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Essays on Fiscal and Monetary Policy

DISSERTATION

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by

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DEDICATION

To my family, for their unwavering belief in me.

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ABSTRACT OF THE DISSERTATION

Essays on Fiscal and Monetary Policy

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This dissertation contains three chapters on impact and conduct of macroeconomic policy. Together the three chapters of this dissertation address important and timely issues in macroeconomic policy. Chapter 1 explores a new channel of short run transmission of fiscal policy under constraints of a monetary union. Chapter 2 looks into how unconventional monetary policy measures transmit to household consumption. In Chapter 3 I pivot from the impact of macroeconomic policy and look at the issue of credibility concerning the monetary policymakers in the US.

In Chapter 1, I argue that fiscal policy is highly effective at stimulating output in countries via its impact on consumer sentiments. Using data for the European Economic and Monetary union, I provide evidence that the sentiments channel for fiscal policy is strongly present in peripheral European countries but absent in core countries. The impact of fiscal policy on consumer sentiments also make fiscal consolidation more costly in terms of output in peripheral countries. I validate my empirical findings using a New Keynesian model of currency union where agents form expectations based on non-fundamental factors (animal spirits) correlated with fiscal policy. I show the existence of a stronger response of output to fiscal policy through the latter's impact on consumer sentiments.

Until recently, the effect of policy on confidence and expectations have largely only been

discussed theoretically. However, surveys conducted by central banks and other academic organizations have allowed us to quantify what Keynes described as "animal spirits". The availability of empirical measures of sentiments gives us an opportunity to measure whether sentiments can transmit into real economic activity, and how macroeconomic policy can influence it. The contribution of this paper is to understand the role played by consumer sentiments, measured using the survey conducted by European Commission, in transmitting fiscal policy to the real economy. I study this question in the context of a currency union where the constraints on monetary policy allows fiscal policy to have a stronger influence within individual economies of the union. This paper provides empirical evidence on the role played by home mortgages in transmission of unconventional monetary policy. Using household level panel data on consumption, I show that the ability of households to refinance their mortgages and extract home equity, determines the efficacy of monetary policy in stimulating consumption. Homeowners who refinance their loan in response to an expansionary monetary policy shock consume more than other households. This heterogeneity is conditioned by local home prices. I find that mortgage owners who refinance their loan in states with higher house prices have higher consumption growth following an expansionary shock.

In Chapter 2, I look at the transmission of unconventional monetary policy shocks (Forward Guidance and Large Scale Asset Purchases) on household consumption. It has been well documented that monetary policy can have heterogeneous effect on households balance sheet. An expansionary policy can reduce inequality in the economy by reducing the real debt burden of borrowers. These facts have been established for conventional monetary policy where the central bank changes the policy rate. However, in the post 2008 world where policy rates in most countries hit the zero lower bounds, the importance of unconventional monetary policy gained cognizance. This paper attempts to document the impact of unconventional policy measures on household consumption. I specifically focus on the heterogeneous transmission of these policy on household consumption via the mortgage market. Using the consumer

expenditure survey data, I find evidence that the channels of transmission of LSAP shock, in particular, vary across households depending on their decision to refinance their existing mortgages. An expansionary monetary policy lowers mortgage rates and allows homeowners to extract home equity via refinancing, resulting in higher disposable income. Higher disposable income converts into higher consumption for debt constrained households relative to homeowners who do not refinance, and households who do not own a house.

Chapter 3 looks at the market returns of investments by Federal Reserve board members to test whether Fed officials take advantage of superior information on interest rate paths to opportunely time their personal investments. Credibility in central banking institutions is key to effectiveness of monetary policy. However, the recent allegations have raised questions on well timed and large volume trades by some senior Fed officials in past couple of years. These allegations have also invited tighter regulations by the Federal Reserve on trades by officials. On average, we find no significant evidence of abnormal returns on trades by FOMC members compared to the average market. However, tighter restrictions and more transparent disclosures by Fed officials can help strengthen the credibility of the institution.

Chapter 1

Fiscal Policy and Sentiments in a Monetary Union

1.1 Introduction

Commonly missing from the analysis of macroeconomic policy is the role played by animal spirits in its propagation. This paper aims to understand the evolution of consumer sentiments in response to fiscal policy, and its impact on economic activity. The first part of the paper conducts an empirical investigation of how fiscal policy impact sentiments using data on eight European countries which are part of the Europe's Economic and Monetary Union (EMU), also known as the Euro area. The second part of the paper allows for a role of sentiments, evolving independently of other fundamentals, by incorporating non-rational expectations in a model of currency union.

The Euro area is a monetary union where monetary policy and exchange rate is determined centrally while individual nations set their fiscal policy independently[1]. In a union, monetary

[1]Subject to the constraints imposed by the European Stability and Growth Pact.

policy only responds to union-wide shocks. This makes fiscal policy as the more important macroeconomic tool in combating country-specific shocks (Gali and Monacelli, 2008). Farhi and Werning (2016) show that the fiscal multiplier in a currency union is higher due to the constraints on monetary policy. An increase in public spending can thus, transmit to economic expectations if agents believe fiscal policy to be the main policy tool for stabilization of domestic output and prices.

In this paper, I study the role of consumer sentiments in transmission of fiscal policy in the Euro area. In the summer of 2011, convinced of region's strong recovery from the financial crisis, the European Central Bank (ECB) raised their key interest rates by 50 basis points over a period of three months. The decision was widely criticized as increasing the woes of peripheral countries which had by then started to grasp the extent of their fiscal vulnerabilities. Throughout the financial crisis, the policy measures taken by ECB were targeted towards fighting the liquidity crunch and the threat of a banking crisis. While these actions complemented those of central banks around the world, it largely ignored the concerns about the impending sovereign debt crisis in one half of the continent (Lane, 2012). I use the unique coordination problem of fiscal and monetary policy in the EMU to study the cross-country heterogeneity in effectiveness of fiscal policy. I argue that the role of fiscal policy in stimulating the economy is stronger for European peripheral countries than core countries such as Germany and France. The main channel for higher prominence of fiscal policy in these economies is through its effect on economic sentiments.

Movements in sentiments have important aggregate implications. Milani (2017) shows that exogenous movements in consumer and business sentiments can account for a large proportion of U.S. business cycle. Blanchard (1993) uses U.S. data to show that the consumer sentiments index, as measured by the the Michigan Survey of Consumer Sentiments, could predict fall of future consumption. He also finds that the confidence dips before the actual decline in forecasts of output. More recently, Barsky and Sims (2012a) show that the expec-

tations component of the Michigan Survey of Consumer Sentiments (for the U.S.) are noisy measures of changes in expected productivity over a long period of time. Nowzohour and Stracca (2020) provide a thorough survey of the literature on sentiments and its contribution to the business cycle.

One of the main hurdles in studying the empirical effects of fiscal policy is the identification of fiscal policy shock. Ramey (2011) and Ramey and Zubairy (2018) have criticized the identification method used in Blanchard and Perotti (2002) and papers following their methodology in failing to account for the anticipated fiscal policy measures differently from the unanticipated "news" shock. She introduces two approaches for identifying the unanticipated component of fiscal policy- narrative method and forecast errors. For Europe, Alesina et al. (2019a) uses the narrative approach to measure unanticipated government expenditure shocks. In this paper, I identify fiscal policy news as the difference between actual and forecast of growth in government expenditure (the forecast error approach used in Ramey (2011)). Section 1.2.1 describes the construction of my news variable in detail. Consumer sentiments in the analysis is measured using the data published by the European Commission on economic sentiments in Europe since 1985. The construction of sentiments index is described in more detail in Section 1.2.2.

In the first part of this paper, I ask the following questions: Does confidence play a role in transmission of fiscal policy in the Euro area? How does the confidence channel of transmission of fiscal policy differ across core and peripheral European economies? To answer the first question, I use a five variable VAR model with government spending news ordered first for each country in my sample. The VAR also includes an interaction term between consumer sentiments and government spending news. The interaction term allows us to capture the relationship between fiscal policy news and output at different levels of confidence. To answer the second question, I introduce a counterfactual analysis that switches the sentiments in each country with sentiments in Germany. The empirical strategy used in the paper is

described in more detail in Section 1.2.3.

Result from my main analysis suggests that fiscal policy is highly effective at stimulating the economy in Italy, Spain, and Finland. The response of output in these economies is also very persistent. In contrast, there is a small positive impact of fiscal policy on output in Germany and Portugal, while the response is insignificant in Belgium and France. The shape of the impulse responses of output are driven by the response of confidence to fiscal policy shock. Confidence in all peripheral countries rises significantly on impact and is highly persistent in Spain, Italy, and Finland. Confidence also rises in Netherlands, and Portugal but reverts to zero within two years. The results also show that the positive effect of fiscal policy on consumer confidence is much stronger in periphery than in core countries. The results from the baseline model are presented in Section 1.3.

The next part of the analysis focuses on the nonlinear effects of fiscal policy during periods of fiscal consolidation and normal times. The consolidation measures adopted by the European Commission during the European debt crisis were criticized to be too costly in terms of loss of output. However, many papers have argued that fiscal consolidation can also raise confidence by reducing the probability of default in high debt countries which translates into smaller and milder contractions and potentially result in expansion of the economy (Afonso (2010), Giavazzi et al. (2000), Fazzari et al. (2015)). I use a panel Threshold VAR model to study how consumer sentiments and output respond to a contractionary fiscal policy shock during periods of fiscal consolidation. I find that while fiscal contraction during periods of consolidation raised consumer sentiments for core countries, sentiments in peripheral countries significantly declined and remained below zero for 20 quarters. The impact on output of a contractionary government spending shock is also significantly negative and persistent for peripheral countries during periods of consolidation, but only marginally negative on impact during normal times. For core countries, the response of sentiments and output is largely indistinguishable during normal times and periods of consolidation. While

the effect is negative on impact, both sentiments and output rise significantly above zero within a year. I find evidence of expansionary effects of fiscal contraction for core countries during both normal times and consolidation. On the other hand, the output cost of fiscal consolidation is high in peripheral countries (more details in Section 1.3.1).

The last part of the paper presents a New Keynesian DSGE model of currency union and draws inference under non-rational expectations. The model incorporates sentiments correlated with government spending. Households exhibit misspecified forecasting behavior where they do not observe government spending but do observe the sentiments shock process which evolves with government spending but independent of other fundamental variables in the economy. The objective of the model is to generate the empirically observed persistence in response of output to government spending shocks due to an increase in consumer sentiments. The model suggests that fiscal policy can have a stronger impact on output in economies where sentiments evolve more closely with government spending.

With the current uncertainty surrounding the macroeconomic conditions, understanding the influence of macroeconomic policy on sentiments takes an even greater importance. This paper aims to contribute by analyzing how interaction between sentiments and macroeconomic policy can affect real economic activity.

1.1.1 Literature Review

A growing literature incorporates empirical measures of consumers sentiments to estimate its impact on the real economy. Bachmann and Sims (2012) is one of the first papers to use sentiments to understand the effect of fiscal policy on output in a VAR for the U.S. economy. They find that, in the U.S., the impact of fiscal policy increases sentiments during recessions but has no effect during normal times, suggesting that the increase in sentiments can explain larger fiscal multipliers during recessions. Consumer sentiments have also been incorporated

in empirical studies of fiscal policy for European countries. Konstantinou and Tagkalakis (2011) study the effect of different components of government spending on consumer and business sentiments in a panel of 9 OECD countries. They find that non-wage government consumption expenditure increases sentiments while higher government wages and investments decrease sentiments. Similarly, Beetsma et al. (2015) show how fiscal consolidations impact consumer and business sentiments in a event study of 17 OECD countries. They find that consolidation of government expenditure negatively impacts consumer sentiments, especially in European countries.

The role of sentiments in transmission of fiscal policy has also been studied in macroeconomic models with heterogeneous expectations and bounded rationality. De Grauwe and Foresti (2020) use a model with two types of agents, one of which uses a simple forecasting rule to form expectations using past information. Their model generates waves of optimism and pessimism and shows that fiscal multiplier is highest in periods of extreme optimism and pessimism. They also find that the impact of fiscal policy is stronger the less the monetary policy focus on output gap stabilization. Hommes et al. (2018) use a similar model to compare between expenditure and tax based fiscal consolidations and find that tax based consolidations are less costly in their model. Other papers that have incorporated features of bounded rationality to study fiscal policy include Mitra et al. (2013) and Mitra et al. (2019). They find that diverging from rational expectations and allowing learning significantly increases fiscal multiplier in a RBC model to empirically plausible estimates. Similarly, Gabaix (2020) shows that introducing cognitive discounting in a New Keynesian model generates a failure of Ricardian Equivalence. Since agents cannot fully anticipate future tax increases, they respond positively and significantly to a tax cut in the current period. Incorporating sentiments in a RBC model, Angeletos and Lian (2022) show that fiscal policy can be significantly more stimulative when the assumption of common knowledge is relaxed.

This paper also relates to the literature studying fiscal policy in a currency union. Two prominent papers in this literature are Farhi and Werning (2016) which study fiscal multiplier under different closed and open economy New Keynesian models. They show that fiscal multipliers are larger in a currency union due to the constraint on monetary policy in responding to a fiscal shock. Similarly, Nakamura and Steinsson (2014) calculate the open economy relative multiplier in a model of currency union and show that the constraints on monetary policy can generate multipliers greater than 1. Finally, the analysis here closely fits with the literature combining bounded rationality with models of currency union to study the impact of country-specific shocks on the economy. Bonam and Goy (2019) show that allowing for home bias in expectations formation results in greater and prolonged impact of country-specific shocks on macroeconomic imbalances.

1.2 Data and Methodology

I use data for eight Euro area countries. The Euro area countries include Belgium, Finland, France, Germany, Italy, Netherlands, Portugal, and Spain. These countries are selected based on the availability of all data. I do not include Austria and Greece in the analysis due to large gaps in time series and forecast data. I use quarterly time series data on real government consumption expenditure, real GDP, 3 month interest rate on government bonds from OECD. All time series data is converted to per capita values. To identify fiscal policy shock I use the quarterly economic projections made by the OECD, released bi-annually. The data on consumer sentiments indicator is sourced from the European Commission. The sample period for each country varies according to the data availability (refer to Table 1.1). I restrict the data for France and Portugal to start in 1999 due to the weak explanatory power of forecasts in these countries before the Treaty of 1999. The sample period ends in 2019Q4 for all countries.

1.2.1 Construction of News Variable

Many changes to fiscal policy are anticipated by the public much before the implementation of the policy. Ramey (2011) raised this issue of identification of fiscal policy shock in a reduced form VAR. She argued that it is important to measure the anticipation of the shock to correctly determine the impact of shock on economic activity. She suggests using the forecast error from professional forecasts to measure the unanticipated component of fiscal policy. A similar method has also been used by Cavallari and Romano (2017) in the context of Europe using the European Commission annual forecasts (ECF). The ECF forecasts are only available in annual frequency and cannot be used for this analysis.

To construct an unanticipated measure of fiscal policy shock, I use the OECD Economic Outlook and Projections data which releases bi-annual forecast reports for all OECD countries for a series of economic variables since 1960. The earliest available forecasts for Belgium, Finland, Netherlands, Portugal, and Spain starts in 1996 edition 2 of the OECD report. The reports use information up to mid May and November for each year and provides forecast for next 2 years in annual and semiannual frequency until 2003, and annual and quarterly frequency starting from the second (November) edition of 2003.

The OECD forecast is a fixed event forecast which implies that the forecast horizon changes in each edition. The first edition of forecast in each year uses data until mid of quarter 2 (mid-May) to make a forecast for next two years. Similarly, the second edition of forecast each year uses data until mid of quarter 4 (mid-November) to make a forecast for next two years. As the forecast reports are only generated twice a year, the forecasts for quarters 1 and 2 in my data is taken from the first edition of the report, and the forecast for quarter 1 and 3 is taken from the second edition of the report. This implies that the forecast is made using information up to period t for quarters 2 and 4, and using information up to period t-1 for quarter 1 and 3.

Table 1.1: Summary Statistics

	(1)	(2)	(3)	(4)
	Sample Size		**Explanatory Power of Forecast**	
	Sample Beginning	**Observations**	**R-squared**	**F-statistics**
Belgium	1997Q1	92	0.73	38.87***
Germany	1991Q1	116	0.69	15.54***
Finland	1997Q1	92	0.98	917.55***
France	1999Q1	84	0.64	26.25***
Netherlands	1997Q1	92	0.52	4.46***
Italy	1995Q1	100	0.79	32.74***
Spain	1997Q1	92	0.57	18.10***
Portugal	1999Q1	84	0.35	4.31***

Column (3) and (4) of the above table shows the explanatory power of the forecast of fiscal policy news variable. Column (3) and (4) report the R-squared and F-statistics respectively for each country from regression of current and two lags of the government spending news variable on actual growth in government spending. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

Dealing with mixed frequency: The forecast data is available in semi-annual frequency until 2003Q3 and quarterly frequency starting from 2003Q4. To handle different frequency in the data, I consider the semi-annual data as quarterly estimates and use Kalman Filter to get a continuous series of forecasts in quarterly frequency. This implies that the forecast of government expenditure for S1 and S2, taken from edition 1 of each year, is divided by 2 and considered as the current and next period forecast for Q2. Similarly, the forecast for S2 and S1 of next year, taken from edition 2, is divided by 2 and considered as the current and future period forecast for Q4. The forecast values for Q1 and Q3 are missing as no reports are released for these quarters. The data is then passed through Kalman Filter using an ARMA(1,0) model with time trend. The model is selected among competing models based on the log likelihood. The Kalman Filter predicts values for missing observations and gives estimates of current latent states. I use the predicted forecasts given by Kalman Filter to compute the fiscal policy news shock. The forecast growth is computed using the predicted forecast for period t and $t+1$.[2]

Following Ramey (2011), I construct the forecast of quarterly growth of real government

[2]To test the robustness of the results to data imputation and information asymmetry, Section A.2 runs baseline specification with semi-annual data for each country.

expenditure as follows-

$$\text{Forecast growth}_t = L.\left(\frac{f_t(d_{t+1}) - f_t(d_t)}{f_t(d_t)}\right)$$

The news shock variable then equals the forecast error of growth of government expenditure.

$$\text{News shock}_t = \text{Actual growth}_t - \text{Forecasted growth}_t$$

Table 1.1 shows the explanatory power of the news variable for each country. Column (3) and Column (4) shows the R squared and the F-statistic respectively from a regression of actual growth of government expenditure on the current and four lags of the news shocks. On average, the news variable is a strong predictor of actual government spending in all countries.

1.2.2 Sentiments Indicator

The European Commission conducts a monthly and quarterly climate survey in multiple sectors for each country across Europe. For the baseline analysis I use the data from the survey of consumer sentiments. Using sentiments from only the consumer sector makes the European sentiments index comparable to the Michigan Survey of Consumer Sentiments index in the US. and the results more comparable to the research using U.S. data.

Construction of confidence index: Barsky and Sims (2012b) find that the forward looking questions of the Michigan survey contain information about the future productivity of the economy. Thus, by limiting the confidence index to expectations component of the sentiments survey helps us capture how the economic agents expect the income and productivity

Table 1.2: Forward-looking Consumer Sentiments Questions

Q2	How do you expect the financial position of your household to change over the next 12 months?
Q4	How do you expect the general economic situation in this country to develop over the next 12 months?
Q7	How do you expect the number of people unemployed in this country to change over the next 12 months?
Q9	Compared to the past 12 months, do you expect to spend more or less money on major purchases (furniture, electrical/electronic devices, etc.) over the next 12 months?

Note that a positive balance in response to Q2, Q4, and Q9 implies a positive outlook for the economy, while a positive balance in response to Q7 implies a negative outlook. When calculating the average, I add the negative of the balance of Q7 to the balance of the other three questions.

growth to evolve, following a fiscal policy shock. Table 1.2 lists the questions that reflect the expectations component of the European Commission's survey of consumer sentiments. The data reports the balance of all positive and negative responses for each question. To construct the confidence index used in the paper I average the balance of all four questions and add 100. The starting value of the average balance for each country is normalized to 100 to create the index with reference to the beginning of the sample.

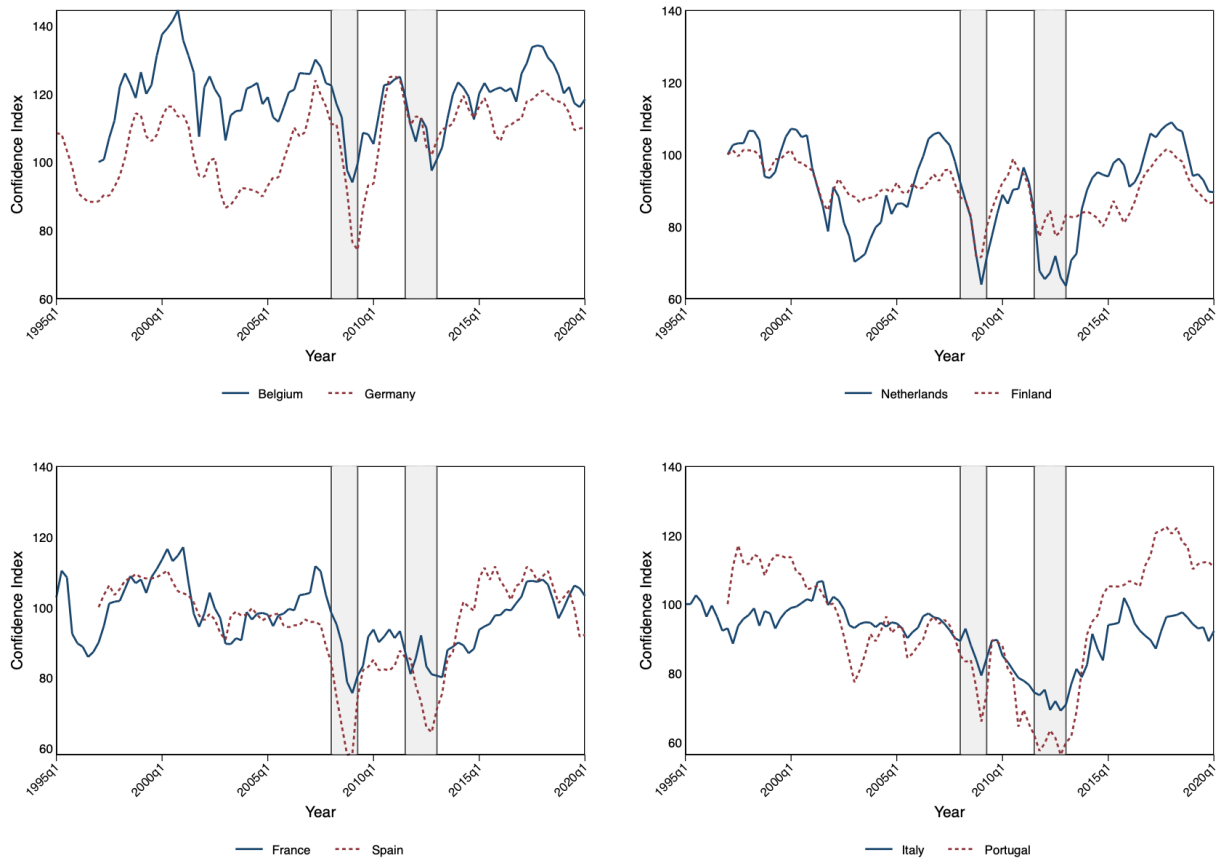
Table 1.3: Sentiments correlation with Germany

	Belgium	**Finland**	**France**	**Netherlands**	**Italy**	**Spain**	**Portugal**
Correlation with Germany	0.62	0.24	0.48	0.48	-0.1	0.27	0.19

Consumer sentiments fell sharply in all European countries at the beginning of the 2008 financial crisis. While confidence in low debt countries, Germany, Netherlands, and Belgium, recovered to their pre-crisis levels, confidence in most high debt countries remained low with the looming threat of a fiscal crisis. The fall and rise in sentiments preceded the onset and end of crisis.

Table 1.3 shows the correlation of the consumer confidence index in each country vis-á-vis confidence in Germany. Consumer confidence in Belgium, France, and Netherlands are particularly highly correlated with that in Germany. Aside from being two of the smallest

Figure 1.1: Consumer Sentiments Indicator



Note: Shaded regions are quarters identified as periods of recession in Europe by CEPR.

countries in the sample, both Belgium and Netherlands also have high economic and cultural integration with their neighbor, which can explain the high correlation in consumer sentiments. Confidence in all peripheral countries in the sample move independently of confidence in Germany. The high correlation of sentiments among core countries but the lack of it in peripheral countries suggests that agents perceive economic conditions differently between core and peripheral countries.

1.2.3 Empirical Analysis

For the baseline model I use a VAR with first order interaction term between confidence and government spending news. The interaction term allows us to capture the non linear effects of fiscal policy due to different levels of confidence. The interacted VAR has been used to capture the non linear effects in Bachmann and Sims (2012) and Caggiano et al. (2017).

Consider the baseline specification-

$$Y_t = \alpha + \sum_{k=1}^{L} A_k Y_{t-k} + \sum_{k=1}^{L} B_k (Sentiments_{t-k} \times News_{t-k}) + u_t \tag{1.1}$$

$$E(u_t u_t') = \Omega_t$$

where Y_t is a vector of five variables in the baseline estimation: government spending news, log real government expenditure per capita, consumer confidence, log real GDP per capita, and real short term interest rate as a measure of monetary policy in the model[3], with the government spending news variable ordered first. The news variable is constructed to account only for the unanticipated component of fiscal policy in period t and thus, does not respond contemporaneously to shocks to other variables. The sample period for each country varies with France having the longest time series data starting from 1985Q1 (see Table 1.1). I use two lags for baseline estimation based on the lowest information criterion for lag length selection for a maximum length of eight lags.

Counter-factual Exercise: The baseline hypothesis is that sentiments in peripheral economies respond more significantly to a fiscal policy shock than sentiments in the core economies. To see how sentiments differ across different European economies and how it affects the response of output to a fiscal policy shock, I introduce a counter-factual exercise. Using

[3]Real interest rate = Nominal Interest rate - CPI inflation

Germany as the benchmark core economy, I replace the sentiments index in each country with the sentiments index in Germany. Table 1.3 shows the correlation between consumer sentiments in Germany with all other countries. As sentiments in peripheral countries evolve independently of sentiments in Germany, we should expect a muted response of sentiments to fiscal policy in the counter factual scenario. If sentiments is important for transmission of fiscal policy to output, the counterfactual exercise should result in a muted response of output to fiscal policy.

Threshold VAR: There has been a growing body of fiscal policy literature focused on heterogeneity in government expenditure multipliers across different states of the economy. Auerbach and Gorodnichenko (2012), Fazzari et al. (2015), and Ramey and Zubairy (2018) all study the difference in fiscal multipliers across expansionary and recessionary regimes. The threshold VAR (TVAR) models are one of the most popular estimation techniques to study this non linearity when the shift in regimes are exogenous. In the second part of the paper I apply the threshold model to study the effect of fiscal policy under two states: Fiscal consolidation vs normal times.

