THE DYNAMIC EFFECTS OF FISCAL POLICY

ON INEQUALITY

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Abstract:

My dissertation consists of two chapters and examines the linear and state-dependent (non-linear) effects of government spending shocks on various inequality measures.

The first chapter examines the dynamic effects of government spending shocks on income and consumption inequality in the United States. Using the recent quarterly micro-level US data on consumption and income estimated by the Consumer Expenditure Survey (CEX), this study analyzes the distributional effects of unanticipated changes in government spending on various economic inequalities considering different inequality measures. I do so by estimating the impulse response functions using the local projections method and utilizing forecasts of the fiscal variable by the Survey of Professional Forecasters for shock identification. Results show that income inequality to the unanticipated spending shock either remains unchanged or declines after five quarters. However, differing from the traditional view of a positive income-consumption inequality correlation, we find that fiscal shock significantly reduces consumption inequality despite any significant decrease in income inequality. Furthermore, results also suggest that the decrease in consumption inequality works through the interest rate channel since a fiscal policy shock significantly lowers interest-sensitive expenditures relative to non-durables. These results also support theoretical predictions of the heterogeneous agent model regarding the fiscal policy impact on inequality.

The second chapter investigates the state-dependent effects of unanticipated changes in government spending on consumption inequality using the Consumer Expenditure Survey (CEX). To do this, this study employs Jorda's (2005) local projections method and estimates the impulse response functions of consumption inequality to a government spending shock. Using the unemployment rate as a state variable, this study also evaluates the transmission of fiscal policy to consumption inequality depending on whether government spending is increasing or decreasing, given the state of the economy. In line with the predictions of the New-Keynesian theoretical model, we find that government spending shocks are state-dependent, and fiscal consolidations are more effective in reducing consumption inequality when there is a high unemployment rate in the economy.

Overall, results suggest that government spending shocks effectively reduce consumption inequality, and contractionary spending shocks are more effective than expansionary ones during the slack state.

TABLE OF CONTENTS

Chapter Page

I. THE EFFECTIVENESS OF GOVERNMENT SPENDING SHOCKS ON US INEQUALITY ……1

1. Introduction……1

2. Literature Review……6

2.1 Distributional Effects of Fiscal Policy on Inequality……6
2.2 Fiscal Policy-Inequality Transmission Channels……9
2.3 Income-Consumption Inequality Correlation……11
2.4 Shock Identification……13

3. The Consumer Expenditure Survey and Inequality Measures……14

3.1 The Consumer Expenditure Survey (CEX) ……14
3.2 Sample Selection and Measures of Inequality……18

4. Inequality Over Time in the US……21

5. Effects of Government Spending Shocks on Inequality……29

5.1 Identification and Estimation Methodology……30
5.2 Inequality Responses to the Government Spending Shocks……32
5.3 Robustness……35
5.4 Contribution of Government Spending Shocks to Historical Inequality…36

6. Conclusion……38

REFERENCES……41

APPENDIX……46

A. Data Description……46
B. Disaggregated Responses to Income Inequality……49
C. Robustness Results……50

Chapter Page

II. STATE-DEPENDENT EFFECTS OF GOVERNMENT SPENDING SHOCKS ON CONSUMPTION INEQUALITY

1. Introduction 52

2. Literature Review 56

2.1 Non-Linear Effects of Fiscal Policy 56
2.2 State Identification 58

3. Data and Methodology 60

3.1 Data and Sample Selection 60
3.2 Shock Identification 63
3.3 Econometric Methods 64

4. Empirical Results 69

4.1 State-Dependent Consumption Inequality Responses 69
4.2 Asymmetric Fiscal Shock Effects on Consumption Inequality Caused by Fiscal Behavior 72

5. Conclusion 75

REFERENCES 77

APPENDIX

A. State-dependent Inequality Responses under Binary State Specification… 82

LIST OF TABLES

Table Page

Chapter I

1 Sample Selection in the CEX, 1990Q1-2021Q4.....18
2 Demographic Characteristics of the Sample in the CEX, 1990Q1-2021Q4.....19
3 Government Spending Shock Contribution to the Forecast Error Variance of Inequality 36

Chapter II

1 Sample Selection in the CEX.....63
2 State of the Economy and Government Spending in the US.....72

LIST OF FIGURES

Figure Page
Chapter I

1 Inequality in Income, Earnings, Total Expenditure, and Consumption in the US.... ……22
2 Inequality in Earnings, Business, Financial, and Other Income in the US.....23
3 Comparison Between Upper and Lower Households' Income Distributions.....25
4 Percentile Differences in Households Earning Sources in the US 26
5 Inequality in Interest-Sensitive and Non-Interest-Sensitive Expenditures 27
6 Comparison between Upper and Lower Households' Expenditure Distributions….....28
7 Percentile Differences of Households' Expenditure Distributions.....29
8 Responses of Economic Inequality to the Government Spending Shock.....33
9 Disaggregated Responses of Economic Inequality to Government Spending Shock.....34
10 Contribution of the Government Spending Shock to Historical Cyclical US Inequality Dynamics 37
11 Response of Inequality in Business, Financial, and Transfer Income to Government Spending Shock 49
12 Inequality Responses to Government Spending Shock (Mean Value) 50
13 Inequality Responses to Government Spending Shocks (AR Lags=5) 51

Chapter II
1 Weights on High Unemployment Periods [1-F(z)] 67
2 State-dependent Response of Consumption Inequality to Government Spending Shock 70
3 State-dependent Response of Consumption Inequality to Asymmetric Government Spending Shocks 73
4 State-dependent Consumption Inequality Responses under Binary State Specification... 83

CHAPTER I

THE EFFECTIVENESS OF GOVERNMENT SPENDING SHOCKS ON US INEQUALITY

1. Introduction

With rising income inequality in the U.S. to record levels in recent years, the current fiscal policy responses to the pandemic (e.g., the Coronavirus Aid, Relief, and Economic Security Act and other related Acts) have been extraordinary, specifically in supporting low-income families and generally the overall economy.[1] While the US stimulus packages were mainly deficit-financed, the fiscal response was successful in that personal income increased in 2020Q2, even though the overall economy was experiencing a contraction. Due to such an effective and stabilizing role of fiscal policy in the global pandemic in 2020 and the great recession in 2008, the literature has shifted from analyzing the determinants of rising inequality toward exploring the causal and subsequent potential distributional effects of various policy measures on economic inequality. Since government actions have substantially disproportionate impacts on households and businesses, fiscal policy effectiveness in reducing economic inequality is an essential empirical question among policymakers and academicians.

[1] See Romer (2021) for a detailed account of the government responses to the pandemic in the US.

Evaluating this question is important since high economic inequality not only impedes the government's choice to implement consolidation measures but also adversely affects sustainable growth (Berg and Ostry, 2017). In this study, we estimate the effects of government spending shock (hereinafter "spending shock") on the cyclical behavior of economic inequality, quantify the role of these shocks to historical variations in inequality, and show some primary evidence of the transmission channel of spending shocks on inequality through a disaggregate level analysis.

Government spending is a powerful fiscal tool to achieve distributional objectives for more inclusive economic growth since changes in government spending affect household welfare through monetary payments (i.e., transfers) and the distribution of other benefits (e.g., education and health services). While economic policies affect inequality in general, economists have left evaluating inequality from aggregate considerations and started examining it through the potential distributional effects of policy actions across the business cycles (e.g., Cloyne *et al.*, 2020; Alpanda and Zubairy, 2019; Coibion *et al.*, 2017; Kaymak and Poschke, 2016, among others). Many of these studies estimate the long-run relationship between a policy shock and economic inequality, with a few exceptions where cyclical changes are studied for policy effectiveness in reducing inequality. Recently, Coibion *et al.*, (2017) have estimated how a contractionary monetary policy shock impacts on the cyclical behavior of income and consumption inequality in the US. However, research is still warranted for the distributional impact of fiscal policy on inequality. Contributing to this strand of literature, this study empirically estimates the distributional effects of the spending shock on various forms of inequality in the US.

Income and consumption inequality measures are important to evaluate consumer well-being, and excessive rise in either one is considered detrimental to macroeconomic stability and economic growth. The evolution of income inequality in the US has long been a core societal concern and is extensively studied because the data sets reporting household income measures are more frequently available, have consistent variable definitions, and have large samples. However, consumption inequality has recently gained more attention among economists and policymakers from a welfare point of view (e.g., Meyer and Sullivan, 2017; Heathcote *et al.*, 2010) and due to measurement issues in income data (Meyer *et al.*, 2015). Theoretically, traditional frameworks predict that income inequality transmits into consumption inequality due to a stable marginal propensity to consume. On the contrary, recent literature shows that consumption inequality may not necessarily mirror income inequality if financial markets are incomplete due to partial insurance against income shocks, asymmetric information, or limited commitment (e.g., Krueger and Perri, 2006). Adding to this strand of literature, we empirically estimate and compare the evolution of changes in income as well as consumption inequality to investigate the empirical ambiguity if consumption inequality tracks income inequality in the US.

Literature on economic inequality highlights the use of various matrices for calculating inequality based on the strengths and weaknesses of each measure and how they can complement each other for a comprehensive view. In particular, to analyze if the fiscal policy has redistributive effects, we calculate three inequality measures (cross-sectional SD, Gini, 90-10th percentile) for various forms of inequality i.e., total income, earnings, total expenditure, consumption, to avoid any possible bias being produced due to use of a single matrix of inequality and explain movements in the entire distribution and specifically if those

movements tend to be concentrated in particular population distribution. For calculating different inequality measures, we utilize the detailed household-level data from the Consumer Expenditure Survey (CEX), which is an inclusive data source on US households' consumption and income for the same household.[2] In this study, we compile an up-to-date dataset till 2021Q4 from the Bureau of Labor Statistics (BLS) public use microdata files of the CEX.

To characterize the distributional effects of a spending shock on income and consumption inequality, we estimate the impulse responses of our inequality variables to the unanticipated spending shock, as identified by Alpanda *et al.* (2021). Using the Survey of Professional Forecasters' (SPF), we identify government spending shocks as forecast errors for federal spending, which is the difference between the growth rates of what government actually spends and the one-quarter ahead forecast of its growth rate by academicians and professionals. We employ Jorda's (2005) local projections (LPs) method to estimate the impulse responses for every variable and inequality measure and test the null hypothesis that spending shock has zero distributional effects over 20 horizons (a five-year period) following the shock. Though LPs method and traditional VAR models estimate the same impulse responses given an unrestricted lag structure (Plagborg-Moller and Wolf, 2021), we use LPs method because it requires fewer restrictions, provides more robust estimates across various specifications, and is specifically easier to extend to non-linear frameworks.

The results obtained are briefly summarized as follows. First, the results show a delayed decline in total income inequality after a government spending shock, while the responses are less precisely estimated in the case of wage earnings, where we cannot reject the null

[2] We overlook wealth inequality since the CEX lacks reliable measures of household wealth, e.g., household currency holdings size, access to the financial market, etc.

hypothesis at the 5% level that a government spending shock has no distribution effects over the five years for Gini and P9010 measures of inequality. Second, the results show a significant decline in total expenditure and consumption inequality, with a more persistent decline in the latter. Moreover, through disaggregate analysis of consumption inequality, we find that spending shock reduces consumption inequality through an interest-rate mechanism since interest-sensitive expenditure declines after a positive spending shock, where the impact remains negative for 8 to 12 quarters, depending on the inequality measure. As opposed to the traditional view of a positive income-consumption inequality correlation, our findings are in line with the strand of literature that argues consumption inequality does not track income inequality in the US. Finally, the historical decomposition of the spending shock to inequality reveals a significant cyclical effect only in the case of consumption and total expenditure inequality. For the robustness check of our estimates, we test if our estimates significantly vary if we have a different specification of the shock and lag structure. The results remain robust to these changes indicating the insensitivity of the effectiveness of the spending shock towards these variations in the baseline model.

These results are important for various reasons. First, the potential role of government spending as a policy tool for inequality in comparison to monetary policy has received relatively little attention in the literature. Understanding and quantifying the sources of inequality and the effectiveness of different policy actions are essential in specifying prudent policies to address inequality issues. Second, the heterogeneous responses of income and consumption inequality to the fiscal policy shock highlight that the government must use more than one policy tool if the policy targets are both income and consumption inequality. Finally, after the Great Recession in 2008, literature (e.g., Heathcote *et al.*, 2010) has highlighted that

the cyclical component of inequality is as vital as the trend in inequality across business cycles. Since the literature highlights fiscal policy as one of the potential factors contributing to the Great Moderation and the Great Recession (e.g., Allsopp and Vines, 2015), fiscal measures can also be considered for affecting cyclical patterns in inequality.

This study is structured as follows. Section 2 provides a brief literature review. Section 3 discusses the CEX, sample selection, inequality measures, and their construction. Section 4 discusses the unconditional properties of inequality at aggregate and disaggregated levels. Section 5 details the estimation methodology and results of the effects of fiscal policy on inequality measures, while Section 6 concludes.

2. Literature Review

2.1. Distributional Effects of Fiscal Policy on Inequality

Fiscal policy is the key macroeconomic tool for achieving a government's redistributive goals since it affects households' welfare through financial payments (i.e., taxes and transfers) and the distribution of other benefits (e.g., education, health, and social services). These redistributive policies help the government move towards inclusive economic growth by achieving equity goals and improving efficiency when focusing on market imperfections. Moreover, the fiscal policy response following the recent global pandemic crisis in 2020 and the global financial crisis in 2008 (also known as the 'Great Recession') has reignited the debate among policymakers and academicians about the effectiveness of fiscal measures in resolving current key economic issues, raising inequality among one of them.

The dramatic increase in economic inequality in the US over the past four decades is extensively studied and at the forefront of the policy debate. Research on the dynamics of inequality over past decades has received an enormous amount of attention, and so is the literature evaluating its causes and consequences. However, the research focus has recently shifted to analyzing the causal effects of macroeconomic policies to address the constantly increasing inequality issue. Many papers have discussed how unanticipated changes in monetary policy affect inequality and what are the possible transmission channels (Alpanda and Zubairy, 2019; Furceri *et al.*, 2018; Coibion *et al.*, 2017; Davtyan, 2017; Saiki and Frost, 2014, among others). Most of these studies find that a contractionary monetary policy shock raises income and consumption inequality. On the fiscal policy side, the literature on the distributional effects of changes in taxes and transfer payments on inequality is also growing (e.g., Kaymak and Poschke, 2016; Bargain *et al.*, 2015; Domeij and Heathcote, 2004, among others). For instance, Bargain *et al.* (2015) evaluates the impact of tax policy reforms on income inequality in the US from 1979 to 2007 and find that tax policy changes increase income inequality by raising the income share of taxpayers above the 80th percentile (i.e., the top 20%).

Many studies have estimated the effects of changes in government spending on output and its components (i.e., consumption and investment), yet empirical evidence on the causal effects of redistributive government spending policies on inequality is scant. Contributing to this strand of literature, Wolff and Zacharias (2007) is an early exception for the United States that assesses, using household-level data from the Current Population Survey's Annual Demographic Supplement (ADS) for the years 1989 and 2000, the response of income

inequality after changes in government expenditure. Using the social accounting method, they find a significant decline in income inequality due to increased net government expenditure. In the case of OECD countries, some panel studies have found a significant inverse relationship between income inequality and fiscal consolidation (Afonso *et al.*, 2010; Doerrenberg and Peichl, 2014; Agnello and Sousa, 2014, among others). In the case of developing countries, Furceri *et al.* (2022), in a recent study, have estimated the effect of government spending shock on income inequality for a panel of 103 countries from 1990 to 2015. Using the Gini index as a dependent variable, they find a persistent increase (decrease) in income inequality in response to an unanticipated fiscal consolidation (expansion).

Our analysis also relates to the literature asserting that unexpected increases in government spending have distributive effects on consumption inequality. In particular, the literature highlights that economic agents are heterogenous, and a positive spending shock significantly increases consumption at the bottom of the distribution (i.e., households in the lower income group) while it falls at the top distribution (De Giorgi and Gambetti, 2012; Anderson *et al.*, 2016; Ma, 2019). Overall, this implies a reduction of consumption inequality in response to a rise in government spending. Such literature (e.g., Gali *et al.*, 2007) suggests that households with a lower level of income usually face credit constraints in the financial market ("rule-of-thumb" or non-Ricardian consumers) and increase their consumption in response to a rise in public expenditure because of a Keynesian style multiplier produced after changes in government spending.

2.2. Fiscal Policy-Inequality Transmission Channels

The theoretical background on the distributional effects of spending shock on income and consumption inequality mainly lies in the heterogenous agent model, where individuals behave differently to a policy shock based on the income group they fall in (the poor and the rich) or if they are constrained consumers or not. The standard Real Business Cycle (RBC) model predicts a decline in consumption after a positive government spending shock since the consumers rationally behave to a transitory spending shock and feel a negative wealth effect induced by an increase in future taxes. On the other hand, in the traditional Keynesian model, consumers increase their consumption after a positive spending shock since they behave in a non-Ricardian fashion. The reason for the differential impact of the same spending shock on consumption across these models lies in consumers' behavior. In the RBC theory, consumption decision at any point in time is based on an intertemporal budget constraint since the consumers are infinitely lived Ricardian households, while the Keynesian theory features non-Ricardian households whose consumption is a function of current disposable income and not of lifetime resources. Recently, literature (e.g., Anderson *et al.*, 2016; Ma, 2019) highlights that the behavior of the poor and the rich to a spending shock can be explained by different theories. More specifically, when the government increases its expenditures, households in the lower income group (rule-of-thumb consumers) increase consumption, while households in the upper-income group (with access to capital markets) reduce their consumption.

