

## Research statement

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I am a macroeconomist with both theoretical and empirical interests. I have been pursuing several interrelated lines of research which broadly focus on the 1) macroeconomic effects of government spending, 2) building dynamic structural general equilibrium models to study the effects of fiscal policy and 3) considering the effects of housing-related policy measures on macroeconomic aggregates and household debt. In what follows, I provide a brief summary of these various lines of research.

**I: Empirical Effects of Fiscal Policy:** In recent years, many governments around the world, including the United States have grappled with the question of whether they can stimulate the economy by increasing government spending. However, there is a lack of consensus among economists on this issue. Many studies seem to find modest effects of spending, whereas others find a government purchase multiplier of above unity in aggregate data, which suggests that a dollar increase in government purchases generates more than a dollar rise in GDP. During the last several years, the fiscal literature has been fast growing and has been exploring different methodologies for identifying exogenous government spending innovations or shocks, not driven by the state of the economy and also whether estimates of effectiveness of spending vary depending on circumstances, type of spending or the stance of monetary policy. I have contributed to this literature in many ways.

In “What is the Importance of Monetary and Fiscal Shocks in Explaining U.S. Macroeconomic Fluctuations?” (*Journal of Money, Credit and Banking*, 2011), joint work with Barbara Rossi, we analyze monetary and fiscal policy innovations jointly in order to understand their interaction, where the literature tended to focus on one or the other. We find that monetary policy explains fluctuations in aggregate output in the short-run, whereas government spending policies have their largest impact on explaining output fluctuations in the long-run. This work also highlights that failing to recognize that both these policies simultaneously affect the economy might incorrectly attribute macroeconomic fluctuations to the wrong source. This paper continues to be cited as recognition that we need to consider monetary variables such as short term rates when studying the effects of fiscal policy shocks.

In departure from the most commonly used approach of considering aggregate data, in “Who Benefits from Increased Government Spending? A State-Level Analysis,” (*Regional Science and Urban Economics*, 2013) Michael Owyang and I look at the effects of federal spending shocks from a regional perspective. We analyze the propagation of both military and non-military spending shocks through different U.S. states. Our findings suggest regional patterns in the manner in which both shocks affect state-level variables where industry composition is an important determinant. Notably, military spending benefits economies with larger manufacturing and retail sectors and states that receive military contracts. While non-military shocks also benefit states with the proper industrial mix, they also appear to stimulate economic activity in lower-income states.

In addition to employing cross-sectional data to quantify the stimulative effects of government purchases, I have also worked on studying these effects from a long time series perspective. In context of the Great Recession, some researchers and policymakers have argued that while government spending multipliers are estimated to be modest on average, they might become greater during times when resources are underutilized or when the interest rates are close to the lower bound. However, most existing literature focuses only on the post-World War II sample, which arguably has limited information to identify differences in multipliers across various states of the economy.

In a joint research agenda with Valerie Ramey, we construct a new quarterly historical data set, extending back to 1889 for the U.S, resulting in a sample that includes episodes of huge variations in government spending, wide fluctuations in unemployment, prolonged periods near the zero lower bound of interest

rates, and notably includes both the World Wars and the Great Depression period. We exploit the rich information in this data set in order to investigate whether government spending multipliers differ according to two potentially important features of the economy: the amount of unemployment and whether interest rates are near the zero lower bound. Preliminary results from this research agenda, “Are Government Spending Multipliers Greater during Periods of Slack? Evidence from Twentieth-Century Historical Data”, with Michael Owyang and Valerie Ramey, were published in *American Economic Review, Papers and Proceedings*. Valerie and I expand on this work and analyze these questions in greater detail in “Government Spending Multipliers in Good Times and in Bad: Evidence from U.S. Historical Data”, (forthcoming in *Journal of Political Economy*).

Our paper extends the literature on state-dependence of government spending effects in two major ways. Firstly, ours is the first paper empirically analyzing the state dependence of multipliers involving the zero lower bound state. Secondly, in addition to the extended sample, our paper also has methodological contributions. Primarily, in the context of studying the non-linear effects of exogenous changes in the economy, we explicitly demonstrate the importance of underlying assumptions on transitions between different states of the economy. We also show that this helps explain the difference between our findings and some of the most widely-cited findings of very large multipliers during recessions. In addition, we introduce a new instrumental variables method for estimating cumulative multipliers in a one-step regression. This also allows one to use multiple instruments, coming from alternative identification schemes for government spending shocks.

We find that the government purchases multipliers remains below unity irrespective of the amount of slack in the economy, suggesting that private spending declines when government spending rises. In contrast, the results are more mixed for periods with interest rates near the zero lower bound. Most samples and specifications indicate no evidence of elevated multipliers during these periods, but a few notable exceptions imply multipliers as high as 1.5.