Many studies have shown that the effect of a contractionary fiscal policy shock under fiscal consolidation is significantly less contractionary than Keynesian estimates, when used to bring stability in high debt countries. In the second part of the paper, I test the response of sentiments and output to fiscal policy under normal times and times of fiscal consolidation using the following TVAR model-

$$\begin{aligned} Y_t = (1 - I_{t-1})[\alpha_A + \sum_{k=1}^{L} \psi_{A,k} Y_{t-k} + \sum_{k=1}^{L} \phi_{A,k}(Sentiments_{t-k} \times News_{t-k})] \\ + (I_{t-1})[\alpha_B + \sum_{k=1}^{L} \psi_{B,k} Y_{t-k} + \sum_{k=1}^{L} \phi_{B,k}(Sentiments_{t-k} \times News_{t-k})] + u_t \end{aligned} \quad (1.2)$$

I_t is the indicator variable which takes the value 1 or 0 depending on the state of the economy.

Generalized Impulse Response Functions: In a linear VAR, the traditional impulse response functions are symmetric, i.e. positive and negative shock have symmetric responses, linear in shocks, and history independent, i.e., past realizations does not affect the responses to the shock. Koop et al. (1996) show that introducing non-linearity in a VAR model makes the impulse responses dependent on the choice of history and shocks. As an alternative, they suggest the algorithm to compute history independent impulse response functions i.e. the Generalized Impulse Response functions (GIRFs). GIRFs are calculated as the difference in conditional expectations given the history and shock. The impulse responses for each horizon is then averaged over all the histories. The computation of GIRFs can be summarized by the following equation:

$$GIRF_y(n, \nu_t, \omega_{t-1}) = E[Y_{t+n}|\nu_t, \omega_{t-1}] - E[Y_{t+n}|\omega_{t-1}] \tag{1.3}$$

Briefly describing the computation steps: For a given history of data, draw a sequence of shocks using the residuals of the VAR. The impulse responses for each history and sequence of shock are then given by the difference between forecast of value of a variable with and without a one standard deviation fiscal news shock in period t. The impulse responses are calculated for period $t+1$ to $t+H$. Repeat the process for N draws of shocks for each history of the data.[4] The impulse response for each history is the average response over all draws of shocks. The Generalized impulse response is then the average of impulse responses for all histories for all horizons 1 to H.[5] The issue of history dependence of impulse responses in the Threshold VAR model can also be addressed by calculating GIRFs over all histories in a given state of the economy.

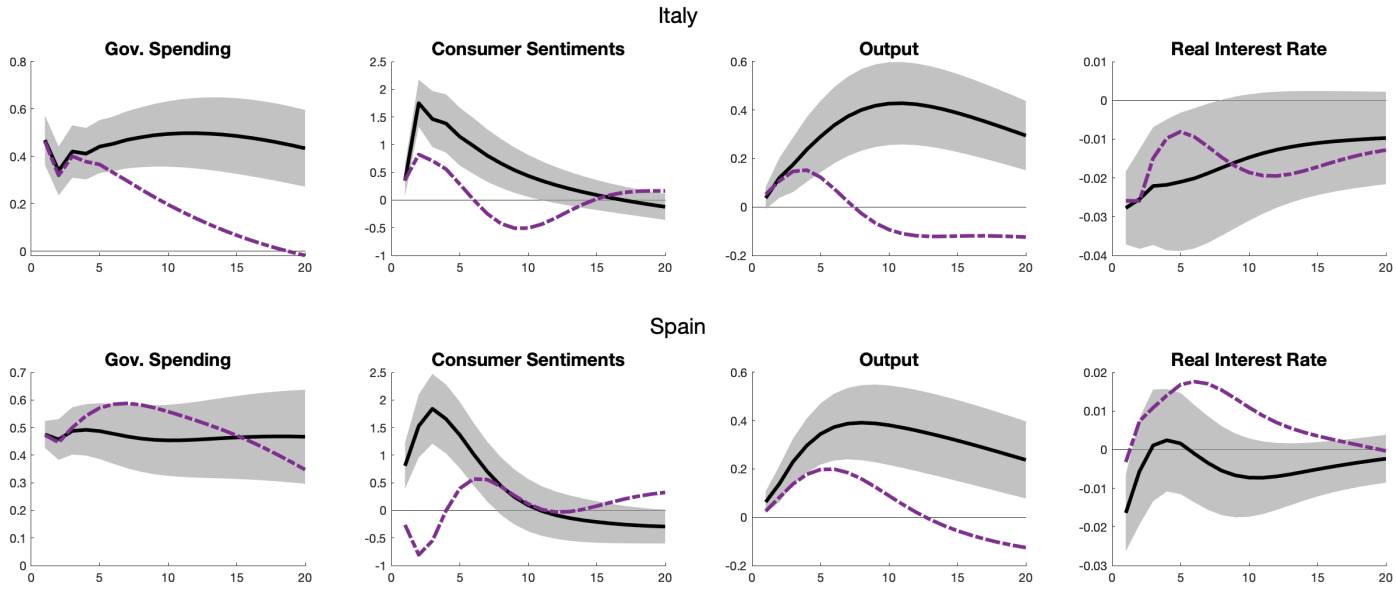
[4]For the simulation, I set N=500 and H=16.

[5]For more details on construction of GIRF, refer to Koop et al. (1996), Fazzari et al. (2015), and Caggiano et al. (2017).

1.3 Empirical Findings

Figure 1.2 presents the result for the baseline VAR with forward looking component of consumer sentiments. The IRFs plotted are Generalized Impulse Response of government spending, consumer sentiments, output, and real interest rate, to a one standard deviation government spending news shock. The solid lines are the baseline IRFs and the dashed lines are the IRFs for the counterfactual where sentiments in each country is replaced with consumer sentiments in Germany. The shaded grey regions are one standard error confidence bands calculated through a bootstrap procedure with 500 simulations. The results below are for two countries: Italy and Spain, to illustrate the mechanism in play. Figure 1.3 then presents the baseline results for rest of the countries in the sample.

Figure 1.2: Results from the Baseline VAR model



The solid lines gives the Generalized impulse responses (GIRFs) for a positive one standard deviation shock to government spending news in the baseline model. The dashed line is the impulse responses for the counterfactual discussed in Section 1.2.3. Shaded region is the one standard error bands around the GIRFs for the baseline model.

Looking at the baseline responses (solid line) for Italy and Spain, an expansionary fiscal

news shock increases government spending, consumer sentiments, and output on impact. The response for government expenditure and output is also significantly persistent for over 20 quarters while the response for consumer sentiments stays positive for approximately 10 quarters. It is important to note that fiscal policy impacts output through two effects: direct Keynesian effect of government expenditure, and through lagged interaction between sentiments and fiscal policy news. Therefore, an increase in sentiments in response to fiscal policy shock feeds into the impulse response for output.

In the counter-factual exercise, the sentiments in Italy and Spain are replaced with the consumer sentiments index in Germany. Therefore, sentiments in each country are no longer moving with domestic macroeconomic news but rather to the economic conditions in Germany, our benchmark Euro economy. This is akin to shutting down the sentiments channel in each country. The lower is the correlation of sentiments in Spain and Italy to the sentiments index in Germany, more dampened will be the response of sentiments to domestic fiscal policy shock. A dampened response of sentiments should weaken the response of output to fiscal policy news.

The above hypothesis is confirmed in the counter-factual impulse responses (dashed line) for Italy and Spain in Figure 1.2. A one standard deviation expansionary fiscal policy news shock has the same impact on sentiments in Italy but the response of sentiments is significantly below the baseline for 15 quarters. It is interesting to note that the response of government spending itself to fiscal news shock in Italy is significantly lower in the counterfactual analysis. The combination of lower response of consumer sentiments and significantly less persistence in response of government spending is reflected in lower medium and longer horizon response of output. For Spain, the response of government spending is statistically same in the baseline and counterfactual. However, the response of sentiments is lower on impact and stays significantly lower for over one year. The lower response of sentiments in reflected in persistently lower response of output in medium and long horizon.

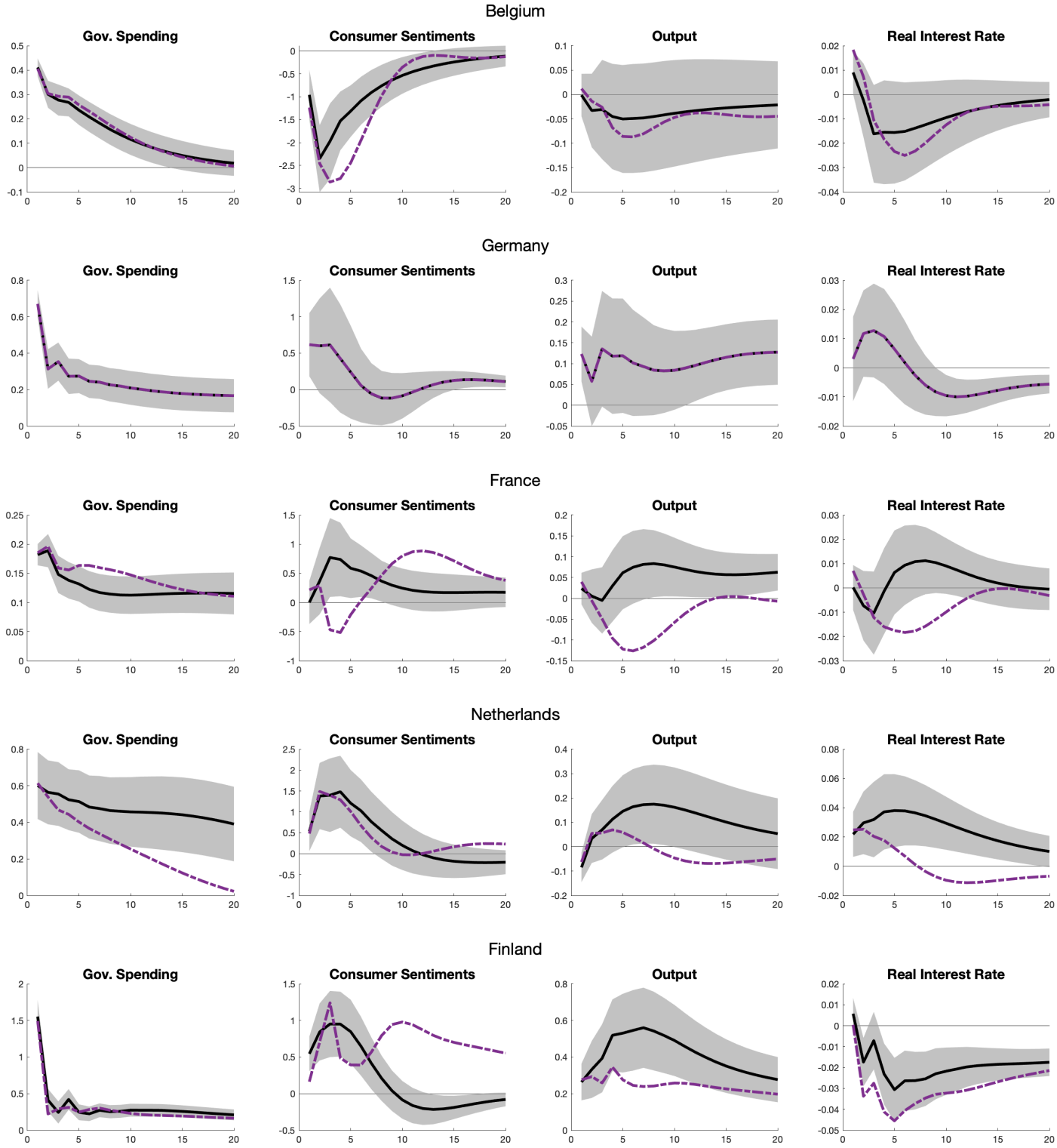
Note that the response of output to fiscal policy news is same on impact under both baseline and counter-factual exercise. The divergence in output multiplier happens after the impact where output increases significantly less in response to the fiscal news shock under counter-factual and the small positive response dies down around two years. This result is similar to Bachmann and Sims (2012) who also find that the dampened impact of consumer sentiments reflects on medium and long-run multiplier, and not the impact.

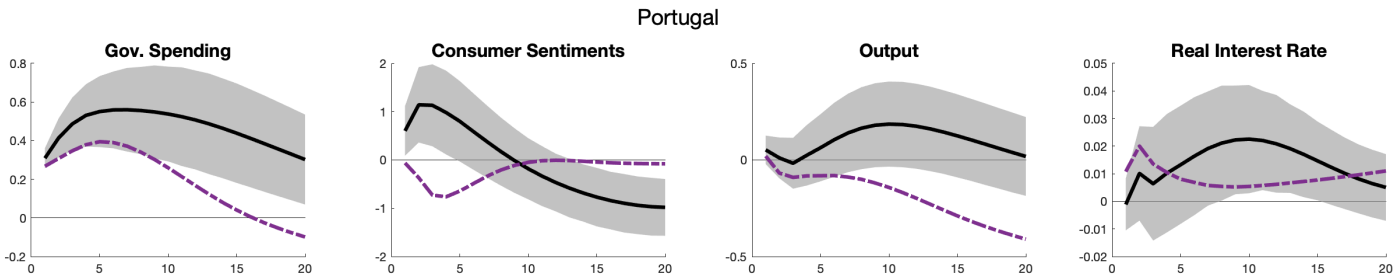
Figure 1.3 presents the results for rest of the countries in the sample. For most countries, a higher government consumption spending news shock increases output, akin to the effects in the New Keynesian model. The shock also increases consumer sentiments on impact in all countries with the exception of Belgium. In Belgium, sentiments decreases significantly on impact before converging to zero. The strongest response of consumer sentiments to fiscal policy news is in Italy, Portugal, and Spain. The strongest response of output to fiscal policy news is in Finland, Italy, and Spain. The response of output to fiscal policy shock is much smaller compared to the response in peripheral countries.

These findings are supported by other country-level studies in the Euro area. Wolff et al. (2006) find mixed evidence for impact of government spending shock in Germany. An increase in personnel expenditure results in contraction of the output while an increase in the consumption expenditure is approximately zero. The response is positive for an increase in the government investment expenditure. On the other hand, Giordano et al. (2007) find a hump shaped response of private GDP to government expenditure in Italy. The response is persistent for roughly 2 years. Both these papers identify fiscal policy shock based on Blanchard and Perotti (2002), and hence are not directly comparable to the analysis in this paper. Ramey (2011) shows that identifying fiscal policy shock following Blanchard and Perotti (2002) can overestimate the fiscal multiplier.

When the sentiments channel are shut down in the counter-factual, consumer sentiments in Belgium and France are slightly lower in the medium horizon. In Portugal, another periph-

Figure 1.3: Results from the Baseline VAR model - All Countries





The solid lines gives the Generalized impulse responses (GIRFs) for a positive one standard deviation shock to government spending news in the baseline model. The dashed line is the impulse responses for the counterfactual discussed in Section 1.2.3. Shaded region is the one standard error bands around the GIRFs for the baseline model.

eral country, the response on sentiments becomes negative in the short run before converging to zero within two years. In Netherlands, the response of sentiments is statistically indistinguishable from the baseline and in Finland sentiments is higher and more persistent in response to an expansionary fiscal news shock. Looking at output, the impact multiplier is same under baseline and counterfactual for all countries. Only in France and Portugal is the response of output significantly different in the counterfactual. In both countries, the response of output falls below zero after impact although the magnitudes are much larger in Portugal than France.

Table 1.4: Maximum Difference in Response of Sentiments and Output to Fiscal Policy Shock

	Belgium	Germany	Finland	France	Netherlands	Italy	Portugal	Spain
Confidence	1.26	0	**-1.11**	1.25	0.45	**1.9**	**1.86**	**2.39**
Output	0.04	0	0.32	**0.2**	0.21	**0.54**	**0.43**	**0.38**

The impulse responses show that consumer sentiments increases in response to a government expenditure shock for all countries. However, when response of sentiments is dampened in the counterfactual, the response of output is dampened. In particular, while the impact of fiscal policy on sentiments and output was statistically same for most countries on impact, the persistence of impact is most significantly reduced in Italy, Portugal and Spain. Table 1.4 shows the maximum difference in response of consumer sentiments and output under baseline vs the counterfactual. Due to the high correlation of sentiments between core countries (Table

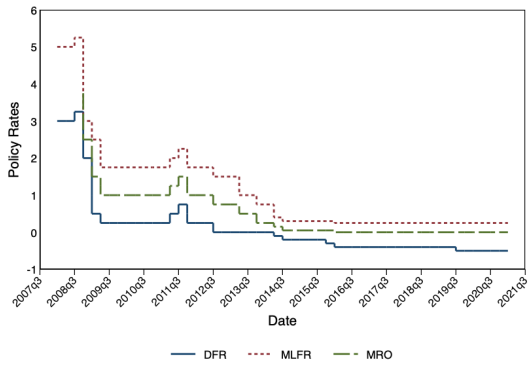
1.3), the difference in response for core countries is largely insignificant, except for France. However, the difference is positive and significant for all peripheral countries in the sample. The results suggest that higher consumer sentiments about future economic conditions raises persistence of government spending multiplier and not the impact.

Role of Monetary Policy: The high degree of trade and macroeconomic linkages between countries of Euro area makes the heterogeneity in findings of the VAR puzzling. Households in relatively higher debt economies like Italy and Spain display stronger sentiments in response to fiscal policy than households in lower debt economies like Germany. One potential explanation of this heterogeneity is that economic agents in core and peripheral countries perceive monetary policy differently. Agents in peripheral countries might view monetary policy as less counter-cyclical for domestic shocks resulting in a stronger co-movement of sentiments with expansionary fiscal measures.

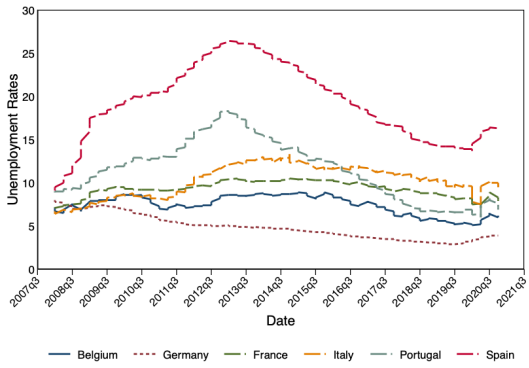
Panel (a) of Figure 1.5 plots the European Central Bank's key policy rates during the period of 2007Q4 to 2021Q2 and Panel (b) plots the unemployment rate in six Euro area countries. The figure draws attention to the heterogeneity in economic conditions among Euro area countries in the aftermath of the 2008 financial crisis and the challenges of setting a uniform monetary policy. As unemployment rates in Germany, France, and Belgium stabilized, the ECB raised policy rates twice in the mid of 2011 citing the end of recession and signs of economic recovery. However, as evident from Panel (b) the unemployment rate continued to increase in many peripheral countries, including Italy, Portugal, and Spain, through 2011. The central bank in a currency union has limited capacity in responding to asymmetric shocks making fiscal policy the main counter-cyclical policy tool.

One natural extension to the above question is whether the firms' and investors' sentiments generate the similar heightening in response of output to fiscal policy shock in high debt countries. An increase in government expenditure in countries with very high levels of

Figure 1.5: Monetary Policy and Economic Activity



(a) Policy rate set by ECB



(b) Unemployment Rate

debt exposes a country to an increase in the risk of sovereign default and high borrowing cost (Bianchi et al., 2021). In the Appendix Section A.1 I repeat the baseline analysis with business sentiments. I find that the response of business sentiments to a government spending shock is zero (France and Italy), positive on impact but not persistent (Spain, Netherlands, Germany), or even negative on impact (Portugal, Belgium). In the counterfactual where sentiments for each country is replaced with sentiments in Germany, the impact on output is not statistically differentiable from baseline for any of the countries.[6]

1.3.1 Sentiments under Fiscal Consolidation

Fiscal expansions in many peripheral European economies are coupled with higher risk of default (Bianchi et al., 2021), resulting in higher borrowing cost and lower confidence. The literature on austerity in Europe shows that exogenous fiscal consolidation can potentially have zero or positive effects on output by raising economic sentiments of agents. This section of the paper looks at the response of sentiment and output to fiscal policy during fiscal

[6]Note that the business sentiments results are not directly comparable to the consumer sentiments results as the expectations horizon is not same between the surveys. For consumer sentiments, the data captures the expectations one year ahead, while for industry sentiments, the expectations are formed for three months ahead. However, the analysis still offers an insight into studying evolution of firms' sentiments with fiscal policy.

consolidation vs normal times.

Table 1.5: Periods of Fiscal Consolidation

Country	**Fiscal Consolidation**	**Total observations**
Belgium	32	92
Germany	68	116
Finland	32	92
France	44	84
Italy	66	100
Spain	32	92
Portugal	44	84

I use the Threshold VAR model presented in Section 1.2.3 to test the effect of a contractionary fiscal shock during fiscal consolidation and expansion. The VAR consists of five variables: Government spending news, log real government expenditure per capita, consumer sentiments, log real GDP per capita, and real long term interest rate to capture the borrowing cost. I include 4 lags in the estimation. Four out of eight countries in the sample were under fiscal consolidation for only 32 quarters. The small sample size of fiscal consolidation state for individual countries results in an issue of insufficient power when estimating the VAR. To address the small sample size issue, I run a Panel TVAR model with core and peripheral countries. The panel of core countries consists of- Germany, France, Belgium, and Finland, and the panel of periphery countries include- Spain, Portugal, and Italy. I drop Netherlands from the analysis due to lack of data on consolidation episodes.

Identifying fiscal consolidation: For identifying the periods of fiscal consolidation I use the data constructed by Alesina et al. (2019b). They use narrative approach to identify fiscal consolidation as the year in which the general government tightens expenditure or increases tax exogenously for the purpose of correcting its primary deficit, and reducing debt. They exclude periods in which the reduction in expenditure or increase in tax revenue is endogenous to the state of the economy. Their dataset expands for the years 1970-2014. I use their methodology to identify the years for which a country in my sample enters fiscal consolidation

for the years 2015-2019. I classify a given quarter as period of consolidation if the country was under consolidation in that financial year. Table 1.5 shows the number of quarters for which a country undergoes expenditure or tax based fiscal consolidation.

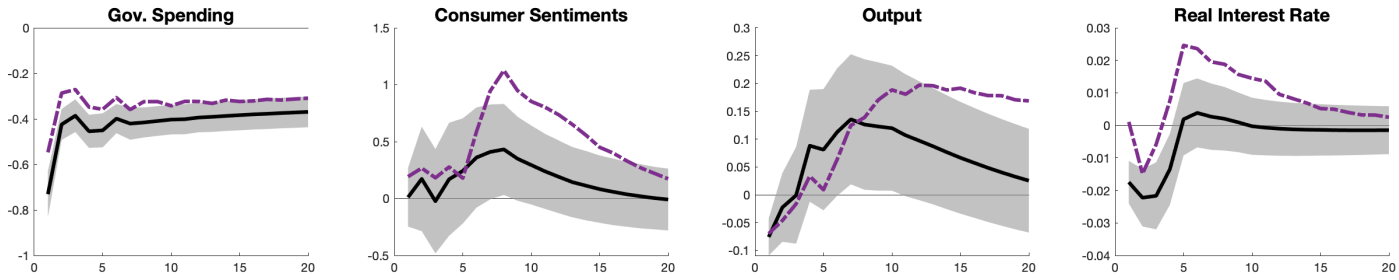
Figure 1.6 shows the Generalized impulse response of government spending, sentiments, output, and long term real interest rate to a one standard deviation fiscal policy news shock. The solid line shows the response during normal times while the dashed line shows the response during fiscal consolidation. The shaded region is the one standard error bands around the GIRFs for normal times.

In core countries, an unanticipated contraction in fiscal policy results in a negative but insignificant response of consumer sentiments on impact in both normal and consolidation periods. The response of sentiments is positive and significant in medium run before converging to zero. At the end of one year, the increase in sentiments is higher during periods of consolidation. The response of output is negative and insignificant on impact during both, normal times and consolidation. Under normal times, output increases in the medium run before converging to zero, mimicking the response of consumer sentiments. Under consolidation, output rises positively and significantly in the medium run and stays persistently high in the long run. The results suggest that fiscal contraction is not very costly for Core countries and can be expansionary in the long run, along with a positive response of sentiments.

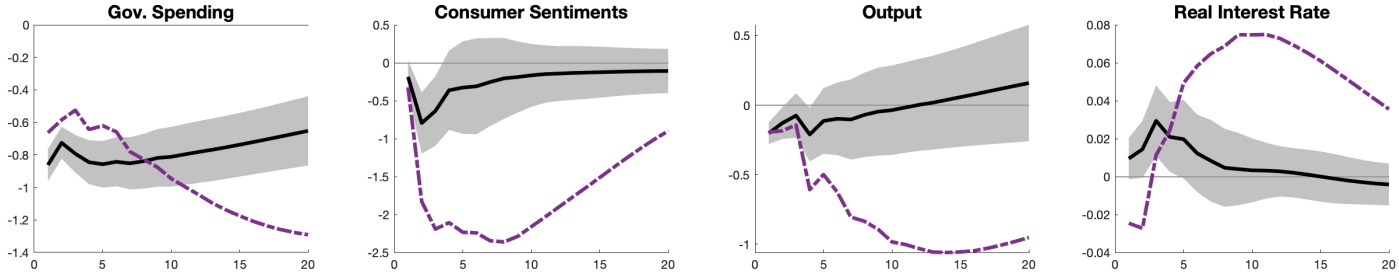
In peripheral countries, an unanticipated contraction in fiscal policy reduces consumer sentiments under both normal times and consolidation. While sentiments converges to zero quickly under normal times, the response remains negative and significant under consolidation. The response of output mimics the response of sentiments. Output is negative and significant on impact but converges quickly to zero during normal times while remaining significantly below zero during periods of consolidation. The response of government ex-

Figure 1.6: Fiscal Consolidation: Non-linear effects of fiscal policy

(a) Core Economies

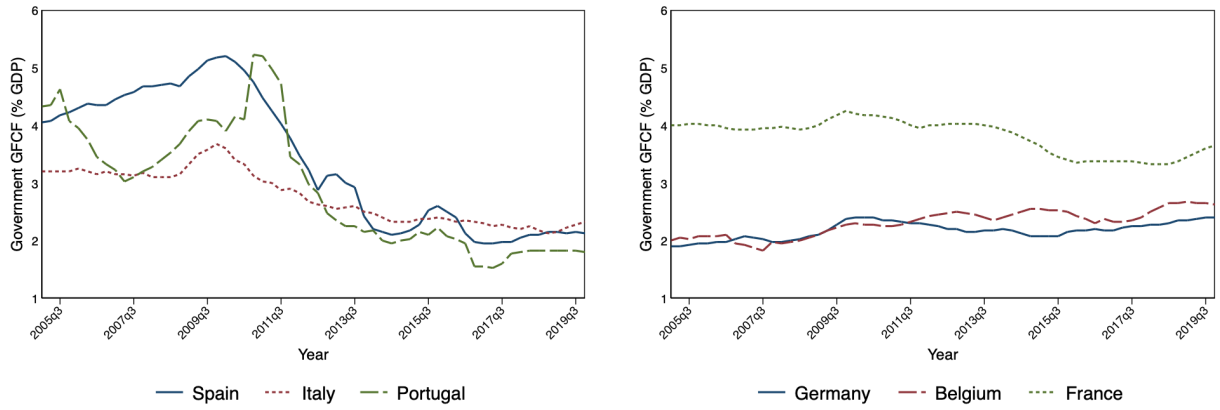


(b) Peripheral Economies



The solid lines gives the Generalized impulse responses for a one standard deviation contractionary shock to government spending news under normal times. The dashed line is the impulse responses during periods of fiscal consolidation. Shaded region is the one standard error bands around the GIRFs for normal times. Core countries comprises of Germany, France, Belgium, and Finland. Peripheral countries include Spain, Portugal, and Italy.