Literature on the monetary policy transmission channels on inequality is quite established, while fiscal transmission channels need to be substantiated and requires much attention. Recently, in an attempt to explain the income and consumption inequality responses to a

contractionary monetary policy in the US, Coibion *et al.* (2017) describe five transmission channels through which a policy change may affect inequality. Among these channels (namely, "*income composition channel, financial segmentation channel, portfolio channel, savings distribution channel, and earnings heterogeneity channel*"), only two channels (the last one) predict a decline in inequality after an expansionary monetary policy shock indicating that the effectiveness of monetary policy in reducing inequality differs on the strength of the two opposing forces.

One important feature of some of these transmission channels is that they are primarily general in nature, and any monetary or fiscal policy action can be explained as affecting inequality through them. For instance, the income composition channel suggests that typical households have diverse income sources broadly categorized as income from labor earnings, business, financial resources, and transfer payments from the government. Since a fiscal or monetary policy action may affect these sources of income in a heterogeneous manner, different income groups across households have a different impact on the incident of a policy shock. For example, wealthy households have more business and financial income, while the households belonging to the lower distribution tend to receive more labor earnings or transfer payments (Carpenter and Rodgers, 2004; Jenkins *et al.*, 2012). Since an expansionary shock tends to increase the income from the financial and business sources relatively more than the labor earnings, this effect widens the income gap between the upper- and lower-income distributions causing an increase in income inequality. However, since transfer payments (e.g., unemployment benefits and food stamps) tend to be countercyclical, a positive spending shock may also result in a reduced level of inequality since the households at the bottom of the

population received most of their income from the transfer payments.

Unlike the income heterogeneity channel, the earning heterogeneity channel predicts an unambiguous inverse relationship between fiscal policy and inequality. A contractionary fiscal policy adversely affects output and employment, at least in the short-run, and an associated decline in the wage share of the total income of the households. Resultantly, income inequality increases since low-income groups have a relatively high wage share in their total income. Moreover, in the face of a contractionary policy shock, employers also hoard skilled labor relative to unskilled ones, which results in a disproportionate unemployment rate among different households falling in unskilled wages relative to the skilled ones (Heathcote *et al.*, 2010; Mukoyama and Sahin, 2006).

2.3. Income-Consumption Inequality Correlation

Though income inequality has long been a core societal concern for developed countries, consumption inequality has recently gained more attention among economists and policymakers for three reasons. First, consumption inequality is more relevant for welfare analysis than income inequality since variations in income are mostly due to transitory components making current income an inappropriate measure of lifetime resources and economic welfare. Second, unlike the conventional idea that consumption inequality almost mirrors income inequality, recent work (e.g., Meyer and Sullivan, 2017; Heathcote *et al.*, 2010; Krueger and Perri, 2006) has shown that an identical change in income inequality might have a different impact on welfare distribution (most studies have shown that consumption inequality is lower than income inequality) depending upon a different financial market situation or another economic factor. Finally, due to the high extent of measurement issues

(under-reporting) in income data (Meyer *et al.*, 2015), understanding what has happened to consumption inequality may be more informative about consumer well-being than income.

Although traditional frameworks predict that income inequality transmits into consumption inequality due to a stable marginal propensity of consumption and any transitory or permanent change in income reflects upon consumption (in the same manner), recent theoretical models show that consumption inequality may not necessarily mirror income inequality if financial markets are incomplete. For instance, Krueger and Perri (2006) develop a model with endogenous debt constraint and illustrate that with-in-group income inequality always leads to a smaller increase in consumption inequality. Using the US household data, several studies have shown that consumption inequality grew weakly in the 1980-2000 period despite the large increase in income inequality (e.g., Meyer and Sullivan, 2009). Recently, Meyer and Sullivan (2017) illustrate that income and consumption inequality in the US have opposite trends after 2006, and the pattern of the two inequality also differs by decades.

This paper empirically examines the ambiguity of the income-consumption correlation using the CEX, which provides household data on both income and consumption of the same household. Evaluating different measures of well-being (e.g., income and consumption) is also important because the joint characterization of these variables reveals information about the nature of the shocks affecting households' income, the smoothing possibilities available to households, and finally, the potential need for government intervention.

2.4. Shock Identification

Shock identification has remained a key methodological challenge in fiscal literature. Identifying the changes in fiscal variables that are uncorrelated with contemporaneous macroeconomic shocks is necessary for establishing the strength of the causal relation. Literature on fiscal policy impacts on business cycle variables proposes different approaches to shock identification, yet the three most popular are the timing approach, the narrative approach, and the forecast errors approach.

The timing approach involves restricting the policy variable response to the other endogenous variables for a certain period. For instance, Blanchard and Perotti (2002) identify government spending shock in the structural autoregressions (SVAR) model by assuming government spending is not responding to the contemporaneous moments in output and taxes. Different variants of the timing approach are used by Auerbach and Gorodnichenko (2012) and Ilzetzki *et al.* (2013), among others. One caveat to this approach is that it is sensitive to forward-looking behavior and gets invalidated when policymakers have superior information.

The narrative approach requires constructing the shock series (government spending or tax) from historical documents by identifying and evaluating the reason and the magnitude associated with a change in the variable unrelated to the business cycle. Studies that used the narrative approach include Romer and Romer (2010), Ramey (2011), Owyang *et al.* (2013), Jones *et al.* (2015), Ramey and Zubairy (2018), among others. One caveat with the narrative approach is the endogeneity issue in the case of fiscal consolidation episodes. More specifically, the causal effects of negative spending shocks on future output are hard to establish if the narrative shock series show that fiscal austerity measures are adopted in

response to bad news about the future state of the economy. Another caveat with this approach is that most studies use only changes in military spending for shock identification, which results in many observations being equal to zero for a substantial part of the sample.

Finally, the forecast errors approach proposed by Auerbach and Gorodnichenko (2013) identifies a fiscal shock as the difference between actual value and its forecasted value. We also utilize, in this study, this approach for spending shock identification. Unlike the previous approaches, this approach precludes the issue of zero observations prevalent in the narrative method and also overcomes the problem of fiscal foresight embedded in the timing approach. The issue of fiscal foresight (see Zeev and Pappa, 2015; Leeper *et al.*, 2012, 2013) arises when economic agents and econometricians have different information sets about the changes in the policy variables. The forecast errors approach, using the expected value information about the future state of a variable, aligns the econometricians' information set to that of economic agents, which leads to unbiased estimates. Studies that have used this approach for shock identification include Ma (2019), Alpanda *et al.* (2021), Furceri *et al.* (2022), among others.

3. The Consumer Expenditure Survey and Inequality Measures

3.1. The Consumer Expenditure Survey (CEX)

Since the literature emphasizes a consistent theoretical framework to define any relationship between income and consumption of households, we aim to use data on income and consumption that are closely linked (given the data limitations) to calculate various inequality measures and compare their distributions. We use the CEX survey data from the Bureau of

Labor Statistics. Though CEX reports measures of consumption and income since 1980, we include waves starting in 1990Q1 since this is the first year with the most consistently available (with any missing years) and comparable data. The CEX consists of two separate surveys, i.e., the Interview Survey and the Diary Survey, and is used for constructing weights and associated price samples of the Consumer Price Index (CPI) in the U.S. We utilize data only from the Interview Survey for two reasons. It covers information on up to 95% of typical household consumption expenditures, and most of the studies in the inequality literature have only used the interview survey for the analysis.[3] CEX is a monthly rotational panel of about 1500-2500 sample consumer units, i.e., households[4], which are selected to be representative of the US population. Households are interviewed about their consumption expenditure once per quarter over five consecutive quarters. We disregarded the first interview since it is used only for pre-sampling purposes. Each household is dropped and replaced by a new unit after the last interview; therefore, 20 percent of the sample is designed to renew every quarter.

Households are retrospectively asked for consumption expenditures covering the three months before the interview month. Consumption is spending on all durable goods (e.g., furniture, appliances, television, etc.), nondurable goods (e.g., food, beverages, clothing, personal care, etc.), and services (e.g., utilities and transportation). Following Coibion *et al.* (2017), we also define an extensive measure of total expenditure by incorporating other larger and non-consumption expenditures better interpreted as an investment (e.g., education, health, vehicle, life insurance, etc.) to household consumption levels. On the income side, the CEX

[3] Though the Dairy Survey accounts for expenditures on frequently purchased small items, most studies on consumption have utilized only the Interview Survey for estimation/analysis. Moreover, Coibion *et al.* (2021) argue that the frequency of shopping trips has declined in the US since 1980.
[4] BLS defines a household as all members of a housing unit related by blood, marriage, adoption, or other legal arrangements.

reports several sources of income. We aggregate them into four groups, namely labor earning, business income (farm and non-farm income), financial income (e.g., interest on saving accounts, income earned from dividends, royalties, estates, and trusts, etc.), and other income (e.g., social security benefit, unemployment compensation, child support, etc.). These income categories refer to before-tax household income in the previous year since the reference period for income flows is the preceding 12 months of the interview, aligning with the period captured for consumption expenditures. Though some income categories are subject to top coding in the survey, those households are of a small proportion (less than 1% in a year). Moreover, to reduce the influence of outliers and mitigate any time-varying impact of top coding, we winsorize income (and consumption) variables in the top and bottom 1 percent of the distribution. Finally, we calculate all variables in constant dollars using the CPI-U (1982-84 =100), and apply the sample weights in all estimations.

The quality of the CEX relative to other datasets has received enormous attention in the literature. Specifically, income data is more prone to be underreported than expenditure data. For this reason, a few studies (e.g., Lusardi, 1996; Blundell *et al.*, 2002) propose combining consumption information from the CEX and income information from other data sets like the Current Population Survey (CPS) – the data source for official inequality measures in the US.[5] However, this suggestion is ineffective for several reasons. First, like the CEX, many studies explain that income data in the CPS is not only substantially under-reported but also the extent of under-reporting has increased over time (Meyer *et al.*, 2003; Meyer and Sullivan, 2017; Davies and Fisher, 2009). Second, many studies have found a strong correlation between the

[5] See Attanasio and Davis (1996) for a study combining the CEX and the CPS for consumption and income data, respectively.

CEX and CPS datasets among various income categories. For instance, Attanasio (2002) and Attanasio *et al.* (2004) show that the wage inequality measure is consistent in the CEX and the CPS. Moreover, after estimating the same income inequality measures from the CEX, PCS, and the Panel Study of Income Dynamics (PSID), Heathcote *et al.* (2010) find a strong comovement of before-tax inequality measures of labor earning among the three surveys. Finally, while combining two separate data sets on consumption and income is reasonable to analyze risk sharing across groups of households, it conceals risk sharing at the household level as the aggregation procedure reduces the strength of idiosyncratic risks.

A similar issue is raised concerning underreporting of households' expenditures in the survey data. CEX underreports consumption expenditures, and the extent of this under-reporting has increased over time (Krueger *et al.*, 2010; Aguiar and Bils, 2015; Attanasio *et al.*, 2014, among others). However, most recently, Bee *et al.* (2012) illustrate that, for large expenditure categories, the CEX Interview Survey closely conforms to the national income accounts data. Besides, underreported consumption expenditures are less of a concern for this study since we do not focus on changes in the level of inequality but the cyclical fluctuations in consumption inequality. The PSID also collects data on household consumption expenditures, but many expenditure categories were missing in the survey until 1999, and some others (e.g., clothing and entertainment) were added in 2005. On the other hand, the CEX provides detailed consumption data on all major expenditure categories for a more extended period.

Moreover, there are some important caveats in the quarterly CEX data despite offering higher frequency variation in both income and consumption of the same households. First is the measurement error issue since the CEX is a survey, but this issue is fairly deliberated in

the literature, and many studies propose how constructing different definitions of consumption using expense categories can help prevent the issue. Second, the CEX disregards the upper end of the income distribution (i.e., the top 1%), which may have a consequential role in income inequality dynamics. However, the issue is trivial for this study since we winsorize the variables at the top and bottom end of the distribution to mitigate the influence of outliers and top-coded variables in the survey data. Finally, CEX has a relatively small cross-section that constrains our capacity to divide the sample into subgroups and analyze the system through which a fiscal policy affects various population subgroups. Still, through disaggregate analysis, we provide primary results that signal the possible transmission channels through which spending shock may affect inequality.

3.2. Sample Selection and Measures of Inequality

Our sample runs from 1990Q1 through 2021Q4. Table 1 summarizes the number of observations dropped at each stage of the process based on selection criteria.

Table 1. Sample selection in the CEX, 1990Q1-2021Q4.

Selection Criterion	Dropped	Remaining Obs.	Remaining CUs
Initial Sample		758,620	270,770
Incomplete income data	107,164	651,456	246,155
Inconsistent age	19,547	631,909	239,711
Zero or missing food consumption	1,915	629,994	239,225
Negative medical care expenditure	2,438	627,556	239,030
Implausible expenditure	4,281		
Our benchmark sample		623,275	238,186

First, we dropped observations where consumer unit (CU) income is considered incomplete. CEX reports this household category classified as incomplete income respondents.

Second, we kept only those observations for whom the reference person's characteristics or weight factor field contained a valid or good data value. As recommended by the BLS, we drop households that report zero food expenditure (sum of both foods at home and food away from home) in any quarter. Households with a negative medical care expenditure in any quarter are also excluded. Finally, we drop households reporting such consumption expenditures that are implausible according to the data codebook, i.e., non-positive elderly care expenditures, since these cannot be zero.

Table 2 reports descriptive statistics on the demographic characteristics of our benchmark sample. Consistent with the statistics for various data sets documented in the literature (e.g., Heathcote *et al.*, 2010), Table 2 broadly indicates, both in terms of levels and trends over time, the conformity of demographic characteristics of the households to other data sources (e.g., PSID and CPS).

Table 2. Demographic characteristics of the selected sample in the CEX.

	1990-1999	**2000-2009**	**2010-2021**
Avg. household size	2.527	2.533	2.528
% households with spouse	52.72	51.74	49.94
Avg. male age	46.61	46.71	48.83
Avg. female age	48.53	47.08	49.26
% white male	85.90	83.36	80.66
% male ≥ 16 years education	25.59	27.43	36.28
% female ≥ 16 years education	19.43	23.42	31.91

Since the CEX provides quarterly data on consumption as well as income, we focus on studying both forms of inequality by estimating three matrices of inequality. We estimate the Gini coefficients, cross-sectional standard deviations, and differences between 90^{th} and 10^{th} percentiles of the cross-sectional distribution. The Gini coefficients are estimated in levels,

while the latter two matrices of inequality are calculated in log levels. Though each measure has pros and cons, estimating various measures of inequality reduces possible bias in explaining the results and, at the same time, illustrates the difference among the impulse response of various inequality measures for a shock. The Gini coefficient is the most used measure and easier to interpret, yet it is sensitive to outliers in the data. On the other hand, the standard deviation and the percentile difference measures reduce the sensitivity to outliers but require us to drop zero observations in the data series. The cross-sectional standard deviation pertains to a change in the difference between the top of the distribution and its middle, without much accounting for what is happening at the bottom of the distribution. Therefore, we also look at the 90-10th percentile difference to illustrate what has happened to the inequality at the bottom of the distribution over the last thirty years.

Following Coibion *et al.* (2017), we characterize inequality in total income as the sum of all forms of income resources i.e., wage earnings, income from the business, financial income, and transfer payments a household receives over a year. Moreover, we investigate the evolution and response of individual income categories to a spending shock to see if any particular source of income is substantially sensitive to the spending shock over the other sources of income. Though the CEX provides after-tax income data, we focus only on the pre-tax measure of total household income. However, it can be shown that our results are robust to the after-tax total income variable of the household. Since households report their income sources in the CEX when they are first interviewed and finally when they are interviewed for the last quarter of their participation, we have only a subset of the data as the sample used to calculate inequality in income each quarter.

To construct the consumption inequality measure, we aggregate all the durable, non-durable, and services expenditures incurred by households over the last three months of their survey participation. Specifically, we construct the consumption variable as it is measured by Parker (1999) and, subsequently, many studies. Note that the consumption variable has durable goods (i.e., household appliances, entertainment goods like televisions, and furniture), yet does not include some major household expenditures such as expenditures on housing, vehicle, education, etc. To account for inequality in those categories of expenditures, we also construct another measure of consumption, namely total expenditures, which includes consumption as well as those non-consumption expenditures, which can better be interpreted as an investment for the households. These expenditures include mortgage payments, purchases of cars, medical supplies and services, and tuition and books for schooling, among others. Most of these expenditures are interest-sensitive and help us explain if the shock has any interest-rate channel to affect household expenses relative to non-interest-sensitive expenditures.

