay	34	0	0	0
Uzbekistan	34	9	1	10
Venezuela	34	0	0	0
Yemen	34	0	13	13
Zambia	34	0	0	0
Zimbabwe	34	0	7	7
Total	4896	285	948	1163

Table A3. Summary Statistics for the Conflict (Magnitude of Violence) Variables

Conflict Variable	Observation	Mean	Std. Dev.	Min.	Max.
Interstate	4,460	0.0439462	0.4132224	0	6
Intrastate	4,462	0.6463469	1.581524	0	10
Total	4,462	0.6902734	1.645571	0	13

NOTE. Conflict Variables taken from Major Episodes of Violence dataset for years 1990-2018.

Appendix B

Supplementary material to Chapter 2

B.1 Expanded Model: Log-Linearized equations

$$c_t^o = \frac{h}{1+h}c_{t-1}^o + \frac{1}{1+h}E_t c_{t+1}^o - \frac{1-h}{1+h}(r_t - E_t\pi_{t+1} + \nu_\chi) \tag{B.1}$$

$$c_t^r = \frac{1-\alpha}{\mu_p \gamma_c}(w_t + n_t^r) - \gamma_c^{-1} t_t^r \tag{B.2}$$

$$c_t = \lambda c_t^r + (1-\lambda)c_t^o \tag{B.3}$$

$$n_t = \lambda n_t^r + (1-\lambda)n_t^o \tag{B.4}$$

$$\begin{aligned} w_t = {} & \frac{1}{1+\beta}w_{t-1} + \frac{\beta}{1+\beta}(E_t w_{t+1} + E_t\pi_{t+1}) - \frac{1+\beta\iota_w}{1+\beta}\pi_t \frac{\iota_w}{1+\beta}\pi_{t-1} \\ & - \frac{(1-\beta\theta_w)(1-\theta_w)}{\theta_w(1+\beta}(\mu_t^w - \mu_t^{w,n}) \end{aligned} \tag{B.5}$$

$$\mu_t^w = w_t - (\lambda c_t^r + \frac{1-\lambda}{1-h}(c_t^o - hc_{t-1}^o) + \sigma_l n_t) \tag{B.6}$$

$$i_t = \frac{1}{1+\beta}i_{t-1} + \frac{\beta}{1+\beta}E_t i_{t+1} + \frac{1}{\varphi(1+\beta)}q_t + \nu_t^i \tag{B.7}$$

$$k_t = (1-\delta)k_{t-1} + \delta i_t + (\delta(1+\beta)\varphi)\nu_t^i \tag{B.8}$$

$$z_t = \psi r_t^k \tag{B.9}$$

$$\tag{B.10}$$

$$q_t = \beta(1-\delta)E_t q_{t+1} + [1+\beta(1-\delta)]E_t r^k_{t+1} - (r_t - E_t\pi_{t+1} + \nu_\chi) \tag{B.11}$$

$$\pi_t = \frac{\iota_p}{1+\iota_p\beta}\pi_{t-1} + \frac{\beta}{1+\iota_p\beta}E_t\pi_{t+1} - \frac{(1-\beta\theta_p)(1-\theta_p)}{(1+\iota_p\beta)\theta_p}(\mu^p_t - \mu^{p,n}_t) \tag{B.12}$$

$$\mu^p_t = (y_t - n_t) - w_t \tag{B.13}$$

$$r^k_t = c_t - z_t - k_{t-1} + (1+\sigma_l)n_t \tag{B.14}$$

$$y_t = (1-\alpha)n_t + \alpha k_{t-1} + \alpha z_t + a_t \tag{B.15}$$

$$y_t = \gamma_c c_t + \gamma_i i_t + \gamma_z z_t + g_t \tag{B.16}$$

$$b_t = \beta^{-1}[b_{t_1} + g_t - t_t] \tag{B.17}$$

$$t_t = \phi_b b_{t-1} + \phi_g g_t \tag{B.18}$$

$$r_t = \rho_r r_{t-1} + (1-\rho_r)[\chi_\pi \pi_t + \chi_y y_t] + \varepsilon^r_t \tag{B.19}$$

B.2 Posterior Estimates: Varying Share of HTM (λ)