Figure 1.7: Government Investment Expenditure (% of GDP)



(a) Peripheral Countries

(b) Core Countries

The figure plots the moving average of government gross fixed capital formation (unadjusted values) as percentage of GDP, for six European countries. The data is obtained from Eurostat.

penditure to a contractionary fiscal policy shock is also more negative and persistent during consolidation than in normal times. The above result suggests that for peripheral countries fiscal contraction during consolidation significantly reduces consumer sentiment and output. This contradicts the argument that fiscal consolidation is less costly for high debt countries due to increase in sentiments.

One possible explanation for the significant fall in sentiments during consolidation is the reduction in government investment expenditure, along with the consumption expenditure, in peripheral countries. On the other hand, the government investment expenditure remained largely stable for all core countries. Figure 1.7 shows the moving average of government fixed capital formation as percentage of GDP for select peripheral and core countries between 2005 and 2019. Panel (a) shows the GFCF for Spain, Italy, and Portugal. Government investment in Spain and Portugal fell by roughly 3% between 2011 and 2016. Panel (b) shows the GFCF for core countries, Germany, Belgium, and France. Only France shows a slight decline in government investment expenditure ($\approx 0.5\%$) while the value is largely stable across time for Belgium and Germany. We can argue that if cut in government consumption expenditure is

coupled with large cut in government investment expenditure it can increase pessimism in the economy about the prospects for future economic growth. A fall in investments can then explain the large and statistically significant decline in sentiments and output for peripheral countries, but the lack of it in core countries. The results complement the findings of Erceg and Linde (2013) who study the effect of fiscal consolidation in a New Keynesian model of currency union. They show that under limited monetary accommodation in a currency union, fiscal consolidation is more contractionary under spending-based consolidation.

An alternative explanation for the high cost of consolidation in the peripheral countries is the lack of credibility in the government's promise of enhanced fiscal responsibility. Section A.3 incoporates the long term yield spread of each country to Germany in the baseline VAR as a measure of credibility. If fiscal consolidation measures are perceived to be credible by the financial markets, the yield spread should decrease in response to a contractionary government spending shock under consolidation. Figure A.5 presents the results with yield spreads. On impact, the yield spread in peripheral countries drop under consolidation. However, the spreads increase significantly within a year and stay persistently high. In contrary, the yield spread for core countries decrease in the first year then increase slightly before quickly converging to zero. The results suggest that the high cost of fiscal consolidation can be ascribed, at least in part, to the lack of believe by economic agents of achieving higher fiscal discipline and lower cost of borrowing.

1.4 Generating role for sentiments in a model of currency union

In this section, I present a theoretical model to understand how interaction between sentiments and fiscal policy impact the real economy. I use a standard two country model which

are part of a currency union, similar to the one presented in Nakamura and Steinsson (2014) and Bonam and Goy (2019). The key equations of the model are described below.

There are two country: Home and Foreign, which are part of a monetary union. Time is discrete. The population of the entire union is normalized to one. The population of the home region is given by n which makes the population of foreign region $(1-n)$. The union is characterized by use of common currency, complete financial markets, and no trade barriers. The assumption of Law of One Price holds.

1.4.1 Households

Each country is characterized by a continuum of households denoted by k each of which have identical preferences and face identical budget constraints. Households face a consumption-leisure trade-off in a standard CRRA utility function.

$$\hat{E}_0^j \sum_{t=0}^{\infty} \beta^t \left[\frac{(C_t^j)^{1-\sigma^{-1}}}{1-\sigma^{-1}} - \chi \frac{(N_t^j)^{1+\nu^{-1}}}{1+\nu^{-1}} \right] \tag{1.4}$$

where C_t^j is the consumption of the composite good, N_t^j is the labor supply by household j, β is the discount factor, $\sigma > 0$ is the coefficient of relative risk aversion, and $\nu > 0$ is the inverse of Frisch elasticity of labor supply. $\hat{E}_0^j$ is the subjective expectation of household j. How households form their expectations is the key feature of the model and is described in detail in Section 1.4.4.

Consumption is a composite of domestically produced goods C_{Ht} and imported foreign goods C_{Ft} given by the CES aggregator:

$$C_t^j = \left(\phi_h^{\frac{1}{\eta}} C_{Ht}^{\frac{\eta-1}{\eta}} + \phi_f^{\frac{1}{\eta}} C_{Ft}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \tag{1.5}$$

where $\eta > 0$ is the elasticity of substitution between home and foreign produced goods. The degree of home bias in household consumption basket is given by ϕ_h which makes ϕ_f the share of foreign consumption. For analytical convenience, it is conventional to assume that $\phi_h + \phi_f = 1$. Define $\phi_h^* = \left(\frac{n}{1-n}\right)\phi_f$ where ϕ_h^* is the degree of home bias in the foreign economy and n is the size of home region. By assumption, $\phi_f^* = 1 - \phi_h^*$. If $\phi_h = n$, there is no home bias i.e. share of consumption in home and foreign goods equals the size of the respective economy. For all values of $\phi_h > n$ the economy exhibits a home bias in consumption. The demand for aggregate home and foreign goods is a CES aggregator of differentiated goods produced by firms in each country. Assuming that there is a continuum measure one of differentiated goods produced in home and foreign, the demand for each good by home consumers is given by:

$$C_{H,t} = \left[\int_0^1 c_{ht}(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} \qquad and \qquad C_{H,t} = \left[\int_0^1 c_{ft}(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} \tag{1.6}$$

Households choose their demand for home and foreign goods to minimize their cost of attaining consumption C_t given the elasticity of substitution, η and θ, the degree of home bias ϕ_h, and the share of population n. Hence, the aggregate demand for home and foreign produced goods, and for each differentiated goods are given by:

$$C_{Ht} = \phi_h \left(\frac{P_{Ht}}{P_t}\right)^{-\eta} C_t \qquad ; \qquad C_{Ft} = \phi_f \left(\frac{P_{Ft}}{P_t}\right)^{-\eta} C_t \tag{1.7}$$

$$c_{ht}(z) = \left(\frac{p_{ht}(z)}{P_{Ht}}\right)^{-\theta} C_{Ht} \qquad ; \qquad c_{ft}(z) = \left(\frac{p_{ft}(z)}{P_{Ft}}\right)^{-\theta} C_{Ft} \tag{1.8}$$

where P_t is the aggregate price index faced by households in home, P_{Ht} is the CES aggregator of price of differentiated goods produced in each country i, and $p_{it}(z)$ is the price of each

differentiated good in country i.

$$P_t = [\phi_h (P_{Ht})^{1-\eta} + \phi_f (P_{Ft})^{1-\eta}]^{\frac{1}{1-\eta}} \tag{1.9}$$

$$P_{Ht} = \left[\int_0^1 p_{ht}(z)^{1-\theta} dz\right]^{\frac{1}{1-\theta}} \qquad and \qquad P_{Ft} = \left[\int_0^1 p_{ft}(z)^{1-\theta} dz\right]^{\frac{1}{1-\theta}} \tag{1.10}$$

Since the economy is characterized by no trade barriers and only one currency, prices will be homogeneous across both countries. This implies that $P_{Ht} = P^*_{Ht}$ and $P_{Ft} = P^*_{Ft}$. Define the terms of trade for home as $q_t = \frac{P_{Ft}}{P_{Ht}}$. Under perfect risk sharing, the Backus-Smith condition holds such that the ratio of marginal utility of consumption across two countries equals the real exchange rate between foreign and home produced goods:

$$\left(\frac{C^*_t}{C_t}\right)^{-\sigma^{-1}} = q_t \quad = \frac{P_{Ft}}{P_{Ht}} \tag{1.11}$$

Households at home maximize their infinite stream of lifetime utility with respect to the following budget constraint:

$$P_t C^j_t + (1 + i_t)^{-1} B^j_{t+1} = W_t N^j_t + \int_0^1 d_t(z) dz + B^j_t - T^j_t \tag{1.12}$$

where B_t is a one period government bond traded locally which pays the union-wide nominal interest rate i_t at the end of the period. Financial markets are complete and there is perfect risk sharing. The households own equal shares of profits in all monopolistically competitive firms in their respective countries. $d_t(z)$ is the dividend paid by firm z operating in home. W_t is the wage earned and T_t is the lump-sum transfers. The foreign block is modeled exactly like the home bloc and the details are omitted to avoid repetition.

Finally, solving the household's utility maximization problem renders the first order condition for labor supply and the consumption Euler equation, given by:

$$C_t^{\sigma^{-1}} = \beta(1+i_t)\hat{E}^j \left[C_{t+1}^{\sigma^{-1}} \frac{P_t}{P_{t+1}} \right] \tag{1.13}$$

$$\chi(N_t^j)^{\nu^{-1}}(C_t^j)^{\sigma^{-1}} = \frac{W_t}{P_t} \tag{1.14}$$

1.4.2 Firms

Each country is characterized by a continuum $z \in [0,1]$ of monopolistic competitive firms each producing differentiated goods. Each good is tradable and is produced for final domestic and foreign consumption. Labor is the only input of production and is not tradable across countries i.e. home firms only use domestic labor. Firms have a constant returns of scale production function.

$$y_{ht}(z) = n_{ht}(z) \tag{1.15}$$

When setting prices, firms face a Calvo styled price rigidity. Each period, a fraction $1-\alpha$ of firms can reoptimize their prices while the remaining fraction α keep their prices same as last period's prices. Let $\bar{p}_t^h(z)$ denote the optimal price set by a firm z. The price setting problem of the firm is then given by:

$$\max_{p_{ht(z)}} \quad \hat{E}_t \sum_{k=0}^{\infty} (\alpha\beta)^k \lambda_{t,t+k} \left[p_{ht+k}(z) y_{ht+k}(z) - W_{H,t+k} y_{ht+k}(z) \right] \tag{1.16}$$

subject to the demand function for each firm:

$$y_{ht}(z) = \left(\frac{p_{ht}(z)}{P_{Ht}}\right)^{-\theta} (nC_{Ht} + (1-n)C^*_{Ht} + nG_{Ht}) \tag{1.17}$$

The aggregate price index domestically produced goods is a weighted average of firms who are unable to re-optimize their prices in the current period and firms who do re-optimize:

$$P_{Ht} = [\alpha(P_{Ht-1})^{(1-\theta)} + (1-\alpha)p_{Ht}(z)^{(1-\theta)}]^{\frac{1}{1-\theta}} \tag{1.18}$$

Solving the firm's optimization problem (Eq. 1.16) and combining it with the aggregate price index yields the New Keynesian Phillips curve for domestically produced goods. The firms are modeled identically in home and foreign.

1.4.3 Government

Monetary policy is governed by a central bank which sets the nominal interest rate for the entire union. The central bank follows a Taylor rule and aims to stabilize union-wide inflation weighted by the population in each country where π_t is the inflation rate at home and π^*_t is the inflation rate in foreign, both expressed in log deviations.

$$i_t = \phi_\pi[n\pi_t + (1-n)\pi^*_t] \tag{1.19}$$

Fiscal policy is set domestically and independently in each country. The government only consumes domestically produced goods which is financed through a lump-sum tax T_{it}. The government's consumption demand for differentiated goods at home is given by: $g_{Ht}(z) = \left(\frac{p_{ht}(z)}{P_{Ht}}\right)^{-\theta} G_t$ and at foreign is given by: $g_{Ft}(z) = \left(\frac{p_{ft}(z)}{P_{Ft}}\right)^{-\theta} G^*_t$ where G_t and G^*_t denote per

capita government spending in home and foreign, respectively. There are no distortionary taxes in the model and government expenditure is financed using lump-sum taxes. I assume that government balances its budget in each period.

The log linearized equations of the model around the non-stochastic steady state are given by:

$$c_t = \hat{E}_t^i c_{t+1} - \sigma(i_t - \hat{E}_t^i \pi_{t+1}) \tag{1.20}$$

$$c_t - c_t^* = \sigma\lambda P_{Ht} \tag{1.21}$$

$$y_t = \frac{C}{Y}\phi_h c_t + \frac{C}{Y}\left(\frac{1-n}{n}\right)\phi_h^* c_t^* - \eta\frac{C}{Y}\left(\phi_h + \frac{1-n}{n}\phi_h^*(1-\lambda)\right)P_{Ht} + g_t \tag{1.22}$$

$$y_t^* = \frac{C}{Y}\left(\frac{n}{1-n}\right)\phi_f c_t + \frac{C}{Y}\phi_f^* c_t^* + \eta\frac{C}{Y}\left(\phi_h\frac{n}{1-n} + \phi_f^*\left(\frac{\phi_h}{\phi_f} + \lambda\right)\right)P_{Ht} + g_t^* \tag{1.23}$$

$$\pi_{H,t} = \beta\hat{E}_t^i\pi_{Ht+1} + \kappa(\sigma^{-1}c_t + \nu^{-1}y_t - P_{Ht}) \tag{1.24}$$

$$\pi_{F,t} = \beta\hat{E}_t^i\pi_{Ft+1} + \kappa\left(\sigma^{-1}c_t^* + \nu^{-1}y_t^* + \left(\frac{\phi_h}{\phi_f} + \lambda\right)P_{Ht}\right) \tag{1.25}$$

$$\pi_t = \phi_h\pi_{Ht} + \phi_f\pi_{Ft} \tag{1.26}$$

$$\pi_t^* = \phi_h^*\pi_{Ht} + \phi_f^*\pi_{Ft} \tag{1.27}$$

$$P_{Ht} = P_{Ht-1} + \pi_{Ht} - \pi_t \tag{1.28}$$

$$i_t = \phi_\pi(n\pi_t + (1-n)\pi_t^*) \tag{1.29}$$

where $\lambda = \left(\phi_h^* - \frac{\phi_h}{\phi_f}\phi_f^*\right)$ and $\kappa = \frac{(1-\alpha)(1-\alpha\beta)}{\alpha}$.

1.4.4 Shocks and Expectations Formation:

The model intentionally abstracts from all other shocks and frictions to focus exclusively on the fiscal policy shock. The government expenditure in both home and foreign follows an AR(1) process: $g_t = \rho_g g_{t-1} + \epsilon_t^g$ where g_t is the government expenditure presented in log deviation from steady state. I assume that the agents cannot observe the home fiscal policy variable when forming expectations. Instead they observe a serially correlated variable z_t which also depends on the past realizations of fiscal policy.

$$z_t = g_{t-1} + \rho_z z_{t-1} + \epsilon_t^z$$

where the shocks ϵ_t^g and ϵ_t^z are iid with mean 0 and variance σ_g^2 and σ_z^2, respectively. z_t can be interpreted as a signal that agents receive on fiscal policy. This kind of noisy signal is common in the literature and is incorporated in different forms in Barsky and Sims (2012a), Benhabib et al. (2015). z_t evolves independently of fundamentals in the economy where ϵ_t^z can be interpreted as the animal spirits shock. Furthermore, I assume that this animal spirits shock is correlated with the fiscal policy shock ϵ_t^g, i.e. $E(\epsilon_t^g, \epsilon_t^z) = \Sigma_{gz} \neq 0$.

Re-writing the model in the state-space form:

$$AX_t = BE_t X_{t+1} + CX_{t-1} + DS_t \tag{1.30}$$

$$S_t = PS_{t-1} + \epsilon_t \tag{1.31}$$

where $X_t = \{c_t, c_t^*, y_t, y_t^*, \pi_{Ht}, \pi_{Ft}, \pi_t, \pi_t^*, P_{Ht}, i_t\}$ is the vector of endogenous variables and $S_t = \{g_t, g_t^*, z_t\}$ is the vector of shocks. Assuming Rational Expectations Equilibrium (REE), the solution to the above VAR will be of the form: $X_t = FX_{t-1} + GS_t$.

Restricted Perceptions Equilibrium:

Under the Rational Expectations assumption, agents observe the correct structural model when forming their forecasts. An alternative way to model expectations is to allow agents to have alternative forecasting rules which does not impose the condition of perfect foresight of all variables in the model. The key behavioral assumption made in this paper is that agents have misspecified beliefs when forecasting a linear VAR, resulting in deviations from rational expectations. The misspecification implies that agents underparameterize by omitting the home fiscal policy variable, g_t, from their forecasting model. Instead, agents condition their forecasts on their observed shock, z_t, which evolves with lagged observation of fiscal policy but independently of other fundamental variables in the economy.

The assumption of allowing agents to only observe a noisy measure of sentiments can be defended as follows. In democratic countries, fiscal expenditure is subject to intense political debates, take longer to be implemented, and are frequently diluted in their final implementation. It is therefore, not unreasonable to assume that agents may not be able to perfectly observe the shock but instead base their forecasts on noisy signals. Literature on political economy shows that agents' belief about the effectiveness of government policy is biased by their political leanings. Benhabib and Spiegel (2019) use political partisanship as an instrument for economic sentiments and show that this instrumented measure of sentiments is significantly associated with output growth. One way to then interpret the sentiments in our model, z_t, is as a measure of political bias, which is correlated with the government expenditure shock but does not depend on other economic variables.

The assumption of constraint on agent's forecasting model allows us to generate a role for sentiments correlated with fiscal policy. Under the misspecification assumption, agents'

linear forecasting model (or Perceived Law of Motion) takes the following form:

$$X_t = \tau_1 X_{t-1} + \tau_2 \tilde{S}_{t-1}$$

$$\implies E_t X_{t+1} = \tau_1 X_t + \tau_2 \tilde{S}_t$$

where $\tilde{S}_t = \{g_t^*, z_t\}$. Expectations are homogeneous across all agents in home and foreign. Substituting the above equation in the VAR (Eq 1.30) renders the Restricted Perceptions Equilibrium (RPE) solution of the form:

$$X_t = (A - B\tau_1)^{-1} C X_{t-1} + (A - B\tau_1)^{-1} B\tau_2 \tilde{S}_t + (A - B\tau_1)^{-1} D S_t \tag{1.32}$$

Under RPE, the agents' least square coefficients τ_1 and τ_2 will satisfy the following orthogonality conditions[7]-

$$E\left[X_t - \tau_1 X_{t-1} - \tau_2 \tilde{S}_t\right]\left[X_{t-1} \tilde{S}_t\right]' = 0 \tag{1.33}$$

1.4.5 Calibration

The Impulse responses are computed to a one standard deviation fiscal policy shock in home for differing levels of correlation with the sentiments shock. I assume that the household discount factor, β is 0.99. Similar to Nakamura and Steinsson (2014) I set the inverse of Frish elasticity of labor supply, ν, and the inter-temporal elasticity of substitution, σ, equal to 1. The value for the trade elasticity parameter, η, is set at 2. The Calvo parameter α is set at 0.65 which is within the range assumed in the literature. The home bias parameter ϕ_h is set as 0.64. It is calculated as one minus the average import share in GDP in 2019

[7]For more details, refer to Branch (2006), Branch and Gasteiger (2020).

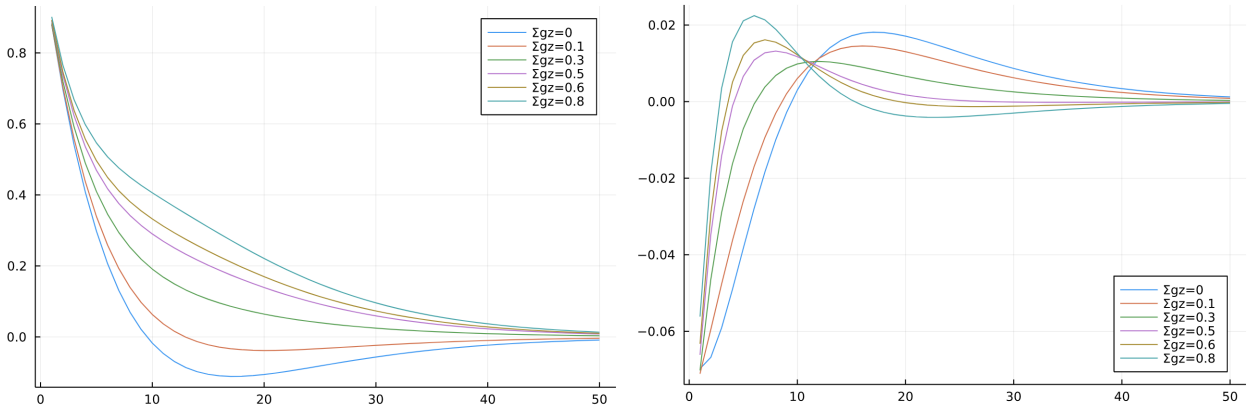
across all countries in our sample except Belgium and Netherlands, which have significantly higher degree of openness due to the small size of their economy. Increasing (decreasing) the home bias parameter increases (decreases) the impact effect of the government spending shock but does not alter our main conclusion with respect to the impact of sentiments. The steady-state share of consumption is set at 0.75, approximately equal to the share of consumption expenditure in Euro area GDP. The size of the economy n is set at 0.1 which implies that monetary policy puts a smaller weight on home inflation for asymmetric shocks. Changing the values of n changes the impact effect of government spending on output with a larger n resulting in a larger response of real interest rate and a smaller impact on output. The response of monetary policy to inflation, ϕ_π is assumed to be 1.5 to satisfy the Taylor principle. Finally, the persistence coefficient of fiscal policy shock ρ_g is assumed to be 0.9 in both countries. The persistence coefficient of sentiments ρ_z is set to be 0.8. While this is an arbitrary choice, it is approximate to the persistence of sentiments estimated in Angeletos et al. (2018). The results presented are also consistent for a range of values for ρ_z. All structural and persistence parameters are assumed to be same across both countries.

1.4.6 Implications for Fiscal Policy

Figure 1.8 shows the impulse response functions to a one standard deviation domestic fiscal policy shock ϵ_t^g under the misspecified equilibrium. Each color coded lines represent the IRFs with different levels of correlation between sentiments and the home government spending shock. Panel (a) plots the response of domestic output (Y_t) and Panel (b) plots the response of domestic real interest rate.

On impact, the response of output to home government spending shock is same for all levels of correlation with the sentiments shock. However, the stronger the correlation of fiscal

Figure 1.8: Impulse Response to fiscal policy shock



(a) Output (b) Real Interest Rate

The figure plots the response of output and real interest rate to a one standard deviation fiscal policy shock for different levels of correlation between fiscal policy and sentiments shock.

policy with the sentiments of agents, the more persistent is the response of output. With no correlation, the response of output to fiscal policy decreases below zero by 10 quarters. However, when sentiments co-move strongly with fiscal policy ($\Sigma_{gz} = 0.8$), the response in 10 quarters is still strongly positive. We can look at the response of the real interest rate to understand why fiscal policy has a more persistent impact on output. The response of real interest rate is negative on impact which happens due to the presence of price rigidity in the model. In a New Keynesian model with price stickiness, prices only gradually respond to the government spending shock resulting in a decrease in real interest rate and a boost to private spending and output. As prices adjust to the new levels, real interest rate rises slightly before converging back to zero. With no correlation between government spending and sentiments, the real interest rate is negative in the short run but rises above zero and stays higher for longer, crowding out private spending. However, for higher levels of correlation between sentiments and fiscal policy, the increase in real interest rate is lower and less persistent, thus, reducing the effect of crowding out.

1.5 Conclusion

This paper hypothesizes that movements in consumer sentiments can determine the efficacy of macroeconomic policy in stimulating the economy. I analyze the interaction between fiscal policy and sentiments using data on the countries in the European economic and monetary union. The results show that in the absence of complete access to monetary policy in combating domestic shocks, fiscal policy strongly influences consumer sentiments. I find that consumer sentiments respond positively for most countries to an expansionary fiscal policy shock. Countries with a larger response of consumer sentiments also experience a larger expansion of output to a fiscal policy shock. Fiscal policy in peripheral European countries have a larger impact on output than in core countries. The effect is also more persistent.

I extend the analysis to then understand how the response to fiscal policy differs between core and periphery countries during different states of fiscal consolidation. Fiscal contraction during periods of fiscal consolidation is not very costly for core countries in the short run and is expansionary in the medium run. On the other hand, fiscal contraction during fiscal consolidation is very costly for peripheral countries. The results suggest that fiscal policy is strongly correlated with consumer sentiments in peripheral countries. Therefore, constraints imposed on fiscal policy under consolidation measures significantly dampens sentiments.

Lastly, allowing for a stronger correlation of agents sentiments with fiscal policy allows us to generate a more persistent response of output, as observed in the data. The paper concludes that, for countries in a monetary union, fiscal policy can have substantially higher impact on the level of economic activity through its impact on consumer sentiments.

Chapter 2

Unconventional Monetary Policy and Consumption

2.1 Introduction

At the peak of the financial crisis of 2008, the Federal Reserve lost its direct influence over the economy with the policy rate hitting its effective lower bound. The Fed then shifted to using unconventional monetary policy in an attempt to lower long term rates and to stimulate demand. Two of the most significant policies used by the Fed during this period are the Large Scale Asset Purchases (LSAP) and Forward Guidance.

A growing literature on the transmission of unconventional monetary policy suggests that these policies were successful in influencing both financial markets and the real economy. Swanson (Swanson (2021a), Swanson (2018)) show that LSAPs and Forward Guidance had a large and significant effect on medium and long term treasury yields, corporate bond yields and interest rate uncertainty. Evidence of the effect of these measures on the aggregate real economy can be found in Gertler and Karadi (2015) and Zhang (2019b). This paper builds

on the literature of effectiveness of unconventional policy shocks, measured by high frequency identification, on the real economy. I specifically focus on the heterogeneous transmission of these policy on household consumption via the mortgage market. I find that the channels of transmission of LSAP shock, in particular, vary across households depending on their decision to refinance their existing mortgages.

Housing debt is an important channel of transmission of monetary policy to consumption.[1] Monetary policy affects interest rates and, hence, the mortgage costs faced by homeowners and their transitory income. Homeowners with positive home equity can respond to lower mortgage rates by refinancing their mortgages. This allows households with mortgages to lower their interest payments or to increase the size of their loan without affecting their monthly payment (known as cash-out refinancing). However, since refinancing requires collateral, only households with sufficient home equity can increase their income and consumption via the refinancing channel. In this paper, I argue that households who refinance their loans after a monetary policy shock, increase their consumption more than households who choose not to refinance and households who do not own houses.