4. Inequality Over Time in the US

In this section, we characterize the evolution of different income and expenditure inequality measures in the United States over the last 30 years. Moreover, we demonstrate the evolution of inequality at the disaggregated level, i.e., inequality in financial-, business-, transfer-income, and durables versus non-durables consumption inequality. Throughout this section, we express all variables averaged over the subsequent and previous quarters to illustrate business cycles and low-frequency variations, together with shaded areas denoting NBER-dated recessions. We express these variables in constant dollars using CPI-U (1984=100), and

all series are HP-filtered so that these reflect cyclical fluctuations rather than trends. To our knowledge, ours is the first paper documenting the evolution of these variables at disaggregated levels using CEX for a recent time (up till 2021Q4) in the United States.

Fig. 1 plots the evolution of inequality measures (i.e., income (before tax), income (after tax), wage earnings, total expenditures, and consumption) calculated by the cross-sectional standard deviation (Panel A), Gini coefficient (Panel B), and the difference between 90th and 10th percentile (Panel C).

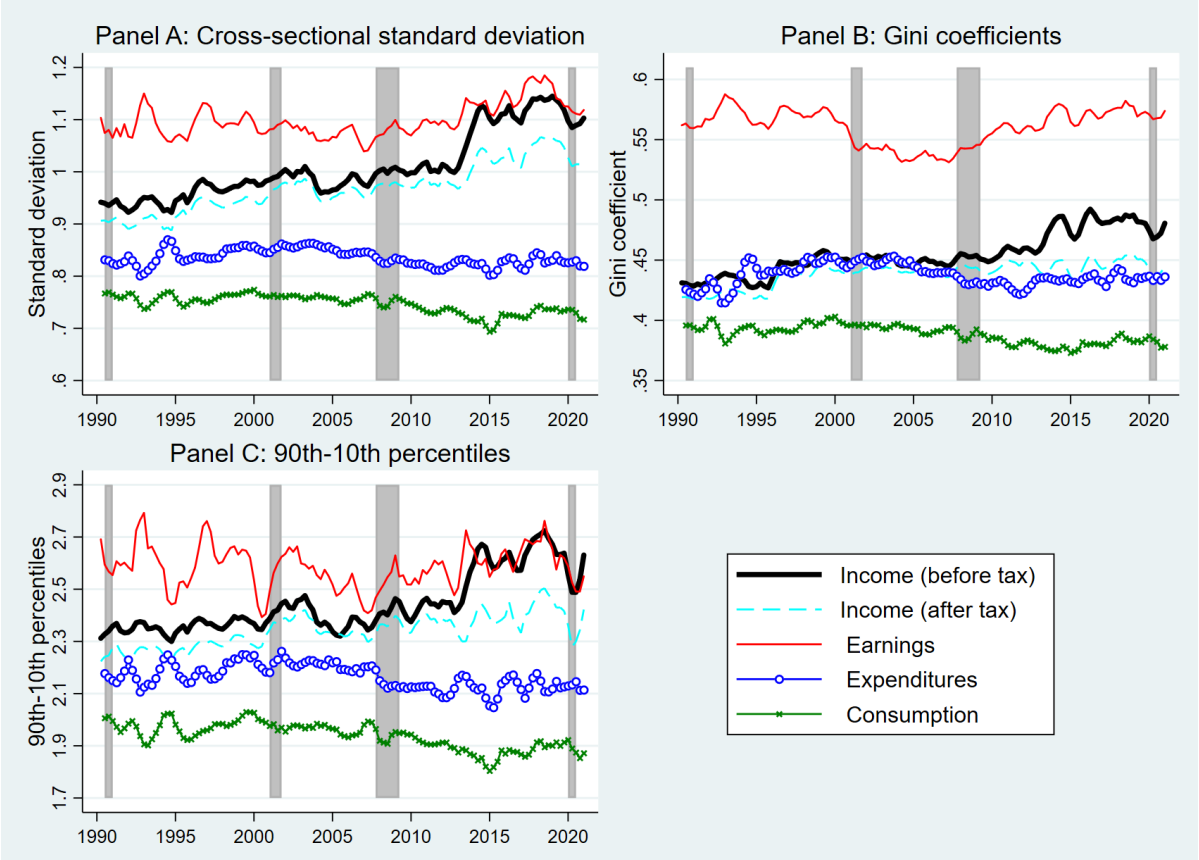

Fig. 1. Inequality in income, earnings, total expenditure, and consumption in the US.

Four points are important here. First, consistent with results in the literature, income inequality trends up over time in all three measures till 2005 (Krueger and Perri, 2006). Second,

the patterns for income inequality and consumption inequality change differently by decade till 2005, and afterwards, they clearly moved in opposite directions after 2006, where the gap is consistently increasing till 2021 (Meyer and Sullivan, 2017). Third, labor earnings inequality shows a decline till 2007, but after that, it starts rising until 2019 and shows a similar pattern to that of income inequality. Finally, consumption and expenditure inequality declined after 2007 despite a significant increase in income inequality over the course of 2000s. In general, all of the different methods tell a similar evolution in economic inequality in the US. Consistent with Coibion *et al.* (2017), these figures of inequality measures reveal evidence of cyclical behavior, especially during the great recession.

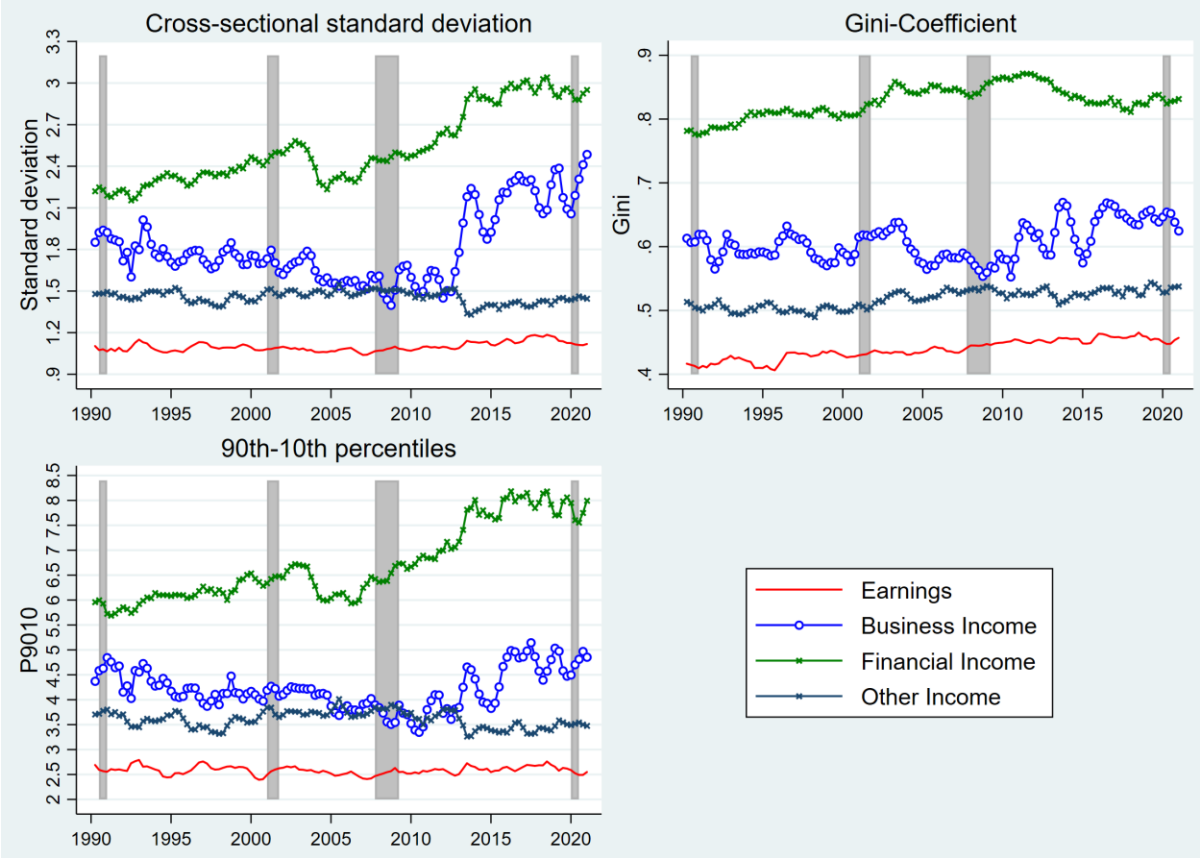

Fig. 2. Inequality in earnings, business, financial and other income in the US.

Understanding economic inequalities at the disaggregated level is vital since every component of income (i.e., earning, finance, business, transfers) and consumption (durables, non-durables, and services) exhibit different dynamics. Moreover, Heathcote *et al.* (2010) suggest that inequality measure that emphasizes the bottom of the distribution (i.e, the difference between P50–P10) generally evolve in a different way from measures characterizing the top of the distribution (i.e., the difference between P90–P50).

Fig. 2 shows the evolution in income inequality at a disaggregate level in the US over the last 30 years. First, inequality in earnings (wages and salaries) has risen either marginally or remained stable across all the measures. Note these findings are not based on race, sex, or marital status, for which studies do find significant differences. Second, like earnings inequality, inequality in other income (transfer payments or payments received without doing any work) shows a stable pattern. Third, business-income inequality, including net business and farm income, shows a persistent decline till 2011, but it started increasing after that for all inequality measures. Another important feature of business inequality is its cyclical pattern during recession periods. Whenever there is a recession, we observe a decline afterward in business inequality. Households at the bottom of the distribution usually hold a lower share of income from business, and the rich lose business income during recessions resulting in lower inequality. Finally, financial income inequality in the U.S. has been consistently rising and is the highest among all forms of income. After 2005, there is a sharp increase in financial inequality calculated by all inequality measures except the Gini coefficient, which, however, is quite high, indicating severe inequality in the distribution of financial resources.

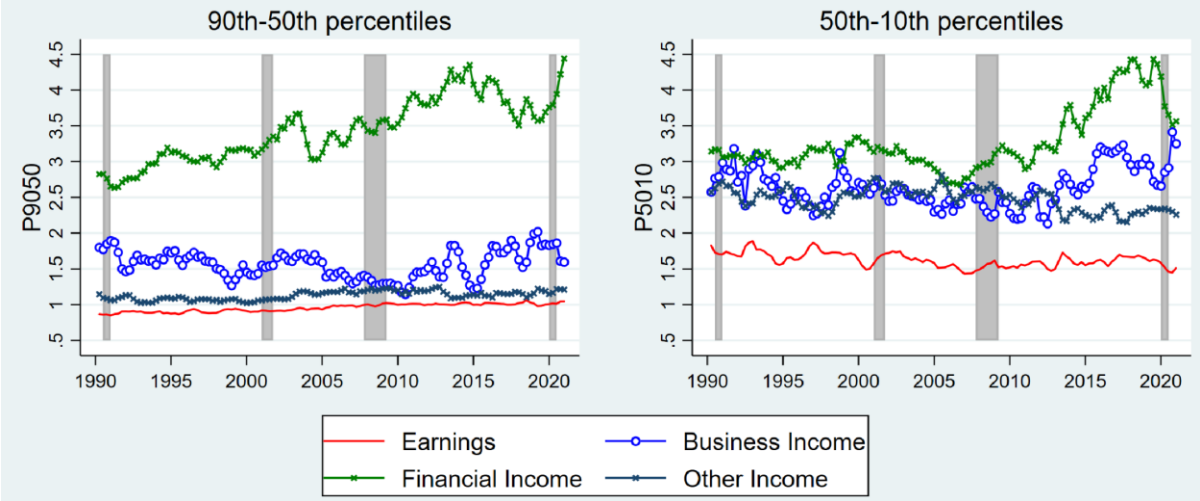

Fig. 3. Comparison between upper and lower households' income distributions.

Fig. 3 depicts the difference between upper (P9050) and lower (P5010) household income distributions. For comparison purposes, we set the same log percentile difference value on the vertical axis. Overall, lower household income distribution shows a relatively higher inequality among all income sources except financial income. After 2000, financial inequality has raised for the upper household distribution relative to the bottom one (i.e., P5010).

inequality is marginally increasing among the top distribution while it is declining in the bottom one indicating a decrease in earnings inequality of middle- and lower-skilled workers over time. Finally, other income (transfer payments) inequality, like salary, remained constant over time. In fact, it went down for the 50th-10th percentile after the Great Recession showing a more equitable distribution of transfer payments at the lower end of the distribution.

Fig. 4 shows the individual income category's percentile differences (P9010, P9050, P5010). All the cases indicate that inequality is high for the 90-10th distribution, but lower for the 90-50th than that of the 50-10th percentile, except in the case of financial income, where the latter two (P9050 and P5010) almost move the same. It implies that inequality is primarily

driven by the upper end of the distribution, i.e., the 90th percentile. Another thing to note is the movement of financial inequality over time: among all sources of income and classes of distributions, only financial inequality shows a significant persistent increase over time.

Fig. 4. Percentile differences in households earning sources in the US.

We conduct the disaggregated analysis for consumption based on interest-sensitive and non-interest-sensitive expenditures for two reasons. First, our definition of durable goods accounts for only small housing-related expenditures disregarding large interest-sensitive household expenses, such as education and vehicles. Second, for the preliminary evidence on the interest rate transmission channel of fiscal policy in case of consumption inequality, this

expenditure category is more relevant than simply looking into durables, non-durables, and services. We base our measure of interest-sensitive expenditure on the sum of housing furnishing and equipment, entertainment, education, vehicle, and own dwelling (e.g., interest on the mortgage, interest on the home equity loan, expenses for property management and security, etc.) while all other expenditures are part of the non-interest sensitive category.

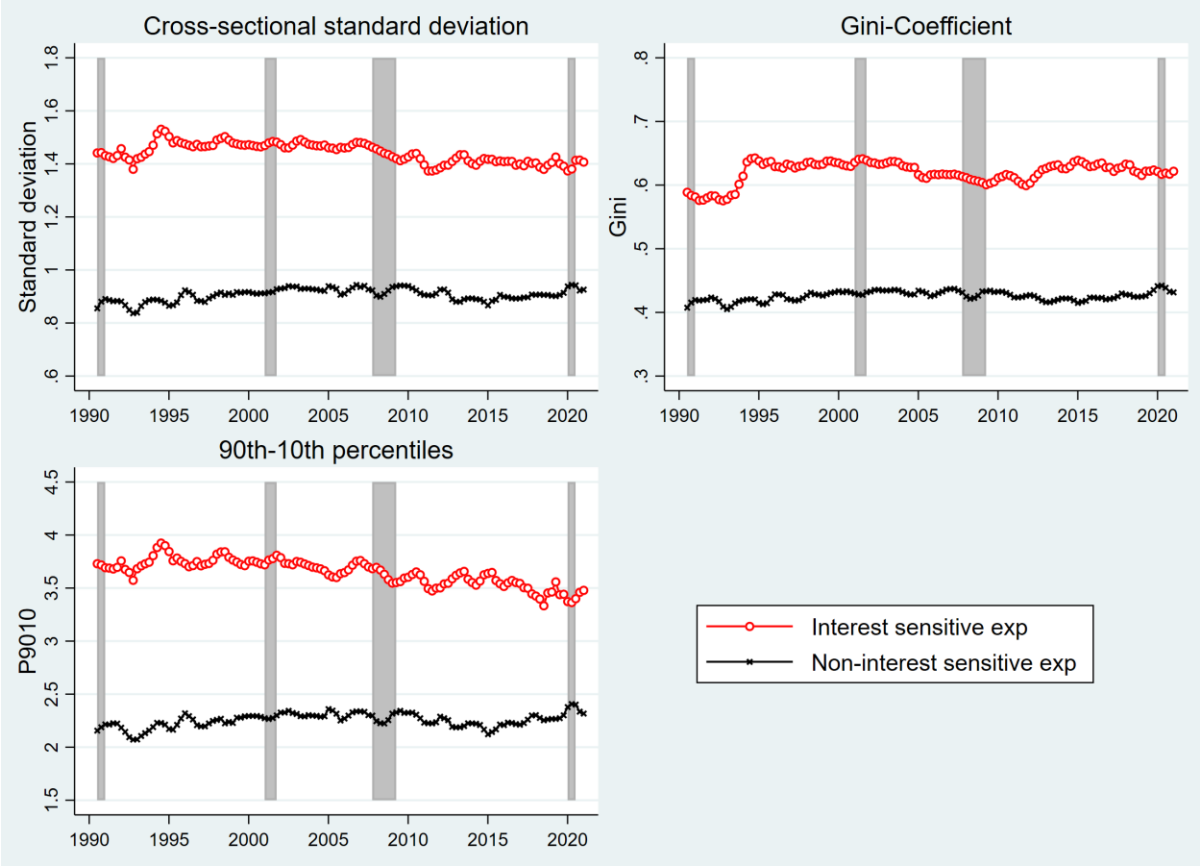

Fig. 5. Inequality in interest-sensitive and non-interest-sensitive expenditures.

Fig. 5 shows that interest-sensitive expenditures tend to rise until the early 1990s and then start declining across all inequality metrics. Inequality in interest-sensitive expenditures tends to decline sharply in recessions than during periods of expansions. For instance, there is a significant decline in inequality related to interest-sensitive expenditure during the great recession, which not only suggests that fiscal policy is effective in reducing expenditure

inequality but also implies that the effectiveness of the fiscal policy may be state dependent. Non-interest-sensitive expenditures inequality shows a stable pattern over time. These trends in inequality also suggest that explaining the interest rate channel of policy transmission may be reasonable if fiscal policy shocks lower expenditure inequality.

