Fiscal Policy Reactions and Impact Over the Labor Income Distribution

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Abstract

This paper investigates how fiscal policy reacts differently to negative income shocks on different points on the labor income distribution, and how fiscal policy shocks may have different effects at different points along the labor income distribution. Empirical examinations of fiscal policy typically consider a fiscal policy reaction function, where a single fiscal policy variable, such as the government budget deficit, responds to a variable related to the aggregate state of the economy, such as the output gap (in addition to outstanding government debt and allowing persistence). In this paper, I consider a fiscal policy reaction function where fiscal policy may respond to a weighted average of multiple quantiles along the labor income distribution. I also examine eight different fiscal policies variables including four types of government transfer variables shown to be countercyclical, government consumption and government investment, and personal versus corporate tax revenue. Embedding the fiscal policy variables into a Bayesian structural vector autoregression (SVAR), I estimate both the reaction of each of these fiscal policy variables to shocks to points along the labor income distribution, and the multiplier effect of fiscal policy shocks over time on points along the income distribution. With impulse response functions predicted by the SVAR, I show which fiscal policy variables are more reactive to shocks along the income distribution, which have larger multiplier effects, and how variable fiscal policy variables attenuate or exacerbate labor income inequality.

Keywords: Fiscal policy, income inequality, structural vector autoregression
JEL classification: E32, E62.

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1 Introduction

The fiscal policy multiplier literature typically measures business cycle fluctuations with one or more aggregate variables that capture average but not distributional effects of fiscal policy. The literature is vast, but notable examples include Auerbach and Gorodnichenko (2012), Blanchard and Perotti (2002), Caldara and Kamps (2008), Christiano *et al.* (2011), Favero and Giavazzi (2012), Galí *et al.* (2007), Mountford and Uhlig (2009), Perotti *et al.* (2007), and Ramey and Zubairy (2018). Ramey (2011) and Ramey (2019) both provide extensive recent reviews of the fiscal policy multiplier literature using both vector autoregressions (VARs) and dynamic stochastic general equilibrium models (DSGEs). The analyses conducted in both papers and in all the cited literature focus on aggregate responses to the output gap or real GDP to capture macroeconomic effects.

There is a tangentially-related literature that does investigates distributional consequences of fiscal policy. Bachmann *et al.* (2020) investigates the distributional consequences of fiscal volatility on a calibrated model of the United States and find welfare costs to fiscal volatility are small, but increase with wealth due to the progressive nature of the U.S. tax system. Furceri *et al.* (2022) use a panel of countries and find international evidence that unexpected fiscal consolidations cause an increase in income inequality and an increase in poverty.

Statistical evidence reveals that business cycles affect different quantiles of the labor income distribution differently. Figure 1 shows estimates of the first, second, and third quartiles of real labor income in the United States for all labor force participants.[1] The plot reveals a widening income gap over time and different responses at different income quartiles in times of recession. The time series reveals that labor income decreases during recessions more at the bottom quartile than the median or upper quartile. Figure 2 focuses on the responses during the recessions and subsequent recoveries for the recessions in 1991, 2001, and 2008. The labor income responses are given in percentages and are relative to the level of income at the beginning period of each recession (Panel A) or the beginning period of the recovery (Panel B). Panel (A) shows that for every recession, the bottom quartile experienced much larger percentage decreases in labor income, and the negative shock was longer lasting. Panel (B) focuses on the response from the beginning of the recovery (end date of the recession) for each recession. These series reveal that the business cycle contractions for the bottom quartile continued after the NBER-identified start of the recovery, and sometimes for

[1] Full details of the data are given in the Methodology section. The data is quarterly, real, and seasonally adjusted from 1982 Q1 through 2020 Q4.

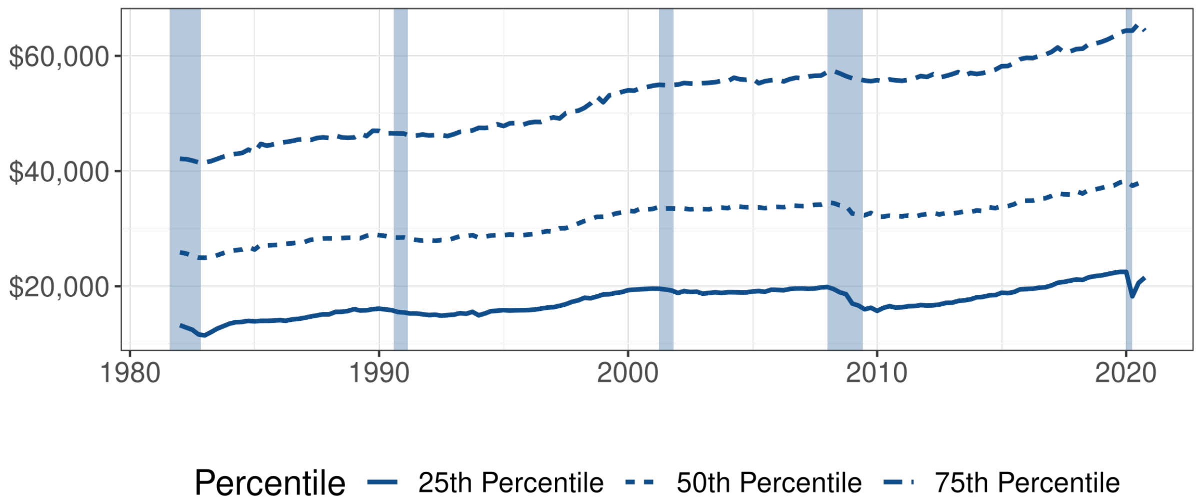


Figure 1: Annual labor market income quantiles for labor force participants (real, season adj.)

years after the other income quartiles started to recover. Figure 3 shows the history of the labor income gap, measured by the percentage difference between the upper quartile and the bottom quartile. Labor income increases in every recession, and severely so for the 1981, 2008, and 2020 recessions, and the effect usually diminishes slowly.

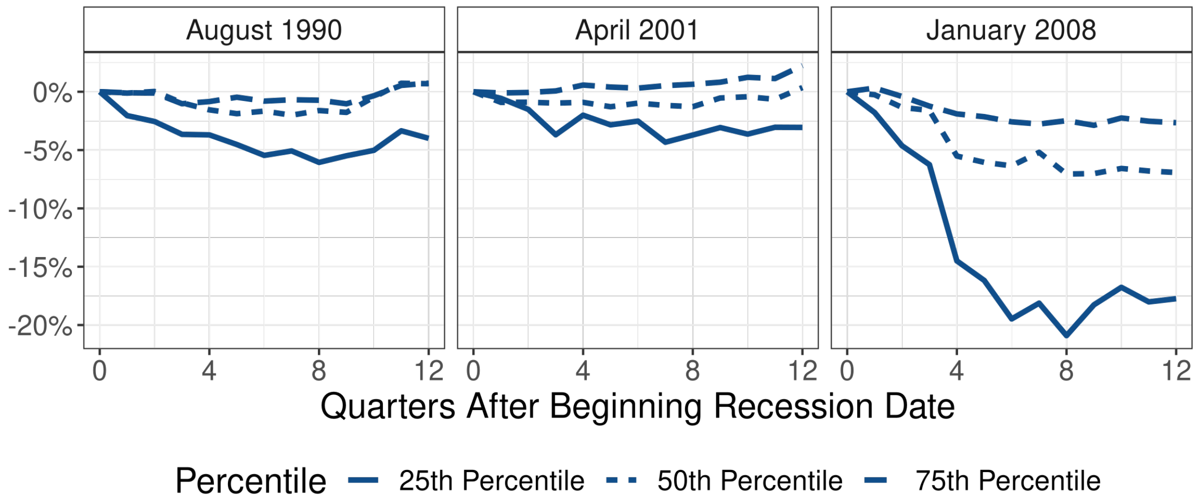
Given the labor income distributional consequences for business cycles, this paper attempts to answer two questions regarding fiscal policy in the context of the labor market distribution: (1) How do various fiscal policies react to changes in labor market income over the three labor income quartiles? (2) What are the effects of various fiscal policies on each of the labor income quartiles? Many papers in the macroeconomics fiscal policy literature focus on only one or two fiscal policy variables, including the primary government deficit, government expenditures, and taxes. Since different transfer programs and tax policies may affect different labor income distributions differently, I consider four transfer programs, unemployment insurance, social security transfers, Medicaid transfers, and "other social benefit" transfers; two government expenditure lines, government consumption and government investment; and two tax revenues, personal income tax and corporate income tax. By considering this wide menu of fiscal policies, I can assess which policies have smaller and larger impacts on lower versus upper quartiles of the income distribution. I estimate eight Bayesian structural autoregression (BSVAR) models, one for each fiscal policy variable, that describe the interactions of the fiscal policy variable with the three labor income quartiles, the inflation rate, the federal funds rate, and the debt-to-GDP ratio. The model incorporates both the behavior of fiscal policy in response to business cycle fluctuations and the impact that fiscal policy has on each of the income quartiles.