The heterogeneity in response to monetary policy shocks are further influenced by regional variation in housing prices.[2] Borrowers are constrained in their capacity to buy and refinance mortgages by the value of their collateral. Low house prices result in low value of collateral and tighter borrowing constraints. Thus, households that suffer large decrease in their home equity are unable to take advantage of expansionary monetary policy and low mortgage rates. The second part of this paper aims to understand how efficacy of monetary policy varied with the severity of 2008 housing market crash across different states in the U.S.

[1] See Fuster and Willen (2010), Auclert (2019), Cloyne et al. (2019), Garriga et al. (2017) for research on housing market and monetary policy.

[2] Zhang (2019a) finds a strong positive relation between house prices and consumption using Dutch data. She also shows that the response is heterogeneous depending on home ownership where homeowners consume significantly more than renters to changes in home prices. I find that the differential response in the U.S. is due to the refinancing channel.

In this paper, I focus on the unconventional policies used by the Federal Reserve during the financial crisis. This is an important period to explore the housing channel for two main reasons. First, the Fed intervened in the mortgage market directly during the crisis by using Large Scale Asset Purchases (LSAP) of mortgage-backed securities.[3] Hence, the unconventional monetary policy had a significant effect on the market for housing loans. Second, this period was also characterized by low house prices and high regional variation in the housing market across the U.S. While households in some regions of the U.S. suffered with low or negative equity, households in other regions were relatively better off. This allows me to study the response of households across regions to unconventional policy shocks.

As a measure of unconventional monetary policy shocks, I use the shocks identified in Swanson (2021a). To construct the series, Swanson (2021a) takes the 30-minute change in asset prices to each FOMC announcement for the period 1991-2015. Using principal component analysis along with identifying assumptions, he extracts the three factors with highest explanatory power of the asset price changes and identifies them as the change in federal funds rate, forward guidance and LSAP, respectively. The high frequency changes in asset prices is a popular approach to measure unanticipated monetary policy shocks. [4].

In the first part of the paper, I study the heterogeneity in behavior of households who choose to refinance their mortgages in response to a monetary policy shock against all other households. To understand consumption response, I exploit the information in Consumer Expenditure Survey in the U.S., which includes detailed consumption and mortgage information, for a panel of households, at quarterly frequency. I find that homeowners who refinance their mortgages enjoy higher consumption as a result of an expansionary monetary policy shock in comparison to renters and all other homeowners. This effect is very strong

[3]Fuster and Willen (2010) shows that mortgage cost significantly dropped across the U.S. (but heterogeneous across borrowers based on creditworthiness) following the announcement for LSAP in November 2008 and March 2009.

[4]Other studies using this approach include Gurkaynak et al. (2005), Krishnamurthy and Vissing-Jorgensen (2011) and Gagnon et al. (2011)

for LSAP measures used by the Fed during the zero lower bound period. The response of consumption to Forward Guidance on the other hand, is relatively homogeneous across all household categories.

Next, I compare the consumption response of households in states where households suffered heavy erosion of home equity during the housing market crash in 2008, to states where households faced a less severe decline in home prices. Following an expansionary LSAP shock, I find no significant difference in consumption among homeowners who refinance their mortgages relative to other homeowners and renters in the distressed states. On the other hand, after an expansionary LSAP shock, homeowners who refinanced their mortgages in non-distressed states, responded with higher consumption, relative to other households.

The structure of this paper is as follows. In section II, I review the related literature on transmission of monetary policy. In section III, I discuss the data and the empirical methodology. Section IV discusses the results. Section V concludes.

2.2 Literature Review

The central bank's policy does not directly respond to inequality but affects macro variables unequally, which can result in greater inequality.[5] There is a growing interest, in departure from the canonical New Keynesian models, to recognize the role of household heterogeneity in transmission of monetary policy. Coibion et al. (2017) show that inequality in earnings, consumption and expenditure across households in the U.S. increases following a contractionary monetary policy shock.

This paper connects to many strands of the literature studying household heterogeneity, monetary policy and inequality. I study how household's debt liability affect the transmission

[5]For example, Albanesi (2007) and Doepke and Schneider (2006) show that unexpected inflation increases inequality.

of unconventional monetary policy used by the Federal Reserve during the financial crisis. My paper is closely related to Beraja et al. (2019), who study the role of regional heterogeneity of housing equity in transmission of the first LSAP announcement by the Fed in November, 2008. They use micro data to show that the first LSAP episode did not transmit to the most distressed regions due to low refinancing activity. They argue that monetary policy affects household wealth by lowering mortgage rates. This allows households with sufficient home equity to refinance and extract housing equity, whereas underwater households are unable to take advantage of lower rates.

My work in this paper builds on their work in two important ways. First, I expand their analysis to focus on all Forward Guidance and LSAP shocks during the period between 1996 - 2018 rather than the first LSAP shock. Although the first LSAP announcement had important implications for the mortgage market, its effectiveness could have been dampened by the weak lending market at the peak of crisis. Considering all unconventional policy shocks is important in understanding the impact of monetary policy during the period of recovery. Second, they measure the response of refinancing activity while I focus on the growth of household consumption. Measuring the response of consumption allows me to study the impact of unconventional policy on the real economy. This paper is also related to Maggio et al. (2016), who identify three channels through which refinancing affects consumption after a LSAP shock. They find that LSAP helped household via higher credit availability and lower interest rates on mortgages and other debts. Their finding complements Beraja et al. (2019), that borrowers who benefited from LSAP disproportionately lived in the least affected areas.[6]

The refinancing channel of transmission of monetary policy is also explored in Wong (2021). She uses the Consumer Expenditure Survey dataset to show that households that adjust mortgages following a monetary policy shock, consume more than households that are not

[6]The transmission of unconventional monetary policy to mortgage rate has also been studied using high frequency data in Gertler and Karadi (2015) and Fuster and Willen (2017).

homeowners or those who do not adjust loans. The mechanism is similar- households that readjust their mortgages after a monetary policy shock enjoy lower interest rate and thus, have higher disposable income and consumption. While her paper looks at the conventional monetary policy shocks, I study unconventional policy shocks. Heterogeneity arising from refinancing of mortgages is also explored in Eichenbaum et al. (2019).

This paper also relates to the literature connecting household balance sheet with heterogeneity in marginal propensity to consume (MPC) across households, and its effect on transmission of monetary policy. Eggertsson and Krugman ((2012) use a New Keynesian model with heterogeneous agents to show that the aggregate effect of monetary or fiscal policy is higher if it eases the borrowing constraint of constrained households. Auclert (2019) finds that an expansionary monetary policy increases inequality because it eases the borrowing constraint for households with debt. The higher MPC of debt constrained households results in higher aggregate effects. Cloyne et al. (2019) use the Consumer Expenditure Survey data to provide evidence on how households with mortgages respond differently to monetary policy shocks compared to the home owners and renters. Their study provides further evidence that households with debt have higher MPC. Other papers that find high MPC for debt constrained households include, Kaplan et al. (2014) and Hedlund et al. (2016) who use the Panel Study of Income Dynamics data to show that high income, high debt households have higher MPC out of transitory income. More evidence on refinancing and effectiveness of monetary policy is discussed in Agarwal et al. (2019) and Fuster and Willen (2010).

2.3 Data

The consumption data in the paper comes from the Consumer Expenditure Survey (CEX) dataset from the Bureau of Labor Statistics (BLS) for the period 1996 - 2018 combined with the unconventional monetary policy shock series from Swanson (2021a). The analysis is at

the household level for the period of 1996 Q1 - 2018 Q2.

2.3.1 Consumer Expenditure Data

The Consumer Expenditure Survey dataset is a household level data published quarterly by the BLS, available since 1980. The dataset contains details on expenditure by households on a vast number of goods and services along with individual level demographic characteristics. I use the classification used in Krueger and Perri (2006) and Wong (2021) to classify household expenditure into durable, non-durable and service expenditure. All variables are deflated with category-wise CPI.[7] The final dataset has 122,990 unique households.

I classify households between homeowners with mortgages who refinance their loan, homeowners who do not refinance their loan, and households that are renters. CEX data records the date and amount of new loans and any change in loan activity which resulted in a new loan i.e. refinancing. I categorize a household as having refinanced their loan if for a household in the dataset, the quarter and year of loan change matches the current quarter and year. Table 2.1 shows the distribution of households across homeowners with mortgages, homeowners without mortgages, and renters.Approximately 7% of all homeowners with mortgages in the sample have refinanced their loan within the sample period.[8]

2.3.2 Monetary Policy Shocks

For LSAP and Forward Guidance shocks, I use the series of shocks from Swanson (2021a). This paper uses high frequency identification which decomposes the effect of a monetary policy announcements on yield rates within a 30-min window around the shocks and sepa-

[7] I discuss the data adjustments in more detail in Appendix A.
[8] This distribution is similar across states.

Table 2.1: Distribution of households by category

	Homeowners with mortgages	Homeowners without mortgages	Renters
Percentage of total households	48.31%	21.68%	30.01%
Homeowners who refinance loan	6.64%	-	-

rates it into federal funds rate, Forward Guidance and LSAP factors.[9] I sum the factors to obtain a continuous series of shocks at quarterly level. This series is from 1991Q2 - 2018Q2 which overlaps with my data on household consumption. Table 2.2 shows the similarity in the moments of aggregated shocks and the raw shocks.

Table 2.2: Summary statistics for monetary policy shocks

	Raw Shocks			Quarterly Shocks		
	Fed Funds Rate	Forward Guidance	LSAP	Fed Funds Rate	Forward Guidance	LSAP
Median	0.1567	-0.0007	-0.02	0.2893	-0.0010	-0.0195
Mean	0.0113	-0.0031	-0.0043	0.0244	-0.0067	-0.0092
Standard Deviation	0.8301	0.9773	0.5857	1.1582	1.2640	0.8942
Min	-5.54	-3.37	-5.63	-5.33	-3.20	-5.31
Max	1.78	4.16	1.97	2.03	5.13	2.19
N	234	234	234	108	108	108

[9]See Swanson (2021a) for more details on identifying strategy and assumptions.

2.3.3 Other Macro Data

I also use the state-wise housing price index dataset from the Federal Housing Finance Agency (FHFA). The data is available in monthly and quarterly frequency. I use the house price dataset to identify the states most affected by the crisis. A state is recorded to have faced a severe effect if the house price changes in the state between 2007Q1 - 2008Q4 was "large enough". I define a "large enough" change as the 75th percentile of the change in house prices in all states between 2004Q1 - 2005Q4. [10] I identify 4 states- California, Arizona, Nevada, and Florida, as states which were severely affected by the housing market crash. I use this variable to identify the channel of refinancing, following Beraja et al. (2019) who show that refinancing activity during the crisis was highly regional specific. I define a dummy variable prime effect which takes the value one for states which were severely affected by the crash and zero for states that were not as severely impacted. Table 2.3 shows the proportion of mortgage owners who adjust loan, who did not adjust loan and renters, by the prime effect variable for the period 2007Q1 - 2018Q2.

Table 2.3: Summary statistics by prime effect variable

	Severely affected states	States not severely affected
Homeowners who refinance	2.55%	2.87%
Homeowners who did not refinance	60.23%	67.91%
Renters	37.22%	29.23%

[10] In Appendix B, I redefine the cut-off as median of the change in house prices in all states between the year 2004Q1 - 2005Q4 and re-run the specification. The results are similar to ones reported in the paper.

2.4 Empirical Specification

This section of the paper discusses the empirical methodology used in this paper. To study the effect of monetary policy on consumption, I run a household level regression with state, month and year fixed effects. The baseline specification is:

$$\Delta \log C_{h,t} = \alpha_0 + \alpha_1 \mathcal{M}_{h,t} + \alpha_2 \mathcal{R}_{h,t} + \sum_{i=1}^{k} \beta_i S^f_{t-i} + \sum_{i=1}^{k} \gamma_{1i} \mathcal{M}_{h,t} S^f_{t-i} + \sum_{i=1}^{k} \gamma_{2i} \mathcal{R}_{h,t} S^f_{t-i} + \alpha_3 X^{(1)}_{h,t} + \alpha_4 X^{(2)}_{s,t} + \lambda_s + \lambda_y + \lambda_m + u_{h,t} \quad (2.1)$$

where $\Delta \log C_{h,t}$ is the growth in real consumption for each household in quarter t. Household consumption composes of non-durable expenditure, durable expenditure excluding housing, and expenditure on services. $\mathcal{M}_{h,t}$ is a dummy variable which takes value one for all households that own home (with or without mortgages) and do not refinance mortgages, and zero otherwise. $\mathcal{R}_{h,t}$ is a dummy variable which takes value one for households that rent the housing unit and zero otherwise. The loan adjustment dummies are interacted with the monetary policy shock denoted by S^f_{t-i} which is a $2 \times T$ vector of Forward Guidance and LSAP shock, where T denotes the total time period. The coefficients of interest are γ_1 and γ_2. These coefficients tells us the difference in percentage change in real consumption based on a household's decision to adjust loan following a monetary policy shock. I include 12 lags of the monetary policy shocks. The sample is weighted by the sample weights calculated by BLS.

2.4.1 Control Variables:

$X^{(1)}_{h,t}$ denotes the household level controls which includes: change in the family size, age of the reference person, age of the reference person squared, education of the head of household,

number of earning members in the household, number of vehicles owned by household and number of quarters for which the household was interviewed [11]. $X_t^{(2)}$ denotes the macro controls which includes quarterly change in unemployment rate at the state level, quarterly change in house prices at the state level, dummy variable for NBER recession dates (following Tenreyro and Thwaites (2016)) and dummy variable for the financial crisis. To measure the financial crisis effect, I construct a binary variable which is one for the periods between 2008 Q4 and 2009 Q2, and zero otherwise. The regressor λ_s denotes state fixed effects, λ_y denotes the year fixed effects and λ_m denotes the month fixed effects. $u_{h,t}$ is the error term.

2.5 Consumption Response to Monetary Policy

I begin by discussing the heterogeneous effect of LSAP and Forward Guidance shocks on household consumption based on the household's decision to refinance their loan. Table 2.4 shows the effect of monetary policy over the full sample period of 1996Q1 - 2018Q2. All shocks are normalized to one standard deviation expansionary shock. The results include household level controls, and month, year and state fixed effects.

On average, household consumption increases by 4% in response to one standard deviation expansionary LSAP shocks over last four quarters. Households in all categories respond significantly to LSAP shocks over the full sample. However, the response is largest for households who refinance their loan. In section IV.A, I focus on the effect of LSAP shocks on consumption post-2007. I find that households who adjust their loans respond much more significantly and immediately to LSAP policy shocks. For Forward Guidance shocks, the response of consumption to past four quarters of the shock suggest that on average, all households reduce their consumption following the shocks. The puzzling negative response however is being driven by the observations during the high volatility period of 2007 - 2009

[11] More details in Appendix A.2

Table 2.4: Differential effect of monetary policy shock on consumption growth

Dep. Var: $\Delta log(C_{h,t})$		Refinance their Loan	Do not Refinance	Renters
LSAP	1st year impact	4.72***	3.95***	3.29***
		(1.702)	(0.958)	(1.108)
	2nd year impact	2.94	2.38*	2.84*
		(2.28)	(1.33)	(1.46)
Forward Guidance	1st year impact	-1.404	-1.47*	-2.01*
		(2.21)	(0.888)	(1.069)
	2nd year impact	1.74	1.36	0.99
		(1.93)	(1.09)	(1.23)

Note: The table shows the consumption response of households who refinance their loan and the differential response against households who do not refinance and renters to a lagged one standard deviation expansionary LSAP shock. The sample period is 1996Q1 to 2018Q2. 1 year response is calculated as: $\beta_1 + \beta_2 + \beta_3 + \beta_4$ while 2 year response is calculated as: $\beta_5 + \beta_6 + \beta_7 + \beta_8$. All observations are weighted by the sample weights calculated by BLS. Standard errors are clustered at the state level. P-values are calculated using delta method. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

as discussed in section IV.B. The cumulative impact of shocks for lags greater than four is small and insignificant, suggesting a diminishing impact of monetary policy on household consumption.

2.5.1 LSAP Policy Shocks

In this section, I focus on how heterogeneity across households affect their consumption response to LSAP shocks. LSAP shocks became a key component of monetary policy after the beginning of financial crisis. To study the effect of LSAP shocks on consumption, I restrict the sample period to 2007Q1-2018Q2. The key heterogeneity that I exploit in this paper is the decision of homeowners with mortgages to refinance their mortgage. Households who refinance their loan following an expansionary shock enjoy lower monthly payments and thus, higher disposable income as against homeowners who do not refinance their loan and households who are renters. Table 2.5 shows the incremental consumption growth of

households who choose to refinance their mortgage over homeowners who do not refinance after an expansionary LSAP shock. The variable "Refinance - Do not Refinance" measures the differential response of households who refinance against households who do not refinance. Similarly, the variable "Refinance - Renters" shows the differential response against renters. All policy shocks are normalized to be one standard deviation expansionary shock.

Homeowners who refinance their mortgage increase consumption by approximately 3% over a quarter in response to a LSAP shock in the previous quarter. An average household in my sample has a quarterly expenditure of $10,000. A 3% difference in consumption implies that households who refinance their mortgages on average spend $300 more on consumption over a quarter or $1200 more over a year relative to homeowners who do not adjust their loan, and renters. The positive effect of the LSAP shock on consumption of homeowners who adjust their loan lasts for roughly four quarters. However, the difference in consumption across categories weakens for longer lags.

The results highlight the role of refinancing channel affecting the transmission of unconventional monetary policy to real consumption. Refinancing allows homeowners with mortgages to enjoy lower mortgage payments and thus, higher disposable income. The income effect is even higher for homeowners who opt for 'cash-out refinancing'. Cash-out refinancing allows mortgage owners to extract their home equity to the extent that their monthly payments remain unchanged. The consumption growth of homeowners with cash-out refinancing would be even larger in response to the large increase in transitory income. The CEX data does not allow us to differentiate between types of refinancing activities by household to exploit their relative effect on consumption. However, data from Freddie Mac suggests that, on average, cash out refinancing comprise 50% of all refinances. Another source of heterogeneity in consumption is the liquidity effect from higher disposable income and lower borrowing constraints. Evidence from the literature on heterogeneity in marginal propensity to consume suggests that household with mortgages also have a higher marginal propensity to consume.

Cloyne et al. (2019) show that households who own mortgages are borrowing constrained and as a result, they are also more responsive to transitory income shocks.

House prices play a significant role in how refinancing channel affects consumption of indebted households. Homeowners with mortgages can refinance their homes to take advantage of lower mortgage rates. However, this channel is conditional on the value of their home against their outstanding debt. Lower house prices would lead to lower home equity. As households need collateral to obtain a mortgage, households with low home equity are unable to refinance and cannot extract similar benefits of low interest rates as households with higher home equity. Mortgage owners facing low house prices are additionally constrained by their existing mortgages because it acts as a lower bound on their homes rendering them unable to lower the price of their home. This tightens their borrowing constraint and dampens the liquidity channel as consumption of constrained households fall.

2.5.2 Heterogeneous response by severity of housing crisis

Since the great recession was driven by the housing market crash, it had significant effects on homeowner's equity. The effect, however, was not homogeneous across the U.S. and some regions experienced much higher drop in house prices than other regions. In this section, I discuss the distribution of house prices and refinancing activity across states within the U.S. I then split the regressions by states that were severely affected by the housing crisis and those that were less severely affected, and show how households in these states change consumption in response to LSAP policy shocks. I find that households in the severely affected states were not able to extract the same level of equity by refinancing their houses, and hence, did not significantly respond to LSAP policy shocks.

Panel A of Figure 1 shows the median house price index for the states for which the absolute change in house price index between 2007Q1 - 2008Q4 is higher than the median house

Table 2.5: Differential effect of LSAP shock on consumption growth

Dep. Var: $\Delta logC_{h,t}$		(1)	(2)	(3)
$LSAP_{t-1}$	Refinance their Loan	3.23***	3.06***	3.04***
		(0.995)	(1.046)	(1.038)
	Refinance - Do not Refinance	2.81***	2.6**	2.57**
		(1.032)	(1.071)	(1.061)
	Refinance - Renters	2.8***	2.68**	2.65**
		(1.006)	(1.058)	(1.05)
$LSAP_{t-2}$	Refinance their Loan	0.83	0.55	0.55
		(1.138)	(1.115)	(1.111)
	Refinance - Do not Refinance	-0.08	-0.375	-0.38
		(1.063)	(1.042)	(1.038)
	Refinance - Renters	-0.07	-0.3	-0.3
		(1.175)	(1.168)	(1.165)
$LSAP_{t-3}$	Refinance their Loan	3.17**	2.82*	2.81*
		(1.444)	(1.455)	(1.45)
	Refinance - Do not Refinance	2.09	1.91	1.9
		(1.34)	(1.321)	(1.313)
	Refinance - Renters	1.19	1.04	1.03
		(1.407)	(1.411)	(1.404)
$LSAP_{t-4}$	Refinance their Loan	3.69**	3.36**	3.38**
		(1.489)	(1.517)	(1.509)
	Refinance - Do not Refinance	2.77*	2.62*	2.64*
		(1.491)	(1.506)	(1.498)
	Refinance - Renters	2.89**	2.79*	2.81*
		(1.461)	(1.489)	(1.485)
Controls			✓	✓
State FE		✓		✓
Month and year FE		✓	✓	✓
Recession dummy		✓	✓	✓
Obs		147,737	145,680	145,680

Note: The table shows the consumption response of households who refinance their loan and the differential response against households who do not refinance, and renters, to a lagged one standard deviation expansionary LSAP shock. The sample period is restricted to 2007Q1 to 2018Q2. Loan adjustment is a categorical variable which divides households into households who own a home and adjusts loan, households who own a home and do not adjust, and households who rent a home. The base category for loan adjustment variable is households who own a home and adjust loan. All regressions include twelve lags of the monetary policy shocks. Results for control variables are presented in Appendix C. All observations are weighted by the sample weights calculated by BLS. Standard errors are clustered at the state level. P-values are calculated using delta method. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

price growth during the period 2004Q1 - 2006Q4. The shaded region denotes the period of housing market crash considered for the classification of severely affected states. The solid line is the median house price index for four most severely affected states, while the dashed line is for next five severely affected states. Panel B shows the cash refinances as a proportion of total refinances in the above nine states.[12] The vertical lines mark the four major LSAP announcements. Cash refinances accounted for approximately 85% of all refinances in the severely affected states at the peak of housing market boom. This suggests that households prefer to extract home equity when the equity is significantly high. These states also dominated other states in equity extraction. However, the housing market crash of 2008 reduced the proportion of cash refinances in these states below the level of relatively less affected states. The variation in proportion of cash refinances shed light on the role of home equity in homeowners' level of disposable income from refinancing mortgages.

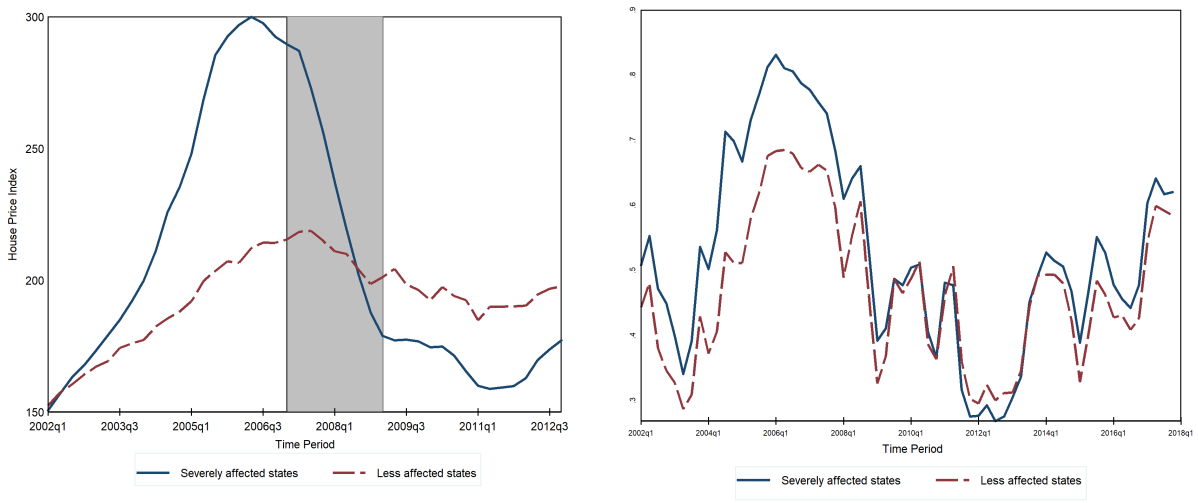
As shown by Figure 1, the gain in transitory income from refinancing after the housing market crash is much lower for all mortgage owners but is particularly low for homeowners in the four most severely affected states. Data from Freddie Mac's annual report on cash-out refinance supports this argument.[13] As recorded, the annual home equity cashed out in the U.S., at the peak of housing price boom in 2006 was $320.5 billion (30% of all refinancing volume) while that in 2008 was only $95.7 billion, a decrease of over $200 billion. Although the report does not provide state level data, Figure 1 suggests that the decrease in volume is likely driven by states most severely hit by the housing market crash.

In this section, I study the average consumption response of homeowners in states severely hit by the housing market crash and those less severely affected to the LSAP shocks. Table 2.6 shows the response of homeowners who refinance their mortgages and their differential

[12]The data from Freddie Mac only includes fixed rate mortgages for which the benefit from lower rates crucially depends on the household's ability to refinance. The data only includes mortgages on owner occupied houses.

[13]Current and past reports can be downloaded at: `http://www.freddiemac.com/research/datasets/refinance-stats/archive.page`

Figure 2.1: Median House Price and Refinancing



(a) Median house price index

(b) Proportion of cash refinances

Note: Panel A shows the house price index measured by FHFA for states with house price crash between the period 2007Q1 - 2008Q4 greater than median house price growth during the period 2004Q1 - 2005Q4. The solid line denotes the median price in four most severely affected states: Arizona, California, Florida and Nevada. The dashed line denotes the median price for the remaining, less affected, states. The shaded area denotes the period of house price collapse, 2007q1-2009q1. Panel B shows the ratio of total cash refinances to total refinances from Freddie Mac's single family loan level dataset for severely and less affected states.

response versus homeowners who do not refinance, and renters, following a LSAP policy shock. The sample period for the analysis is restricted to 2007Q1 - 2018Q2 to capture the effect of housing market crash on consumption effects of refinancing. Columns (1), (2), and (3) show the response of states classified as severely affected states and columns (4), (5), and (6) show the response of less severely affected states. All regressions include month and year fixed effects and the dummy variable for NBER recession dates. The policy shocks are standardized to capture the effect of one standard deviation expansionary shock.