Our data and programs are publicly available and the paper has been rather influential already with our approach being employed in a lot of follow-up work considering fiscal multipliers and effects of policy innovations, in general. Given the paper’s relevance to both policy-makers and economists, and its contribution to the literature, this work continues to gain attention.

In ongoing work, Valerie and I are exploring historical data for Canada, where we want to exploit the fact that the entry of Canada in World Wars was earlier than the U.S. so the increase in spending coincides with periods of high unemployment. Thus far, we find interesting differences from the case of United States and evidence of state dependence in multipliers driven by the fact that there were longer delays between news and actual government spending, particularly during World War II.

In another ongoing project, Michael Owyang and I build on our previous work on regional effects of policy, where we had considered each U.S. state separately while making simplifying assumptions of symmetric spillover effects across states. In this project, along with Laura Jackson, we study the propagation of monetary and fiscal policy shocks across countries in the Euro area, in a unified framework where we show how to deal with the issue of high dimensionality. In particular, we construct latent factors to represent area-wide and country-specific economic activity by imposing restrictions on factor loadings. When we identify the policy shocks, we use the fact that there is a single monetary instrument that may or may not react to the idiosyncratic shocks within a single particular country but reacts to area wide activity. Meanwhile, fiscal policy is conducted independently in each country. This project provides a nice framework to study the effects of various policy innovations in any given currency union, and we are working to use it to study interesting and relevant policy questions.

**II: Structural General Equilibrium Models of Fiscal Policy:** This strand of my research is also motivated by the renewed interest in the dynamic effects of fiscal policy actions and the fact that there is relatively little consensus in the literature on modeling fiscal policy changes. Structural models of fiscal policy that fit the data well are essential for simulating fiscal policies like the American Recovery and Reinvestment Act of 2009 or running counterfactual experiments.

In a typical real business cycle model, when there is increased government spending, the primary effect on household is that they feel poorer in expectation of taxes going up to finance the increased public spending. This results in a fall in consumption and an increase in labor supply that also results in wages going down. Most empirical evidence suggests that increased government spending can, on the contrary, result in either a non-negative or even a positive response of consumption and wages. The response of private consumption to government spending shocks is important when quantifying the effects on output, since it accounts for over 60 percent of GDP.

I explore a transmission mechanism for increased public spending that can potentially overcome this negative effect on consumption and allow for the possibility of consumption to rise or be muted in response to government spending. I consider *deep habits* as an additional feature, which implies that household's consumption of goods in their basket of consumption depend on how much of that good they consumed in the previous period. One can think of this as brand loyalty. This feature affects the firm's problem where in times of high demand, say from increased government spending, firms want to capture a larger share of the market since that can affect their profits in the future as well. As a result they increase labor demand, which can cause wages in the economy to rise, and also have a positive effect on consumption.

In "Interest Rate Rules and Equilibrium Stability under Deep Habits" (*Macroeconomic Dynamics*, 2014), I study how the introduction of deep habits affects the equilibrium properties of a new-Keynesian model. In "Explaining the Effects of Government Spending Shocks", I embed deep habits into a medium scale dynamic stochastic general equilibrium (DSGE) model with various nominal and real rigidities, and focus specifically on the propagation of government spending shocks. I show that the model can successfully explain the empirical effects of an unanticipated spending shock for most macroeconomic variables of interest. In particular, deep habits give rise to countercyclical markups and thus act as a transmission mechanism for the effects of government spending shocks on private consumption and wages.

In "On Fiscal Multipliers: Estimates from a Medium-Scale DSGE Model" (*International Economic Review*, 2014), I further extend the framework to allow for a rich fiscal block with distortionary labor and capital income taxes and a careful modeling of the government financing behavior. Unlike monetary policy, since there was no widely accepted specification for fiscal policy, I consider various fiscal rules, allowing fiscal variables to respond to the state of the economy and the level of government debt. Ultimately, the focus is on how the economy responds to fiscal policy actions in the form of changes in government spending, tax rates, and lump-sum transfers. This model is estimated using a full information Bayesian approach, employing data on all major macroeconomic aggregates including fiscal variables.

I find that 1 percent of GDP increase in government spending increases GDP overall by 1.07 percent. The multiplier is larger than 1 since the estimated model predicts a small, slightly positive response of private consumption to government spending, which is in contrast to models that do not consider a channel of transmission of government spending shocks. The median multipliers for labor and capital tax on impact are much smaller. A cut in tax revenues of 1 percent of GDP, driven by labor and capital taxes, causes GDP to increase by 0.13 percent and 0.34 percent, respectively. The results of this paper also highlight the fact that effectiveness of fiscal measures vary significantly across the horizon and thus the stimulative effect in

the short-run differs from effects in the longer-run. So for instance, while increased spending causes output to rise considerably in the short-run, the effects of tax cuts take time to build. In fact, the stimulative effects of tax cuts exceed the effects of higher spending after 12 to 20 quarters and are primarily driven by the response of investment.