2 Related Literature

This paper contributes both to the literature on the behavior of fiscal policy and the literature on the impact of fiscal policy on the macroeconomy. On the conduct of fiscal policy, Fatás and Mihov (2012) find with a panel of 23 countries that fiscal policy is widely used as an economic stabilization tool. They find evidence that government budget surplus is procyclical, consistent with increasing expenditures and decreasing tax revenues during economic contractions. Furthermore, they find evidence that some of this is explained specifically by discretionary policy (versus automatic stabilizers), and that using discretionary fiscal policy as an economic stabilization tool has increased in importance since the 1990s. Plödt and Reicher (2015) find further evidence in the Euro area that budget surpluses are procyclical and that budget surpluses adjust positively to increases in outstanding government debt. Using a panel of 20 OECD countries, Reicher (2014) finds that tax revenues and transfer payments, in particular, response most strongly to business cycle fluctuations, that tax rates respond positively to outstanding government debt, and that government expenditures respond negatively to outstanding government debt, but is not widely used as a stabilization tool. Combes *et al.* (2017) use a panel of 56 countries and also find government budget surpluses are procyclical for most countries in most time periods, but only when debt-to-GDP is below a threshold, which they estimate, and then turns countercyclical.

There is a large literature on the impact fiscal policies can have on the business cycle. Caldara and Kamps (2008) use a VAR methodology and find that positive shocks to government expenditures in the United States lead to hump-shaped increases in real GDP, consumption, and real wage, but no change in total hours. They furthermore demonstrate that the findings are robust to the methodology for identifying the contemporaneous structural relationships between the variables. Afonso and Sousa (2012) find similar results for the United States, but for the United Kingdom and Italy find the impact from an increase in government expenditures on real GDP is smaller and the impact on consumption and investment is negative. They further find for all three countries that decreases to taxes have stimulative effects on real GDP and consumption, but lead to decreases in

Panel (A): Percentage response from the beginning of recession



Panel (B): Percentage response from beginning of recovery

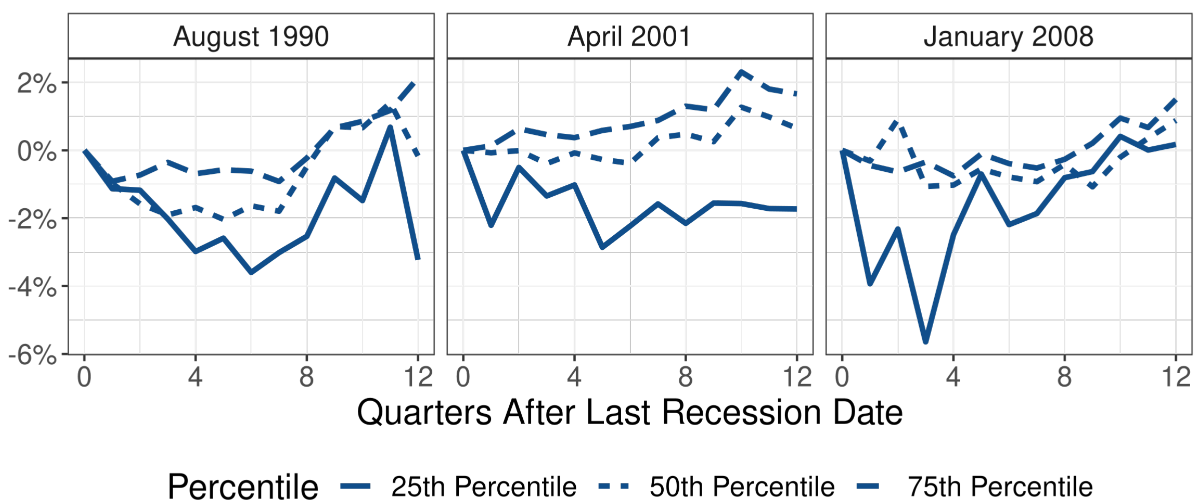


Figure 2: Response to Labor Income Quartiles During Recessions and Recoveries

Figure 3: Labor income gap: Percentage difference in labor income between top and bottom quartiles

investment.

The magnitude of the estimated impact of fiscal policy on the business cycle does depend on other structural assumptions regarding the behavior of consumers and producers. Ramey (2011) gives a concise description for what estimated DSGE models with forward-looking optimizing agents predict for fiscal policy multipliers. An increase in government expenditures leads to an increase in the net present value of lifetime expected tax obligations for consumers. Utility maximizing consumers respond by decreasing consumption and leisure. Consumption smoothing leads to a decrease in consumption that is not as large as the increase in government expenditures. The decrease in leisure is equivalent to an increase in labor supply, which leads to an increase in hours, decrease in wages, and an increase in production. An increase in equilibrium interest rates also leads to a decrease in investment. The net effect is an increase in real GDP, but the multiplier is less than one. The impact on real GDP is smaller than the increase in government expenditures due to the decrease in consumption and investment demand. Galí *et al.* (2007) and Cogan *et al.* (2010) find a similar dampened impact of shocks to government expenditures in typical New Keynesian frameworks, but demonstrate that if consumers follow rules-of-thumb decisions for consumption based on current-period income, increases government expenditures can lead to increases in consumption and multiplier effects on real GDP greater than one. Cwik *et al.* (2011) similarly show that fiscal multipliers greater than one are predicted only in frameworks that ignore forward-looking behavior.

Ravn *et al.* (2006) show that increases in consumption demand in response to increases in government expenditures are possible in a DSGE with "deep habit formation", where utility depends on habits over individual varieties of goods instead of the overall level of consumption.

There is mixed evidence that the impact on fiscal policy may change with time or economic conditions. Gechert and Rannenberg (2018) find evidence for larger multipliers in recessions versus expansions. Christiano *et al.* (2011) find that fiscal policy has larger multipliers when monetary policy is at the zero lower bound. When above this boundary, to the extend fiscal policy is effective at increasing real GDP, the central bank increases the interest rate, partially offsetting the stimulative impact of fiscal policy. When at the zero lower bound, there is no such response, and the fiscal multiplier is shown to be larger. Ramey and Zubairy (2018) consider a data set going as far back as 1889 for the United States, a period which includes many recessions and multiple instances of monetary policy at the zero lower bound. With the large data set, they find government expenditure multipliers on average less than one and not significantly different between recessions and expansions, or different when at the zero lower bound or above.