The results in Table 2.6 highlight the regional heterogeneity in consumption response to unconventional policy shocks. Column (1) shows that the average consumption response of households in severely affected states is small. Although the difference in consumption of households who refinanced relative those who did not refinance or households which are renters, is positive, the coefficients are statistically insignificant. On the other hand, consumption of homeowners who refinanced their loan in less severely affected states responded

significantly to LSAP shocks. The difference in average consumption for homeowners who refinanced is also much higher than households falling in other two categories. On average, homeowners who refinanced their mortgages increased their consumption by 3% more than homeowners who did not refinance, and renters. With average household consumption expenditure of $10,000 in the CEX data, the result suggests that homeowners who refinanced increased their consumption by $300 following a LSAP shock in the previous quarter. Although, the difference in consumption across household types becomes insignificant for longer lags of LSAP shocks, the positive effect on consumption for those who refinance remains positive and significant at 10% significance level. The effects are robust to inclusion of control variables and state fixed effects.

Overall, the result suggests that LSAP shocks are highly effective in stimulating consumption in states that were not severely hit by the housing market crash. The result is not driven by the variation in cost of refinancing faced by homeowners as the mortgage rates do not vary with local economic activity across different states in the U.S. (Beraja et al., 2019), (Hurst et al., 2016). Table 2.6 suggests that the unconventional monetary policy was unable to stimulate refinancing activity in worst hit regions resulting in lower growth in household consumption. A large proportion of homeowners in these states faced low or negative home equity and could not take advantage of the falling mortgage rates, reducing their capacity to gain from the policy shocks. The LSAP shocks thus, aggravated the regional inequality in consumption which resulted from the housing market crash.

2.5.3 Forward Guidance policy shocks

The effect of Forward Guidance shock on household consumption and its channel of transmission is relatively ambiguous. Table 2.4 shows that over the period of 1996Q1 - 2018Q2, Forward Guidance shock has negative and weakly significant effect on consumption for shorter

Table 2.6: Differential effect of LSAP shock on consumption growth by severity of housing market crash

Dep. Var: $\Delta logC_{h,t}$		Severely Affected States			Less Severely Affected States		
		(1)	(2)	(3)	(4)	(5)	(6)
$LSAP_{t-1}$	Refinance their Loan	2.23	2.31	2.23	3.49***	3.27***	3.24***
		(1.99)	(2)	(1.977)	(1.176)	(1.226)	(1.219)
	Refinance - Do not Refinance	1.5	1.34	1.24	3.16***	2.89**	2.87**
		(2)	(2.004)	(1.97)	(1.209)	(1.249)	(1.237)
	Refinance - Renters	1.63	1.49	1.41	3.12***	2.98**	2.96**
		(1.84)	(1.794)	(1.758)	(1.189)	(1.245)	(1.236)
$LSAP_{t-2}$	Refinance their Loan	1.12	1.33	1.25	0.77	0.43	0.44
		(2.733)	(2.602)	(2.562)	(1.318)	(1.286)	(1.288)
	Refinance - Do not Refinance	-0.31	-0.29	-0.39	0.04	-0.33	-0.32
		(2.56)	(2.435)	(2.406)	(1.224)	(1.2)	(1.198)
	Refinance - Renters	0.07	0.14	0.06	-0.08	-0.36	-0.36
		(3.128)	(3.002)	(2.967)	(1.303)	(1.298)	(1.297)
$LSAP_{t-3}$	Refinance their Loan	3.42	3.33	3.37	3.08*	2.72	2.71
		(3.058)	(2.801)	(2.822)	(1.734)	(1.743)	(1.74)
	Refinance - Do not Refinance	1	0.88	0.89	2.4	2.19	2.18
		(2.881)	(2.77)	(2.783)	(1.57)	(1.534)	(1.525)
	Refinance - Renters	0.97	0.94	0.96	1.25	1.06	1.04
		(2.798)	(2.788)	(2.792)	(1.721)	(1.71)	(1.701)
Controls			✓	✓		✓	✓
State FE		✓		✓	✓		✓
Month and year FE		✓	✓	✓	✓	✓	✓
Recession dummy		✓	✓	✓	✓	✓	✓
Obs		32,825	32,550	32,550	114,854	113,130	113,130

Note: The table shows the consumption response of households who refinance their loan and the differential response against households who do not refinance, and renters, to a lagged one standard deviation expansionary LSAP shock. The sample period is restricted to 2007Q1 to 2018Q2. There are 4 states identified as severely affected states- California, Arizona, Florida and Nevada. Loan adjustment is a categorical variable which divides households into households who own a home and adjusts loan, households who own a home and do not adjust, and households who rent a home. The base category for loan adjustment variable is households who own a home and adjust loan. All regressions include twelve lags of the monetary policy shocks. All observations are weighted by the sample weights calculated by BLS. Standard errors are clustered at the state level. P-values are calculated using delta method. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

lags and a positive but insignificant effect for longer lags. In this section, I run the baseline specification for Forward Guidance shock for the period of 1996Q1 - 2007Q4. This shorter sample measures the effect of forward guidance before the financial crisis. The results are presented in Table 2.7.

Across all specifications, Forward Guidance shocks do not significantly affect consumption at the shorter horizon. Consumption responds significantly to shocks on the medium horizon and the response dies down for longer horizons. More specifically, the cumulative impact of four quarters of one standard deviation Forward Guidance shock one year ago on consumption growth of households today is 2-4% on average. There is no significant difference in growth in consumption response across household categories.

The effect of Forward Guidance shock on household consumption growth during the period of Great Recession is largely insignificant (Table 2.7). One potential explanation for the result is the relative effectiveness of LSAP shocks in influencing bank lending during the financial crisis. Rodnyansky and Darmouni (2017) show that the LSAP measures targeting mortgage backed securities resulted in an aggressive increase in bank lending. The large effect of the Fed's LSAP program on long term rates potentially overshadowed the impact of Forward Guidance, thus weakening the refinancing channel of transmission of Forward Guidance shocks.[14]

2.6 Conclusion

In this paper, I find that the Fed's influence on the housing loan market through the LSAP policies, in particular, increases aggregate consumption. The effect is more pronounced for households who directly benefit from the low rates by refinancing their home mortgages. An expansionary monetary policy lowers mortgage rates and allows homeowners to extract

[14]See Gagnon et al. (2011).

Table 2.7: Differential effect of Forward Guidance shock on consumption growth

Dep. Var: $\Delta logC_{h,t}$		(1)	(2)	(3)
1st year impact	Refinance their Loan	-1.38	-0.79	-0.8
		(2.07)	(2.093)	(2.091)
	Refinance - Do not Refinance	-0.01	-0.14	-0.12
		(1.774)	(1.797)	(1.792)
	Refinance - Renters	0.84	0.68	0.69
		(1.843)	(1.868)	(1.862)
2nd year impact	Refinance their Loan	3.03*	3.24*	3.23*
		(1.662)	(1.7)	(1.7)
	Refinance - Do not Refinance	0.73	0.64	0.63
		(1.236)	(1.301)	(1.305)
	Refinance - Renters	0.7	0.59	0.59
		(1.242)	(1.326)	(1.332)
3rd year impact	Refinance their Loan	0.4	0.45	0.46
		(1.51)	(1.644)	(1.645)
	Refinance - Do not Refinance	-0.81	-1	-1
		(1.525)	(1.596)	(1.594)
	Refinance - Renters	-0.34	-0.62	-0.62
		(1.637)	(1.737)	(1.735)
Controls			✓	✓
State FE		✓		✓
Month and year FE		✓	✓	✓
Recession dummy		✓	✓	✓
Obs		177,447	172,504	172,504

Note: The table shows the consumption response of households who refinance their loan and the differential response against households who do not refinance, and renters, to a lagged one standard deviation expansionary LSAP shock. The sample period is restricted to 1996Q1 - 2008Q4. Loan adjustment is a categorical variable which divides households into households who own a home and adjusts loan, households who own a home and do not adjust, and households who rent a home. The base category for loan adjustment variable is households who own a home and adjust loan. All regressions include twelve lags of the monetary policy shocks. All observations are weighted by the sample weights calculated by BLS. Standard errors are clustered at the state level. P-values are calculated using delta method. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

home equity via refinancing, resulting in higher disposable income. Higher disposable income converts into higher consumption for debt constrained households relative to homeowners who do not refinance, and households who do not own a house.

This differential response of household consumption is dependent on the local housing conditions. Homeowners in states with severe crash in housing prices during the 2008 recession were constrained by their low or negative home equity. Thus, their capacity to refinance and extract home equity was limited by the floored prices in their region. This is reflected in the positive but insignificant response of average consumption to monetary policy in distressed states. However, households in less distressed states could successfully refinance their mortgages following a monetary policy shock, and thus, increased their consumption on average. The result for LSAP policy shocks is robust to alternative data adjustments and consumption measures. Lastly, the Fed's policy of Forward Guidance is effective at stimulating consumption with approximately a one year lag. The policy's influence on household consumption growth during the period of financial crisis is, however, ambiguous.

The result shows that heterogeneities across households and regions significantly affect the transmission of monetary policy to real economy. An emphasis solely on aggregate measures of monetary policy can overlook these effects and result in exacerbating inequality. The evidence in the paper highlights the importance of incorporating heterogeneous agents in theoretical models studying monetary policy.

Chapter 3

Stock Returns of Federal Reserve Officials

In order for central banks to function effectively, they must be trusted institutions. However, allegations in late 2021 regarding the market operations of Federal Reserve officials may have served to undermine this trust. In particular, a series of large volume and well-timed trading activities by some officials have raised questions about whether Federal Reserve insiders used their unique information advantage to outperform the market. These transactions have been particularly concerning in recent years given the large swings in financial markets and highly accommodative monetary policy.

The financial disclosures in 2021 showed that three members of the Federal Open Market Committee (FOMC) had actively traded in 2020. Most of these transactions were large in volume and consisted of individual stocks and bonds. In 2020, Eric Rosengren, then President of the Boston Fed, traded in real estate investment trusts (REITs) constructed from mortgage-backed securities. These trades occurred while the Federal Reserve actively pursued Quantitative Easing policies that involved purchases of mortgage-backed securities,

thereby significantly affecting their value. Similarly, Richard Clarida, former Vice Chair of the Fed, was criticized for re-balancing his portfolio in February 2020, only a day before the Fed released a press statement announcing plans to safeguard the economy from the evolving risk of coronavirus on economic activity. Robert Kaplan, former President of the Dallas Fed, has been questioned for his many multi-million dollar trades in individual securities and interest-rate funds without citing a clear date for his transactions (The Wall Street Journal, 2021b). Media and government have since raised questions about whether Federal Reserve officials were using insider information on Fed's policies to make opportunistic trades. In a letter to the Securities and Exchange Commission, Senator Elizabeth Warren asked for a review of financial transactions of Federal Reserve officials to determine the legality of these transactions (The Wall Street Journal, 2021a). While no allegations were substantiated, between 2020 and 2021, all of the above three Federal Reserve officials resigned from their positions, citing various reasons (The Wall Street Journal, 2021c).

In his testimony to Congress in September 2021, Jerome Powell, the chair of the Federal Reserve, announced his intentions to update the rules regarding trading practices of Federal Reserve officials. The new rules prohibit central bankers from holding and trading individual stocks and bonds, sector funds, agency securities, cryptocurrencies, commodities, or foreign currencies, as well as, entering into derivative contracts and engaging in short sales. Senior Fed officials are also required to announce non-retractable notice for trades at-least 45 days in advance, obtain prior approval of their investment plans, hold their investments for longer periods, and face tighter requirements on financial disclosures. Aside from regular FOMC meetings, trading will also be restricted during periods of heightened financial market stress (Federal Open Market Committee, 2022). These rules are designed to strengthen the public's confidence in the monetary policymakers. The FOMC formally adopted the new rules in February 2022.

As policymakers, members of the FOMC have significant information advantage about the

future path of interest rates and upcoming changes in monetary policy.[1] It is therefore important to analyze whether trade portfolios of these individuals reflect the superior information they have over other investors. Indeed, according to the literature on informed trading (see, e.g., Bernile et al. 2016, Nicola 2021), there is evidence of higher returns before macroeconomic news and FOMC announcements. In particular, Nicola (2021) find that information leaks from Fed officials to institutional investors can explain significantly higher stock market returns before the scheduled FOMC announcements. We argue that superior information about monetary policy could also be used by Fed officials towards enhancing their personal portfolio performance.

In this paper, we analyze the financial market transactions of FOMC members to study whether Fed officials benefit from opportunely timing their stock market transactions. The accusations of misuse of insider information against FOMC members have three main components. First, the informational advantage of FOMC members allows them to trade better performing securities, which was most notable in the criticisms against Eric Rosengren. Second, FOMC members can also use their informational advantage to adjust their portfolio in favor of the asset class with the best returns, as was made clear in the accusation against Richard Clarida. Third, incomplete financial reporting may allow FOMC officials to hide details about their trading activities. While the paper cannot address any reporting oversights, the data suggests that this issue is largely limited to Robert Kaplan's transactions.

To test whether the insider information about monetary policy is reflected in average transactions of FOMC officials, we ask the following questions. 1) Do the returns earned by FOMC members beat the average returns of the market? 2) Is there any evidence that the trading behavior of FOMC members is different around monetary policy announcements,

[1]The literature on Fed information effect suggests that Federal Reserve officials also hold an informational advantage about the future path of the macroeconomy. However, Bauer and Swanson (forthcoming) find evidence disputing the theory that Fed officials hold superior macroeconomic information than private forecasters. We are agnostic about the source of information advantage and focus our analysis on whether these advantages materialize into high portfolio returns for Fed officials.

particularly announcements with surprise changes in monetary policy? 3) Do FOMC members strategically rebalance their portfolio to take advantage of surprise monetary policy announcements?

Building upon the literature examining abnormal returns of members of Congress, we calculate the stock market returns of members of the FOMC to test whether portfolios of FOMC members earn higher returns than the market. To test whether FOMC members incorporate superior private information about upcoming rate changes, we measure the response of abnormal returns on FOMC portfolios to changes and surprises in monetary policy. To test whether there is any opportunistic rebalancing of portfolios, we evaluate the relative and absolute returns of stock and bond market indices following every transaction.

We find no evidence of abnormal returns on portfolios of FOMC members. In fact, our results suggest that if anything, stocks returns of members of the FOMC may under perform relative to the overall market. One possible explanation for the relative poor performance is the restrictions on trade by Fed Board members and other senior officials around the FOMC meeting dates, constraining the trades by FOMC members. Lucca and Moench 2015 show that average stock market returns increase by 0.5% just before the scheduled FOMC announcements. More broadly, Cieslak et al. (2019) show that the markets exhibit higher excess returns in even weeks starting from the week prior to the scheduled FOMC meeting. The timing constraints imposed by Federal Reserve trading policies may prevent Fed officials from maximizing their returns. We also do not find any evidence that transactions of FOMC members reflect the direction of monetary policy decisions. However, we cannot rule out the use of superior information by FOMC members to re-balance their portfolios against stocks.

The structure of the paper is as follows. Section 3.1 reviews the relevant literature. Section 3.2 discusses the data and methodology. Section 3.3 estimates the abnormal returns of FOMC members. Section 3.4 analyzes the market timing of transactions. Section 3.5 considers the robustness of our results. Section 3.6 concludes.

3.1 Related Literature

Our paper is closely related to the literature examining the abnormal stock market returns of members of the United States Congress. Ziobrowski et al. (2004) look at the portfolios of U.S. Senators during the period 1993-1998 and find evidence of significantly positive excess returns on these portfolios. Building on their paper, Ziobrowski et al. (2011) look at the portfolio of members of U.S. House of Representatives between 1985 to 2001 and find further evidence of positive abnormal returns. Similar results are found in Cherry et al. (2017) and Stephan et al. (2021). Abdurakhmonov et al. (2022) find evidence that, at least in the short-term, these abnormal returns are larger when stocks are purchased by members of Congress who have direct jurisdiction over the firm.

However, other recent studies by Eggers and Hainmueller (2013) and Belmont et al. (2022) find no evidence of superior performance of portfolios of U.S. House and Senate representatives in the recent years. On the contrary, they find some evidence of under-performance by these portfolios compared to the average investor.

All of the above studies limit their analysis to the policymakers in the Congress. Our paper departs from the above literature by studying the abnormal returns of FOMC members. The actions of central bank have large impacts on the stock market, which has been evident in the aftermath of the pandemic. We bridge an important gap in the literature on the investment behavior of public officials by analyzing the returns of monetary policymakers.

3.2 Data and Methodology

3.2.1 Data

We obtain data on Federal Open Market Committee (FOMC) members from financial disclosure statements.[2] These statements are available upon request from regional Federal Reserve banks and the Federal Reserve Board.[3] The statements contain detailed records of the financial market transactions of each FOMC member that include the date of transaction, name of security, type of transaction, and the bin of transaction size.[4] Data on select FOMC members is available from 2009 through 2022. However, the analysis in this paper restricts the sample to 2015-2021 due to the higher volume of transactions in the later years.[5] Data on financial markets are obtained from Bloomberg and Center for Research in Security Prices (CRSP).

Close to three quarters of trades in our sample are under $50,000 in size, and approximately 20% of transactions are over $50,000 but under $250,000. Only 6.6% of transactions are over $250,000. We categorize our data into three broad categories based on Bloomberg's security classifications: common stock, equity focused funds, and fixed income securities. Common stocks include securities that are classified as ADRs and Tracking Stocks; both of these form a very small proportion of the sample. Equity focused funds consist of all funds that are focused on investing in equities, which includes mixed allocation funds. Fixed income securities includes all bond focused funds and money market securities. Any security

[2]More accurately, we obtain data on all members on the Board of Governors and Reserve Bank Presidents, regardless of whether they are voting members on the committee in a given year.

[3]Financial disclosure statements for Federal Reserve Board of Governors are available for download from the Board's website.

[4]Fed officials are not required to state the exact value of their transaction, only the bin to which each transaction belongs. Moreover, the size of the bins varies across the Federal Reserve System. We consolidate this information across reports and group transactions into five bins. Table C.2 provides a summary of all bins reported.

[5]There are a total of 58 trades between 2009 and 2014, though we only have trading data for 29 of these trades. Including these trades in our analysis does not change the results.

classification which is not contained in the above three categories are reported as "Others". This include Real Estate Investment Trust (REITs), Real Estate focused funds, private equity funds, state and municipality bonds, and University of California retirement funds. Approximately 20% of our sample contains transactions in common stocks, another 34% are equity-based funds, and 20% are fixed income securities and funds.[6] It is also interesting to note that less than 20% of transactions in fixed income securities are sale of securities while transactions in stocks are equally split between purchases and sales. Our baseline analysis includes all assets categorized as common stocks as well as funds that focus on equities. We also extend the baseline analysis for different portfolio constructions: a portfolio of only common stock, a portfolio of only fixed income securities, and the full portfolio combining all assets for which we have pricing data.

The trading activity also varies heavily by individuals, with Lael Brainard, Jerome Powell, Eric Rosengren, Robert Kaplan, Patrick Harker, and Lorreta Mester accounting for over 81% of all transactions. However, all of Robert Kaplan's transactions are ambiguous on the date on which the trades are executed, with the date column listing the term "Multiple dates" for each transaction. 89% of these trades are over $100,000. The lack of clarity regarding dates likely results in under-counting of Kaplan's trades. The ambiguity on dates also limit our sample of transactions for Fed chairman, Jerome Powell. Approximately 37% of Powell's transactions are dropped from the sample due to lack of a clear recorded date. Over 93% of these transactions are under $100,000. Our data includes the exact date of transactions for all remaining Fed officials.[7]

It is also interesting to note the variation in frequency of trading among other FOMC members, with Raphael Bostic, James Bullard, Charles Evans, and Esther George reporting zero trades in the past four years. While the lack of any trading activity may be puzzling, it is important to note that the forms only disclose purchases, sales, or exchanges of real estate

[6]Table C.1 summarizes the frequency of trades by the size of transactions and asset class.
[7]Table 3.1 summarizes the trading activity of each individual FOMC member by year.

or securities in excess of $1,000.[8] We cannot rule out the possibility of omission of some trades by FOMC members, potentially due to errors in reporting. However, given the role of ethics officers in this process, we would expect this to be minimal.

Finally, we exclude the following from our empirical analysis: (1) All transactions recorded to have occurred over "Multiple dates". This drops all transactions by Robert Kaplan from our sample, and roughly 37% of all transactions by Jerome Powell. (2) All transactions which do not involve a purchase or sale of security and are listed as "Exchange". (3) Transactions that do not specify whether they are purchase or sale (missing type of transaction). This excludes 8 transactions by Thomas Barkin. (4) All assets for which Bloomberg pricing data is not available, which includes private equity funds as well as state and municipal bonds. After making the above adjustments, our sample contains a total of 1045 transactions from 14 Fed officials, over a period from 2015 to 2021.[9] We also exclude bonds and bond-based funds from our baseline analysis although we reintroduce them when discussing the full portfolio in Section 3.5.

3.2.2 Methodology

To assess whether members of the FOMC have earned superior returns on their investments, we use two approaches: the buy-and-hold abnormal returns (BHAR) approach and the calendar-time portfolio approach. The BHAR approach, which provides our preferred estimates, calculates the abnormal returns of an investment relative to a benchmark. In

[8]Moreover, the disclosures don't include the following: (1) a personal residence, unless rented out; (2) cash accounts (e.g., checking, savings, CDs, money market accounts) and money market mutual funds; (3) Treasury bills, bonds, and notes; and (4) holdings within a federal Thrift Savings Plan account. Additional exceptions apply.

[9]To avoid over-weighing repeat trades we combine the transactions of the same type for the same stock on the same date by the same individual. This reduces our effective sample size to 946 transactions.

particular, BHAR is given by

$$BHAR_{i,t,h} = \prod_{t=t_0}^{t_0+h}(1+R_{i,t}) - \prod_{t=t_0}^{t_0+h}(1+R_{b,t}), \tag{3.1}$$

where $BHAR_{i,t,h}$ is the BHAR of asset i over horizon h, t_0 is the date of the trade, and $R_{i,t}$ and $R_{b,t}$ are the returns of the asset and the benchmark, respectively, on day t. We calculate the BHAR relative to two benchmarks. The first benchmark is the CRSP Value-Weighted Index, which gives an estimate of daily overall fluctuation in the stock market. Our second benchmark is the Daniels Greenblatt Titman and Wermers (DGTW) size-value-momentum matched portfolio as described in Daniel et al. (1997). We then take the average BHAR across all trades to obtain the mean BHAR for the portfolio. A positive mean BHAR would indicate that a portfolio's transactions outperformed the benchmark on average. This methodology is testing for whether there are abnormal returns but is agnostic about the reason for these abnormal returns (e.g., better stock picking, better market timing).

The results are calculated and reported separately for purchase and sale transactions. This is due to the fact that positive abnormal returns on purchases are desirable, as they indicate that assets outperformed the market after being added to the portfolio. However, for sales, these positive abnormal returns would indicate that assets outperformed after they left the portfolio, which would be undesirable.

To complement our BHAR results – and to address any potential concerns with this approach (see Kothari and Warner 2007 for an overview) – we also consider the calendar-time portfolio approach (CAPM). The CAPM approach works as follows – first, we construct a portfolio using any corresponding trades made within a particular time period; we will consider all trades made within the previous year.[10] Next, we calculate the daily return for this constructed portfolio which is aggregated into monthly return. These monthly returns

[10]The results are qualitatively similar if shorter horizons are considered instead.

are then included in a regression of the form

$$R_{p,t} - R_{f,t} = \alpha_i + \beta(R_{m,t} - R_{f,t}) + s_p SMB_t + h_p HML_t + \epsilon_{p,t},$$

where $R_{p,t}$ is the monthly portfolio return at time t, $R_{f,t}$ is the risk-free rate, and $R_{m,t}$ is the market return which we calculate as the CRSP value-weighted index at time t. The constant term α in this regression indicates whether there are any abnormal returns to account for risk.[11] The β accounts for the sensitivity to the excess market return, s_p accounts for the sensitivity to the difference in returns between a portfolio of small cap stocks and a portfolio of large cap stocks, and h_p accounts for the sensitivity to the difference in returns from a low book-to-market portfolio to a high book-to-market portfolio.

The calendar-time portfolio approach is conducted in two ways: using an equally-weighted portfolio and using a trade-weighted portfolio. Under the equal weight portfolio, each trade contributes equally. Under the trade weighted portfolio, each trade is weighted by the midpoint of minimum and maximum of the trade value.[12]

3.3 Security Selection

3.3.1 BHAR Approach

Figure 3.1 shows our baseline estimate of the mean BHAR of both purchases and sales for all FOMC members for whom data is available for up to one year (255 trading days) after the

[11] One may be concerned that the insider information is driving β rather than α (e.g., FOMC members switch from more sensitive stocks to less sensitive stocks when they anticipate bad news), but if this was the case, the difference should be picked up by the BHAR approach.

[12] There are a few transactions with no max value. For these transactions, the minimum value was used instead of the midpoint. There might be some concern about the introduction of measurement error due to the imputation of the midpoint of each bin. However, the transaction size of trades only enters our analysis in determining the relative weighting when calculating trade-weighted portfolio returns. Any concern about the transaction size is addressed by the consistency of results when using equally-weighted portfolios.

transaction date. These results suggest that purchases by FOMC members underperformed relative to the CRSP benchmark, which is contrary to the spirit of the recent allegations, though the results are only significant at shorter horizons. Sales also underperformed relative to the benchmark, though the estimates are not significant at any horizon. While the negative abnormal returns of sales is consistent with the recent allegations, the estimates of the abnormal returns for purchases are more negative than those for sales at most horizons. Taken together, these results suggest that the returns of FOMC members are not superior. To the extent that something is unusual, it is that the overall returns are lower than we would expect. Not only are purchases significantly negative at shorter horizons, they constitute a much larger portion of transactions.

Numerical estimates of Figure 3.1 at one month, three month, six month, and one year horizons can be found in Table 3.2, Part A. We can see that relative to the CRSP benchmark, assets purchases by FOMC members underperformed by 1.2%, 0.6%, and 1.6% at the 3-month, 6-month, and 1-year horizon, respectively, though only the results at the 3-month horizon are significant. On the sale side, assets earned -1.1%, 0.1%, and -0.1% relative to the CRSP benchmark at the 3-month, 6-month, and 1-year horizon, respectively, though none of these results were significant.

In addition to the estimates using the CRSP benchmark, Table 3.2 also shows the results relative to the DGTW benchmark. Since the DGTW benchmark is comparing these assets to other assets with similar characteristics, the abnormal returns may be more precise than just comparing to the overall stock market. The estimates relative to the DGTW benchmark are similar to those relative to the CRSP, though the estimates of abnormal returns for sale transactions are closer to those of the purchases. In particular, at the 3-month, 6-month, and 1-year horizon, purchases significantly underperformed by -1%, -1.2%, and -2.6% while sales underperformed by -1.4%, -1.3%, and -3.3%.

Individual level estimates of the most frequent trading FOMC members are shown in Table

3.2, Part C. Although the lower number of transactions, particularly on the sell side, make these estimates less representative, they are still interesting and broadly consistent with the overall results. Estimates of Eric Rosengren's abnormal returns are worse than the FOMC overall. In particular, the assets outperformed by over 10% in the year after he sold them, which is contrary to any allegations that he was profiting from superior knowledge. Chair Jerome Powell, who would likely have the largest informational advantage of any FOMC member, has a mean BHAR of -5.1% and -6.7% on purchases and sales, respectively, after one year.