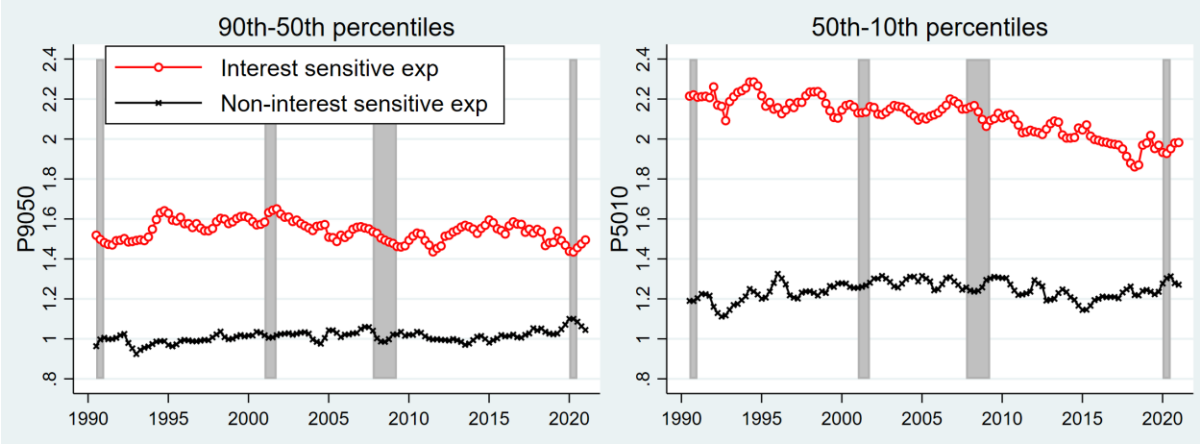

Fig. 6. Comparison between upper and lower households' expenditure distributions.

Fig. 6 compares upper and lower household expenditure distributions. Households at the lower distribution (P5010) face a higher inequality in both interest-sensitive and non-interest-sensitive expenditures relative to the households at the upper distributions (P9050). For the households at the bottom of the distribution (P5010), the difference in interest-sensitive expenditure is persistently declining. Moreover, the figure also indicates some relationship between business cycles and inequality patterns by illustrating how inequality in interest-sensitive expenditures goes down whenever there is a recession in the economy.

Fig. 7 illustrates percentile differences (P9010, P9050, P5010) for expenditure categories. Like income, all the cases indicate that inequality is high for the 90-10th distribution but lower for the 90-50th than that of the 50-10th percentile, except in the case of total expenditure where the latter two (P9050 and P5010) closely move together.

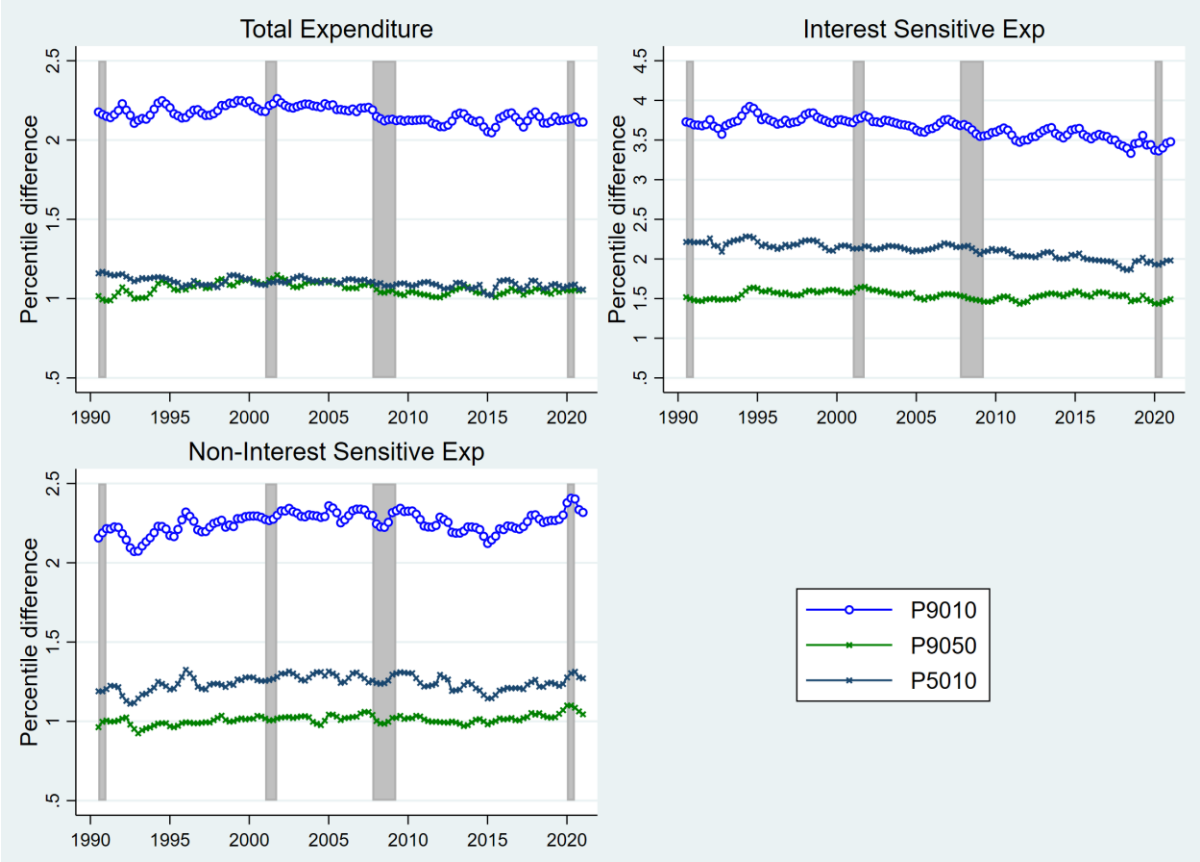

Fig. 7. Percentile differences of households' expenditure distributions.

It implies that inequality is primarily driven by the upper end of the distribution, i.e., the 90th percentile.

5. Effects of Government Spending Shocks on Inequality

In this section, we present the impulse responses of the measures of economic inequalities at aggregate and disaggregate levels to the spending shock. We first discuss the identification of the government spending shock and estimation methodology. Second, we discuss the effects of the shock on various forms of inequality, followed by a discussion on the results of some robustness checks. Results on the historical contribution of the shock in inequality conclude the section.

5.1. Identification and estimation methodology

To estimate the causal effects of government spending shock on inequality measures, we follow Alpanda *et al.* (2021) to identify innovations to the spending shocks. Using the Survey of Professional Forecasters (SPF)[6] forecast for federal spending, we identify our shock variable as the difference between actual government spending growth and the one-quarter ahead forecast of its growth rate by macroeconomists and policymakers.

$$e^{g}_{t|t+1} = G_t - G_{t|t+1} \qquad (1)$$

where *G* is government spending and *t* is time. Since identifying the shock is necessary for establishing the strength of the causal effect, the key assumption here is that these government spending shocks are orthogonal to professional forecasts of future government spending. Our specification of shock identification essentially ensures this assumption since the SPF survey timing is geared to the release of the Bureau of Economic Analysis (BEA) advance report of the national income and product accounts (NIPA) and the most recent reports of other government statistical agencies, which has the preliminary estimate of GDP and its components for the previous quarters. Therefore, in submitting their projections, the forecasters incorporate all available information about the state of the economy.

Other existing identification strategies include the construction of shock series through structural vector autoregressions (SVARs) model with Cholesky decomposition and short-run timing restrictions (e.g., Blanchard and Perotti, 2002), but these shocks are not subject to innovation effects, and these model assumptions become invalidated when there is superior

[6] American Statistical Association (ASA) and NBER initially conducted the SPF survey in 1968 and the Philadelphia Fed took over the survey in 1990. It is available on a quarterly basis.

information on the part of policymakers (Ramey, 2016). The narrative method of government spending based on military news (Ramey, 2011) is another alternative. However, in the post-Korean war sample, these shocks have demonstrated relatively low predictive power and our sample exhibits the same data span. On the other hand, SPF forecast errors preclude any time or sign restriction in structural models and have large first-stage F-statistics for predicting government spending in samples not covering significant military events (Ramey, 2011).

To quantify the empirical effects of the spending shocks on economic inequality, we employ Jorda's (2005) local projections method and estimate the accumulated impulse response of inequality variables to the shocks at different horizons *h*, specified as:

$$\Delta y_{t+h} = c^{(h)} + \sum_{j=1}^{J} \alpha_j^h \Delta y_{t-j} + \sum_{i=0}^{I} \beta_i^h e_{t-i}^g + \varepsilon_{t+h}, \quad \text{for} \quad h = 1, 2, 3, \ldots, H. \qquad (2)$$

Where *y* is the variable of interest i.e. inequality measures, and e_t^g are quarterly government spending shocks as identified in eq (1). Since CEX is a rotating panel that features time aggregation in the data, we estimate impulse responses as a system of equation jointly across horizons, which also permit for the contemporaneous response of dependent variable, i.e., inequality measure, to the exogenous spending shock. Therefore, equation (2) generates accumulated impulse responses to government spending shocks from the estimated $\{\hat{\beta}_0^H\}_{h=0}^H$, as calculated by Coibion *et al.* (2017). We measure Driscoll and Kraay (1998) standard errors to correct for cross-sectional and temporal dependence across horizons and time. In line with the fiscal policy literature, we consistently set for all estimations *J*=4, *I*=20, and *H*=20 quarters. However, we also show in the Appendix that our results are robust to changes in lag structure. For each accumulated impulse response, we report confidence intervals based on one and 1.65

standard deviations. We also report *p*-values for tests of the null hypothesis that government spending shocks do not affect the inequality measure across all horizons $h = 0,1,\ldots,H$.

5.2. Inequality Responses to the Government Spending Shocks

Fig. 8 shows the accumulated impulse responses for each form of inequality (presented column-wise) and the measure of that inequality (given row-wise) to a government spending shock and the associated confidence intervals (one and 1.65 standard deviations, respectively) as estimated by equation (2) using data from 1990Q1 until 2021Q4. In all cases, the p-values show that we can reject the null hypothesis of no inequality response to the government spending shock across all horizons at the 5% level except for the income and earnings 90-10th percentile difference. We can reject the null hypothesis for consumption and total expenditure inequality even at the 1% level, implying that fiscal policy shocks unambiguously have redistributive effects.

For total income inequality, only the measure of cross-section standard deviation shows a delayed decline, with most of the decrease occurring after six horizons. This result is typical since most of the literature on the fiscal policy impact on output states that either government spending shock multipliers are below unity or statistically insignificant (e.g., Ramey and Zubairy, 2018). For earning inequality, the accumulated impulse response to a government spending shock shows an unclear pattern for all inequality measures and even insignificant results at 5% level for the 90-10th percentile difference. This result is in line with the finding of Coibion *et al.* (2017), who found the same result for earning inequality under a monetary policy shock. We propose that contractual wage practice in the US causes wage rigidity that significantly precludes the effect of any fiscal shock on the wage earnings of the households.

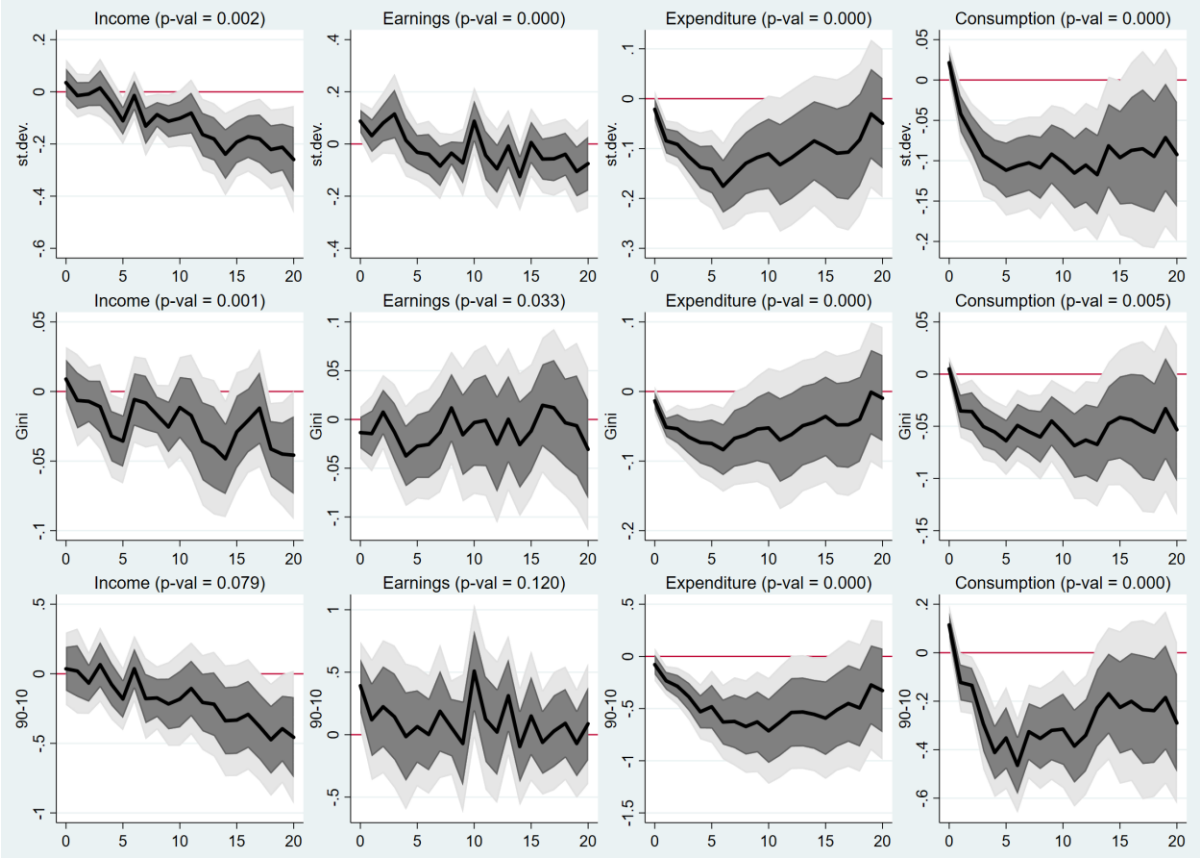

Fig. 8. Responses of economic inequality to the government spending shock.
Note: The solid black lines are the accumulated impulse responses, whereas the dark and light gray areas show 1 and 1.65 standard deviation confidence intervals for income (first column), earnings (second column), expenditures (third column), and consumption (fourth column) inequality. Inequality is measured by the cross-sectional standard deviation (first row), Gini coefficient (second row), and the log difference between the 90th and 10th percentiles of the cross-sectional distribution. "*p*-values" are for the null hypothesis that the impulse response is zero for all horizons.

Unlike income inequality response, every measure of consumption inequality (and expenditure inequality) points to a statistically significant decline after an expansionary government spending shock. Results for consumption/expenditure inequality support the recent literature that negates the traditional frameworks that predict income inequality transmits into consumption inequality due to a stable marginal propensity to consume. Our results show that consumption inequality declines in the US after a government spending shock without any significant decline in income inequality.

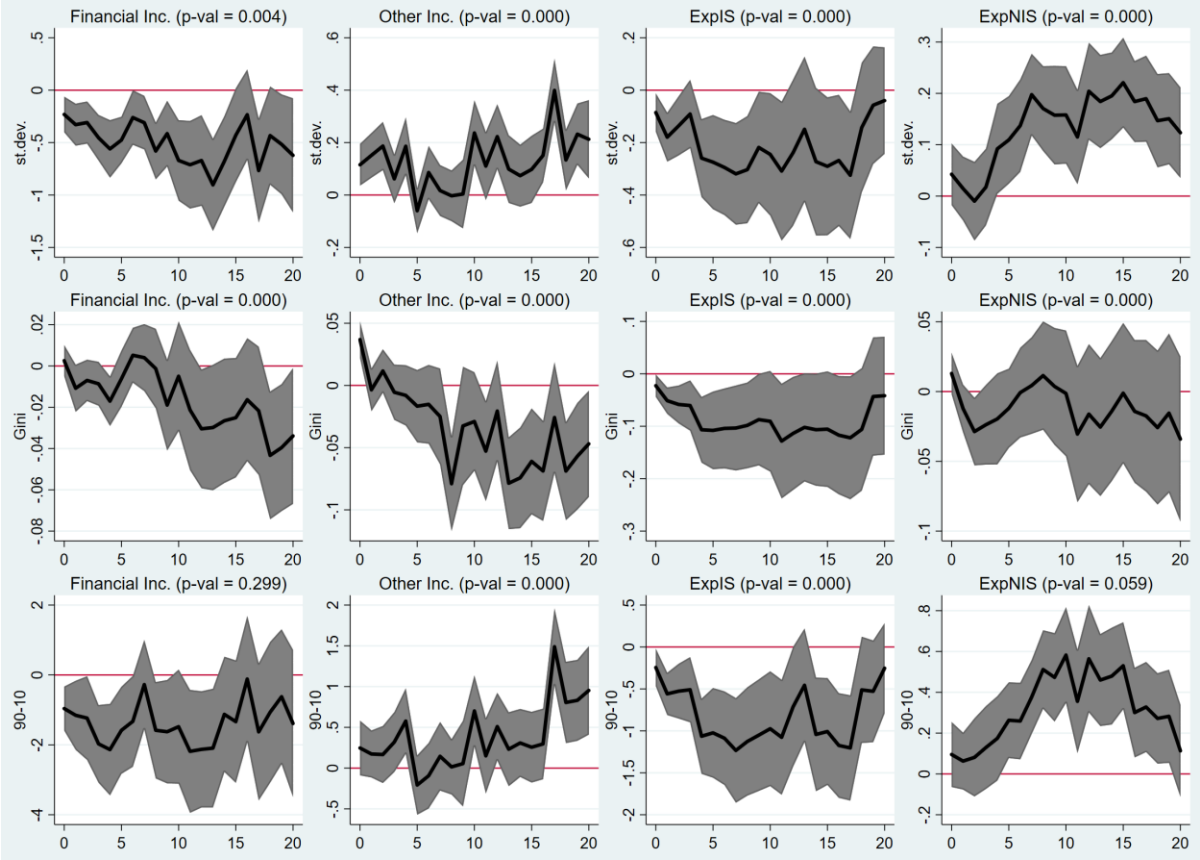

Fig. 9. Disaggregated responses of economic inequality to the spending shock.