This paper takes a structural VAR estimation approach which requires confronting an endogeneity problem. Fiscal policy can depend contemporaneously on business cycle variables such as real GDP or real labor income, and business cycle variables can depend contemporaneously on fiscal policies. There are four general categories of approaches to account for the endogeneity problem. The first is a Cholesky-ordering approach, where the contemporaneous structural matrix is assumed triangular, and an ordering assumption is made for the causal relationships. For example, government expenditures may be assumed to simultaneously affect real GDP, but due to implementation lags, real GDP does not contemporaneously affect government expenditures. Caldara and Kamps (2008) begin with this approach and illustrate the predictions for the United States. This may be satisfactory for government expenditures, but it becomes problematic for taxes and transfers which respond automatically to changes in the business cycle. Blanchard and Perotti (2002) introduce a second approach using institutional information on the structure tax policy. They identify the causal effect of a change in real GDP on taxes and calibrate this parameter in the structural VAR. For government expenditures, they also use the implementation lag reasoning to assume that the contemporaneous causal effect of the business cycle on government expenditures is equal to zero. Mountford and Uhlig (2009) suggest a third approach to identifying fiscal policy shocks and their impact by making a minimal number assumptions on the sign of the impulse response functions. The fourth approach is to identify exogenous changes expenditures from known exogenous shocks such as build ups of military spending (see, for example, (Perotti *et al.*, 2007)) or exogenous changes in tax policies, whose motivations are identified to be exogenous from presidential speeches and Congressional reports (Romer and Romer, 2010).

The approach taken is this paper follows Baumeister and Hamilton (2015), who suggest a compromise between calibrations like Blanchard and Perotti (2002) and sign restrictions like Mountford and Uhlig (2009). In a Bayesian structural VAR, prior beliefs on the magnitude and direction of the response of one variable to another is made explicit in specifying the prior distribution. Typical sign restrictions following Mountford and Uhlig (2009) do not make the signs of the impulse response functions explicit in the functional forms of the prior distributions, but impose loss function penalties or simply discard posterior draws when the sign restrictions fail to hold. The prior distributions on the structural parameters can put most of their probability over the areas where sign restrictions will likely hold. The prior distributions also make use of typical assumptions where the response to government policy from a business cycle shock is near zero and the response of taxes to business cycle shocks are centered near values suggested by Blanchard and Perotti (2002).

3 Methodology

3.1 Data

I estimate a structural VAR on U.S. data using three categories of variables: personal labor income quartiles, fiscal policy variables, and other macroeconomic variables inter-related with the business cycle, namely the inflation rate and interest rate.

Personal income percentiles are available only at an annual frequency from the the Bureau of Labor Statistics dating back to 1984, which results in only 38 observations (at the time of this writing) and likely smooths out important business cycle behavior that can fluctuate from one quarter to another (for example, with recessionary episodes that last less than one year). I construct a quarterly time series from monthly microeconomic data from the Current Population Survey (CPS) and downloaded via IPUMS CPS.[2] I use the IPUMS variable EARNWEEK which measures usual weekly earnings from working, and multiply by 52 weeks to get an estimate for annual labor income

[2]The Integrated Public Use Microdata Series (IPUMS) is provided by the University of Minnesota. See Ruggles *et al.* (2020).

earnings. I use the LABFORCE variable to identify only workers who are in the labor force, and include both people that are working and that are unemployed (but in the labor force and looking for work) and earning zero labor income. Each of these variables are measured on a monthly basis going back to 1982. I use the EARNWT weighting variable and estimate the percentile for earnings for every worker in the sample. The CPS measures individuals for four consecutive months (and then again one year later for four consecutive months), so one month and the next contains many of the same individuals. As a consequence, there is sometimes little variability in the labor income levels at any given percentile. To include more information in the distribution of labor earnings surrounding these three quartiles of the labor income distribution (and therefore including more unique individuals in the quartile estimates), I group workers in each of the following three intervals which are centered on the quartiles, the 20-30th percentile earnings, the 45-55th percentile earnings, and the 70-80th percentile earnings. In each group I compute the mean labor income, and use this measure for the quartile estimates for annual labor income. I seasonally adjust the data in R using the SEATS (Seasonal Extraction in ARIMA Time Series) decomposition method, the same process used by the U.S. Census Bureau.[3] I then put the series in real terms by dividing by the GDP implicit price deflator. It is this data that is shown in Figure 1.

For fiscal policy, I consider four transfer payment policies, two tax revenue sources, and two categories of government expenditures. The Bureau of Economic Analysis has quarterly data for six types of transfer payments that sum to the total amount of all transfer payments: Medicare payments, Medicaid payments, Social Security payments, unemployment insurance, veterans payments, and "other social benefits." I downloaded the data via FRED (Federal Reserve Economic Database provided by the Federal Reserve Bank of St. Louis). Figure 4 shows each of these variables in real per-capita terms.

To get a visual understanding of which fiscal variables may respond to the business cycle, Figure 5 shows scatterplots of the output gap (percentage difference between real GDP and potential GDP) relative to the each of the transfer variables, expressed as a ratio of potential GDP. Veterans payments do not fluctuate with the business cycle, but there is visual evidence that the remaining five variables do. The negative visual relationships suggest that except for veterans payments, all other transfer payment programs are counter-cyclical. When the economy contracts, these transfer payments increase. This is result is expected and intuitive for unemployment insurance, a well

[3] See Dagum and Bianconcini (2016) for the methodology and Sax (2016) for the implementation in R.

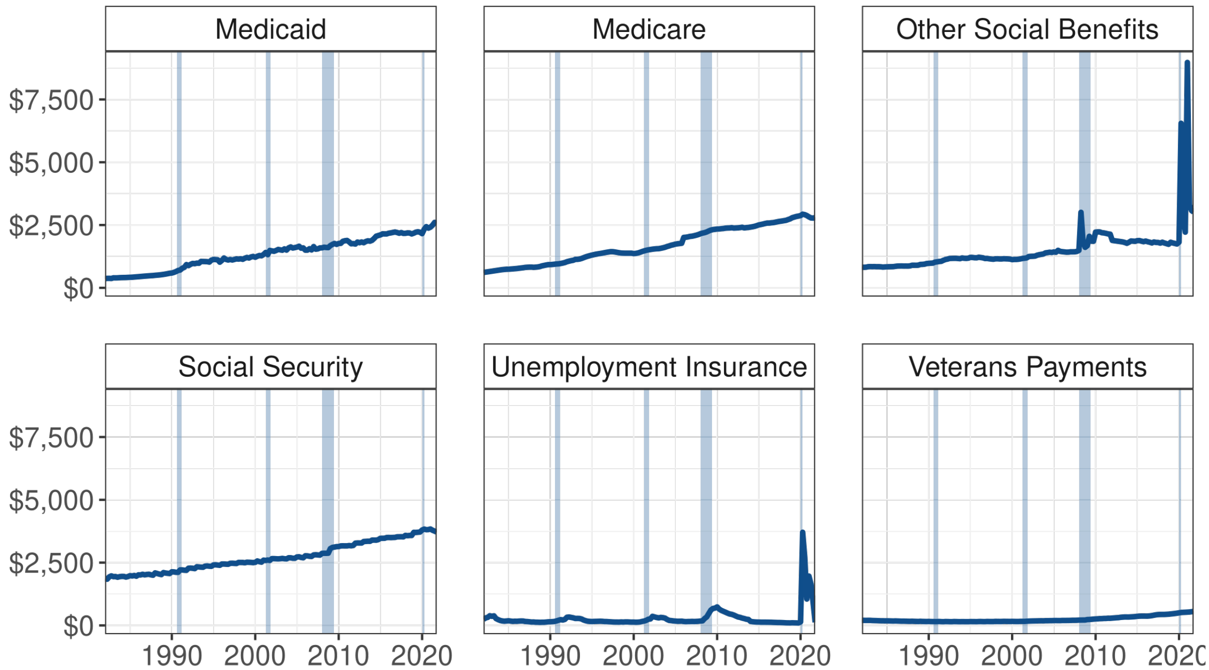


Figure 4: Real transfer payments per capita by type

known automatic stabilizer. As the economy contracts and unemployment increases, applications and subsequently payments for unemployment benefits increase. Some of this increase may also be discretionary, as the federal government has occasionally expanded time eligibility windows during severe unemployment episodes. The category of "other social benefits" also includes discretionary fiscal policies that have accompanied stimulus bills that were passed in the last two recessions. Spikes in these benefits visibly stand out during the 2008 and 2020 recessions. These bivariate visual relationships by themselves are not intended to be sufficient to conclude these fiscal policies respond to the business cycle. This question will be examined more deeply in the structural VAR analysis below. Still, the visual relationship motivates further examination of each of these fiscal policy behaviors in more detail and exploring the macroeconomic impacts of each.