3.3.2 Calendar-Time Portfolio Approach

In addition to the BHAR approach shown in the previous section, we also calculate excess returns using the calendar-time portfolio approach and accounting for systematic risk factors from Sharpe (1964), Fama and French (1992), and Fama and French (2015). The results, which are shown in Table 3.3, are broadly consistent with those shown in the previous section. The alpha values, which can be thought of as the excess return, are negative for the buy portfolio in all cases and positive for the sell portfolio excluding the CAPM, but not statistically significant for either portfolio under any model. Using the Fama-French 3-factor model on equally weighted portfolio, we find that purchase transactions have an alpha of -0.19 – approximately -2% annually – while sale transactions have an alpha of 0.02. It is also worth noting that the β in the majority of specifications is less than 1, suggesting that FOMC officials are purchasing stocks and funds that tend to be less volatile than the overall market. To the extent that this is true, some of the underperformance found in the previous section for both purchases and sales may be due to the lower level of risk being taken.

In total, these results indicate that the FOMC does not systematically outperform the market, which suggests that the FOMC either does not have superior information to market

participants or, for whatever reason, does not incorporate this information into their personal trading decisions. Of course, our results do not apply to individual trades, some of which may have outperformed for this very reason. However, to the extent that these trades exist, they are relatively infrequent and not sufficiently profitable to drive the overall results.

3.4 Market Timing

It is possible that rather than selecting assets that outperform the market, FOMC members are able to more effectively time financial transactions due to superior information about upcoming changes in monetary policy. Figure 3.2 shows when trades were executed, relative to the nearest regularly scheduled FOMC meeting. As Figure 3.2 indicates, there were relatively few trades made in the week or two leading up to an FOMC meeting, which would likely be the most beneficial time to make trades informed by monetary policy. This is likely predominantly due to the FOMC's financial blackout periods. The trading blackout period typically begins on the Saturday prior to a week before an FOMC meeting and lasts till the final day of an FOMC meeting, which is usually a Wednesday.[13] However, there are some trades made during this period; potential explanations can include long-scheduled programmed payouts or oversights on timing from financial advisors (Bialek, 2022).

In this section, we test whether FOMC officials use their superior information about monetary policy to better time their transaction.

[13]The new rules that the FOMC adopted in Februrary 2022 extended the financial blackout period by one day, so that it matches the external communication blackout period.

3.4.1 Security Selection and Market Timing

First, we directly test whether FOMC officials use their superior information about monetary policy to better time the purchase or sale of particular securities. To measure the extent of this superior information on market timing, we use two measures: the actual change and the surprise change in the Federal Funds Rate at the next regularly scheduled FOMC meeting after a transaction. The idea is that the abnormal returns that FOMC members can earn is higher when there are large (surprise) changes in monetary policy.[14] The results for this estimation are shown in Table 3.4, Part A. These results show that trades made prior to large changes in monetary policy – whether anticipated or unanticipated – did not appear to systematically earn higher short-term returns, which support the conclusion that FOMC members were not benefiting from knowledge about monetary policy decisions.

There might be concerns that FOMC members are able to benefit from the information communicated in Federal Reserve speeches, particularly those made by the Federal Reserve Chair. This is particularly important during our sample period as more public correspondence from FOMC officials has resulted in smaller surprises from FOMC meetings. Indeed, the trades by Richard Clarida received substantial criticism for closely preceding a significant statement released by the Chair Jerome Powell. We focus solely on speeches made by the chair because these speeches appear to contain the most information and have the largest impact on financial markets. Neuhierl and Weber (2019) show that speeches by Fed chair and vice chair contain information on path of interest rate and future conduct of monetary policy. Similarly, Rosa (2016) show that only communication by the Fed chair significantly increases asset price volatility and trading volume. We address the issues of market timing with respect to Fed speeches in Part B of Table 3.4. Our sample contains 129 speeches by the chair between April 2015 and May 2021. We test whether trades made prior to speeches that

[14] Our independent variable is the absolute change in target and surprise measures of monetary policy to measure the size of change, independent of its direction.

cause surprise rate changes earn higher abnormal returns. On average, we find no evidence of market timing by Fed officials with respect to speeches by Fed chairs. The results are statistically insignificant except for sales which are positive and weakly significant at three months horizon.

3.4.2 Asset Allocation and Market Timing

Our results clearly show that FOMC members do not systematically choose particular securities that outperform the corresponding benchmark. Further, we do not find any evidence that FOMC members use information about monetary policy surprises to buy and sell particular securities that would benefit from upcoming monetary policy decisions. However, our analysis has not yet addressed the question of whether FOMC officials appear to be able to benefit by timing the market when rebalancing their portfolio (e.g., selling stocks in favor of other assets classes), which may be motivated by knowledge about monetary policy.

Figure 3.3 shows the bifurcation of Figure 3.2 by asset class and type of transaction. The purchases panel indicates that FOMC officials are actively purchasing both stocks and bonds but it does not correlate strongly with the FOMC meeting cycle. However, the sales panel indicates that there are few and infrequent bond sales across the FOMC cycle, but a relatively large amounts of stock sales that occur just before the FOMC blackout period.

Superior information about the future path of interest rates could allow FOMC officials to avoid potential loses by adjusting their portfolio. For example, news about a positive interest rate shock can potentially lower the price of both stocks and bonds. A well-timed sale of stocks, for instance, would then result in avoidance of future losses. In this section, we want to address whether FOMC members use their information about monetary policy to make such adjustments.

One simple way to answer this question is to consider the relationship between monetary policy surprises, which proxy for additional information available to FOMC members, and transactions made by these officials. In other words, are FOMC officials more likely to sell (buy) stocks and, to a lesser extent, bonds before a positive (negative) surprise shock. We estimate this by calculating the Kuttner surprise of the FOMC meeting immediately succeeding a transaction. We calculate these surprises separately for purchases and sales of both stock-based and bond-based assets and take the average across all transactions for each asset class and transaction type. The results are shown in Table C.6. In all cases, the average surprise change was negative. For the full sample, the average policy surprise is more negative for sales than for purchases, which is surprising as negative policy surprises are typically associated with higher stock prices. If we restrict the sample to the three weeks prior to an FOMC meeting, this relationship reverses. Given the large volume of stock transactions close to FOMC meetings, as well as the fact that information would be clearer and more valuable closer to FOMC meetings, the more focused results seem more appropriate here. We also repeat the process with the monetary policy factors from Swanson (2021b). Aside from forward guidance, there is no clear difference in these measures between purchases and sales.

One concern about the above approach is that we are only considering the monetary surprise at the upcoming meeting. This potentially ignores monetary policy surprises in the interim that arise from other events, like speeches by Fed chair. Further, it is not clear how to determine if the results in Table C.6 are significant. To address for these shortcomings, we consider a separate approach that examines the cumulative return in the period following the transaction.

An alternative way to test whether FOMC officials are advantageously adjusting the asset allocation of their portfolios is to examine the market returns for each asset class following their transactions. In our baseline analysis (Section 3.3.1), we calculate how an asset

transaction performs relative to the asset's benchmark (e.g., returns on a stock transaction is compared to the stock benchmark). However, that does not allow us to capture the return relative to other asset classes, such as whether a stock sale proceeds a period in which the market return on stocks is lower than the market return on other assets. In particular, it may be the case that individuals rebalance their portfolio towards or away from stocks, as they are more volatile than bonds and may respond differently to some types of policy news.

To test whether FOMC officials are adjusting their portfolio between asset classes, we calculate the relative market return between stocks and bonds following each purchase and sale transaction. We then average these returns across all transactions for each asset class. The relative returns as calculated follows:

$$V_{t,h} = \prod_{t=t_0}^{t_0+h}(1 + R_{m,t}) - \prod_{t=t_0}^{t_0+h}(1 + R_{b,t}),$$

where $R_{m,t}$ represents the return of the stock market and $R_{b,t}$ represent the return of the bond market index. If $V_{t,h}$ is positive, then the stock market outperformed the bond index over the given horizon. To account for the possibility that individuals may simply liquidate their position rather than rebalance their portfolio, we also calculate the cumulative average return separately for stocks and bonds for both purchases and sales.[15] However, given the concerns about Vice Chair Clarida were largely related to rebalancing, we focus on the relative market return.

These results, which are shown in Table 3.6 Part A, are mixed. Each cell shows the average market return of stocks relative to the market return of bonds for 1 month and 3 months horizon from the date of transaction. If we look at relative returns on bond purchases, we find that on average, after FOMC officials purchased bonds, stock market significantly outperformed the bond market at both 1 month and 3 month horizon. This is true for

[15]These results, which are shown in Part B of Table 3.6, are broadly consistent with those in Part A of Table 3.6.

bond purchases even when we restrict our sample to purchases that happened within three weeks prior to a FOMC meeting. Similarly, we see little evidence that bonds are sold at advantageous times, both for the full and restricted sample.

Looking at stock market transactions, we do not find evidence that stock purchases are well timed, at least at the 1-month horizon. However, following the sale of stocks by FOMC members, the stock market significantly underperforms the bond market at both the 1- and 3-month horizon. This is perhaps concerning given both the large amount of stock sales that occur shortly before the FOMC blackout period as well as the fact that we would expect this measure to be positive on average, as stocks tend to outperform bonds over the long-run.

In some ways it is difficult to conclusively test for the presence of insider information in adjustment of portfolio as we do not observe the exact monetary value of each transaction in the financial disclosures. Moreover, there is no prevalent methodology to test how insider information can be used to re-balance portfolios between different asset class. In this section, we present two different ways of testing whether FOMC officials are using information advantage for personal gains. When we look at surprise monetary policy shocks, on average, we do not find any evidence that the FOMC trading pattern reflects future monetary policy surprises. However, when looking at relative market returns, we do find that on average, FOMC officials tend to sell stocks prior to periods in which stocks underperform relative to bonds. Thus, we cannot completely rule out potential market timing of stock sales by FOMC officials.

3.5 Robustness

In this section, we consider the robustness of our results to alternative portfolio construction, alternative timing, and alternative monetary policy factors. We also consider the trades of

senior FOMC staff members, who may have had similar information sets to members of the FOMC.

3.5.1 Alternative Portfolios

We provide estimates of the mean BHAR under alternative constructions of the portfolio, which are shown in Table 3.5. In addition to our preferred portfolio, which consists of all common stocks and stock-based funds as well as alternative investments like REITs, we also provide estimates for three other portfolios. The Common Stocks portfolio consists of only common stocks and ADRs and excludes all funds. The Bond Portfolio consists of bonds and bond-based funds. The Full Portfolio consists of all assets for which trading data is available, which includes bond-based funds as well as everything in baseline portfolio. These added bonds and bond-based funds are benchmarked relative to the S&P U.S. Aggregate Bond Index.[16]

The goal of estimating the mean BHAR for different portfolios is twofold. First, it shows that our overall results are not sensitive to the inclusion or omission of specific trades. Second, the expected response across assets might be different, depending on the perceived source of the FOMC's informational advantage. In particular, the FOMC may have a greater advantage investing in fixed-income assets given the importance of the federal funds rate.

The estimates for the bond portfolio and full portfolio are qualitatively similar to those in which bonds are removed, which suggests that omitting these transactions does not bias our baseline results. The results on bond portfolio suggest that at the one year horizon sale of bonds significantly underperforms the benchmark by 2.3%. However, it is important to keep in mind that there is only a small number of bond sale transactions over our sample period. If the portfolio is restricted to only common stock, the results are still broadly consistent

[16]The S&P U.S. Aggregate Bond Index is a broad metric that tracks a wide variety of U.S. government, municipal, quasi-government, and corporate bonds.

with the same story: a lack of superior returns by the FOMC. However, the estimates are noticeably different from the baseline. At the three-month horizon, purchases underperform by 2.9% relative to the CRSP while sales underperform by -0.6%.

3.5.2 Trades by Senior Staff Members

In February 2022, a report published by The Wall Street Journal (2021d) highlighted the high frequency of trades in early 2020 by some senior staff members at the Federal Reserve Board amidst Fed's large and frequent interventions to stimulate the economy. In this section, we extend our baseline analysis to the trades conducted by Federal Reserve senior staff members in divisions closely working with the FOMC.[17] Given that senior staff also have access to inside information but serve in a less scrutinized position, it is not unreasonable to believe that their behavior may differ from FOMC members.

The final sample contains trading information of eight senior staff members who reported non-zero trades within our sample period, with majority of trades being conducted by a single staff member. Consistent with the result for FOMC members, we do not find any evidence of insider trading by the senior staff members. On average, we find that both purchases and sales of staff portfolio equally under-perform the market over 12 month period, resulting in a net zero abnormal returns on the hedged portfolio. We restrict the focus of our main analysis to the trading activities of monetary policymakers and relegate the results on staff portfolio to the Appendix.[18]

[17]Because of the large number of staff members working at the Federal Reserve Board, we limited our analysis to Directors, Deputy Directors, and Senior Associate Directors at three divisions: Monetary Affairs, Research and Statistics, and Office of Board Members. We selected these three divisions because their description explicitly states that the researchers here provide background information to FOMC. For example, for the Monetary Affairs division, the description states - "The Division also monitors financial conditions, assists the Board and FOMC in preparing policy communications, maintains records of FOMC deliberations and decisions, ..."

[18]See Table C.3 for details.

3.5.3 Alternative Timing of Transactions

Given that the timing of transactions may positively or negatively affect returns, one useful exercise is to vary the timing of FOMC member transactions and repeat our previous calculations. If FOMC members are constricted by rules and regulations, this variation should, on average, improve returns. However, if FOMC members are using superior information, this variation should make the timing of their trades worse and decrease returns.

Cieslak et al. (2019) argue that most of the equity premium from FOMC announcements are earned over week 0, 2, 4, and 6, between two scheduled FOMC meetings, with week 0 starting on the day before a scheduled announcement day. Due to the constraints imposed by blackout trading periods, Federal Reserve officials cannot completely optimize their returns with respect to the market. Take for example, a recurring stock purchase scheduled by a Fed official two weeks prior to an FOMC meeting (before the beginning of the blackout period). If, as suggested by Cieslak et al. (2019), the average excess returns are higher in even weeks, then transactions by FOMC officials made in odd weeks (due to blackout restrictions) can explain why both purchases and sales of FOMC officials tend to underperform the market.

We first test whether the portfolio of FOMC officials would earn a different abnormal return under an alternative timing. To do so, we randomly adjust the date of transactions within ± 90 days of each transaction. We then calculate the log abnormal returns for all stocks purchased or sold by FOMC members over 1, 3, 6, and 12 month periods. We simulate the data 5000 times alternating the timing of transaction with each simulation. Part B of Table 3.2 reports the mean BHAR and standard deviation for our simulations. Abnormal returns in the first row are calculated relative to the CRSP Value Weighted Index. Abnormal returns in the second row are calculated relative to the DGTW benchmark when possible and to the CRSP Value Weighted Index otherwise. The results are quantitatively similar to our baseline results suggesting that the portfolios of FOMC members are neither under nor

over-performing due to the timing restrictions.

We also test whether the relative and absolute performance of stock and bond indices varies in response to a change in the timing of the transactions. Table C.5 shows the Monte Carlo simulations for the rebalancing exercise introduced in Section 3.4.2. Part A of Table C.5 shows the relative return of stock market index to the bond market index for buy and sell transactions performed within ±90 days of the original transaction; Part B shows the average cumulative return for the stock and bond market, respectively. The most noticeable difference between these results and those under the previous timing is that stock market no longer performs poorly – absolutely or relative to the bond market – following stock sales. Thus, the Monte Carlo simulations raise concerns that, on average, FOMC officials may have avoided unrealized losses by opportunely timing their sales of stocks.

3.5.4 Alternative Monetary Policy Factors

One drawback of only considering the surprise change in the federal funds rate is that it does not take into consideration other monetary policy tools like large-scale asset purchases (LSAPs) or forward guidance as an alternative source of information. To alleviate potential concerns about FOMC officials taking advantage of the information contained in these policy tools, we test whether the results in Table 3.4 are robust to alternative measures of monetary policy shocks. Specifically, we use the shocks from Swanson (2021b), which decomposes each monetary policy announcement into surprise movements in three factors: Federal Funds Rate, Forward Guidance, and LSAPs. Consistent with our baseline results on security selection and market timing, we do not find any evidence of average excess returns by FOMC officials.[19]

[19]Refer to Table C.4 for more details.

3.6 Conclusion

We analyze the trading behavior of members of the FOMC over two main metrics. First, we test whether portfolios of FOMC officials earn abnormal returns and whether these returns can be predicted by surprise monetary policy decisions. We find that there is there is no evidence of abnormal returns on transactions by FOMC officials. Neither can the returns on transactions by FOMC officials be predicted by surprise changes in federal funds rate. Indeed, to the extent that there is any difference between the returns of the FOMC and those of the overall market, it would appear that the FOMC is underperforming the market, perhaps as a result of the inability to fully capture pre-FOMC drift returns.

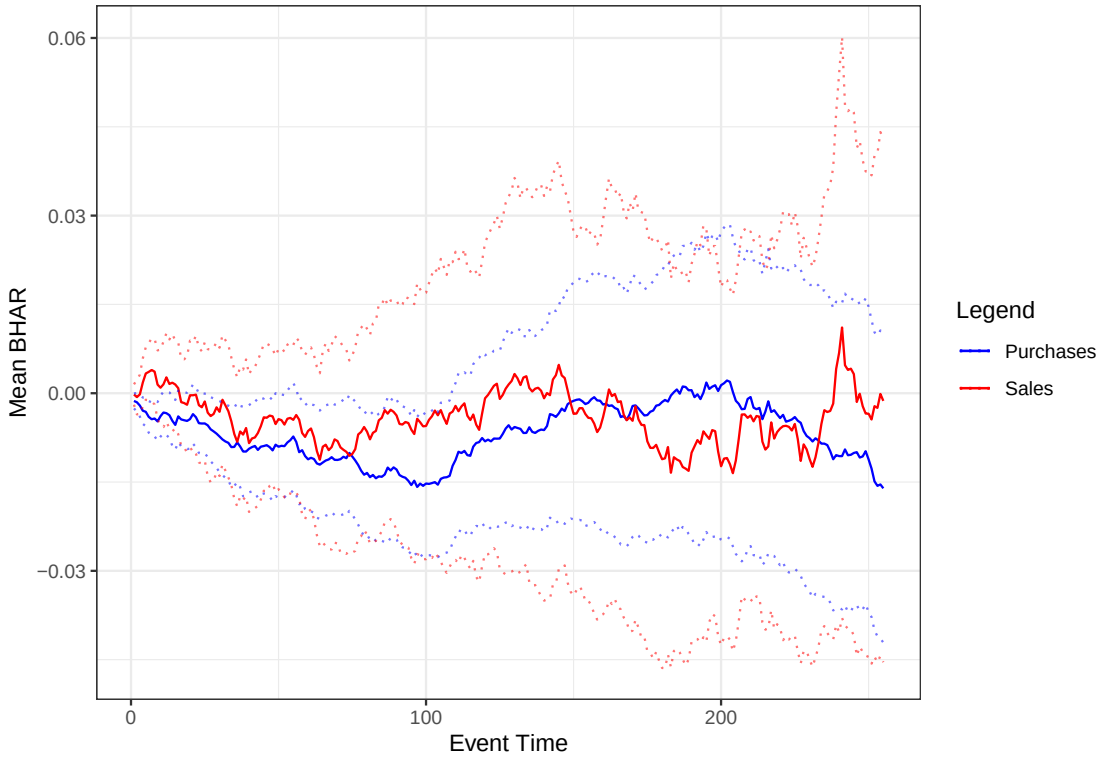
Second, we test whether trades by FOMC officials reflect superior information about future surprise movements in monetary policy. Moreover, do their transactions suggest that they are re-balancing their portfolios to avoid unanticipated future loses in the asset market. We do not find any evidence that trades in stocks or bonds by FOMC officials reflect information about the direction of monetary policy surprises in the future. This result is consistent for surprise changes in federal funds rate, forward guidance, and LSAP shocks. However, we find evidence that FOMC officials sell stocks preceding the fall in return on the stock market relative to the bond market, thus, correctly anticipating and avoiding a lower future return on their stock holdings. However, this mechanism is missing for transactions in bonds. This behavior is slightly puzzling as superior information on monetary policy is potentially more advantageous in predicting future returns in the bonds market.

To conclude, we do not find strong evidence of security selection and abnormal returns by FOMC officials. These results are consistent with some of the recent findings on returns on portfolios of members of Congress (e.g., Eggers and Hainmueller 2013 and Belmont et al. 2022). However, we argue that the recent tightening of regulations may be necessary to ensure better financial reporting in the future, and to restrict the ability of FOMC officials

to perform well-timed transactions. Moreover, if stricter trading regulations on FOMC members remove a perception of misbehavior and result in greater trust in the members of the central bank, such regulations may also improve the conduct of monetary policy.

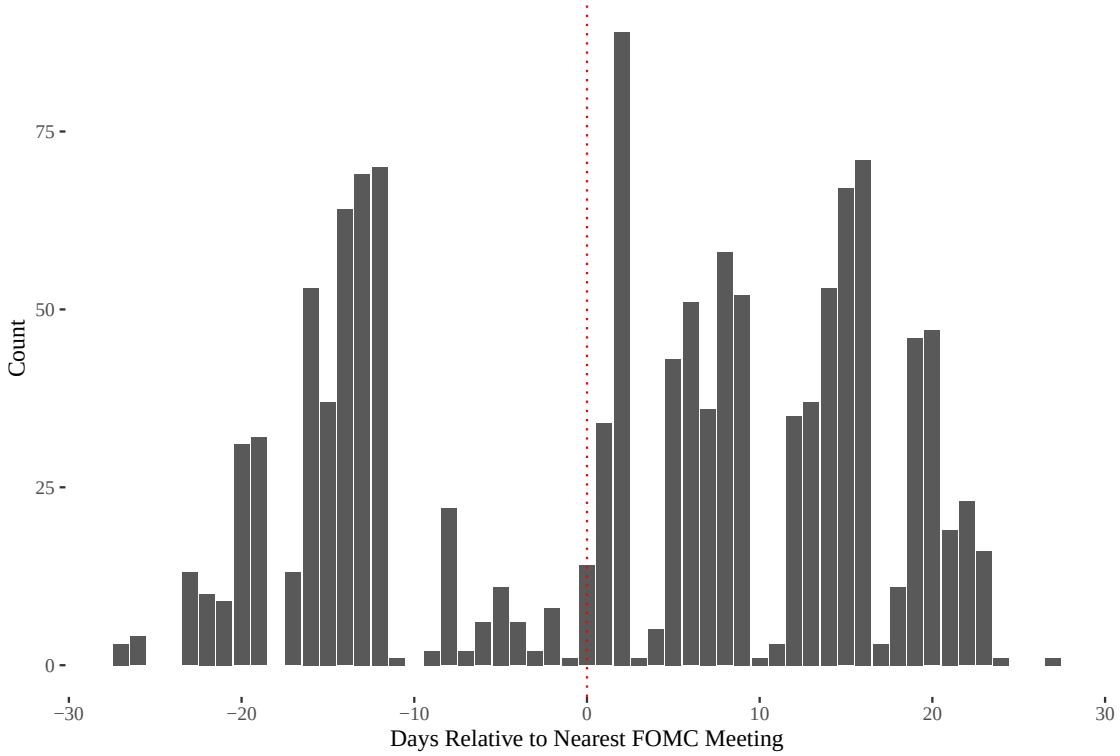
Figures

Figure 3.1: Buy and Hold Abnormal Returns



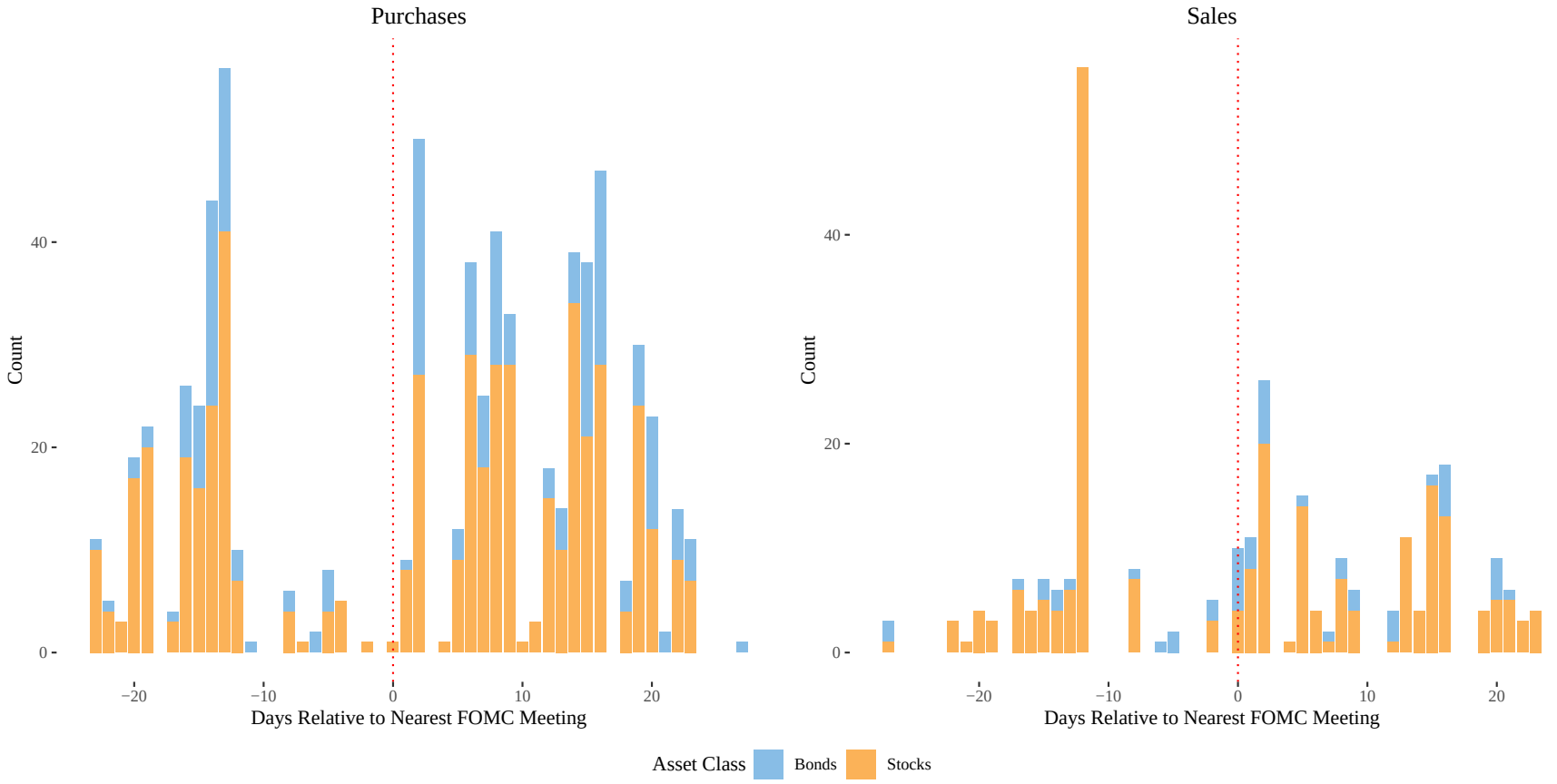
Notes: The solid line shows the Buy and Hold Abnormal Returns for all transaction from the trade date forward. The trade transactions are for FOMC officials over the sample period 2015 to 2021. The returns are the cumulative excess returns from the CRSP Value Weighted Index. The dotted lines are the 95% confidence intervals.