		Prior			Posterior		
Parameter	Description	Dist.	Mean	Dev.	Mean	10%	90%
φ	Inverse Frisch elas.	Normal	4.00	1.50	5.34	5.22	5.48
h	Habit formation	Beta	0.70	0.10	0.74	0.73	0.74
θ_p	Calvo prices	Beta	0.50	0.10	0.94	0.93	0.94
θ_w	Calvo wages	Beta	0.50	0.10	0.69	0.68	0.70
ι_p	Price indexation	Beta	0.50	0.15	0.70	0.69	0.72
ι_w	Wage indexation	Beta	0.50	0.15	0.97	0.96	0.97
σ_l	Labor supply elas.	Normal	2.00	0.75	0.14	0.11	0.16
ψ	Capital util. elas.	Beta	0.50	0.15	0.60	0.59	0.60
α	Capital share	Normal	0.30	0.05	0.40	0.40	0.40
M	Myopia	Beta	0.85	0.10	0.93	0.93	0.94
χ_π	MP inflation	Normal	1.50	0.25	1.94	1.87	2.00
χ_y	MP output	Normal	0.12	0.05	0.11	0.11	0.11
ϕ_g	FP govt. spending	Normal	0.10	0.05	0.08	0.07	0.08
ϕ_b	FP debt	Normal	0.33	0.10	0.26	0.25	0.26
y^*	Trend	Normal	0.40	0.10	0.82	0.81	0.83
π^*	Trend	Normal	0.60	0.10	0.79	0.78	0.80
i^*	Trend	Normal	0.75	0.10	0.76	0.74	0.78

Table B.1: Posterior Estimates: Structural Parameters Under Determinacy, $\lambda = 0.65$

		Prior			Posterior		
Parameter	Description	Dist.	Mean	Dev.	Mean	10%	90%
Persistence							
ρ_χ	Preference	Beta	0.50	0.20	0.83	0.83	0.84
ρ_w	Wage markup	Beta	0.50	0.20	0.69	0.68	0.70
ρ_p	Price markup	Beta	0.50	0.20	0.50	0.49	0.50
ρ_a	Technology	Beta	0.50	0.20	0.80	0.78	0.81
ρ_g	Govt. Spending	Beta	0.50	0.20	0.98	0.97	0.99
ρ_i	Investment specific	Beta	0.50	0.20	0.60	0.59	0.60
ρ_r	Monetary Policy	Beta	0.50	0.20	0.95	0.93	0.96
Deviation							
σ_χ	Preference	Γ^{-1}	0.30	1.00	0.57	0.53	0.61
σ_w	Wage markup	Γ^{-1}	0.30	1.00	1.60	1.53	1.66
σ_p	Price markup	Γ^{-1}	0.30	1.00	0.12	0.11	0.13
σ_a	Technology	Γ^{-1}	0.30	1.00	0.59	0.55	0.63
σ_g	Govt. Spending	Γ^{-1}	0.30	1.00	0.46	0.41	0.50
σ_i	Investment specific	Γ^{-1}	0.30	1.00	0.70	0.63	0.77
σ_r	Monetary Policy	Γ^{-1}	0.30	1.00	0.13	0.13	0.14

Table B.2: Posterior Estimates: Shock Processes Under Determinacy, $\lambda = 0.65$

		Prior			Posterior		
Parameter	Description	Dist.	Mean	Dev.	Mean	10%	90%
φ	Inverse Frisch elas.	Normal	4.00	1.50	10.5	10.3	10.7
h	Habit formation	Beta	0.70	0.10	0.48	0.47	0.50
θ_p	Calvo prices	Beta	0.50	0.10	0.77	0.75	0.79
θ_w	Calvo wages	Beta	0.50	0.10	0.40	0.39	0.41
ι_p	Price indexation	Beta	0.50	0.15	0.49	0.45	0.52
ι_w	Wage indexation	Beta	0.50	0.15	0.83	0.81	0.85
σ_l	Labor supply elas.	Normal	2.00	0.75	0.40	0.35	0.44
ψ	Capital util. elas.	Beta	0.50	0.15	0.60	0.58	0.62
α	Capital share	Normal	0.30	0.05	0.23	0.23	0.24
M	Myopia	Beta	0.85	0.10	0.82	0.82	0.82
χ_π	MP inflation	Normal	1.50	0.25	0.00	0.00	0.00
χ_y	MP output	Normal	0.12	0.05	0.11	0.10	0.12
ϕ_g	FP govt. spending	Normal	0.10	0.05	0.08	0.07	0.08
ϕ_b	FP debt	Normal	0.33	0.10	0.11	0.11	0.12
y^*	Trend	Normal	0.40	0.10	0.71	0.70	0.71
π^*	Trend	Normal	0.60	0.10	0.30	0.28	0.31
i^*	Trend	Normal	0.75	0.10	0.46	0.44	0.48