The Bureau of Economic Analysis provides quarterly estimates for government consumption and government investment and the data can be downloaded via FRED. Figure 6 shows each in real, per capita terms. Figure 7 takes a preliminary look on whether these government expenditures are countercyclical. Again, each scatterplot shows the output gap relative to the government expenditure category as a percentage of potential GDP. Government consumption appears to be possibly

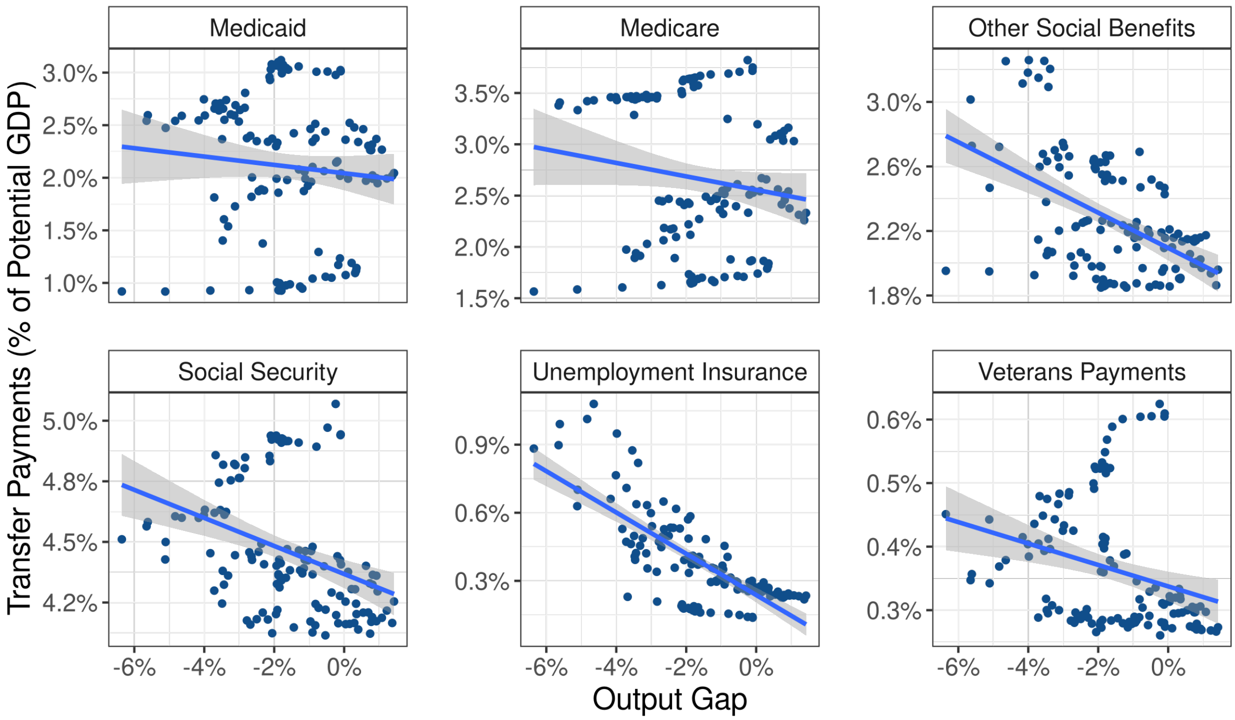


Figure 5: Relationship of the output gap and transfer payments relative to potential GDP

countercyclical and government investment appears acyclical. The SVAR analysis below includes both variables and examines the behaviors and stimulative effects of each.

The Bureau of Economic Analysis provides quarterly estimates for tax receipts and categorizes tax revenues deriving from federal taxes versus state and local taxes. The data is further delineated as revenues collected from personal income taxes versus corporate income taxes. I downloaded the data via FRED and added together federal with state and local taxes for each personal and corporate income taxes. Figure 8 shows the history of each and Figure 9 illustrates the relationship with the output gap. Both corporate and personal tax revenues are procyclical and are likely automatic stabilizers.

I include government debt in the VAR model below to allow the fiscal policy variables to possibly respond to rising levels of debt. I add together the estimates of federal debt and state and local debt provided by the Federal Reserve Board of Governors and downloaded via FRED. Figure 10 shows the evolution of government debt over the sample period.

Finally, the model below includes inflation and the interest rate. I use the growth rate of the GDP implicit price deflator for inflation and the federal funds rate for the interest rate. Figure 11

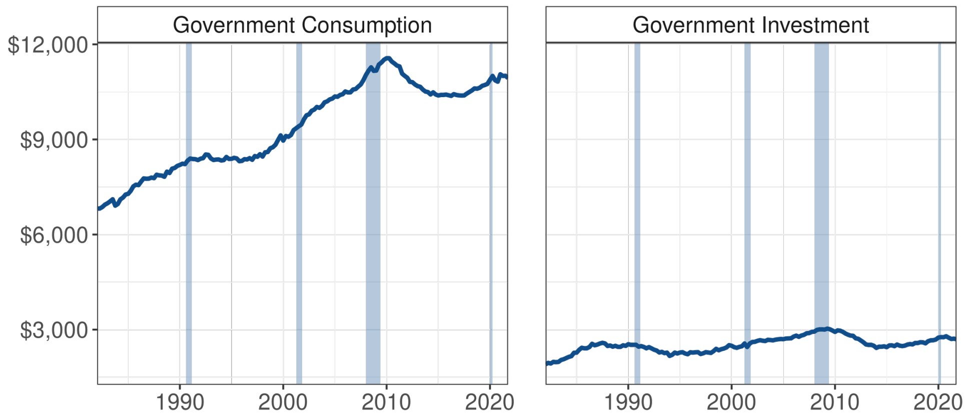


Figure 6: Real government expenditures per capita by type

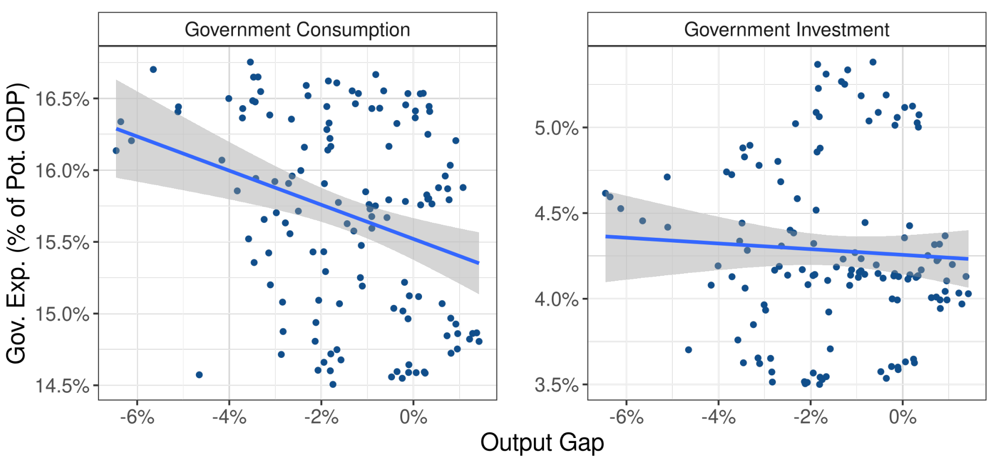


Figure 7: Relationship of the output gap and government expenditures relative to potential GDP