Figure 3.2: Timing of FOMC Trades Relative to Meeting Dates



Notes: The above figure shows the frequency of stock market transactions by FOMC members around the date of scheduled FOMC meetings.

Figure 3.3: Timing of FOMC Trades: Transaction Type and Asset Class



Notes: The above figure shows the frequency of stock market transactions by FOMC members around the date of scheduled FOMC meetings. Stocks include all common stocks and all ETFs comprimising of stocks. Bonds include all fixed income securities, money market securities, and ETFs comprimising of fixed income securities.

Table 3.1: FOMC Members Trading Activity by Year

	2015	2016	2017	2018	2019	2020	2021	Total
Thomas Barkin			2	20	6	5		33
Raphael Bostic			0	0	0	0		0
Michellel Bowman					3	3	1	7
Lael Brainard	6	85	84	133	37	0		345
James Bullard	0	1	0	0	0	0		1
Richard Clarida				14	8	8		30
Mary Daly						0		0
William Dudley	0	16	5					21
Charles Evans		0	1	0	0	0		1
Stanley Fischer	3	23	42					68
Esther George	1	0	0	0	0	0		1
Patrick Harker	13	31	13	17	29	33	23	159
Robert Kaplan		54	41	51	38	47		231
Neel Kashkari	0	2	0	7	0	0		9
Lorreta Mester		30	21	27	21	18		117
Jerome Powell	58	84	62	34	45	26		309
Randal Quarles			12	39	33	2	1	87
Eric Rosengren	0	8	44	37	27	68		184
Daniel Tarullo	1							1
John Williams				4	11	15		30
Janet Yellen		11	28					39
All	82	345	355	383	258	225	25	1673

Notes: The above table summarizes the frequency of stock market transactions by FOMC members, by year. Blanks are years for which the individual does not have an available financial disclosure statement and zero represents no financial transactions reported. Robert Kaplan's transactions are counted twice, one as Purchase and another as Sale, when the type of transaction is listed as "Purchase/Sale".

Table 3.2: Mean BHAR

	Purchases (N=457)				Sales (N=207)			
	1 Month	3 Months	6 Months	1 Year	1 Month	3 Months	6 Months	1 Year
Part A: All FOMC officials								
BHAR Market	-0.004	-0.012**	-0.006	-0.016	-0.000	-0.011	0.001	-0.001
	(0.003)	(0.005)	(0.008)	(0.013)	(0.005)	(0.007)	(0.016)	(0.023)
BHAR DGTW	-0.003	-0.010**	-0.012*	-0.026**	-0.000	-0.014**	-0.013	-0.033
	(0.002)	(0.005)	(0.007)	(0.011)	(0.004)	(0.007)	(0.012)	(0.021)
Part B: Monte Carlo Simulations with Alternate Timings								
BHAR Market	−0.005*	−0.012**	−0.009	−0.012*	−0.003	−0.005	−0.004	−0.002
	(0.003)	(0.005)	(0.007)	(0.007)	(0.006)	(0.011)	(0.012)	(0.015)
BHAR DGTW	−0.005**	−0.012***	−0.015***	−0.024***	−0.005	−0.013*	−0.024***	−0.044***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.007)	(0.007)	(0.010)
Part C: Officials with high trading frequency								
Jerome Powell	−0.010	−0.002	−0.015	−0.051**	−0.013***	−0.015**	−0.031***	−0.067***
	(0.010)	(0.015)	(0.021)	(0.026)	(0.005)	(0.007)	(0.009)	(0.015)
Lael Brainard	0.001	−0.007	−0.009	−0.031**	0.002	−0.024*	−0.037*	−0.087***
	(0.004)	(0.005)	(0.007)	(0.012)	(0.004)	(0.014)	(0.022)	(0.021)
Eric Rosengren	-0.017**	-0.062***	-0.025	-0.056	0.005	0.006	0.077*	0.105*
	(0.008)	(0.017)	(0.033)	(0.050)	(0.011)	(0.017)	(0.041)	(0.057)
Patrick Harker	-0.004	-0.013	-0.051***	-0.114***	-0.006	-0.077**	-0.125***	-0.149***
	(0.004)	(0.008)	(0.011)	(0.017)	(0.018)	(0.036)	(0.032)	(0.050)

Notes: We calculate the log abnormal returns for all stocks purchased or sold by FOMC members over 1, 3, 6, and 12 month periods. Part A shows the mean log abnormal returns for our baseline sample with standard errors reported in parenthesis. Abnormal returns in the first row are calculated relative to the CRSP Value Weighted Index. Abnormal returns in the second row are calculated relative to the DGTW benchmark when possible and to the CRSP Value Weighted Index otherwise. Part B shows the results for Monte Carlo Simulations described in Section 3.3.1. Part C reports individual estimates for FOMC members with over 150 trades in our sample. Superscripts *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 3.3: Calendar-Time Portfolio Abnormal Returns

	Buy EW			Sell EW			Buy TW			Sell TW		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Alpha	−0.31	−0.18	−0.19	−0.17	0.02	−0.01	−0.31	−0.26	−0.28	−0.11	0.07	0.10
	(0.30)	(0.30)	(0.31)	(0.28)	(0.29)	(0.29)	(0.25)	(0.26)	(0.26)	(0.51)	(0.53)	(0.54)
Mkt.RF	1.08***	1.02***	1.06***	0.93***	0.88***	0.93***	0.94***	0.94***	0.98***	0.95***	0.88***	0.91***
	(0.06)	(0.07)	(0.08)	(0.06)	(0.07)	(0.07)	(0.05)	(0.06)	(0.07)	(0.11)	(0.12)	(0.14)
SMB		0.16	0.12		0.08	0.04		−0.01	−0.07		0.17	0.06
		(0.12)	(0.14)		(0.12)	(0.13)		(0.11)	(0.12)		(0.21)	(0.24)
HML		0.07	0.03		0.16*	0.10		0.06	0.03		0.12	0.19
		(0.10)	(0.11)		(0.09)	(0.11)		(0.08)	(0.10)		(0.17)	(0.19)
RMW			−0.18			−0.15			−0.24			−0.38
			(0.21)			(0.19)			(0.18)			(0.36)
CMA			0.19			0.25			0.18			−0.12
			(0.21)			(0.19)			(0.18)			(0.36)
Observations	60	60	60	60	60	60	60	60	60	60	60	60
R^2	0.84	0.85	0.86	0.81	0.83	0.84	0.85	0.85	0.86	0.59	0.60	0.61

Notes: The above regressions show the results for excess portfolio returns of FOMC members using both the CAPM and Fama-French three factor model. Dependent variables are the monthly return on the portfolio of purchases and sales by FOMC members in the past 365 days. EW and TW are the equal-weighted and trade-weighted portfolios of purchases and sales within the previous year. Mkt.Rf is the excess return of the CRSP value-weighted index over the risk free rate; SMB is the difference between a portfolio of small stocks to big stocks; HML is the difference high book-to-market stocks and low-book to market stocks portfolio; RMW is the difference between robust and weak operating profitability portfolios; and CMA is the difference between conservative vs aggressive investment portfolios. Superscripts *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 3.4: Relationship between Monetary Policy and BHAR

	Target Change				Surprise Change			
	Purchases		Sales		Purchases		Sales	
	1 Month	3 Month	1 Month	3 Month	1 Month	3 Month	1 Month	3 Month
Part A: Scheduled FOMC Meetings								
Rate Change	−0.01	−0.04	−0.04	−0.01	−0.06	−0.32	−0.09	−0.05
Magnitude	(0.01)	(0.04)	(0.03)	(0.07)	(0.05)	(0.20)	(0.07)	(0.17)
Constant	−0.00	−0.01*	0.00	−0.01	−0.00	−0.01*	0.00	−0.01
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
Observations	680	680	259	259	680	680	259	259
Part B: Chair Speeches								
Rate Change					−0.08	−0.10	0.25	1.06*
Magnitude					(0.21)	(0.53)	(0.45)	(0.63)
Constant					−0.00	−0.01***	−0.00	−0.01*
					(0.00)	(0.00)	(0.00)	(0.01)
Observations					666	666	254	254

Notes: We regress the 1- and 3-month log abnormal returns for purchases and sales of FOMC members on Federal funds rate changes. Target change is the actual change in Fed funds rate. Surprise change is the Kuttner surprise change in the Fed funds rate (see Kuttner 2001). Robust standard errors are in parenthesis. Part A shows the response of abnormal returns to the target and surprise change in Fed Funds rate following a scheduled FOMC meetings. Part B shows the result for surprise change in Fed Funds rate following a speech by the Fed Chair. Superscripts *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 3.5: Mean BHAR of Alternative Portfolios

	Purchases				Sales			
	Baseline	Stocks	Bonds	Full	Baseline	Stocks	Bonds	Full
One	-0.004	-0.015*	-0.001	-0.003*	-0.000	0.002	0.001	-0.001
Month	(0.003)	(0.009)	(0.001)	(0.002)	(0.004)	(0.008)	(0.001)	(0.004)
Three	-0.012**	-0.029**	-0.006***	-0.011***	-0.011	-0.006	-0.003	-0.009
Months	(0.005)	(0.014)	(0.001)	(0.003)	(0.007)	(0.011)	(0.007)	(0.006)
Six	-0.006	0.029	-0.012***	-0.009*	0.001	0.018	-0.008	-0.001
Months	(0.008)	(0.033)	(0.002)	(0.005)	(0.014)	(0.025)	(0.007)	(0.013)
One	-0.016	0.032	-0.026***	-0.024***	-0.001	0.052	-0.023**	-0.007
Year	(0.013)	(0.052)	(0.002)	(0.009)	(0.020)	(0.034)	(0.009)	(0.018)
Obs.	457	86	187	681	207	130	40	259

Notes: We calculate the log abnormal returns for all stocks purchased or sold by FOMC members over 1, 3, 6, and 12 month periods under alternative portfolios. Baseline portfolio includes common stocks and stock-based funds, stocks only include transactions involving common stock and ADR, bonds include bonds, and bond-based funds, and full portfolio considers all assets for which pricing data was available. The mean abnormal returns are reported with standard errors in parenthesis. Abnormal returns are calculated relative to the CRSP Value Weighted Index with the exception of any bonds in the full portfolio, which are calculated relative to the S&P U.S. Aggregate Bond Index. Superscripts *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table 3.6: Asset Allocation and Rebalancing

	Full Sample				Three Weeks Prior			
	Purchases		Sales		Purchases		Sales	
	1 Month	3 Month	1 Month	3 Month	1 Month	3 Month	1 Month	3 Month
Part A: Relative Return								
Stocks	0.004	0.014***	-0.008**	-0.011*	-0.020***	0.028***	-0.019***	-0.014**
	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Bonds	0.012***	0.022***	0.008	-0.002	-0.016*	0.015*	-0.004	0.019
	(0.004)	(0.006)	(0.006)	(0.017)	(0.009)	(0.009)	(0.017)	(0.026)
Part B: Cumulative Return								
Stocks	0.005**	0.020***	-0.007*	-0.004	-0.020***	0.034***	-0.022***	-0.012**
	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Bonds	0.001	0.007***	0.001	0.010***	0.001	0.009***	-0.002	0.009**
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.002)	(0.004)

Notes: In Part A, we calculate the mean relative return of overall stock market (CRSP benchmark) to the S&P Aggregate Bond index in the 1 and 3 month period following transactions for stocks and bonds, split across purchases and sales. In Part B, we calculate the mean cumulative return of stock market index (CRSP benchmark) and S&P bond market in the 1 and 3 month period following transactions for stocks and bonds, split across purchases and sales. The full sample consists of all trades. Three Weeks Prior consists of only trades that occurred in the three weeks prior to an FOMC meeting.

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Appendix A

Appendix for Chapter 1

A.1 Do Businesses feel the same? Fiscal Policy and Business Sentiments

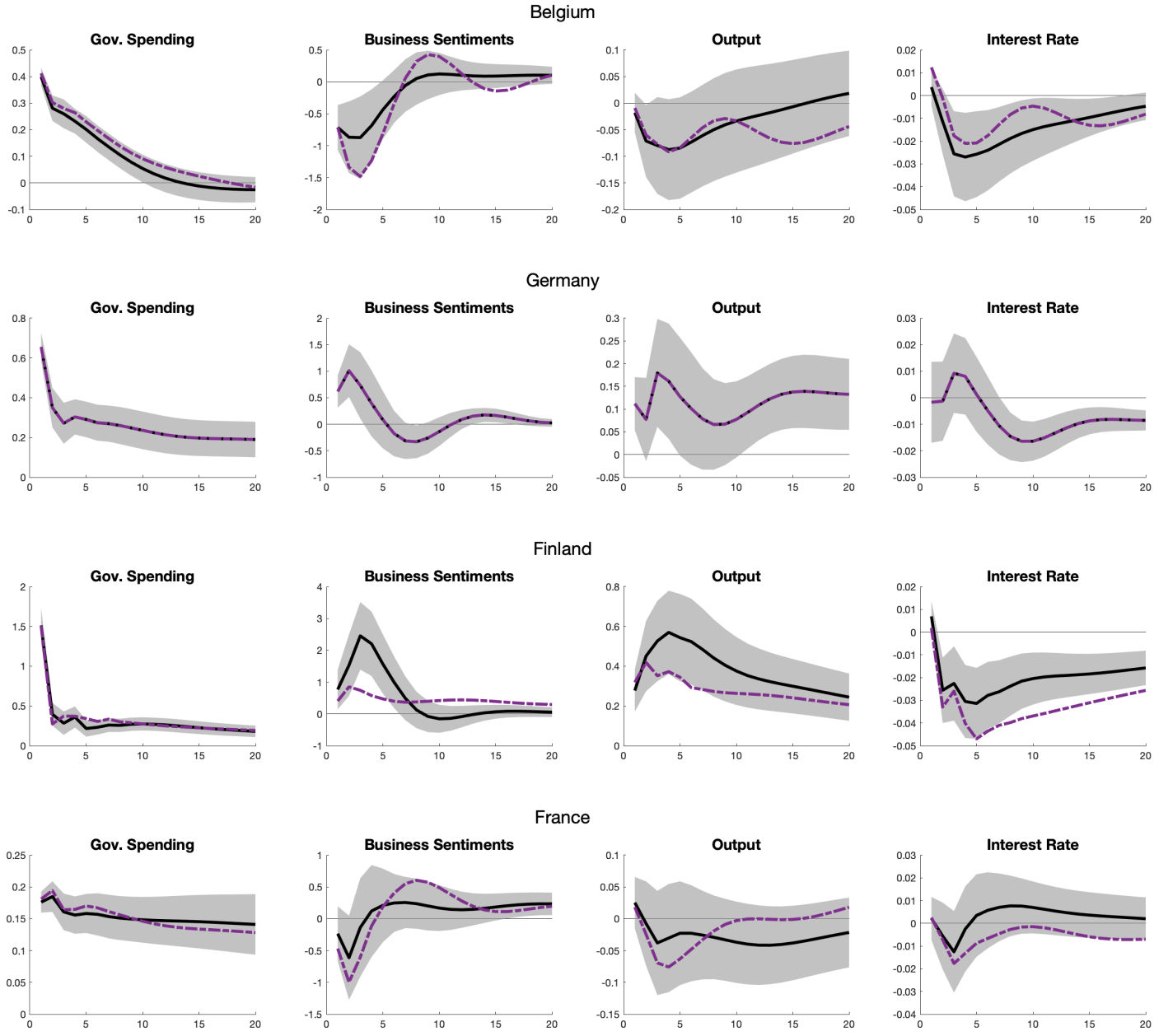
An expansionary fiscal policy shock increases household's future economic outlook reflected in the response of consumer sentiments to a fiscal policy shock (Figure A.1). However, the increase in government expenditure also increases the probability of default in higher debt countries. This should be factored into the sentiments of firms who may fear higher cost of investment, lower access to financial markets, and more expensive imports. Repeating the baseline exercise with business sentiments, the response of sentiments to an expansionary government expenditure news shock should be weaker relative to the response of consumer sentiments, in countries with higher levels of government debt. Table A.1 shows the questions used from the industry survey by European Commission to create the expected components of the business sentiments index.

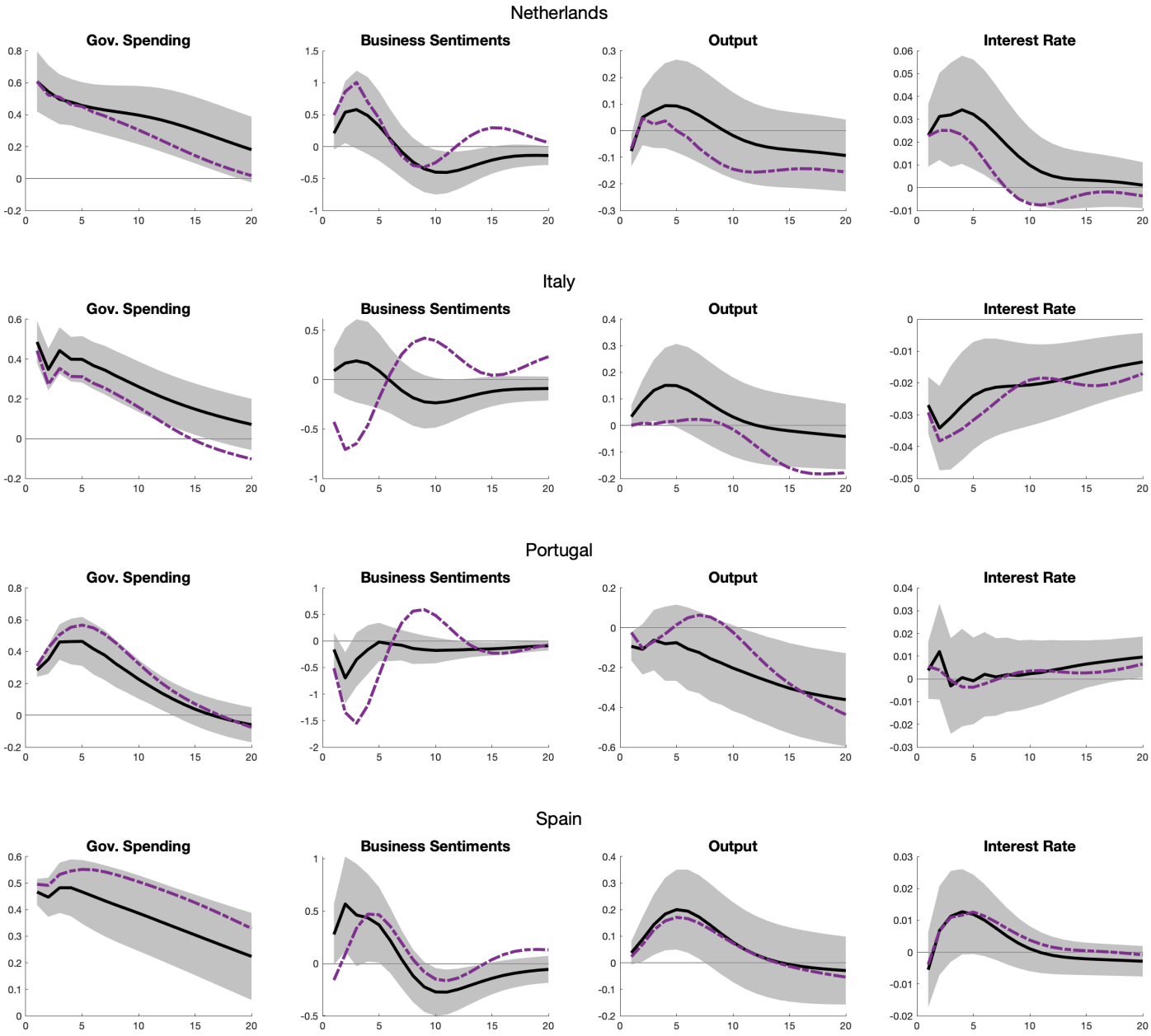
Table A.1: Forward-looking Industry Sentiments Questions

Q5	How do you expect your production to develop over the next 3 months?
Q6	How do you expect your selling prices to change over the next 3 months?
Q7	How do you expect your firm's total employment to change over the next 3 months?

Figure A.1 shows the response of government spending, business sentiment, output, and interest rate to a one standard deviation fiscal news shock. The solid line is the baseline GIRF and the dashed line is the response under the counterfactual analysis where sentiments of all countries is replaced by that of Germany (see Section 1.2.3).

Figure A.1: Results from the Baseline VAR model with Business Sentiments





The solid lines gives the Generalized impulse responses (GIRFs) for a positive one standard deviation shock to government spending news in the baseline model. The dashed line is the impulse responses for the counterfactual discussed in Section 1.2.3. Shaded region is the one standard error bands around the GIRFs for the baseline model.

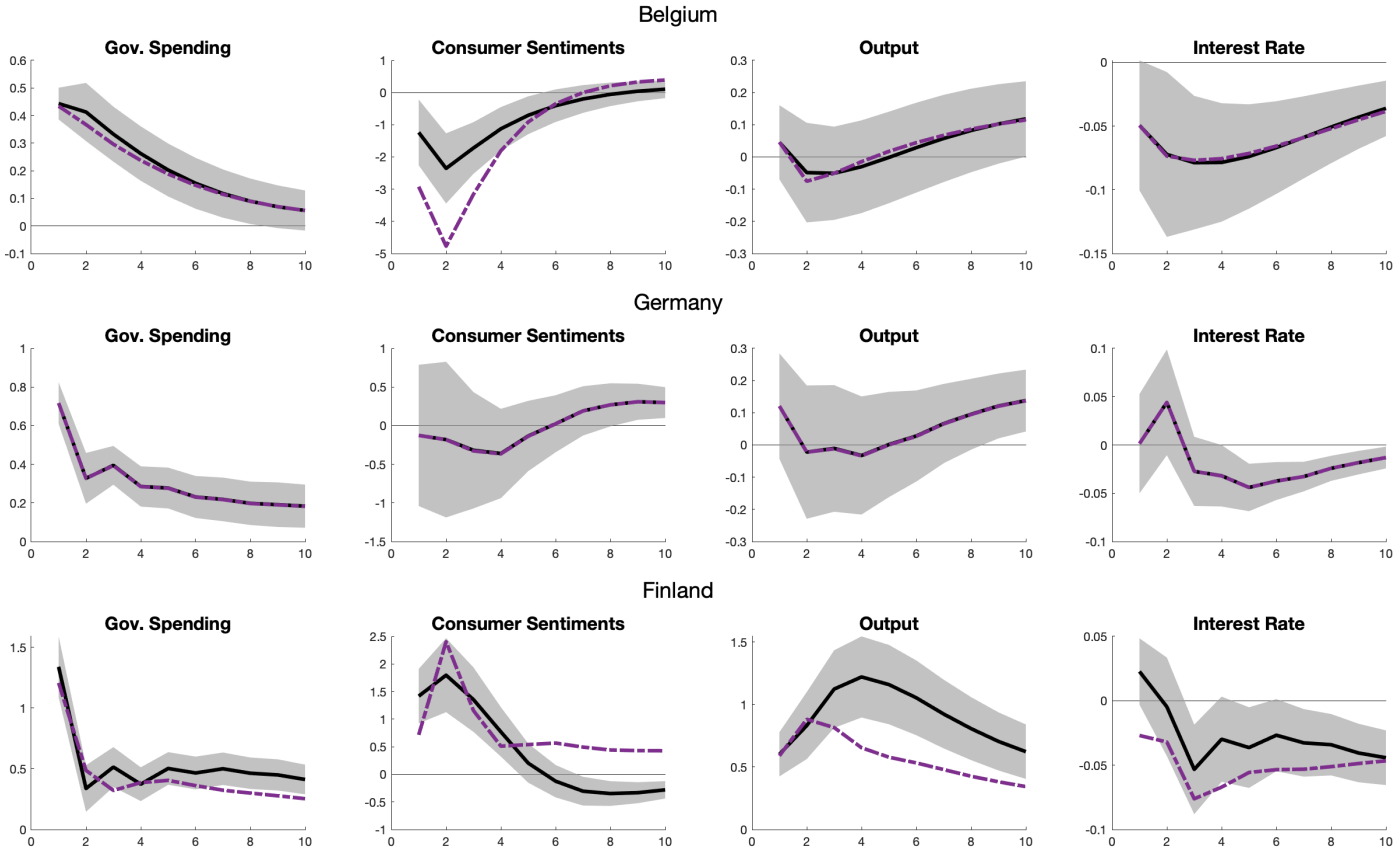
A.2 Robustness: Using Semi-Annual Data

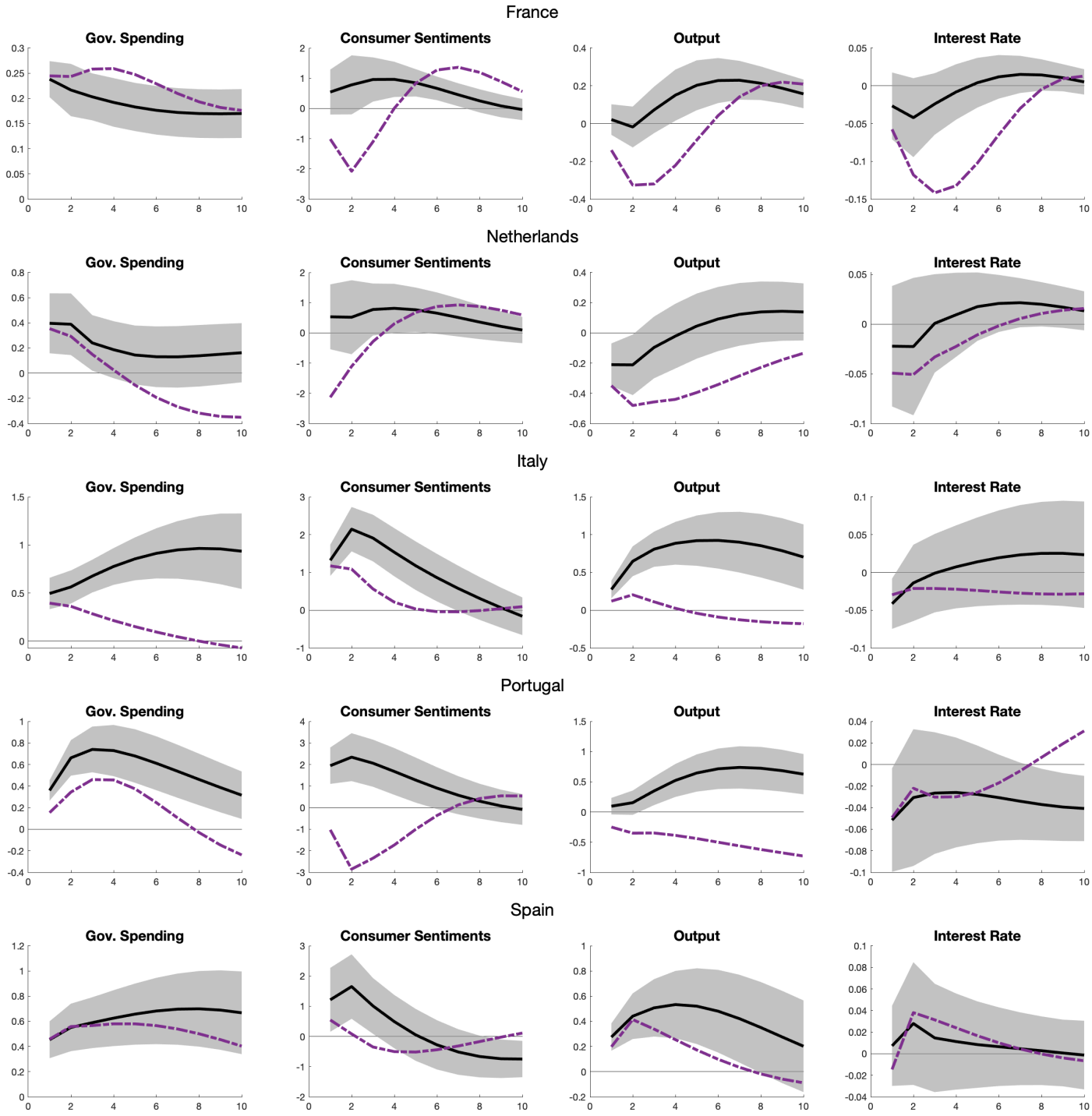
The forecast data used to compute fiscal policy news variable is only available in semi-annual frequency until 2003. Moreover, the forecasts are generated only twice a year and thus result in changing horizon for two out of the four quarters. Conducting the baseline analysis in

semi-annual frequency solves the issue of mixed frequency data and information asymmetry in two consecutive forecasts. In this section, I test the robustness of the baseline results by using semi-annual data. All variables except consumer sentiments is converted from quarterly to semi-annual frequency by summing the values for two quarters. For example, the government consumption expenditure for the first half year is equal to the sum of government consumption expenditure in Q1 and Q2. For sentiments indicator, I calculate the mean sentiments index at semi-annual frequency. The lag length for all countries is one, as picked by the information criterion.