Since the estimated model provides an empirical framework to critically evaluate different fiscal policies, I also carry out several counterfactual exercises to show how alternative financing methods have consequences for the size of fiscal multipliers. I also provide evidence on how expected monetary policy has consequences for the stimulative effects of fiscal measures. I find that if the monetary authority is relatively accommodative, then increased spending has a significantly higher stimulative effect. This is however, not the case for all fiscal measures, as shown in the case of labor tax cuts. This paper was among the first wave of quantitative models of fiscal policy (first circulated in 2009), and has been highly cited.

In a follow-up paper in the same research agenda, “Propagation Mechanisms for Government Spending Shocks: A Bayesian Comparison” (revise and resubmit at *Journal of Money, Credit and Banking*), Anna Kormilitzina and I consider many of the different transmission mechanisms proposed in the literature for government spending, in order to reconcile empirical evidence on the response of consumption to a spending shock, and study their relative fit to data. In addition to deep habits, mentioned above, we also consider productive government capital, government spending directly affecting household utility, and modeling a share of households being unable to borrow and save, and consuming their disposable income each period. While models incorporating these distinct mechanisms have been estimated in separate studies, they normally have variations in model assumptions and data sets, which makes comparisons difficult or impossible. For proper model comparison, we embed the transmission mechanisms into identical frameworks, and estimate them using identical data sets and prior distributions for all common parameters in the models. We find that while these features are motivated by the study of effects of government spending, none of them help to improve the overall fit of the model to aggregate data. This suggests that if one is interested in a model that is quantitatively good at describing the data overall, then introducing any of the considered transmission mechanisms for government spending may be unnecessary.

**III: Housing, Household Debt and Policy:** The elevated levels of household debt during the mid-2000s posed significant financial stability and macroeconomic risks to the U.S. economy. Even now, several countries around the world are dealing with record high levels of household debt like Canada, Norway and Sweden. Thus, how best to prevent household debt from reaching unsustainable levels remains a critical issue of discussion among economists. The last line of research I am pursuing is primarily joint work with Sami Alpanda, where we are interested in understanding the effects of housing-related policy measures on macroeconomic aggregates and household debt, in particular.

Policy-makers already possess a suite of tools with the potential to address concerns related to household indebtedness. For instance, macro-prudential regulations can be tightened to ensure a decline in household credit, for example, by reducing the regulatory loan-to-value (LTV) ratio on new mortgage lending. Second, in the fiscal realm, housing-related tax policies could be tightened; for example, the statutory or effective property tax rates on residential properties can be increased or the tax deductibility of mortgage interest can be curbed. Finally, monetary policy can be tightened to induce an increase in borrowing costs in the form of mortgage rates.

While the favorable tax treatment of home-ownership had been studied widely in the context of life-cycle models, which typically consider the implications for housing tenure decision, there is a limited

understanding in the literature of the macroeconomic effects of housing tax reforms. In our first joint paper, “Housing and Tax Policy” (*Journal of Money, Credit and Banking*, 2016), Sami and I develop a dynamic general-equilibrium model featuring borrowers, savers and renters and analyze the effects of changes in various housing-related tax policy measures. We use our model to explore the impact of (i) reducing the mortgage interest deduction, (ii) instituting partial taxation of imputed rental income from owner-occupied housing, (iii) increasing property tax rates, and (iv) reducing the depreciation allowance for rental income, on macroeconomic aggregates. We find that among these fiscal tools, eliminating the mortgage interest deduction would be the most effective in raising tax revenue per unit of output lost. On the other hand, eliminating the depreciation allowance for rental income would be the least effective. The key behind these results is the type of household being affected directly by each policy. In particular, mortgage interest deductions directly affect only the cost of housing for borrowers, taxing imputed rents targets owner-occupied housing of borrowers and savers, and property taxes affect all types of housing (owner-occupied and rental). Our experiments also highlight the differential welfare impact of each tax policy on savers, borrowers and renters in the economy. For instance, while the reduction in the mortgage interest deduction is the most effective policy on the aggregate, it is also the one that causes the largest redistribution of wealth among agents, and as a consequence, could be one of the hardest to implement in practice.