Table B.3: Posterior Estimates: Structural Parameters Under Indeterminacy, $\lambda = 0.65$

		Prior			Posterior		
Parameter	Description	Dist.	Mean	Dev.	Mean	10%	90%
Persistence							
ρ_χ	Preference	Beta	0.50	0.20	0.93	0.90	0.96
ρ_w	Wage markup	Beta	0.50	0.20	0.85	0.83	0.87
ρ_p	Price markup	Beta	0.50	0.20	0.63	0.62	0.64
ρ_a	Technology	Beta	0.50	0.20	0.68	0.66	0.69
ρ_g	Govt. Spending	Beta	0.50	0.20	0.57	0.56	0.58
ρ_i	Investment specific	Beta	0.50	0.20	0.91	0.90	0.93
ρ_r	Monetary Policy	Beta	0.50	0.20	0.51	0.50	0.52
Deviation							
σ_χ	Preference	Γ^{-1}	0.30	1.00	0.58	0.52	0.63
σ_w	Wage markup	Γ^{-1}	0.30	1.00	2.31	2.27	2.37
σ_p	Price markup	Γ^{-1}	0.30	1.00	0.33	0.29	0.39
σ_a	Technology	Γ^{-1}	0.30	1.00	1.05	1.02	1.10
σ_g	Govt. Spending	Γ^{-1}	0.30	1.00	1.90	1.82	1.95
σ_i	Investment specific	Γ^{-1}	0.30	1.00	0.73	0.64	0.82
σ_r	Monetary Policy	Γ^{-1}	0.30	1.00	0.68	0.67	0.70

Table B.4: Posterior Estimates: Shock Processes Under Indeterminacy, $\lambda = 0.65$

		Prior			Posterior		
Parameter	Description	Dist.	Mean	Dev.	Mean	10%	90%
φ	Inverse Frisch elas.	Normal	4.00	1.50	11.4	11.00	11.9
h	Habit formation	Beta	0.70	0.10	0.43	0.39	0.47
λ	Fraction HTM	Beta.	0.35	0.10	0.19	0.16	0.22
θ_p	Calvo prices	Beta	0.50	0.10	0.60	0.59	0.60
θ_w	Calvo wages	Beta	0.50	0.10	0.46	0.43	0.50
ι_p	Price indexation	Beta	0.50	0.15	0.82	0.76	0.88
ι_w	Wage indexation	Beta	0.50	0.15	0.35	0.27	0.41
σ_l	Labor supply elas.	Normal	2.00	0.75	2.77	2.53	3.00
ψ	Capital util. elas.	Beta	0.50	0.15	0.89	0.84	0.94
α	Capital share	Normal	0.30	0.05	0.17	0.13	0.19
M	Myopia	Beta	0.85	0.10	0.98	0.98	0.99
χ_π	MP inflation	Normal	1.50	0.25	4.07	3.81	4.27
χ_y	MP output	Normal	0.12	0.05	0.00	0.00	0.01
ϕ_g	FP govt. spending	Normal	0.10	0.05	0.15	0.11	0.17
ϕ_b	FP debt	Normal	0.33	0.10	0.12	0.07	0.18
y^*	Trend	Normal	0.40	0.10	0.53	0.50	0.56
π^*	Trend	Normal	0.60	0.10	0.45	0.42	0.49
i^*	Trend	Normal	0.75	0.10	0.16	0.07	0.28