Figure 9 shows the accumulated impulse responses of financial income, other income (transfers), interest-sensitive and non-interest-sensitive expenditure inequality, and the related one standard deviation confidence interval (see Appendix Figure 11 for responses of all disaggregated income sources to spending shocks). These results at disaggregated levels reveal that most of the decline in consumption and expenditure inequality after a fiscal policy shock comes from the decline in interest-sensitive expenditures. In traditional macroeconomic frameworks, an increase in government spending is associated with a rise in the interest rate that affects the fraction of durable goods or, more specifically, the interest-sensitive goods in the households' basket. This increase in interest rate disproportionally affects the rich and the poor, with the former significantly reducing their expenditure.

Moreover, Ma (2019) recently gets the same finding from the CEX data and theoretically shows that an unexpected increase in government spending (with a progressive rise in tax) increases the consumption of poor households since they are hand-to-mouth consumers while the rich decrease their consumption as the effect of productive government spending is unable to offset the rise in the tax rate. Therefore, an expansionary spending shock lowers consumption inequality. In the case of non-interest sensitive expenditures, fiscal policy shocks show a rise in inequality after 4 quarters only when measured by cross-sectional standard deviation. For the 90-10th percentile difference, the *p*-value shows a statistically insignificant result; for Gini, the results show no clear pattern. Though income inequality has either an insignificant (in the case of Gini and P9010) or delayed (in the case of SD) response to a government spending shock, Fig. 8 reveals that a decline in financial income inequality is the possible channel through which a positive fiscal shock can reduce income inequality.

In short, across all forms of inequality and the different matrices of inequality measurements, the impulse responses indicate that an unexpected increase in government spending is associated with lower consumption and expenditure inequality, while it has an insignificant impact on income inequality.

5.3. Robustness

We consider two robustness checks on this benchmark result. First, we investigate if taking a different shock specification significantly alters our benchmark results. The survey of professional forecasters provides median and mean values for the government spending forecasts, and our benchmark results use the former identification of the shock. The results under mean value shock specification (Appendix Figure 12) show that our benchmark results

are largely unaffected. Accumulated impulse responses of income and consumption inequality to positive fiscal policy shock appear robust to the mean or median forecast value of government spending.

Second, we assess if a change in the lag length of the inequality variable changes the estimated results. Though taking 4 lags in the time series model is the standard practice in the fiscal literature, using fewer fiscal policy lags may affect the results. Hence, we consider using 5 lags (J = 5) of the dependent variable. As illustrated in Appendix Figure 13, the estimates are qualitatively unchanged for all variables and measures of inequality. In short, an expansionary government spending shock has a distinct effect on consumption and expenditure inequality and an insignificant impact on income and earning inequality.

5.4. Contribution of Government Spending Shocks to Historical Inequality

To access the quantitative contribution of the government spending shock accountable for the income and consumption inequality dynamics in the US, we recover the share of variance in inequality that may be accounted for by fiscal shock directly using estimates from equation (2) over this time period. Table 3 presents the results of those estimates from the variance decomposition at different horizons (values in the parenthesis) for total income, earnings, consumption, and expenditure inequality.

Table 3. Fiscal shock contribution to the forecast error variance of inequality.

	Income	**Earnings**	**Expenditure**	**Consumption**
St. Dev.	0.045 (20)	0.017 (20)	0.024 (06)	0.072 (20)
Gini	0.025 (20)	0.005 (09)	0.016 (06)	0.036 (13)
P9010	0.021 (18)	0.045 (20)	0.009 (14)	0.021 (20)

Consistent with the impulse responses results in section 5.2., we find that the fiscal shock accounts for 5% of forecast error variance for total income and earning inequality, less than 3% for expenditure inequality, and 7% for consumption inequality at longer run horizons. These magnitudes look ambiguous but are similar to what most studies have found related to the contribution of fiscal policy shocks to income and spending inequality. This also indicates a few aspects of the estimations; a relatively short time series is involved and the spending shocks are also small for much of the sample.

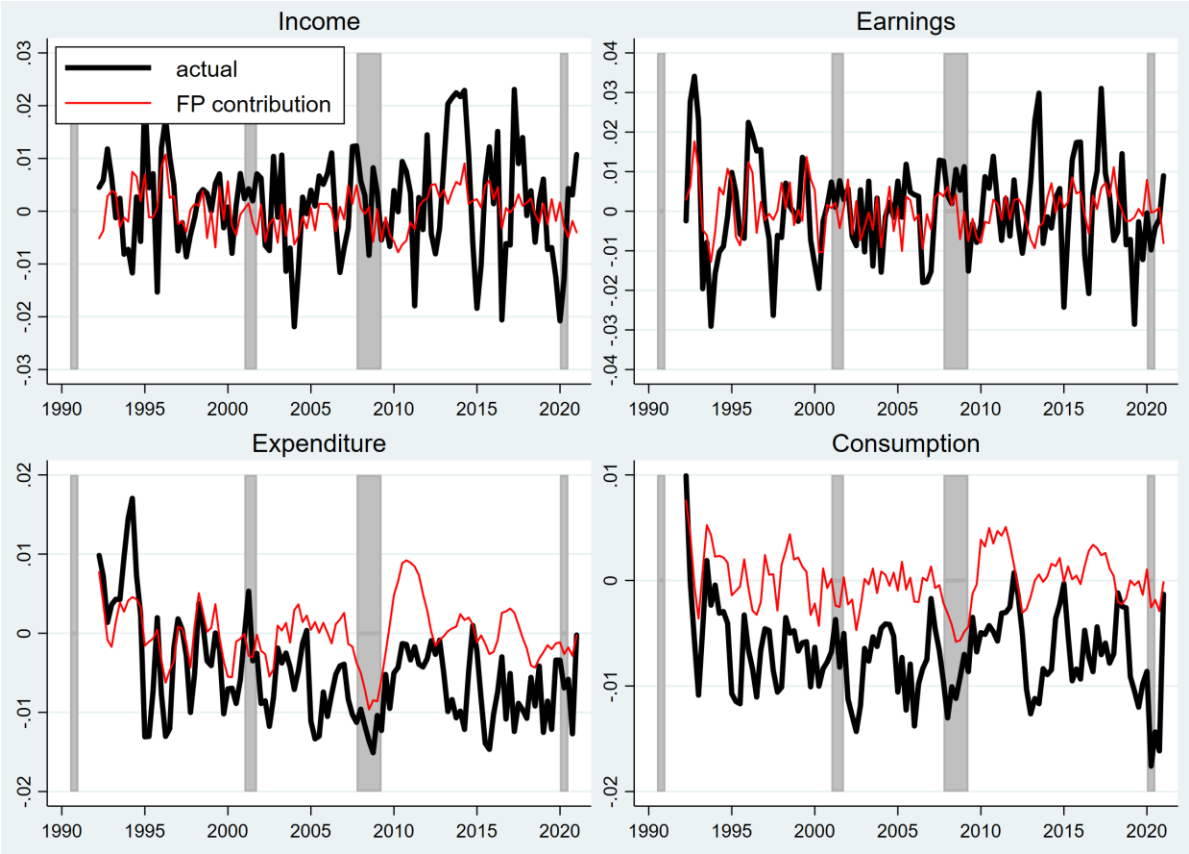

Fig. 10. Contribution of the fiscal shock to historical cyclical US inequality dynamics.

In order to moderate high-frequency variation in inequality measures, we have averaged both the predicted and actual variable series over the lag and lead quarter values in figure 10. Fig. 10 presents the predicted variation in inequality results using the 90-10th percentile

difference measure of inequality.[7] Consistent with the results of the forecast error variance decomposition, we find that government spending shocks account for a small variation in earnings inequality. We similarly find that fiscal shocks account for little variations in income inequality after 2000 though fiscal shocks seem significantly responsible for income inequality in the 1990s. In contrast, for consumption and expenditure inequality, results show a higher correlation between the predicted movements from the spending shocks and the actual changes in these variables throughout the sample.

Since all series are HP-filtered, government spending shocks do not account for the trends in these variables. Consistent with our impulse responses, these results also suggest that spending shocks have played a significant role in accounting for higher frequency movements only in consumption inequality in the U.S. We also find that the strength of the predicted changes of inequality due only to fiscal shocks varies during the episodes of NBER recessionary periods relative to that of non-recessionary times. This highlights the part of the literature focusing on the state-dependent analysis of the effectiveness of spending shock in reducing economic inequality.

6. Conclusion

Recent research has documented rising economic inequality in the US and the significance of fiscal policy responses to mitigate their impacts, particularly for low-income households. Using the household-level survey data for consumption and income, this study first documents

[7] We have estimated the predicted changes in inequality using the other measures, i.e., SD and Gini, but they also yield quantitatively similar results.

the evolution of different categories of income and consumption inequality measures in the US. Overall, income inequality has increased over the last three decades while consumption inequality is either stable or shows a marginal decline. We quantify the impact of government spending shock on cyclical fluctuations in consumption and income inequality at aggregate and disaggregate levels. Expansionary fiscal policy shock significantly reduces consumption and total expenditure inequality, while it seems ineffective in reducing income inequality.

With the disaggregate analysis, we show that the decline in consumption inequality is reasonably explained through interest-sensitive expenditures. We divide total expenditure into interest sensitive versus non-interest-sensitive expenditures, and a positive fiscal shock significantly reduced the interest-sensitive expenditures. These results are supported by previous literature, both theoretically and empirically. As predicted in the theoretical model of Gali *et al.* (2007) and later empirically illustrated by Ma (2019), Alpanda *et al.* (2021), and other studies, our results also empirically support the heterogeneous agent model in the case of the U.S., where the economy features both poor and rich households responding differently to a policy shock. The hand-to-mouth households raise their consumption after an expansionary fiscal shock while the households at the upper distribution do not change their consumption, taking it as a future tax increase. The overall impact turns out to be a decline in consumption inequality.

Disaggregated results for income inequality show an insignificant impact of the fiscal shock on business, financial, and transfer income. Our results also support the recent literature on the income-consumption relationship and suggest that any change in income does not necessarily cause a change in consumption. This result also strengthens our explanation of the heterogeneous agent model, where some households are financially constrained and act in a

Keynesian fashion. In sum, we found that government spending shock effectively reduces consumption inequality but the same policy shock appears ineffective in reducing income inequality in the US. Future research can explore the state-dependent effects of government spending shocks since, as highlighted in the recent literature, fiscal measures may be more effective under a particular state of the economy.

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APPENDIX

A. Data Description

In this section, we describe how we construct the data for our benchmark sample from the microdata files of the Consumer Expenditure Survey. We compile the data from 1990Q1 to 2021Q2 directly from the public-use microdata provided by the Bureau of Labor Statistics (BLS). We extract all consumption and income data from the FMLY files. Additional information on household characteristics is also given in FMLY files, such as family size, education, age, gender, etc.

For correction of the sample breaks in the data, we use the data dictionary for the CE public use microdata published by the BLS. This data dictionary contains detailed information on variables, their universal classification codes (UCC), and year and quarter information in which a particular variable or a new UCC appears in the data. As expenditures are dynamic in nature, new UCCs appear as a variable as the survey evolves over time. Since there have been slight changes in the questionnaire of the CEX over time mainly due to the introduction of new UCCs in a variable, following Coibion *et al.* (2017), we correct sample breaks for those periods by regressing each expenditure series on a time trend and indicators for the corresponding sample breaks. We then subtract from the original series the effect of the dummies.

The variables we corrected for sample breaks are as follows; own dwelling (1990Q1-1993Q4), other lodgings (1990Q2-2004Q1), telephone (2001Q2), household operations (1993Q1-2013Q1), housing furnishing and equipment(2013Q2), apparel (1991Q2), health care (1995Q2), entertainment (2004Q2), reading (2011Q2), and education (2006Q2). Although most of the changes in the survey represent slight changes in the questionnaire due to the inclusion of the new UCC, the interview survey went through significant questionnaire change in 1990, where questions related to housing expenditure had some significant adjustments.

The BLS started bracketing income data in 2001Q1 and imputing missing income data in 2004Q. However, the imputation of income data is not done for previous years, and non-imputed income values are unavailable for 2004 and 2005. This study follows Fisher, Johnson, and Smeeding (2013) and preserves the BLS methodology as closely as possible to impute all income before 2004. To do so, we simply use the raw and mean values of the bracketed series to construct the income variables to remain close to the true reported values of the survey. Only the first or last interview numbers for income variables are kept for final data since incomes in intermediate interviews are repetitions. Many sources of income are redefined from one category to another in 2013Q2; therefore, to be consistent in defining different sources of income (e.g., earning, business, finance, transfers), we use the same income categories under a source of income for all periods.

After constructing expenditure and income data files, we calculate various matrices of inequality after censoring each series of income and consumption at the corresponding values of the top and bottom percentiles. Note that we aggregate the variables first in the case of an aggregated series and then apply censoring. Following Coibion *et al.* (2017),

OECD scale is used to adjust for differences in household size. Specifically, the (effective) number of household members is calculated as follows:

$$HH = Household\ Head + 0.7[No.\ of Adults\ (\geq 18\ years) - 1] + 0.5[No.\ of\ children]$$

For seasonal adjustment of all inequality and transition probability series, we use X12 to separate out seasonal components.

B. Disaggregated Responses of Income Inequality

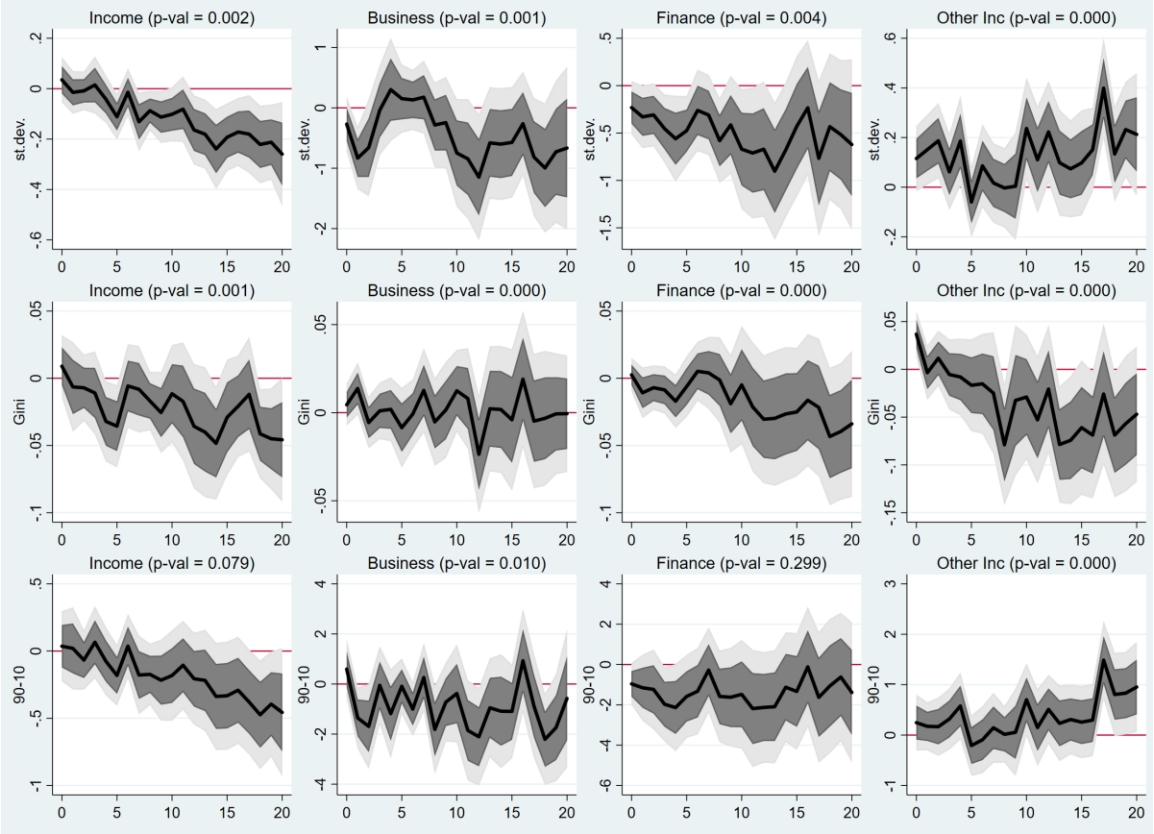

Fig. 11. Disaggregated income responses to the government spending shock.