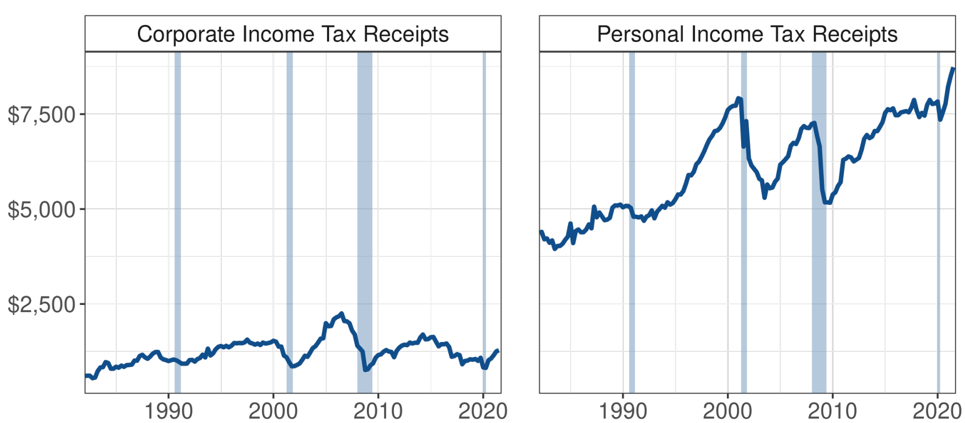


Figure 8: Real tax receipts per capita by type

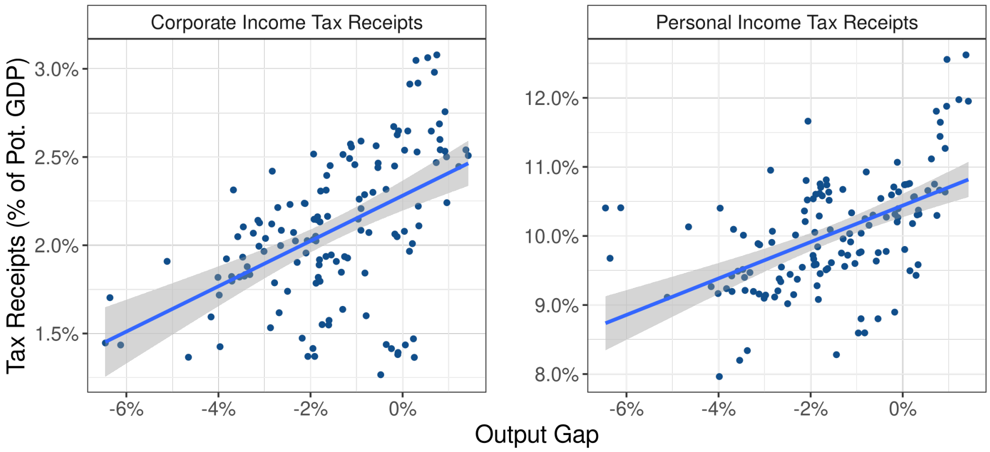


Figure 9: Relationship of the output gap and tax receipts relative to potential GDP

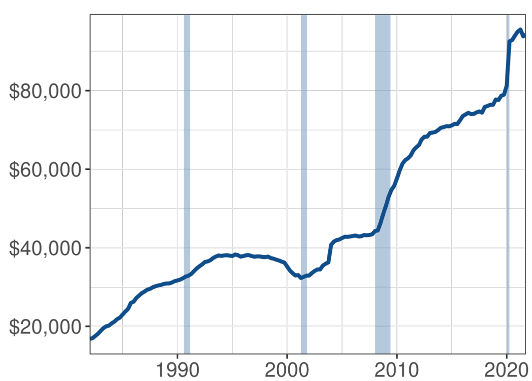


Figure 10: Real total government debt per capita

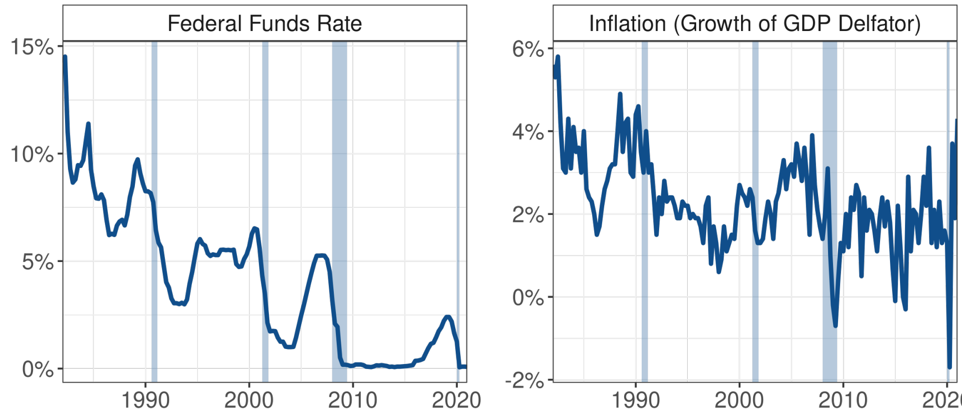


Figure 11: Other macroeconomic variables included in the model

shows the evolution of each of these variables over the sample period.

3.2 Estimation Strategy

I estimate eight structural VARs, one for each fiscal variable, of the form,

$$\begin{aligned} A_0 x_t &= \mu + \eta t + A(L)x_t + u_t \\ &= B z_t + u_t \\ u_t &\sim \mathcal{N}(0, D) \end{aligned} \tag{1}$$

The vector x_t includes the following seven endogenous variables:

1. log(25th Percentile Labor Market Earnings)
2. log(50th Percentile Labor Market Earnings)
3. log(75th Percentile Labor Market Earnings)
4. log(Fiscal Variable)
5. log(Total Public Debt)
6. Inflation rate
7. Federal funds rate

The structural matrix A_0 captures the contemporaneous causal effects between the variables, where the element in the ith row and jth column represents the dependence of the ith variable on the jth variable. The parameter μ is a vector of intercepts. The model allows for growth of the variables over time with t, which is the number of quarters since the beginning of the sample, and η, which is a vector of coefficients on t allowing for a unique deterministic trend for each variable. The $A(L)$ lag polynomial captures the dependence on lags. I use a lag length of 4 quarters for all the estimation results below. The vector u_t represents structural shocks to each variable. The structural shocks are all independently and normally distributed, so the variance/covariance matrix, D, is diagonal with the diagonal elements equal to the variances of structural shocks for each variable.

All the explanatory variables, including all lags, intercept, and time, are grouped into the vector, z_t, so the second line of equation (1) expresses the same structural form in compact form.

The reduced form can be found by pre-multplying both sides of equation (1) by A_0^{-1}. Let the compact reduced form be given by,

$$\begin{aligned} x_t &= C z_t + e_t, \\ e_t &\sim \mathcal{N}(0, W) \end{aligned} \tag{2}$$

where $C = A_0^{-1}\ B$ and $W = A_0^{-1} D A_0^{-1\prime}$

The Baumeister and Hamilton (2015) method involves making structural assumptions explicit in the prior $p(A_0)$. For given values in A_0, priors are specified for each diagonal element of D, given by $p(d_{ii}|A_0)$, and so $p(D|A_0) = \Pi_{i=0}^{k} p(d_{ii}|A_0)$, where $k = 7$ is the number of endogenous variables in the system. For the coefficients including the intercept, time trend, and lags, I follow Baumeister and Hamilton (2015) in specifying priors for reduced form matrix, C, and follow Litterman (1986) with priors centered on a random walk model, with the priors for all of the elements of C centered at zero except those associated with each variable's own first lag, which are centered at one.

Table 1 describes the priors put on the elements of A_0 associated with the fiscal policy variables. The impact of an increase in personal taxes on income is likely negative. Consumers experience a decrease in disposable income, and they respond with a decrease in spending. Lower sales for final goods and services reduces demand for labor, which would lead to a decrease in hours and wages, leading to a decrease in labor income. Because the contemporaneous variables appear on the same side of the equation, a negative relationship between two variables is captured with a positive coefficient in A_0. I, therefore, impose a prior that covers primarily positive numbers. I set the prior equal to the t-distribution, $t(\mu = 1.0, \sigma = 0.5, df = 2)$. A mean value equal 1.0 implies a 1% increase in taxes leads to a 1% decrease in labor income. The small value for the degrees of freedom gives the distribution fat tails to allow for uncertainty in our prior knowledge. Approximately 80% of this t-distribution is between and 0.0 and 2.0 and approximately 10% of the distribution is less than 0.0.