Figure A.3 shows the impulse response from the baseline model discussed in Section 1.2.3 with the semi-annual data frequency. The solid line shows the impulse response of real government spending, consumer sentiments, real GDP, and real interest rate to a one standard deviation expansionary shock to the fiscal policy news. The dashed line shows the response for a one standard deviation shock in the counterfactual analysis where consumer sentiments for all countries is replaced with the sentiments in Germany. The shaded area is the one standard error bands around the GIRFs. The results for the baseline hypothesis is largely robust with the lower frequency data.

Figure A.3: Results from the Baseline VAR model with Semi-Annual Data



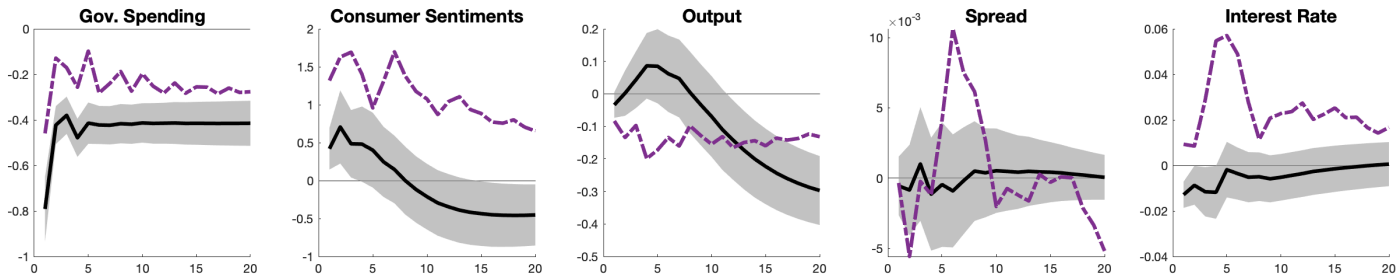


The solid lines gives the Generalized impulse responses for a positive one standard deviation shock to government spending news in the baseline model. The dashed line is the impulse responses for the counterfactual discussed in Section 1.2.3. Shaded region is the one standard error bands around the GIRFs for the baseline model.

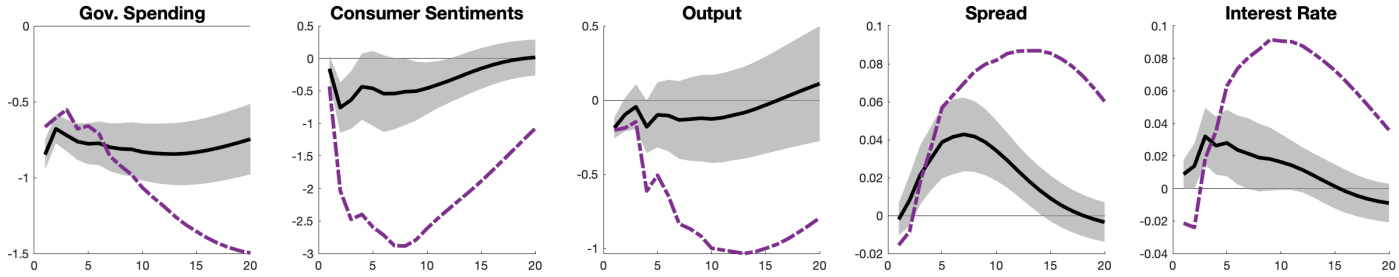
A.3 Robustness: Including Interest Rate Spreads

Figure A.5: Fiscal Consolidation: Non-linear effects of fiscal policy

(a) Core Economies



(b) Peripheral Economies



The solid lines gives the Generalized impulse responses for a one standard deviation contractionary shock to government spending news under normal times. The dashed line is the impulse responses during periods of fiscal consolidation. Shaded region is the one standard error bands around the GIRFs for normal times. Core countries comprises of Germany, France, Belgium, and Finland. Peripheral countries include Spain, Portugal, and Italy.

While the consolidation measures enacted after the financial crisis were largely successful in reducing the debt levels in core countries and restoring market confidence, they were not as successful in peripheral countries like Italy or Spain which continue to struggle with higher debt levels. Consolidation measures can be viewed as counterproductive by the economic agents if they are not believed to have long term reduction in public debt. This section incorporates the long-term yield spread of each country with Germany to analyze whether the high cost of consolidation in peripheral countries could be explained by the lack of commitment of peripheral governments towards fiscal consolidations. The results are shown in Figure A.5. I also drop Germany from the panel of Core countries.

Appendix B

Appendix for Chapter 2

B.1 Consumer Expenditure Survey (BLS)

I use the Consumer Expenditure Survey (CEX) dataset published by Bureau of Labor Statistics (BLS). The survey is conducted quarterly, with data on a rich set of variables on household level expenditure, income and individual level demographics. I use the interview dataset from 1996 Q1 to 2018 Q2, downloaded from the BLS website.[1] A household in the data is surveyed for at most 4 quarters and only once per quarter. The information on household level income and expenditure is recorded in FMLI datafile along with demographic characteristics such as age of head of household and spouse, number of household members, housing tenure, etc. Each household can be identified using a unique ID recorded under the variable NEWID after removing the last digit.

B.1.1 Data Adjustments:

I make the following adjustments to the CEX data largely consistent with Coibion et al. (2017) and Wong (2021):

1. The CEX data records data with 1 quarter lag and needs to be adjusted. For example, data recorded for April of year 2015 till March of 2016 is adjusted to be data for the financial year 2015 following Krueger and Perri (2006).

[1] Link: `https://www.bls.gov/cex/pumd_data.htm`

2. Keep only households where the age of head of the household is between 25 and 75 years (inclusive).

3. Drop households with tenure status recorded as student housing or occupied without payment of cash rent.

4. Drop households with zero food expenditure in all quarters.

5. Drop all observations with missing state IDs.

Other than the above adjustments, I also adjust the data on food, tobacco and utility expenditure of households which were first interviewed in February and March and thus report expenditures for less than 3 months in the first calendar quarter. For these households, I impute the data for the first quarter but proportionally increase the reported expenditure. For example, a household first interviewed in February of 2010 has data for November and December of 2009 but not October. I impute the food expenditure for October as half of the total food expenditure for November and December of the household. The imputation is crucial to avoid under-estimating the consumption expenditure for households first interviewed in second and third month of a quarter. The imputation affects 20% of the total observations. In Appendix B.3, I show the results after dropping these observations. In the main analysis, I retain all households interviewed for at least two quarters. However in appendix B.4, I show that the results are robust to excluding all households interviewed for less than four quarters.

I define expenditure categories with their CPI deflators, as follows:[2]

B.1.2 Mortgage Adjustments:

To identify households who refinanced their loans in the data, I use the detailed expenditure file on Owned Living Quarters and Other Owned Real Estate - Mortgages. CEX records existing mortgages which were changed due to refinancing under the variable "qnewdate" as a new loan date, while the variable "qrfindat" records changes for all other reasons. To capture the heterogeneity in policy transmission effectively, I keep values for only owner occupied houses (recorded by the house type code 100). I also drop bottom 1% of households by mortgage amount similar to Wong (2021). I create a binary variable to identify homeowners who adjusted loan. The variable equals one if the date of loan change is same as the current date and zero otherwise. The variable "qnewdate" can have an entry for reasons other than refinancing, like cash out refinancing, CEX does not have sufficient details to separate these and so I do not distinguish between all types of refinancing in the analysis.

[2]All CPI data is monthly, city average for all urban consumers with base year 1982-84, not seasonally adjusted.

Table B.1: Table recording expenditure categories and CPI series used to deflate it.

Category	**Variable**	**CPI Category**
Non-durable Expenditure		
Food	food	Food
Alcoholic Beverages	alcbev	Alcoholic Beverages
Tobacco	tobacc	Tobacco and Smoking Products
Gas and Motor Oil	gasmo	Motor Fuels
Apparel	appar	Apparel
Durable Expenditure		
Household Furnishings and Equipments	houseq	Household Furnishings and Operations
Purchase of vehicles	evehpur	New Motor Vehicles
Miscellaneous Household and Expenditures	misceq	Household Furnishings and Operations
TV, Radio and Sound Equipment	tvrdio	Recreation
Service Expenditure		
Household Utilities	util	Fuels and utilities
Household Operations	housop	Household Furnishings and Operations
Recreational Services	misc1	Miscellaneous Personal Services
Public Transportation	pubtra	Public Transportation
Personal Care Services	persca	Personal Care
Health Care	health	Medical Care
Education	educa	Tuition Expenditures
Entertainment	entert	Recreation
Reading	read	Recreational Reading Material

B.2 Robustness

B.2.1 Re-categorizing severely affected states:

In this section, I check the robustness of my results by the prime effect category in table 2.5. I change my measure of states who were severely affected by the crisis by redefining the cut off for categorization. I take house price change in all states durig the period 2004Q1-2005Q4 and take the median change in house prices as the new cut-off. I then find change in house prices in all states between 2007Q1 - 2008Q4 and classify all states above the cut-off as states that were severely affected by the housing crisis. There are 9 states that now fall into the severely affected category- Arizona, California, Florida, Maryland, Michigan, Minnesota, Nevada, Oregon and Virginia.

Table B.2 shows the result from equation 2.1 with the revised definition for severely affected states. Columns (1), (2), and (3) correspond to the differential effect of a one standard deviation expansionary LSAP shock to households in severely affected states. I find that homeowners in these states do not respond with higher consumption to the unconventional policy shocks. Columns (4), (5), and (6) show results for all other states. Homeowners in these states, who do not adjust loan, consume approximately 1.5% less than homeowners who adjust loan, in response to a one standard deviation LSAP shock in the previous quarter. These households also consume 2.8% less than households who adjust loan in response to a LSAP shock two quarters ago. The average consumption response of all households in states which were not severely affected is also higher and significant than the response of household consumption in states which were severely affected. On average, an household in the less affected states increased their consumption 1.46% in response to a one standard deviation expansionary LSAP shock last quarter and 2% higher in response to the LSAP shock two quarters ago (in column (5)).

The results in Table B.2 shows that the differential effect on households across the two categories of states is robust to changes in the definition of the categorization.

B.2.2 Without data imputation:

Table B.3 shows the result for Table 2.6 without the data imputations for food, tobacco and utilities as described in Appendix A.1. Homeowners who refinance in severely affected states do not respond significantly to LSAP shocks. On the other hand, homeowners who refinance following a LSAP shock in less affected states increase their consumption by approximately 3.5% following a LSAP shock.

Table B.2: Heterogeneous response of household consumption in severely affected states vs all other states

Dep. Var: $\Delta logC_{h,t}$		Severely Affected States			Less Affected States		
		(4)	(5)	(6)	(1)	(2)	(3)
$LSAP_{t-1}$	Refinance	2.78*	2.39	2.36	3.29***	3.23**	3.2**
		(1.638)	(1.655)	(1.641)	(1.28)	(1.359)	(1.352)
	Refinance - Do not Refinance	2.38	2.07	2.03	3**	2.8**	2.79**
		(1.736)	(1.747)	(1.735)	(1.314)	(1.366)	(1.354)
	Refinance - Renters	2.4	2.04	2.02	2.97**	3**	2.94**
		(1.614)	(1.587)	(1.576)	(1.311)	(1.384)	(1.374)
Controls			✓	✓		✓	✓
State FE		✓		✓	✓		✓
Month and Year FE		✓	✓	✓	✓	✓	✓
Recession dummy variable		✓	✓	✓	✓	✓	✓
Obs		50,400	49,754	49,754	97,279	95,926	95,926

Note: The table shows differential response of households who adjust loan and who do not adjust loan to a lagged one standard deviation expansionary monetary policy shock for the period 2007Q1 to 2018Q2. There are 9 states identified as severely affected states- California, Arizona, Florida, Nevada, Maryland, Michigan, Minnesota, Oregon and Virginia. Loan adjustment is a categorical variable which divides households into households who own a home and adjusts loan, households who own a home and do not adjust, and households who rent a home. The base category for loan adjustment variable is households who own a home and adjust loan. I include twelve lags of the monetary policy shocks. Results from longer lags decreases in significance. All observations are weighted by the sample weights calculated by BLS. Standard errors are clustered at the state level. P-values are calculated using the delta method. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

Table B.3:
Heterogeneous response of household consumption in severely affected states vs all other states

Dep. Var: $\Delta logC_{h,t}$		Severely Affected States			Less Affected States		
		(4)	(5)	(6)	(1)	(2)	(3)
$LSAP_{t-1}$	Refinance	2.85	2.94	2.89	3.9***	3.56***	3.54***
		(2.931)	(3.108)	(3.083)	(1.317)	(1.377)	(1.373)
	Refinance - Do not Refinance	2.15	2.06	1.98	3.67***	3.29**	3.27**
		(2.746)	(2.902)	(2.874)	(1.375)	(1.402)	(1.394)
	Refinance - Renters	2.1	2.11	2.05	3.37**	3.22**	3.2**
		(2.7)	(2.813)	(2.784)	(1.325)	(1.392)	(1.385)
Controls			✓	✓		✓	✓
State FE		✓		✓	✓		✓
Month and Year FE		✓	✓	✓	✓	✓	✓
Recession dummy variable		✓	✓	✓	✓	✓	✓
Obs		32,825	32,550	32,550	114,854	113,130	113,130

Note: The table shows the consumption response of households who refinance their loan and the differential response against households who do not refinance and renters to a lagged one standard deviation expansionary LSAP shock. The sample period is restricted to 2007Q1 to 2018Q2. There are 4 states identified as severely affected states- California, Arizona, Florida and Nevada. Loan adjustment is a categorical variable which divides households into households who own a home and adjusts loan, households who own a home and do not adjust, and households who rent a home. The base category for loan adjustment variable is households who own a home and adjust loan. The regression includes twelve lags of the monetary policy shocks. Result for longer lags decreases in significance. All observations are weighted by the sample weights calculated by BLS. Standard errors are clustered at the state level. P-value is calculated using delta method. *, **, and *** indicate significance at 10%, 5% and 1% significance level respectively.

B.3 Result for control variables

Table B.4 shows the results for control variables for the regression in Table 2.5, 2.6 and 2.7 with all the fixed effects. The direction and significance of coefficients are similar across regressions. Household consumption growth is 11% higher on average for households with

Table B.4

	Table 5	Table 6		Table 7
		Severely Affected States	Less Affected States	
Dep. Var: $\Delta logC_{h,t}$	(1)	(2)	(3)	(4)
Age	-0.32***	-0.29	-0.33***	-0.18**
	(0.069)	(0.216)	(0.069)	(0.072)
Age^2	0.004***	0.004	0.003***	0.002***
	(0.001)	(0.003)	(0.001)	(0.001)
Δ Family Size	10.5***	11*	10.34***	7.52***
	(1.143)	(4.094)	(1.108)	(0.702)
Δ Unemp_{state}	-1.32**	-3.19**	-1.26*	0.59
	(0.559)	(0.781)	(0.72)	(0.53)
Δ HP_{state}	-0.86	0.012	-1.21**	-0.611
	(0.531)	(0.806)	(0.451)	(0.472)
No. of vehicles	1.75***	1.42*	1.84***	1.85***
	(0.177)	(0.524)	(0.171)	(0.158)
State FE	✓	✓	✓	✓
Month and Year FE	✓	✓	✓	✓
Recession dummy variable	✓	✓	✓	✓

Note: The table shows the result for non-dummy variables for Table 5, 6 and 7. The sample period for Columns (1), (2), and (3) is 2007Q1 - 2018Q4. The sample period for Column(4) is 1996Q1 - 2008Q4. There are 4 states identified as severely affected states- California, Arizona, Florida, Nevada. The less severely affected states include all other states. Using the OECD scale, the family size of a household is calculated as: (head of household) + 0.7*([number of 18 years old or older] - 1) + 0.5*(number of children). Δ Unemp_{state} is the quarterly change in state's unemployment level. Δ HP_{state} is the quarterly change in house price index at the state level. All observations are weighted by the sample weights calculated by BLS. P-values are calculated using delta method. Standard errors are clustered at the state level. *, **, and *** indicate significance at 10%, 5% and 1% significance level.

bigger family size, and 1.8% higher for households with at least one vehicle. Consumption growth also responds negatively and significantly to local change in unemployment rate, and the response is even larger for households in severely affected states. If unemployment rate increase by 1%, household consumption growth decreases by 1.3% on average in less affected states, and 3% in severely affected states. The response to growth in regional house prices is largely insignificant.

Appendix C

Appendix for Chapter 3

Table C.1: Summary Statistics

	Purchases	Sales	Total	Percentage
Transaction Size				
\$1000-\$50000	806	248	1054	64.15%
\$50000-\$250000	151	136	287	17.47 %
\$250000-\$500000	17	18	35	2.13%
\$500000-\$1000000	15	7	22	1.34%
> \$1000000	127	118	245	14.91%
Asset Class				
Common Stock	138	185	323	19.66%
Equity-Based Funds	479	90	569	34.63%
Fixed Income	275	55	330	20.09%
Other	224	197	421	25.62%

Notes: In this table we summarize the volume of transactions made by FOMC members in our sample. The figures show the frequency of purchase and sales transactions within each transaction size bracket. We also split the transactions by asset classes. Robert Kaplan's transactions are counted twice, one as Purchase and another as Sale, when the type of transaction is listed as "Purchase/Sale".

Table C.2: Details on Trade Brackets Reported

Brackets Reported	Frequency	Percent	Details
1000 - 15000	217	13.70	Jerome Powell (102), Randal Quarles (41), Lael Brainard (31), Janet Yellen (21), Stanley Fischer (19), Michelle Bowman (3)
15000 - 50000	363	22.92	Lael Brainard (244), Jerome Powell (71), Stanley Fischer (37), Randal Quarles (6), Janet Yellen (4), Daniel Tarullo (1)
1000 - 50000	475	29.99	Eric Rosengren (175), Patrick Harker (122), Lorreta Mester (117), John Williams (30), William Dudley (20), Thomas Barkin (5), Neel Kashkari (4), Charles Evans (1)
50000 - 100000	156	9.85	Jerome Powell (95), Lael Brainard (37), Randal Quarles (11), Stanley Fischer (11), Michelle Bowman (2)
100000 - 250000	69	4.36	Jerome Powell (33), Lael Brainard (28), Janet Yellen (5), Randal Quarles (4), Richard Clarida (4), Stanley Fischer (1)
50000 - 250000	63	3.98	Patrick Harker (26), Thomas Barkin (15), Robert Kaplan (10), Eric Rosengren (8), Neel Kashkari (5), William Dudley (2), Esther George (1), James Bullard (1)
250000 - 500000	35	2.21	Thomas Barkin (8), Jerome Powell (6), Patrick Harler (6), Randal Quarles (5), Robert Kaplan (5), Janet Yellen (4), Lael Brainard (3), Eric Rosengren (2), Michelle Bowman (2), Richard Clarida (2)
500000 - 1000000	21	1.33	Randal Quarles (8), Patrick Harker (5), Richard Clarida (5), Robert Kaplan (2), Jerome Powell (1)
>1000000	157	9.91	Robert Kaplan (150), Thomas Barkin (5), Randal Quarles (3), William Dudley (2)
1000000 - 5000000	25	1.58	Richard Clarida (16), Randal Quarles (9), Jerome Powell (1)
5000000 - 25000000	3	0.19	Richard Clarida (3)

Notes: The figures in the brackets show the number of transaction for each official in a particular transaction bracket.

Table C.3: Mean BHAR of Federal Reserve Board Senior Staff

	Purchases			Sales		
	Common Stocks	Baseline	Full Portfolio	Common Stocks	Baseline	Full Portfolio
One Month	-0.000	-0.003	-0.005	-0.000	-0.004	-0.003
	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Three Months	0.003	-0.004	-0.006	0.004	-0.005	-0.008
	(0.010)	(0.009)	(0.008)	(0.009)	(0.007)	(0.007)
Six Months	0.009	-0.005	-0.008	0.013	-0.006	-0.007
	(0.018)	(0.014)	(0.013)	(0.012)	(0.010)	(0.009)
One Year	-0.000	-0.033*	-0.034***	-0.015	-0.034**	-0.034***
	(0.024)	(0.020)	(0.018)	(0.015)	(0.013)	(0.012)
Observations	191	245	273	320	399	444

Notes: We calculate the log abnormal returns for all stocks purchased or sold by Senior Federal Reserve Board staffs over 1, 3, 6, and 12 month periods under alternative portfolios. Common stock only considers transactions involving common stock and ADR, baseline considers common stocks and stock-based funds, and full portfolio considers all assets for which pricing data was available. The mean abnormal returns are reported with standard errors in parenthesis. Abnormal returns are calculated relative to the CRSP Value Weighted Index with the exception of any bonds in the full portfolio, which are calculated relative to the S&P U.S. Aggregate Bond Index. Superscripts *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table C.4: Relationship between Monetary Policy and BHAR – Extended

	Purchases		Sales	
	1 Month	3 Month	1 Month	3 Month
Federal Funds Rate factor	0.01	−0.01	-0.00	0.03
	(0.02)	(0.02)	(0.02)	(0.05)
Forward Guidance factor	−0.00	0.00	−0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.01)
LSAP factor	0.02	0.01	0.01	0.02
	(0.01)	(0.02)	(0.02)	(0.03)
Constant	−0.00	−0.00	0.00	−0.02
	(0.00)	(0.00)	(0.01)	(0.01)

Notes: We regress the 1- and 3-month abnormal returns for purchases and sales of FOMC members on Federal funds rate changes. The rate change is decomposed into surprise changes in Federal funds rate factor, Forward Guidance factor, and LSAP factor calculated using the high frequency identification in Swanson (2021b). The end of sample is restricted to June 2019 due to unavailability of monetary policy changes. Robust standard errors in parenthesis. Superscripts *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Table C.5: Rebalancing - Monte Carlo Simulations with Alternative Timings

	Full Sample				Three Weeks Prior			
	Purchases		Sales		Purchases		Sales	
	1 Month	3 Month	1 Month	3 Month	1 Month	3 Month	1 Month	3 Month
Part A: Relative Return								
Stocks	0.009***	0.024***	0.005*	0.016***	0.010**	0.027***	0.006	0.015**
	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)	(0.006)
Bonds	0.008***	0.022***	0.008	0.003	0.008	0.020**	0.006	0.027
	(0.003)	(0.004)	(0.009)	(0.012)	(0.005)	(0.008)	(0.018)	(0.025)
Part B: Cumulative Return								
Stocks	0.010***	0.030***	0.007*	0.023***	0.011***	0.032***	0.006	0.018***
	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.006)
Bonds	0.001	0.006***	0.003***	0.011***	0.002**	0.007***	0.003	0.009**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.004)

Notes: In Part A, we calculate the mean relative return of overall stock market (CRSP benchmark) to the S&P Aggregate Bond index with Monte Carlo Simulations described in Section 3.5. In Part B, we calculate the mean cumulative return of stock market index (CRSP benchmark) and S&P bond market using the same algorithm. We calculate returns over the 1 and 3 month period following transactions for stocks and bonds, split across purchases and sales. The full sample consists of all trades. Three Weeks Prior consists of only trades that occurred in the three weeks prior to an FOMC meeting.

Table C.6: Asset Allocation and Monetary Policy Shocks

	Full Sample		Three Weeks Prior	
	Purchases	Sales	Purchases	Sales
Part A: Kuttner Surprise				
Stocks	-0.009	-0.024	-0.018	-0.010
Bonds	-0.003	-0.006	-0.005	-0.019
Part B: High Frequency Shocks				
Federal Funds Factor				
Stocks	0.12	0.16	0.16	0.17
Bonds	0.14	0.14	0.20	0.21
Forward Guidance Factor				
Stocks	-0.09	0.04	-0.14	0.25
Bonds	-0.12	-0.37	-0.30	-0.08
LSAP Factor				
Stocks	-0.05	0.05	-0.06	-0.06
Bonds	-0.07	-0.04	-0.03	0.04

Notes: We calculate the mean Kuttner surprise for stocks and bonds split across purchases and sales. The full sample consists of all trades in the sample. Three Weeks Prior consists of only trades that occurred within the three weeks prior to an FOMC meeting. Changes in Federal funds rate factor, Forward Guidance factor, and LSAP factor are calculated using the high frequency identification in Swanson (2021b). The end of sample is restricted to June 2019 due to unavailability of monetary policy factors.