C. Robustness Results

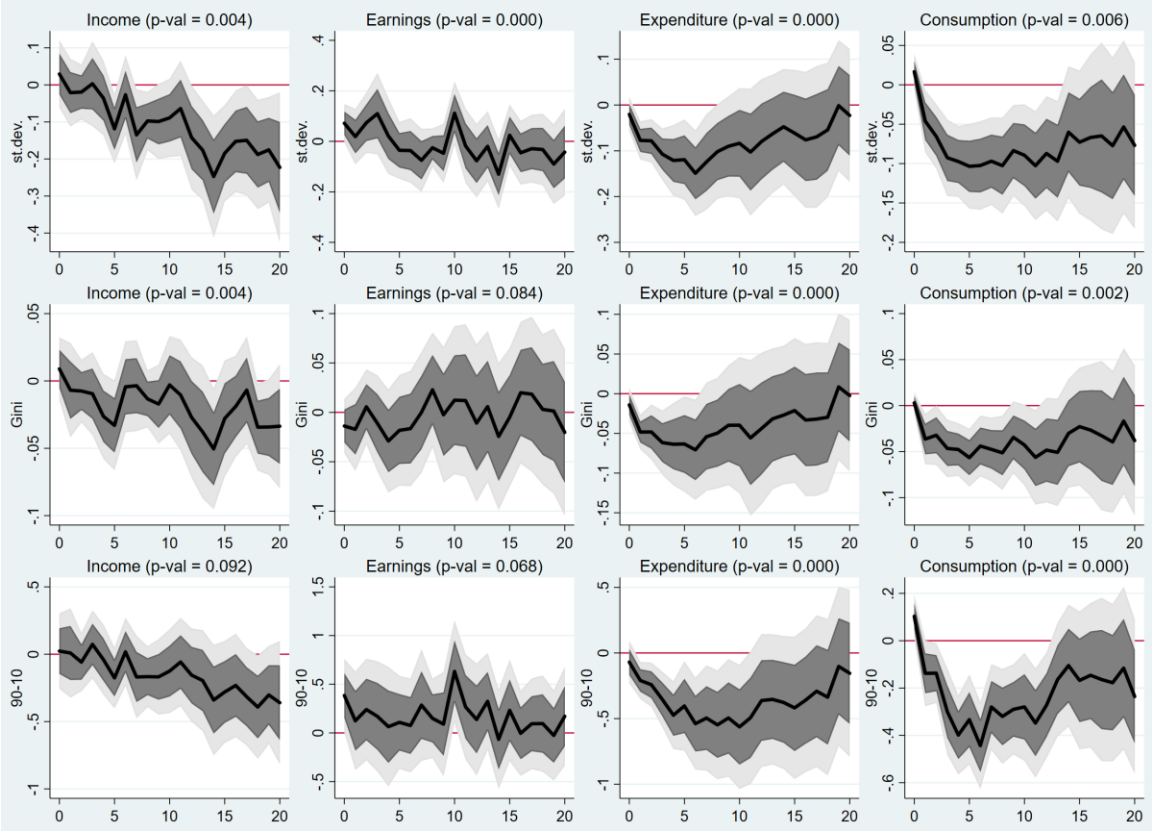

Fig. 12. Inequality responses to government spending shock (mean value).

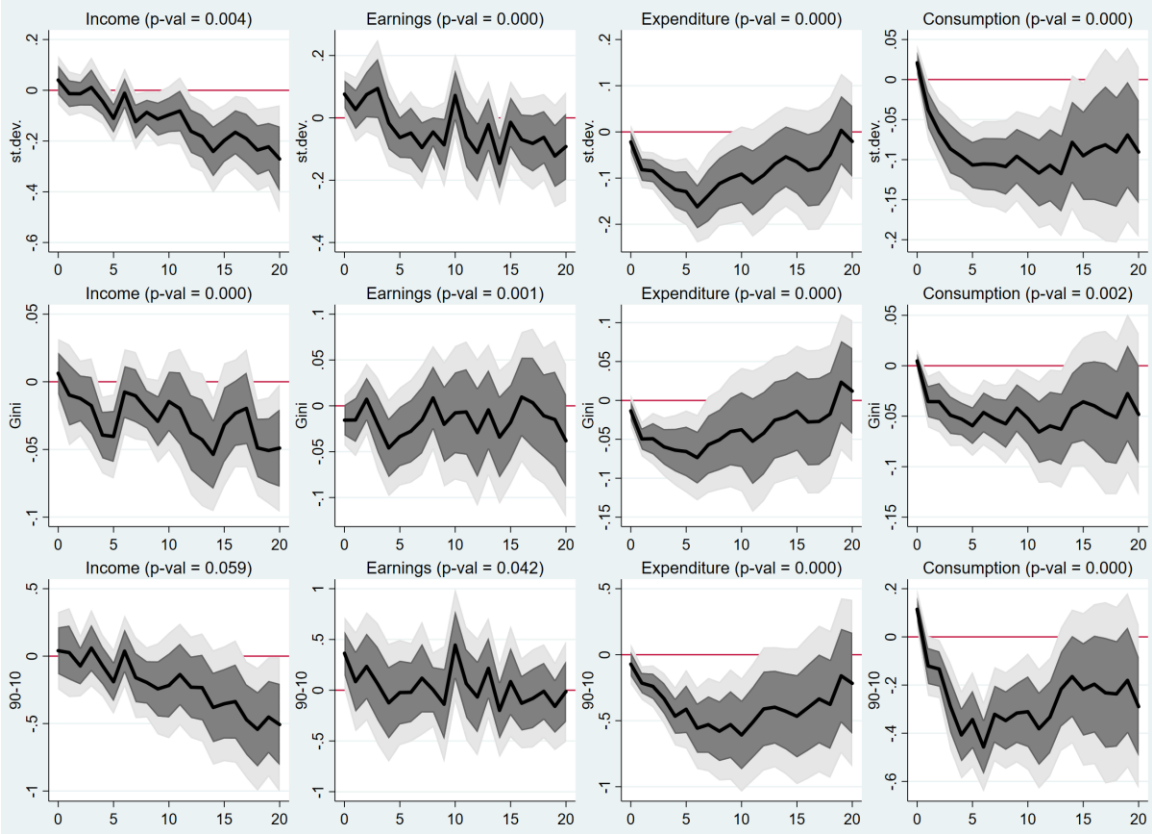

Fig. 13. Inequality responses to government spending shock (AR Lags=5)

CHAPTER II

STATE-DEPENDENT EFFECTS OF GOVERNMENT SPENDING SHOCKS ON CONSUMPTION INEQUALITY

1. Introduction

Over the last two decades, successful policy responses to the Great Recession and the global pandemic crisis in the United States have reinstated academic and policy research for evaluating the state-dependent effectiveness of discretionary fiscal policy. More broadly, the fiscal policy response to these unusual events has been extraordinary in supporting households experiencing a significant loss in income and businesses facing financial distress, yet its effectiveness remains debatable both theoretically and empirically. Some economists acknowledging traditional Keynesian theory assert the strength of countercyclical fiscal policies in stabilizing the economy (Auerbach and Gorodnichenko, 2012a, 2013; Romer, 2012, among others), while others relying on the modern economic paradigm (i.e., neoclassical economic theory) are skeptical about the effectiveness of utilizing any fiscal measures as policy tools (see Alesina and Ardagna, 2010; Hebous, 2011; Monacelli and Perotti, 2008, among others). Moreover, recent literature shows that a fiscal policy may prove more effective under a specific state of the economy. Specifically, such literature postulates non-linear or state-dependent effects of fiscal policy, with the transmission of policy effects to economic activity greater during

recessions than during expansion (see Auerbach and Gorodnichenko, 2012a; Fazzari *et al.*, 2015; Ramey and Zubairy, 2018, among others).

In this study, our objective is to empirically investigate one possibility for such effects: whether the responses of economic inequality (as measured by consumption inequality) to fiscal policy shock are state-dependent. Specifically, we contribute to the literature on state-dependent (non-linear) effects of government spending shock by addressing two critical questions: (i) Whether the effectiveness of unanticipated government spending shock depends on the state of the economy. (ii) whether fiscal consolidation is more effective than fiscal stimulus when the economy has a high or low unemployment rate?

To proceed, we follow Coibion et al (2017) to characterize the distributional effects of policy shocks on various measures of consumption inequality. In contrast to their study, this study differs in the following points. First, unlike Coibion *et al.* (2017), who evaluate the impact of monetary policy on inequality in a linear framework, we estimate the impulse responses of consumption inequality caused by changes in government spending in a non-linear fashion on a self-collected up-to-date database published by the Bureau of Labor Statistics. Second, to characterize the state-dependent responses of consumption inequality to a spending shock, we construct a smooth transition function following Auerback and Gorodnichenko (2013) to index the state variable. This approach precludes the small sample bias problem that arises when dummy variables differentiate the economy's states and the data has fewer observations under a particular state. Moreover, we estimate the state-dependent responses of inequality to government spending shock using Ramey and Zubairy (2018) dummy variable specification for state identification. Inequality responses to government spending shocks using binary specification also work as robustness analysis,

ensuring the validity of our estimates under dummy variable state specification. Finally, we estimate consumption inequality responses to spending shock, considering whether the shock was procyclical or countercyclical given the slack or non-slack state of the economy. Impulse response functions to positive or negative government spending shock considering the state of the economy, may give a clearer picture of the policy effectiveness that can help policymakers conduct prudent policy responses under a particular situation regarding fiscal consolidation or fiscal stimulus measures.

For examining the dynamic responses of consumption inequality to government spending shocks when the economy is in a slack state or non-slack state (times of expansion), we estimate inequality measures from the Consumer Expenditure Survey (CEX), which uniquely provides information on US households' consumption and income since 1980. While there are many matrices available to measure inequality, we calculate three inequality measures, namely the Gini coefficient (Gini), cross-sectional standard deviation (SD), and 90-10th percentile difference (P9010) for consumption variable, similar to Coibion *et al.* (2017). Since these measures account for different aspects of the entire distribution, evaluating them simultaneously helps us explain if those movements tend to be concentrated in specific population distribution. Following Ramey and Zubairy (2018), we define the state variable as the slack in the economy, that is when the unemployment rate is equal to or above 6.5 percent. We employ Jorda's (2005) local projections approach for estimation and shock identification is achieved using forecasts errors data on federal expenditures from the Survey of Professional Forecasters. To our knowledge, this study is the first to empirically explore the transmission of fiscal effects

on cyclical inequality in the US conditioned on the state of the economy and fiscal behavior (austerity/stimulus).

Our results support the literature on state-dependent fiscal policy effects since we find differential effects of government spending shocks on inequality during low and high unemployment periods only when there is a negative spending shock. Specifically, fiscal consolidation episodes geared by a decrease in actual government spending relative to what was expected by the economic agents are more effective in reducing consumption inequality during periods of slack in the economy than when the economy has a low unemployment rate. If not account for the asymmetric fiscal shock, we do not find any significant support for the state-dependent effects of spending shock on consumption inequality. Moreover, as predicted in the theoretical models of Gali *et al.* (2007) and Barnichon *et al.* (2022), we interpret our empirical results for asymmetric and state-dependent effects through the heterogenous agent models where an economy has both financially constrained (hand-to-mouth) and rich consumers along with labor markets frictions. An unanticipated fiscal shock becomes more effective in a state where the share of hand-to-mouth consumers is large. These results are important since they fall in line with the literature that postulates the importance of the sign of the shock along with its magnitude.

This study is structured as follows. Section 2 provides a brief discussion on the state-dependent effects of fiscal policy and state identification methodologies. Section 3 describes data and the methods used in this study to estimate the impulse response functions of inequality to government spending shocks given the state of the economy. Section 4 presents empirical results and discussion, while Section 5 concludes this study.

2. Literature Review

2.1. Non-Linear Effects of Fiscal Policy

Since the global financial crisis, the literature on the state-dependent fiscal policy effects has caught the substantial interest of economists and policymakers. One strand of this literature demonstrates the state-dependent effects of unanticipated fiscal policy shocks using the smooth transition or threshold Vector Autoregression (VAR) model along with some form of structural restrictions on some parameters. Auerbach and Gorodnichenko (2012a) and Fazzari *et al.* (2015) illustrate the state-dependent effects of unanticipated fiscal shock on business cycle variables and show that the fiscal multiplier in the United States is larger than unity during a recession or in a period of low-capacity utilization. Other studies that find state-dependent fiscal policy effects include Auerbach and Gorodnichenko (2013), Bachmann and Sims (2012), Baum *et al.* (2012), Candelonand Lieb (2013), Caggiano *et al.* (2015), Bi *et al.* (2016), Mumtaz and Sunder-Plassmann (2021), among others. On the other hand, Owyang *et al.* (2013) examine the state-dependent effects of anticipated fiscal policy shock and find that the effectiveness of fiscal news shock is independent of the state of the economy where they take high or low unemployment rate as a state variable. Moreover, in a recent study, Ramey and Zubairy (2018), using various shock identification schemes, find little support for state-dependent policy effects.

On the theoretical side, using the neoclassical growth model and New Keynesian dynamic stochastic general equilibrium (DSGE) models, many studies have highlighted potential fiscal policy transmission channels through which policy shocks nonlinearly transmit into the goal variables. While most empirical studies demonstrate the positive

response of consumption to an increase in fiscal spending (e.g., Blanchard and Perotti, 2002), the traditional view relying on the standard Real Business Cycle model (e.g., Baxter and King, 1993) implies lower private consumption when government spending increases since the rational agents consider an increase in government spending as an increase in future tax. This empirical-theoretical dichotomy is also known as the government spending puzzle. Using a New Keynesian-type DSGE model, Gali *et al.* (2007) is the first study to explain this puzzle and suggest the asymmetric effects of fiscal policy shock on macroeconomic variables due to the large presence of rule-of-thumb consumers. Their theoretical model predicts a greater effect of fiscal stimulus on consumption during the slack periods since the ratio of rule-of-thumb consumers is naturally high when there is a high unemployment rate in the economy. Other theoretical studies highlight the state-dependent fiscal policy effects through the government debt (Bi *et al.*, 2016), favorable consumer preferences (Leeper *et al.*, 2017), and the credit constraint channel (McManus *et al.*, 2021).

Another issue is the sign of shock. More specifically, whether the economy responds to fiscal stimulus in the same way it responds to fiscal austerity. This is a valid concern, and recent empirical studies have examined this asymmetric effect mostly in a sign-dependent framework. Unlike most studies that find a marginal or delayed increase in output after a fiscal stimulus, Jorda and Taylor (2016) and Guajardo *et al.* (2014) find large decreases in output after exogenous fiscal consolidations. Moreover, for the state-dependent framework, literature also demonstrates that unanticipated decreases in government spending have larger effects than unanticipated increases on the output given that the economy is in recession (Barnichon and Matthes, 2015) or the level of private debt

is high (Klein, 2017). For a panel of 16 OECD countries, Alesina *et al.* (2015) illustrate that fiscal consolidation policies that feature government spending cuts are less costly regarding output loss than those based on tax increases. Similarly, Jones e*t al*. (2015) find that fiscal stimulus caused by the decrease in tax rate has significant positive effects on US output, while fiscal consolidation based on tax increases has no significant adverse effects.

2.2. State Identification

The strand of fiscal literature related to the non-linear or state-dependent effects of fiscal measures has taken varied approaches to state identification. The original Keynesian notion states that a countercyclical fiscal policy is more powerful during a recession than in a time of expansion.[8] The literature highlights three variables as potential measures of slack; output growth, capacity utilization, and unemployment rate. Although all these measures are highly correlated, the key assumption here is that a proposed measure of slack fairly captures the true degree of the level of economic activity or the under (or over) utilization of resources in the economy.

The output gap as the measure of slack features the difference between actual and potential log real GDP, where large negative values imply high slack in the economy. Numerous studies use the output gap as a potential proxy of slack (see, for example, Baum *et al.*, 2012; Baum and Koester, 2011) and find substantial evidence for state-dependent effects with larger fiscal multipliers in recessions than in expansions. However, the

[8] Several papers have also explored the possibility of state-dependent multipliers depending on alternative states, e.g., the fiscal debt situation, the household debt, the financial system condition, zero lower bound, exchange rate regimes, labor market frictions, and downward wage rigidities. For example, Corsetti *et al.* (2012), Michaillat and Saez (2015), Bi *et al.* (2016), Canzoneri *et al.* (2016), Shen and Yang (2018), and Alpanda *et al.* (2021), among others.

estimation of the output gap variable is subject to estimation error since it depends on estimates of GDP that are subject to revisions and estimating the natural level of output that is unobservable (see, for example, Orphanides and Van Norden (2005) on the measures of the output gaps and Billi (2011) on potential challenges associated with output gap as an indicator of economic activity). Moreover, using variations of the VAR model, many studies demonstrate large discrepancies in the output gap variable as a measure of slack (see Morley and Piger, 2012; Perron and Wada, 2016; Morley and Panovska, 2020). Due to these caveats in the output gap variable, researchers propose using real GDP growth for state identification since it is measured in real-time with greater accuracy. Studies that use the moving average of output growth rate for state-dependent effects of fiscal policy on business cycle variables include Auerbach and Gorodnichenko (2012a, b), Bachmann and Sims (2012), Mencinger *et al.* (2017), among others.