I use the same prior distribution for the impact of increase in corporate income taxes on income. Again, we may reasonably expect the impact on income to be negative. An increase in corporate taxes may lead to a decrease in labor demand and therefore a decrease in labor market earnings.

Increases to income should have a positive impact on tax receipts. An increase in taxable income leads to an increase in personal income tax receipts. An increase in income also leads to an increase in consumer spending, which leads to increases in revenues and profits for firms, leading to an increase in corporate tax receipts. The positive relationship implies the coefficient in A_0 is negative, so I set these priors equal to the t-distribution, $t(\mu = -1.0, \sigma = 0.5, df = 2)$.

The impact on the income quartiles from an increase government expenditures or transfer payments is expected to be positive. Any of these policies should stimulate aggregate demand, leading to an increase in sales of final goods and services, leading to an increase in labor demand, and therefore an increase in labor earnings. The coefficient in A_0 has the opposite sign, so I set these priors equal to the t-distribution, $t(\mu = -1.0, \sigma = 0.5, df = 2)$.

The impact on transfer payments and government expenditures variables from an exogenous increase in income should be negative. To the extent these fiscal policies respond to the business cycle, an increase in income should lead to a decrease in these expenditures. I set these priors equal to the t-distribution, $t(\mu = 1.0, \sigma = 0.5, df = 2)$.

Regarding government debt, an exogenous increase in tax revenues should decrease government debt. I set these priors equal to the t-distribution, $t(\mu = 0.1, \sigma = 0.05, df = 2)$. The center value of 0.1 implies that a 1% increase in government expenditures or transfer payments leads to a one-tenth of 1% increase in total government debt. The fiscal policies are assumed to not respond contemporaneously to government debt, so these elements of A_0 are set equal to zero. Still, the lags for government debt appear in the VAR, so fiscal policies may respond to recent levels of government debt.

The priors for other macroeconomic behavior are given in Table 2 and are based on the structural relationships implied by a typical three equation New Keynesian model:

$$y_t = E_t y_{t+1} - \nu(r_t - E_t \pi_{t+1} + \upsilon_t^y, \tag{3}$$

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t + \upsilon_t^\pi, \tag{4}$$

Table 1: Prior distributions identifying structural relationships related to fiscal variables

Parameters in A_0	Causal relationship	Likely Sign on coefficient in A_0[†]	Reasoning	Prior
$a_{income,tax}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$ $tax \in \{\text{corporate tax, personal tax}\}$	Percentage impact that a 1% increase in corporate or personal tax receipts has on each of the income quartiles	Positive	Tax increases reduce disposable income, spending, and therefore income.	$t(\mu = 1, \sigma = 0.5, df = 2)$
$a_{tax,income}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$ $tax \in \{\text{corporate tax, personal tax}\}$	Percentage impact that a 1% increase in labor income has on corporate and personal tax receipts	Negative	As incomes labor increase, tax receipts increase for personal income. Spending also increases, so corporate tax receipts should increase.	$t(\mu = -1, \sigma = 0.5, df = 2)$
$a_{income,gov}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$ $gov \in \{\text{gov. cons., gov. inv.}\}$	Percentage impact that a 1% increase in either government consumption or government investment has on each of the income quartiles	Negative	An increase in government expenditures boosts aggregate demand and so may lead to an increase in hours and wages.	$t(\mu = -1, \sigma = 0.5, df = 2)$
$a_{gov,income}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$ $gov \in \{\text{gov. cons., gov. inv.}\}$	Percentage impact that a 1% increase in labor income has on government consumption and government investment	Positive	As labor incomes increase, the need for government spending stimulus decreases, and so government expenditures decrease.	$t(\mu = 1, \sigma = 0.5, df = 2)$
$a_{income,tran}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$ $tran \in \{\text{Medicaid, Soc. Sec., unempl., other}\}$	Percentage impact that a 1% increase in transfer payments has on each of the income quartiles	Negative	An increase in transfer payments boosts aggregate demand and so may lead to an increase in hours and wages.	$t(\mu = -1, \sigma = 0.5, df = 2)$
$a_{tran,income}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$ $tran \in \{\text{Medicaid, Soc. Sec., unempl., other}\}$	Percentage impact that a 1% increase in labor income has on each of the transfer payments	Positive	As labor incomes increase, the need for transfer payments decreases, and so transfer payments decrease.	$t(\mu = 1, \sigma = 0.5, df = 2)$
$a_{debt,tax}$ $tax \in \{\text{corporate tax, personal tax}\}$	Percentage impact that a 1% increase in tax receipts has on government debt	Positive	An increase in tax receipts decreases outstanding government debt.	$t(\mu = 0.1, \sigma = 0.05, df = 2)$
$a_{debt,gov}$ $gov \in \{\text{gov. cons., gov. inv.}\}$	Percentage impact that a 1% increase in government expenditures has on government debt	Negative	An increase in government expenditures adds to outstanding government debt.	$t(\mu = 0.1, \sigma = 0.05, df = 2)$
$a_{debt,tran}$ $tran \in \{\text{Medicaid, Soc. Sec., unempl., other}\}$	Percentage impact that a 1% increase in transfer payments has on government debt	Negative	An increase in transfer payments adds to outstanding government debt.	$t(\mu = 0.1, \sigma = 0.05, df = 2)$

[†] Because both contemporaneous variables appear on the right side of the equation, the sign on the coefficient in A_0 is the opposite of the direction of the effect one variable has on another.

Table 2: Prior distributions regarding macroeconomic behavior

Parameters in A_0	Causal relationship	Likely Sign on coefficient in A_0[†]	Reasoning	Prior
$a_{income,inflation}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$	Percentage impact that a 1 percentage point increase in the inflation rate has on each of the income quartiles	Negative	IS curve effect: An increase in inflation (that may be expected to persist into the future) reduces the real interest rate and increases demand for goods and services, which leads to an increase in labor earnings.	$t(\mu = -0.5, \sigma = 0.25, df = 2)$
$a_{income,interest}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$	Percentage impact that a 1 percentage point increase in the interest rate has on each of the income quartiles	Positive	IS curve effect: An increase in the real interest rate causes a demand for goods and services, which leads to a decrease in labor earnings.	$t(\mu = 0.5, \sigma = 0.25, df = 2)$
$a_{income_i,income_j}$ $income_i, income_j \in \{25\text{th},50\text{th},75\text{th perc}\}$	Percentage impact that a 1 percentage point increase in income from one quartile has on another quartile	Negative	Positive multiplier effect: An increase in labor income at any quartile of the labor income distribution increases demand for goods and services, which leads to an increase in labor earnings for the other quartiles.	$t(\mu = -0.5, \sigma = 0.25, df = 2)$
$a_{inflation,income}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$	Percentage impact that a 1% increase in income at each quartile has on the inflation rate	Negative	Phillips curve effect: An increase in income leads to an increase in inflation.	$t(\mu = -0.066, \sigma = 0.033, df = 2)$
$a_{inflation,interest}$	Percentage impact that a 1% increase in the interest rate has on the inflation rate	Positive	Phillips curve effect: In the Phillips curve, inflation depends positively on expected inflation, and inflation expectations should depend negatively on the interest rate	$t(\mu = 0.5, \sigma = 0.25, df = 2)$
$a_{inflation,tran}$ $tran \in \{\text{Medicaid, Soc. Sec., unempl., other}\}$	Percentage impact that a 1% increase in transfers has on the inflation rate	Negative	Phillips curve effect: An increase in net-of-transfers income leads to an increase in inflation.	$t(\mu = -0.5, \sigma = 0.25, df = 2)$
$a_{inflation,gov}$ $gov \in \{\text{gov. cons., gov. inv.}\}$	Percentage impact that a 1% increase in government expenditures has on the inflation rate	Negative	Phillips curve effect: An increase in government spending leads to an increase in aggregate spending, which leads to an increase in inflation.	$t(\mu = -0.5, \sigma = 0.25, df = 2)$
$a_{inflation,tax}$ $tax \in \{\text{corporate tax, personal tax}\}$	Percentage impact that a 1% increase in tax revenue has on the inflation rate	Positive	Phillips curve effect: A decrease in after-tax income leads to a decrease in inflation.	$t(\mu = 0.5, \sigma = 0.25, df = 2)$
$a_{interest,income}$ $income \in \{25\text{th},50\text{th},75\text{th perc}\}$	Percentage impact that a 1% increase in income at each quartile has on the federal funds rate rate	Negative	Taylor rule: An increase in income should lead to an increase in the interest rate	$t(\mu = -0.167, \sigma = 0.083, df = 2)$
$a_{interest,inflation}$	Percentage impact that a one percentage point increase in inflation has on the federal funds rate rate	Negative	Taylor rule: An increase in income should lead to a more than one-to-one increase in the interest rate	$t(\mu = -1.5, \sigma = 0.5, df = 2)$