Table B.5: Posterior Estimates Under Determinacy: Structural Parameters

		Prior			Posterior		
Parameter	Description	Dist.	Mean	Dev.	Mean	10%	90%
Persistence							
ρ_χ	Preference	Beta	0.50	0.20	0.91	0.89	0.93
ρ_w	Wage markup	Beta	0.50	0.20	0.97	0.95	0.99
ρ_p	Price markup	Beta	0.50	0.20	0.97	0.96	0.97
ρ_a	Technology	Beta	0.50	0.20	1.00	1.00	1.00
ρ_g	Govt. Spending	Beta	0.50	0.20	1.00	0.99	1.00
ρ_i	Investment specific	Beta	0.50	0.20	0.46	0.43	0.49
ρ_r	Monetary Policy	Beta	0.50	0.20	0.90	0.89	0.91
Deviation							
σ_χ	Preference	Γ^{-1}	0.30	1.00	0.20	0.17	0.23
σ_w	Wage markup	Γ^{-1}	0.30	1.00	0.99	0.86	1.11
σ_p	Price markup	Γ^{-1}	0.30	1.00	0.25	0.23	0.26
σ_a	Technology	Γ^{-1}	0.30	1.00	0.50	0.46	0.54
σ_g	Govt. Spending	Γ^{-1}	0.30	1.00	0.46	0.43	0.48
σ_i	Investment specific	Γ^{-1}	0.30	1.00	0.55	0.52	0.59
σ_r	Monetary Policy	Γ^{-1}	0.30	1.00	0.15	0.13	0.16

Table B.6: Posterior Estimates Under Determinacy: Shock Processes

Appendix C

Supplementary material to Chapter 3

$$c_t^o = \frac{h}{1+h}c_{t-1}^o + \frac{1}{1+h}E_t c_{t+1}^o - \frac{1-h}{1+h}(r_t - E_t\pi_{t+1} + \nu_\chi) \tag{C.1}$$

$$c_t^r = \frac{1-\alpha}{\mu_p\gamma_c}(w_t + n_t^r) - \gamma_c^{-1}t_t^r \tag{C.2}$$

$$c_t = \lambda c_t^r + (1-\lambda)c_t^o \tag{C.3}$$

$$n_t = \lambda n_t^r + (1-\lambda)n_t^o \tag{C.4}$$

$$w_t = \frac{1}{1+\beta}w_{t-1} + \frac{\beta}{1+\beta}(E_t w_{t+1} + E_t\pi_{t+1}) - \frac{1+\beta\iota_w}{1+\beta}\pi_t \frac{\iota_w}{1+\beta}\pi_{t-1} \tag{C.5}$$

$$- \frac{(1-\beta\theta_w)(1-\theta_w)}{\theta_w(1+\beta}(\mu_t^w - \mu_t^{w,n})$$

$$\mu_t^w = w_t - (\lambda c_t^r + \frac{1-\lambda}{1-h}(c_t^o - hc_{t-1}^o) + \sigma_l n_t) \tag{C.6}$$

$$i_t = \frac{1}{1+\beta}i_{t-1} + \frac{\beta}{1+\beta}E_t i_{t+1} + \frac{1}{\varphi(1+\beta)}q_t + \nu_t^i \tag{C.7}$$

$$k_t = (1-\delta)k_{t-1} + \delta i_t + (\delta(1+\beta)\varphi)\nu_t^i \tag{C.8}$$

$$z_t = \psi r_t^k \tag{C.9}$$

(C.10)

$$q_t = \beta(1-\delta)E_t q_{t+1} + [1+\beta(1-\delta)]E_t r^k_{t+1} - (r_t - E_t \pi_{t+1} + \nu_\chi) \tag{C.11}$$

$$\pi_t = \frac{\iota_p}{1+\iota_p\beta}\pi_{t-1} + \frac{\beta}{1+\iota_p\beta}E_t\pi_{t+1} - \frac{(1-\beta\theta_p)(1-\theta_p)}{(1+\iota_p\beta)\theta_p}(\mu^p_t - \mu^{p,n}_t) \tag{C.12}$$

$$\mu^p_t = (y_t - n_t) - w_t \tag{C.13}$$

$$r^k_t = c_t - z_t - k_{t-1} + (1+\sigma_l)n_t \tag{C.14}$$

$$y_t = (1-\alpha)n_t + \alpha k_{t-1} + \alpha z_t + a_t \tag{C.15}$$

$$y_t = \gamma_c c_t + \gamma_i i_t + \gamma_z z_t + g_t \tag{C.16}$$

$$b_t = \beta^{-1}[b_{t_1} + g_t - t_t] \tag{C.17}$$

$$t_t = \phi_b b_{t-1} + \phi_g g_t \tag{C.18}$$

$$r_t = \rho_r r_{t-1} + (1-\rho_r)[\chi_\pi \pi_t + \chi_y y_t] + \varepsilon^r_t \tag{C.19}$$