Capacity utilization is a survey-based measure that captures the sustainable maximum output in the economy. This measure is found highly correlated with the NBER business cycle chronology (Morley and Piger, 2012), yet it is subject to reporting errors, and only limited studies have used it for state-identification in non-linear studies (see, for example, Fazzari *et al.*, 2015).

The unemployment rate has long been considered a key measure of underutilized resources and used as a potential threshold variable in nonlinear fiscal policy studies. Ramey and Zubairy (2018) highlight that half of the quarters that are official recessions in the US are also high unemployment periods. Studies that use the unemployment rate as the switching variable to identify different states include Barro and Redlick (2011), Owyang *et al.* (2013), Ramey and Zubairy (2018), among others.

One strand of the literature on state identification considers the estimation of a smooth transition equation rather than indexing states by dummy variables (see, Auerbach and Gorodnichenko (2012a) for a regime-switching transition function). The binary indexing approach for defining a state in the economy involves the small sample bias issue if the economy spends a brief time in a specific state (Kilian and Kim, 2011; Herbst and Johannsen, 2021). On the other hand, the smooth transition equation exploits all observations by establishing a continuous curve that is not only time-varying but also a weighted function across states (i.e., expansion and recession).

3. Data and Methodology

3.1. Data and Sample Selection

To calculate various measures of inequality for consumption in the US, we use the CEX public use data files collected for the Bureau of Labor Statistics by the Census Bureau. Though CEX reports measures of consumption and income since 1980, due to the unavailability of data for some initial years (i.e., 1982 and 1983 for all quarters) and a secular structural shift in 1989, we include waves starting in 1990Q1, since this is the first year with the most consistently comparable data, through 2021Q4.

The CEX consists of two separate surveys, i.e., the Interview Survey and the Diary Survey, and similar to previous literature, we utilize data only from the Interview Survey, which covers about 95% of information on regular consumption expenditures of US

households.[9] The survey is a monthly rotational panel with about 1500-2500 sample consumer units, i.e., households. Households are interviewed retrospectively about their consumption expenditure once per quarter over five consecutive quarters and each household is dropped and replaced by a new unit after the last interview; therefore, 20 percent of the sample is designed to renew every quarter.

Consumption is spending on all durable goods (e.g., furniture, appliances, television, etc.), nondurable goods (e.g., food, beverages, clothing, personal care, etc.), and services (e.g., utilities and transportation). Following Coibion *et al.* (2017), we omit some larger and non-consumption expenditures better interpreted as an investment (e.g., education, health, vehicle, life insurance, etc.) to household consumption levels. Moreover, for a consistent and comparable sample selection, we winsorize income and consumption variables in the top and bottom one percent of the distribution that also accounts for the effects of the outliers in the data. Finally, we express the consumption variable in constant dollars using the CPI-U (1982-84 =100), and consistently apply sample weights in all estimations.

The quality of the CEX relative to other datasets, specifically the Panel Study of Income Dynamic (PSID) and National Income and Product Accounts (NIPA), has received attention in the literature. The PSID also collects data on household consumption expenditures, but many categories are missing in the survey until 1999, and some important expenditures (e.g., clothing and entertainment) are added only after 2005. On the other

[9] Though the Dairy Survey accounts for expenditures on frequently purchased small items, most studies on consumption have utilized only the Interview Survey for estimation/analysis. Moreover, Coibion *et al.*, (2021) argue that the frequency of shopping trips has declined in the US since 1980.

hand, the CEX provides detailed consumption data on all major expenditure categories for a more extended period. Heathcote *et al.* (2010) compare consumption categories in the CEX and PSID and report the food expenditure in the two data sets track each other quite closely.

Research also reports that the survey-based estimates of consumption expenditures are lower than NIPA aggregate expenditure, and the gap between the two series is increasing over time, specifically for housing services, furniture, and vehicles Slesnick, 2001; Garner *et al.*, 2006; Heathcote *et al.*, 2010). A part of this discrepancy can be explained in the conceptual difference between the CEX and the NIPA data sets. For example, in the case of medical care expenditures, the CEX reports only out-of-pocket expenses, whereas the NIPA accounts for Medicare and Medicaid expenditures as well. Due to these definitional differences across a broad range of consumption categories, numerous studies show that CEX underreports consumption expenditures and that this under-reporting has increased over time (e.g., Krueger *et al.*, 2010; Aguiar and Bils, 2015; Attanasio *et al.* (2015), among others). On the other hand, for large expenditure categories, Bee *et al.* (2015) report that the CEX Interview Survey closely conforms to the national income accounts data. Besides, this study examines the cyclical fluctuations in consumption inequality and not the trend in inequality, so the underreporting of expenditures is a trivial concern here.

Table 2.1 summarizes the sample selection procedure by explaining the number of observations dropped at each stage of the selection process. First, to improve the data quality, we dropped observations where households are classified as incomplete income respondents. Second, we kept only those observations for whom the reference person's characteristics or weight factor field contained a valid or good data value. Moreover, as

recommended by the BLS, we drop households that report zero food expenditure and a negative medical care expenditure in any quarter. Finally, we also drop households reporting implausible consumption expenditure, i.e., non-positive elderly care expenditures, since these cannot be zero according to the data codebook.

Table 2.1. Sample Selection in the CEX.

Selection Criterion	Dropped	Remaining Obs.	Remaining CUs
Initial Sample		758,620	270,770
Incomplete income data	107,164	651,456	246,155
Inconsistent age	19,547	631,909	239,711
Zero or missing food consumption	1,915	629,994	239,225
Negative medical care expenditure	2,438	627,556	239,030
Implausible expenditure	4,281		
Our benchmark sample		623,275	238,186

With our benchmark sample, we calculate three inequality measures for consumption: Gini coefficients of levels, cross-sectional standard deviations of log levels, and differences between individual percentiles of the cross-sectional distribution of log levels. Though each measure has pros and cons, estimating various measures of inequality reduces the possible bias that exists in explaining the results through a single inequality matrix and, at the same time, illustrates the movements in the entire distribution and if those moments accumulate in a particular population distribution.

3.2. Shock identification

In order to estimate the causal effects of government spending shocks on consumption inequality, we first discuss our shock identification scheme. Using the Survey of Professional Forecasters (SPF) forecast for federal spending, we identify the spending

shock as the difference between actual government spending growth and the one-quarter ahead forecast of its growth rate by macroeconomists and policy-makers.

$$e^{g}_{t|t+1} = G_t - G_{t|t+1} \qquad (2.1)$$

where *G* is government spending and *t* is time. Since identifying the shock is necessary for establishing the strength of the causal effect, the key assumption is that these government spending shocks are orthogonal to professional forecasts of future government spending. The forecast error shock identification approach essentially ensures this assumption since the forecasters are incorporating all available information about the state of the economy and other aspects in their forecasts.

Other identification strategies include structural vector autoregressions (SVARs) with Cholesky decomposition, short-run timing restrictions, and the narrative method. Unlike these approaches, this forecast error approach precludes the issue of zero observations prevalent in the narrative method, the anticipation effect existing in the SVARs approach, and the problem of fiscal foresight embedded in the timing approach. Numerous studies have used this approach for shock identification, e.g., Auerbach and Gorodnichenko (2013), Mencinger *et al.* (2017), Alpanda *et al.* (2021), Furceri *et al.* (2022), among others.

3.3. Econometric Methods

To evaluate the state-dependent effects of government spending shocks on consumption inequality at different horizons *h*, we employ Jorda's (2005) local projections (LPs) method. Recent studies have shown that LPs and traditional VAR models estimate the same impulse responses if the lag structure is unrestricted (Plagborg-Mollar and Wolf, 2021),

yet LPs method has been getting more attention since it is easy to estimate, requires fewer restrictions, and is specifically easier to extend to non-linear frameworks.

Moreover, LPs method is more robust to misspecifications and prevents the need for the tests of non-linearity for a correct choice of the transition function as a prior requirement in the smooth transition models. The evidence of state dependence using the measure of the unemployment rate in the economy is well established in the literature. Studies (see, for example, Ramey and Zubairy, 2018; Fazzari *et al.*, 2021; Barnichon *et al.*, 2022) have found that the unemployment rate as a measure of slack significantly captures the degree of over- or under-resource utilization in the US economy and causes non-linear responses of consumption to policy shocks.[10]

We estimate the following equation to estimate the accumulated response of consumption inequality to the spending shock according to the state of the economy.

$$\Delta x_{t+h} = F(z_t)\left[c^{(h)} + \sum_{j=1}^{J} \alpha_j^h \Delta x_{t-j} + \sum_{i=0}^{I} \beta_i^h e_{t-i}^g\right] +$$

$$(1 - F(z_t)\left[c^{(h)} + \sum_{j=1}^{J} \alpha_j^h \Delta x_{t-j} + \sum_{i=0}^{I} \beta_i^h e_{t-i}^g\right] + \varepsilon_{t+h}$$

for $h = 0,1,2,\ldots,H.$ (2.2)

[10] See Fazzari *et al.* (2021) for a detailed description of various measures of slack and the correlation between them. Using various choices of threshold variables (i.e., unemployment rate, capacity utilization, output gap), they find strong robust support for non-linearity/state-dependent effects of fiscal policy shocks on output.

where x is the variable of interest i.e. measures of consumption inequality, z is the state measure, e_t^g are quarterly government spending shocks as identified in eq (2.1), and ε is the iid error term. We use the unemployment rate as the indicator of slack in the economy, similar to Ramey and Zubairy (2018). Specifically, we characterize the economy to be in slack when the unemployment rate is equal to or above 6.5%. Following Auerbach and Gorodnichenko (2012a), the transition function $F(z_t)$ between the two regimes takes the following form:

$$F(z_t) = \frac{e^{-\gamma z}}{1+e^{-\gamma z}}, \quad \gamma > 0 \tag{2.3}$$

$$var(z_t) = 1, \quad E(z_t) = 0. \tag{2.4}$$

$F(z_t)$ measures the probability of being in a specific state of the economy (slack vs. non-slack) and therefore is a weight of the corresponding state in our estimation. Variable z is an index of the unemployment rate gap (the difference between the unemployment rate and the natural rate of unemployment), with positive z indicating an expansion in the economy. Before calculating the probability weights, we normalize z so that it has zero mean and unit variance, which also makes γ a scale-invariant parameter. Another important feature of using the unemployment rate as the state variable is that it differs from Auerbach and Gorodnichenko's (2012a) moving average of GDP growth rate. The latter measure features recession as the period when the business cycle is going to trough from the peak while the unemployment rate moves from its low point to its high point during typical recession times. Since $\gamma > 0$, we interpret $F(z_t)$ as the state describing the behavior of the system in an expansion and $[1 - F(z_t)]$ as the behavior of the system in a recession.

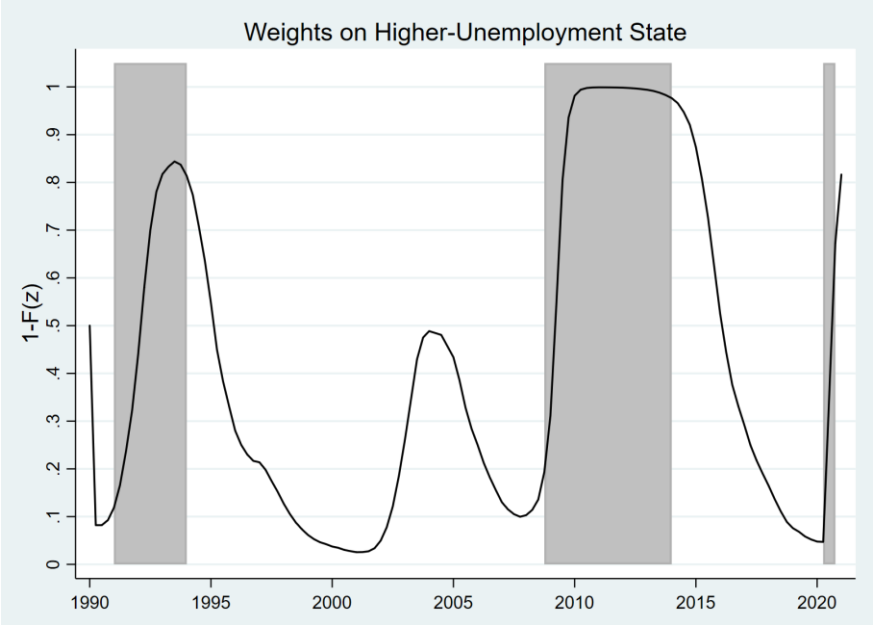

Fig. 2.1. Weights on high unemployment periods [1-F(z)].

Following Auerbach and Gorodnichenko (2012a), we calibrate γ =2.78 so that the US economy spend 30% of the time in high unemployment, $Prob[1 - F(z_t)] = 0.3$. The calibration is consistent with the duration of high unemployment periods (UR≥6.5) in the US, according to FED St. Louis data (29.7% of the time since 1990). Fig 2.1 compares the dynamics of the weights on the unemployment rate gap with the US periods of unemployment exceeding 6.5%.

In a comparison of using binary state indicators, such as Ramey and Zubairy (2018), the smooth transition function has the advantage of utilizing a full sample for estimations making our estimates comparable and robust. On the contrary, the binary indexing approach for defining a state involves the small sample bias issue if the economy spends a brief time under one state. Moreover, by assigning the probability weights to different states, the smooth transition function captures both whether and to what extent the economy remains in a particular state. Finally, the smooth transition approach allows us to

consider dynamic feedback from policy changes (such as government spending shocks) to the regime's state.

In order to evaluate the asymmetric government spending effects on consumption inequality according to fiscal action i.e., stimulus and austerity shock, we follow Riera-Crichton *et al.* (2015) methodological approach. Specifically, to get our sample of interest, we first divide each variable according to the state of the economy (slack vs. non-slack) and whether the calculated spending forecast errors are positive $e_t^{g,POS}$ or negative $e_t^{g,NEG}$ in period *t*. Then, we estimate the following smooth transition model with LPs for a nonlinear specification.

$$\Delta x_{t+h} = c^{(h)} + \sum_{j=1}^{J} \alpha_j^h \Delta x_{t-j} + F(z_t) \sum_{i=0}^{I} \beta_i^h e_{t-i}^{g,POS} + (1 - F(z_t) \sum_{i=0}^{I} \beta_i^h e_{t-i}^{g,POS} +$$

$$F(z_t) \sum_{i=0}^{I} \beta_i^h e_{t-i}^{g,NEG} + (1 - F(z_t) \sum_{i=0}^{I} \beta_i^h e_{t-i}^{g,NEG} + \varepsilon_{t+h}$$

for $h = 0,1,2,\ldots,H.$ (2.5)

with the same smooth transition equations for state identification described above.

$$F(z_t) = \frac{e^{-\gamma z}}{1+e^{-\gamma z}}, \quad \gamma > 0 \tag{2.6}$$

$$var(z_t) = 1, \quad E(z_t) = 0. \tag{2.7}$$

This non-linear specification estimates the transmission of an increase or decrease in government spending shock to consumption inequality given the current state of the economy as measured by the smooth transition function.

Since CEX is a rotating panel that features time aggregation in the data, we estimate impulse responses as a system of equation jointly across horizons, which also permit for the contemporaneous response of dependent variable, i.e., inequality measure, to the exogenous spending shock. Therefore, equation (2) generates accumulated impulse responses to government spending shocks from the estimated $\{\hat{\beta}_0^H\}_{h=0}^H$, as calculated by Coibion *et al.* (2017). We measure Driscoll and Kraay (1998) standard errors to correct for cross-sectional and temporal dependence across horizons and time. In line with the fiscal policy literature, we consistently set for all estimations J=4, I=20, and H=20 quarters. However, we can show that our results are robust to changes in lag structure. For each accumulated impulse response, we report confidence intervals based on one and 1.65 standard deviations. We also report *p*-values for tests of the null hypothesis that government spending shocks do not affect the inequality measure across all horizons $h = 0,1,\ldots,H$.

4. Empirical Results

4.1. State-dependent consumption inequality responses

Fig. 2.2 presents the accumulated impulse responses for each measure of inequality (standard deviation, Gini, and 90th to 10th percentile differential) from estimates of eq. (2.2) using the smooth transition function where the state of the economy is defined to be in slack when the unemployment rate is equal or above 6.5%, where is the non-slack state features the state of the economy with unemployment rate below 6.5%. State-dependent

responses are presented column-wise, whereas linear results are also presented for reference purposes. For each response, we illustrate the associated confidence bands at one and 1.65 standard deviation, respectively, and report *p*-values for the null hypothesis test of a zero consumption inequality response to the spending shock across all horizons. In all cases, we can reject the null hypothesis at the 1% level, which clearly points toward government spending having redistributive effects.