[†] Because both contemporaneous variables appear on the right side of the equation, the sign on the coefficient in A_0 is the opposite of the direction of the effect one variable has on another.

$$r_t = \psi_p i\pi_t + \psi_y y_y + +\upsilon_t^r. \tag{5}$$

Equation (3) is the IS equation, and represents utility-maximizing demand decisions for goods and services. The variable y_t is real GDP, r_t is the interest rate, and π_t is the inflation rate. An increase in interest rate or a decrease in the expected inflation rate leads to a decrease in the expected real interest rate, which lowers the opportunity cost of current-period consumption, leading to an increase in demand for goods and services. This in turn leads to an increase in real GDP and an increase in labor market income.

Equation (4) is the Phillips curve, representing the pricing behaviors of profit-maximizing producers subject to pricing frictions. Inflation increases with expectations of higher future inflation and increases in real GDP. The SVAR does not explicitly include real GDP, but increases in labor income are associated with an increase in total output. Because there are three income variables in the model, we can imagine in equation (4) the sum of the three income quartiles in place of y_t. The priors for the coefficients $a_{inflation,income}$, given by $t(\mu = -0.066, \sigma = 0.033, df = 2)$, represent the specific effect of an increase in just one income quartile, but not the others. Therefore, the priors are centered at one-third of the value that might be expected if the whole income distribution increased by 1%. Similarly, Table 2 shows how inflation depends on fiscal policies, given they can affect y_t through changes in after-tax income, net-of-transfers income, and aggregate expenditures.

Equation (5) is a typical monetary policy rule advocated by Taylor (1993). The interest rate should increase in response to an increase in inflation or an increase in real GDP. Again, we can imagine the sum of the three income quartiles in place of y_t in the monetary policy rule, so each coefficient on the income quartiles represents approximately one-third of the response expected by a 1% shift in the entire labor income distribution. A prior distribution on $a_{interest,income}$ of $t(\mu = -0.167, \sigma = 0.083, df = 2)$ represents a prior belief that $\psi_y = 3(0.167) = 0.5$, a value suggested by Taylor (1993). The prior distribution for $a_{interest,inflation}$ is $t(\mu = -1.5, \sigma = 0.5, df = 2)$ and is centered around a belief that $\psi_\pi = 1.5$.

Prior beliefs for the diagonal variance/covariance matrix, D, are constructed by first setting the beliefs for the reduced form variance/covariance matrix, W, then using prior beliefs for A_0 to construct D. Following Baumeister and Hamilton (2015), I estimate univariate autoregressions with 8 lags for each of the endogenous variables. Let $\hat{e}_i$ represent the residuals from the AR(8) estimation for endogenous variable i, and let $\hat{E}$ be a $(T \times k)$ matrix of residuals where each column i is given by $\hat{e}_i$. The center for prior belief for the reduced-form variance/covariance matrix, W, is given by,

$$\hat{W} = \hat{E}'\hat{E} \tag{6}$$

Given matrix, A_0, the prior beliefs for the diagonal elements of structural variance/covariance matrix are given by,

$$\widehat{diag(D)} = diag(A_0 \hat{W} A_0') \tag{7}$$

The prior distribution for inverses of the diagonal elements of D are given by the following gamma distribution,

$$p(d_{ii}^{-1}|A_0) = \left\{ \begin{array}{ll} \frac{\tau_i^{\kappa_i}}{\Gamma(\kappa_i)} \left(d_{ii}^{-1}\right)^{\kappa_i - 1} exp\left(-\tau_i d_{ii}^{-1}\right) & \text{for } d_{ii} \geq 0, \\ 0 & \text{otherwise,} \end{array} \right\} \tag{8}$$

where $\Gamma(\cdot)$ is the gamma function. Note that κ_i/τ_i is the prior mean for d_{ii}^{-1} and κ_i/τ_i^2 is the variance. I choose $\kappa_i = 3.0$, then compute the value for τ_i so that prior mean for d_{ii}^{-1} is equal to the inverse of the ith element of $\widehat{diag(D)}$. The prior distribution for D is then given by,

$$p(D|A_0) = \Pi_{i=1}^{k} p(d_{ii}^{-1}|A_0) \tag{9}$$

The prior distribution for the coefficients on the lags begins with beliefs on the reduced form coefficients in C. Following Litterman (1986), I use priors centered around a random walk model. I use normal distribution priors for every element of C centered at zero, except for the elements associated with each variable's own first lag, which are centered at one. Given that construction for C, the prior for structural matrix B is centered around A_0C.

To determine the variances of the prior, let $\hat{w}_{ii}$ denote the ith diagonal element of $\hat{W}$ in equation (6). The prior belief for the variance of the ith equation in the reduced form VAR is given by $\hat{w}_{ii}$, which implies a belief on the variance/covariance matrix for row i of the estimate for C to be given by,

$$\widehat{Var(C_i)} = \hat{w}_{ii} \left(Z'Z\right)^{-1}, \tag{10}$$

where Z is a matrix with each row t given by the time t vector of explanatory variables, z_t.

For simplicity, I assume the priors for all the elements of C are independent from one another.

Let $\hat{s}_{ij}$ denote the jth diagonal element of $\widehat{Var(C_i)}$, i.e. the expected variance of the estimated coefficient c_{ij} in matrix C. The variance for the prior on c_{ij} is assumed to be,

$$v_{ij} = \nu_{ij} c_{ij} \tag{11}$$

where ν_{ij} is a tightening parameter. Following Baumeister and Hamilton (2015), I assume tighter priors for lags further in the past. Let l denote the lag length associated with the explanatory variable multiplying c_{ij}. I calibrate ν_{ij} according to,

$$\nu_{ij} = \left\{ \begin{array}{ll} l^{-2\lambda} & \text{for explanatory variables } z_j \text{ associated with lagged variables at length } l \\ 10 & \text{for explanatory variables } z_j \text{ associated with the intercept or time trend,} \end{array} \right\} \tag{12}$$

where the parameter λ can be adjusted to widen or tighten the priors on lags greater than one. I use $\lambda = 0.2$.

Let V_i be a diagonal matrix with each diagonal element j given by v_{ij} in equation (11). The variance of the priors associated with the ith row of the structural matrix, B, is given by $A_0 V_i A_0^{-1}$.

I estimate eight structural VARs using this procedure, one for each of the fiscal variables considered. Given the prior distributions, and quarterly data for all the variables from 1982 Q1 through 2020 Q4, I run a Metropolis Hastings Markov Chain to generate 1,000,000 draws from the posterior distributions. I use the simulations to generate impulse response functions which I describe in the next section.

4 Results

4.1 Impact of Fiscal Policy

Figure 12 shows the impulse response functions for shocks to each of the eight fiscal policy variables on each of the three labor income quartiles. The results show the impact of a \$100 expansionary shock to each of the fiscal variables. The shock is positive for government expenditures and transfer payments, and negative for taxes, therefore representing an expansionary tax cut.