Building on these insights, in “Addressing Household Indebtedness: Monetary, Fiscal or Macro-prudential Policy?” (*European Economic Review*, 2017), we analyze the relative merits of using fiscal policy measures, notably property taxes and mortgage interest deductions, in addition to monetary policy and macro-prudential regulations in reducing household indebtedness. These issues are of particular interest to central bankers considering alternative policy prescriptions to monetary policy, in achieving financial stability goals and controlling escalating household debt levels. We consider a DSGE model with housing and household debt, featuring borrower and lender households, and fixed-rate mortgage loans amortized over the long term, thereby allowing us to differentiate between the flow and the stock of household debt. This is key for differentiating the effects of policies that apply only to new lending (e.g., regulatory LTV) as opposed to all existing mortgage debt (e.g., mortgage interest deduction).

In our estimated model, we find that monetary tightening is able to reduce the stock of real mortgage debt in the short run, but given that the response of output to monetary policy is stronger, our model implies an increase in the household debt-to-income ratio after monetary tightening. Thus, our baseline results suggest that, while monetary policy may be a good last line of defense against the buildup of certain financial imbalances, it is not that effective (or can even have perverse effects) when it comes to households' mortgage debt, which remains an area of major financial stability concern in many countries. Among the other policy tools we consider, we find that reducing mortgage interest deduction and regulatory LTV are the most effective and least costly in reducing household indebtedness, followed by increasing property taxes. This ranking is generally consistent with the scope of each policy. Reducing mortgage interest deduction is slightly more effective in reducing mortgage debt relative to regulatory LTV in our baseline case, since mortgage interest deductions alter the effective cost of borrowing for all loans, including those originating from withdrawals of home equity. We also analyze the optimal values for regulatory LTV and mortgage interest deductibility, and by considering a social welfare measure we find that lowering regulatory LTV and mortgage interest deductions from their current levels would be welfare improving.

In our most recent work, “Debt Overhang and Transmission of Monetary Policy”, Sami and I consider the interaction between monetary policy effects and household debt, and specifically address the questions of whether the effectiveness of monetary policy in stimulating the economy depends on the level of household indebtedness in the U.S. economy. Theory suggests that the level of debt can affect the transmission of

monetary policy through different channels. The standard interest rate channel of monetary policy suggests that expansionary monetary policy will have a larger stimulative effect when debt levels are high since it would lead to a larger decline in borrowers' interest burden, when borrowers carry a higher initial debt stock. On the other hand, if the households are highly indebted, there might be some opposing forces that prevent their willingness or ability to take on additional debt or maintain a certain level of consumption even in the face of an interest rate cut.

We find that the effectiveness of monetary policy is curtailed during periods of high household debt. Namely, the impact of a monetary policy shock is significantly smaller on GDP, consumption, residential investment, house prices and household debt during a high-debt state. We then consider a very simple partial equilibrium model to focus on the effects of a policy rate cut on the interest burden of borrowers (i.e., interest rate channel), and their new borrowing through home equity loans (i.e., home-equity loan channel). We first show that the former channel is stronger when debt levels are higher. The latter channel, however, is operational only when debt levels are relatively low and borrowers hold adequate levels of home equity. Thus, the expansionary impact of a decline in interest rates may be curtailed under high initial debt levels, when the effects of the home-equity channel surpasses those from the interest rate channel. The model thus points to the weakening of the home-equity loan channel as a possible reason for the decline in monetary policy effectiveness when initial debt levels are high.

Overall, the project on household debt and monetary policy has led us to think more deeply about various issues such as the relative strengths of these and other opposing forces on households. In future work we are hoping to explore this further, likely from a cross-sectional or household perspective. In addition, as mentioned above, there are many countries facing elevated levels of household debt, and so in a current ongoing project, we are considering whether we find evidence of non-linear effects of monetary policy shocks based on household debt across various other developed countries.

In another ongoing project, in departure from my previous work, I consider the effects of borrowing constraints and transactions costs associated with adjusting housing on the extensive margin for housing asset decisions, namely homeownership. This project "Homeownership Trends and Demographic Composition" is joint work with Eunseong Ma (a graduate student at Texas A&M University). We focus on the 1995-2015 period, where homeownership rate rose steadily to reach a record high of close to 70 percent around 2005 and then fell back to the long-run average of about 64 percent by 2015. We document the changes in the homeownership rate by age distribution for this period, and the role of each age group in driving the aggregate variations. In addition we also look at the transition of housing tenure across age groups during this time period. We then build a DSGE life-cycle model with idiosyncratic productivity shocks and lumpy and indivisible housing investment, in order to explore how much the evolution of down payment requirements and transaction fees for buying and selling houses can help explain both the aggregate and distributional effects in homeownership by age groups. Initial results are rather encouraging as the change in down payment requirements play an important role in the decisions of the younger cohorts and transaction costs help explain the dynamics of home-ownership for the older cohorts. We are currently working to incorporate intensive margin for housing stock and transitory aggregate income shocks into the model framework. We hope that the findings of the paper will contribute to the growing literature considering the distributional effects of various policy measures.