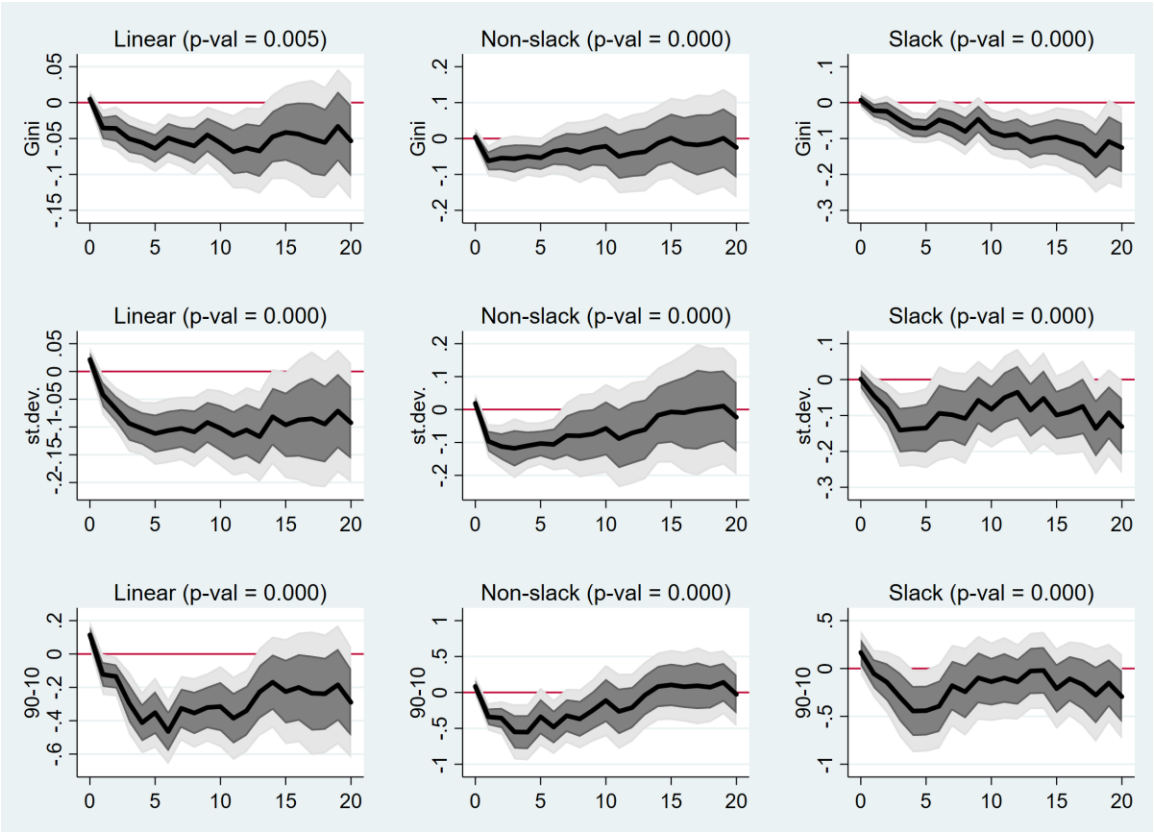

Fig. 2.2. State-dependent response of consumption inequality to government spending shock.

Note: The solid black line denotes accumulated impulse responses to one-standard deviation government spending shock, whereas the dark and light gray areas, respectively, show corresponding confidence intervals of 1 and 1.65 standard deviation. Inequality is measured by the Gini coefficient (first row), cross-sectional standard deviation (second row), and the 90th and 10th percentiles difference of the distribution. "*p*-values" show the significance against the null hypothesis that the impulse response is zero for all horizons.

In comparison with the linear responses of consumption inequality to government spending shock, the state-dependent results do not point towards the effectiveness of the government spending shocks under a particular state of the economy. The confidence bands around the accumulated impulse responses of consumption inequality during the non-slack overlap the confidence bands during the slack state. In other words, consumption inequality responds similarly to government spending shocks, irrespective of the state of the economy. This result indicates a few factors: we have a relatively short time series for estimation, government spending shocks are relatively small for most of the data, and there is noise in the measure of consumption inequality since the high-frequency data is based on a relatively small cross-section. These results are also consistent with other state identification. For instance, in the Appendix, we find similar results when states are identified based on dummy variable specification as prescribed by Ramey and Zubairy (2018).

However, note that for consumption inequality during slack, we observe a persistent decline in inequality after three quarters in the case of Gini, while in the case of the standard deviation matrix of inequality, the effect becomes insignificant after six quarters. This result points towards the higher effectiveness of government spending shock during slack, which may result due to a specific type of shock, e.g., expansionary or contractionary government spending shock. Recent literature on the fiscal policy effects on business cycle variables has postulated that it is not only the size of the shock but also the sign of the shock that matters for attaining the welfare goals of society. The following section examines the case when government spending shocks based on its sign disproportionately affects consumption inequality, given the state of the economy.

4.2. Asymmetric Fiscal Shock Effects on Consumption Inequality Caused by Fiscal Behavior

Table 2.2 depicts how often the unanticipated change in government spending increase/decrease in during slack and non-slack periods. We first indicate the time US economy behaves pro-cyclically or otherwise (the computed upper number in every cell), and then show the average time the spending shock was positive (expansionary) or negative (contractionary) during the non-slack and slack state of the economy (the lower figure in every cell (bold one)). Overall, we have an almost equal number of observations for expansionary and contractionary spending shocks, yet the economy spends about 70% of its time in a non-slack state.

Table 2.2. State of the economy and government spending in the US.

		Government Spending		
		Expansionary	**Contractionary**	**Total**
State of Economy	Non-slack	47	43	90
		52.22	**47.78**	100
	Slack	16	22	38
		42.11	**57.89**	100
	Total	63	65	128

Fig 2.3 illustrates the accumulated impulse responses of consumption inequality measures (presented row-wise) to an increase/decrease in government spending according to the non-slack and slack states of the economy (presented column-wise). Overall, the results do not show support for state-dependent asymmetric effects of government spending shocks on consumption inequality if we ignores the sign of the shock when the economy is in a slack state. First, we examine how consumption inequality response to an increase in spending shock when the economy is in non-slack (column one) versus slack

(column three) state. Under the condition of fiscal stimulus shock, we do not find any significant state-dependent results since the confidence bands under the slack state overlaps the confidence bands under the non-slack state. Individually, during non-slack periods, a positive spending shock (first column) has redistribution effects on consumption, yet the maximum decline in inequality occurs in the fourth quarter before rising to normal if estimated by percentile differential measure.

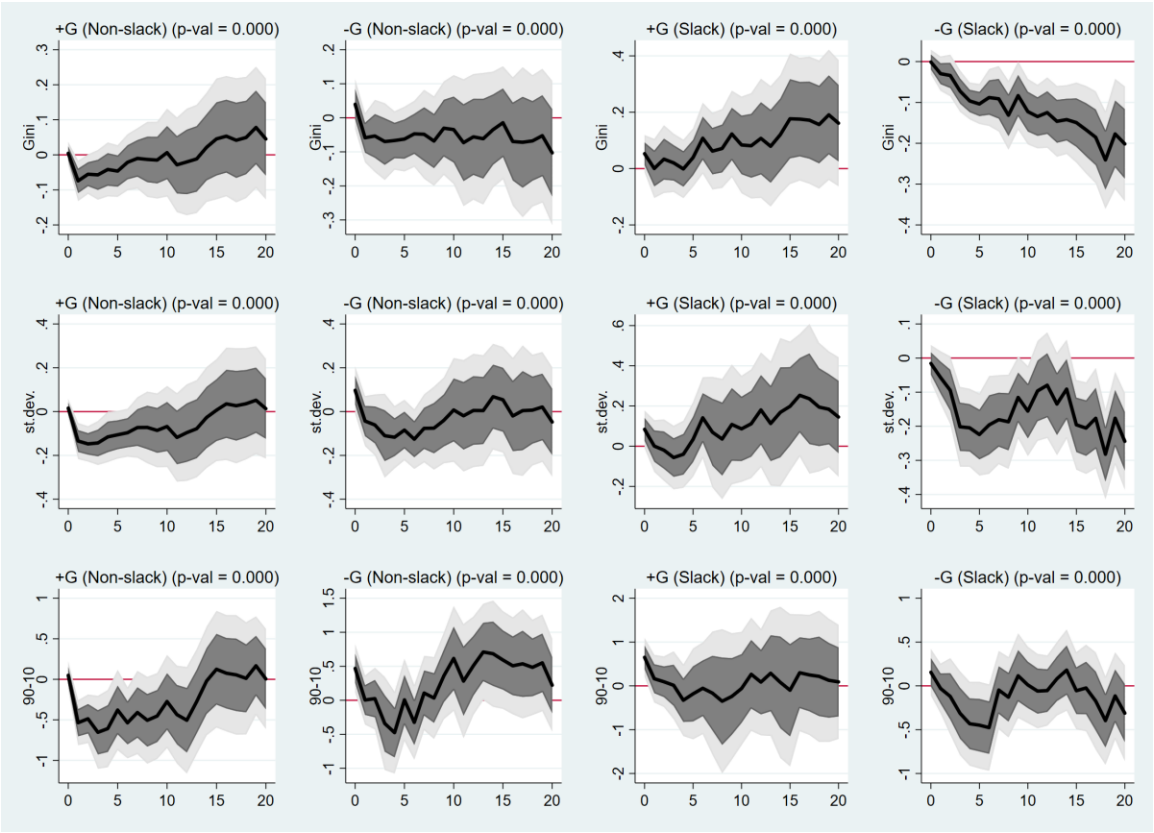

Fig. 2.3. State-dependent response of consumption inequality to asymmetric fiscal effects.

Notes: The solid black line denotes accumulated impulse responses to government spending shock, and the dark and light gray areas, respectively, show corresponding 1 and 1.65 standard deviation confidence intervals. The first two columns show impulse responses of consumption inequality to an expansionary and contractionary spending shock, respectively, given the economy is in a non-slack state. The third and fourth columns show the inequality responses to an increase and decrease in government spending given that there is high unemployment in the economy (slack). Inequality is measured by the Gini coefficient (first row), cross-sectional standard deviation (second row), and the 90th and 10th percentiles difference. "*p*-values" reports against the null hypothesis that the consumption inequality's impulse response to the shock is zero for all horizons.

On the other hand, in case of negative spending shock, we find a state-dependent effect where a negative spending shock during the slack state has a larger adverse impact on consumption inequality than the one under non-slack state. These results are consistent with the literature since many studies find a substantially low government spending multiplier effect on consumption when the economy expands. The fall in consumption inequality after positive spending shocks may be driven by the lower end of the distribution, whose income share improved due to better wages and more transfer payments during low unemployment times. When considering the slack (high unemployment) periods in the economy, consumption inequality responses are imprecise for a positive government spending shock while a negative spending shock significantly lowers consumption inequality for all but for the difference between 90^{th}-10^{th} percentile measure of inequality.

Although look conflicting, these findings are consistent with both empirical and theoretical literature on state-dependent fiscal multipliers. Incorporating incomplete financial markets and downward nominal wage rigidities in a simple theoretical model, Barnichon *et al.* (2022) have recently demonstrated that government spending multipliers associated with a negative shock are substantially larger in times of economic slack while the expansionary multipliers are below one regardless of the state of the economy. Our results are also in line with the findings of the heterogenous agents' model where the presence of the hand-to-mouth consumers raise consumption at the bottom distribution and, at the same time, lowers it at the top so the overall consumption inequality goes down (see, Ma, 2019; Alpanda *et al.*, 2021).

5. Conclusion

This paper uses U.S. household data (CEX) and a standard identification scheme to estimate the state-dependent effects of government spending shocks on consumption inequality. Employing a smooth transition function to avoid small sample bias associated with dummy state identification, we first estimate the inequality responses to government spending shocks during high and low unemployment times in the economy. Then, using the sign restriction approach, we estimate the asymmetric responses of inequality based on government spending action given the state of the economy.

Overall, the results point towards the state-dependent effects of spending shocks on consumption inequality in the U.S. only when sign restriction is accounted for the spending shock. For state-dependent responses of consumption inequality to average government spending shocks, we do not find that results supporting higher effectiveness of government spending shocks during slack over the non-slack state of the economy. For state-dependent inequality responses under positive/negative fiscal shock, the results show that government spending shocks have asymmetric effects on consumption inequality, and the policy effectiveness depends on the sign of the shock as well as the degree of asymmetry varies over the business cycle. We find a significant decline in consumption inequality to a negative spending shock when the economy is in slack, while positive spending shocks during the slack period are less effective in reducing inequality. Theoretically, these results are in line with the New-Keynesian model that features heterogeneous agents in the economy with constrained consumers raising their consumption after a positive government spending shock. During the period of slack, the magnitude of the negative shock impact on consumption inequality amplifies since the share of those hand-to-mouth

consumers rises in the economy. This finding empirically supports the theoretical prediction of Barnichon *et al.* (2022) and empirical findings of fazzari *et al.* (2021) regarding the state-dependent contractionary fiscal policy impacts on business cycle variables.

One caveat is that our analysis only considers one state (slack vs. non-slack) for state-dependent analysis, while there are other economic variables that can alter the effectiveness of policy shocks. Future research can be done evaluating the impact of fiscal shocks on inequality given those states (e.g., household debt situation, the degree of financial constraint, etc.). Furthermore, research is warranted on how the combination of various state variables impacts the transmission channel of fiscal policy shock on economic inequality.

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APPENDIX

A. State-Dependent Inequality Responses Under Binary State Specification

Ramey and Zubairy (2018) use the following model specification to estimate state-dependent effects on business cycle variables.

$$\Delta x_{t+h} = I_t \left[c^{(h)} + \sum_{j=1}^{J} \alpha_j^h \Delta x_{t-j} + \sum_{i=0}^{I} \beta_i^h e_{t-i}^g \right] +$$

$$(1 - I_t) \left[c^{(h)} + \sum_{j=1}^{J} \alpha_j^h \Delta x_{t-j} + \sum_{i=0}^{I} \beta_i^h e_{t-i}^g \right] + \varepsilon_{t+h}$$

for $h = 0,1,2,\ldots,H.$ (2.8)

where I_t is the dummy variable for the slack state when the unemployment rate is equal to or above 6.5%. Similar to our baseline findings, impulse responses in Figure 2.4 indicate that consumption inequality is not state-dependent.

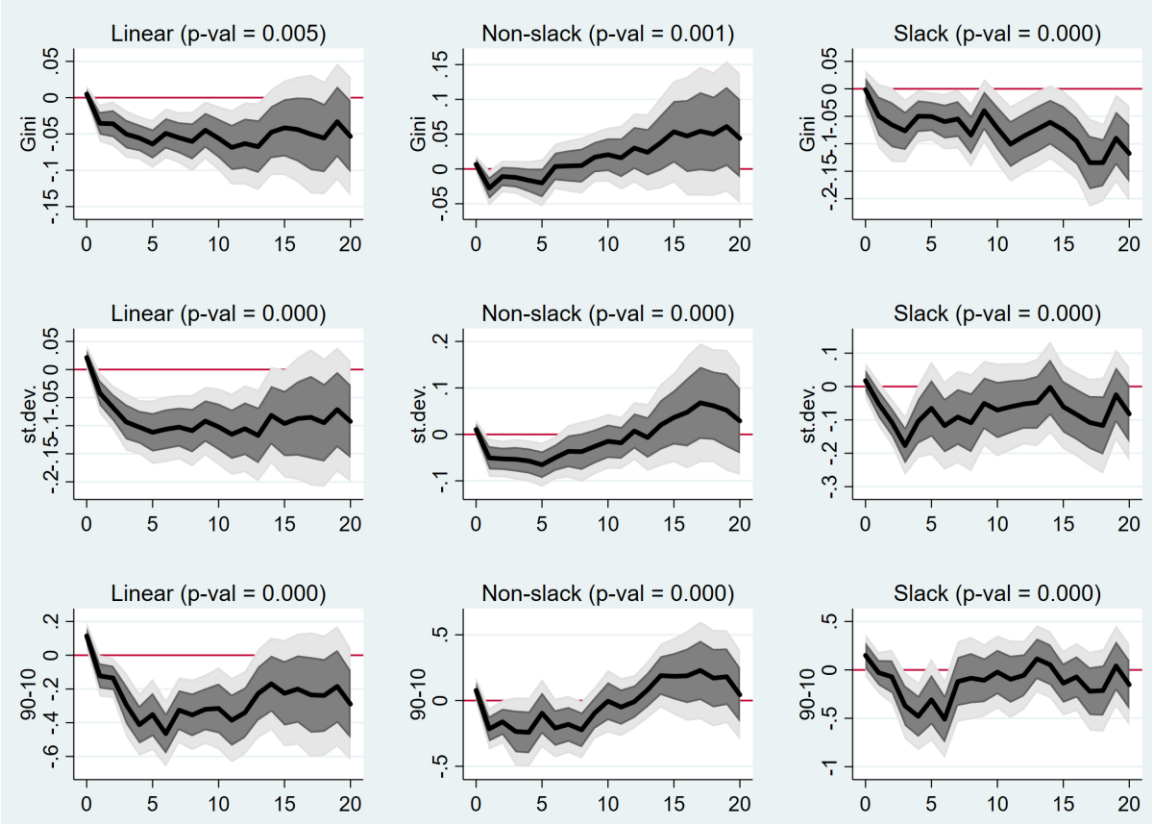

Fig. 2.4. State-dependent responses of consumption inequality to the government spending shock under binary state specification

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