The results reveal that some fiscal policies have more impact on labor income than others. Positive shocks to government investment are shown to have exceptionally large effects on labor income and are quite long lasting. The impact is largest for the highest quartile earners. Similarly,

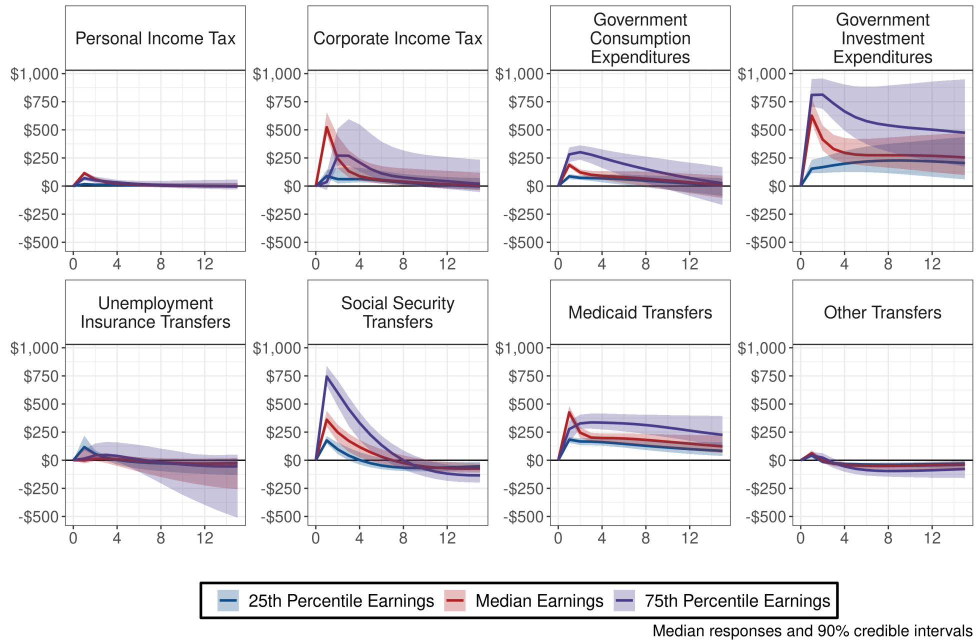


Figure 12: Impact of $100 Expansionary Fiscal Shocks for each Income Quantile

shocks to social security transfers have large effects on labor earnings, and again the impact is largest for top earners. While social security transfers directly assist its recipients, this is not what is being captured in the impulse response functions. The impact is on labor market earnings, but many recipients are not in the labor force because they are retired or disabled. But their additional expenditures boosts demand for final goods and services, which may increase labor demand, and therefore labor market earnings.

Government consumption expenditures also have a positive effect on labor earnings, but smaller than government investment expenditures, and most of the benefit goes to middle and upper income workers.

Personal tax cuts have relatively small multiplier effects across the labor income distribution. Interestingly, corporate income tax cuts have fairly large positive effects on labor market earnings, but only for the middle and upper end of the labor income distribution. Still, for all quartiles of the labor income distribution, corporate tax cuts have had more stimulative effect than personal tax cuts.

Unemployment benefits have little effect on labor market earnings. This is somewhat expected, as the unemployment benefits are not intended to help people that are working and earning labor income, but to people not working and earning zero income. The benefits are only paid when earning zero income. Like with the social security benefits shock, the impulse response function does not illustrate the impact to the population directly targeted, but rather the multiplier benefits to the rest of the labor market distribution.

The effects for the first year are small and non-negative. Interestingly, the effect is positive and largest for the lowest income workers. There are potentially two offsetting effects at play from an increase in unemployment benefits. The first is a Keynesian expenditure multiplier effect, where people receiving unemployment benefits increase their expenditures leading to an increase in demand for goods and services, and therefore an increase in demand for labor, resulting in an increase in labor income. This likely happens for goods and services that are necessities. The other possible effect is a disincentive to put forward effort to find another job. Unemployed people are part of the labor force and so their zero level of labor income is used in calculating the quartiles. If unemployment benefits create a prolonged incentive to remain unemployed, we would see larger proportions of the labor force earning zero income, which would move the 25th percentile labor income downward. The impact for the 25th percentile earnings is positive, suggesting that any disincentives to finding employment that are created by providing unemployment benefits are more than offset by the stimulative Keynesian expenditure multiplier effect.

Interestingly, the impact of an increase in "other social benefits" transfers are very small and turn negative within a year. Figure 4 shows were significant increases in this category of transfers in the 2008 and 2020 recessions.

Since different fiscal policies have different effects at lower versus upper ends of the income distribution, they differ too in the impact they have on income inequality. Figure 13 shows the differences in the impulse responses to the 75th percentile versus the 25th percentile. Positive responses indicate that the positive impact was larger for the upper level versus the lower level, and therefore the fiscal policy had the effect of widening the income gap.

The figure reveals that most fiscal policies worsen labor income inequality, at least temporarily. The most impactful fiscal policies also had the worst effects on the income gap. Expansionary shocks to government investment expenditures and Social Security transfers were most beneficial for all income quartiles. However, the impact was greatest at the highest ends, so these fiscal policies still worsen income inequality. Only increases to unemployment benefits lead to decreases in income inequality. Other social benefits transfers have minimal impact on income inequality.

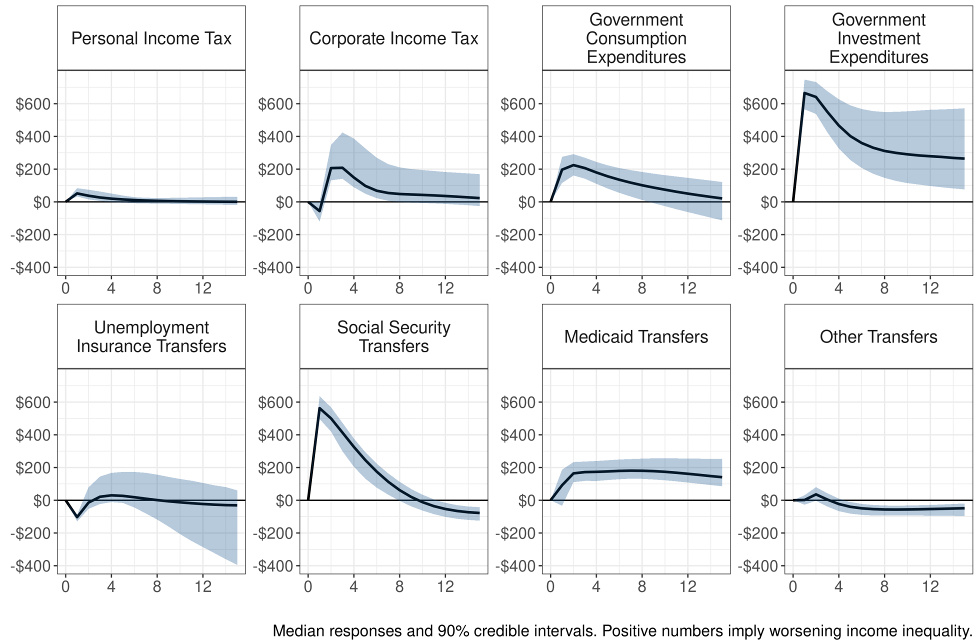


Figure 13: Impact of $100 Expansionary Fiscal Shocks on Income Gap

4.2 Fiscal Policy Behavior

To gauge the behavior of fiscal policy in response to the business cycle, I construct impulse response functions of each of the fiscal policy variables in response to labor income shocks at each income quartile. To view in the context of recessionary shocks, I shock each labor income variable by -$100. Figure 14 shows the result. The different colors are associated with shocks to different quartiles of the labor income distribution, and each panel shows the response of a different fiscal policy. Larger responses are indications that the variable is more highly used as an automatic or discretionary stabilizer.

Not surprisingly, personal income taxes are highly counter-cyclical. When labor income falls, so does personal tax liability, and so personal income taxes fall. The largest decreases in tax revenues happen with negative shocks at the lowest end of the income distribution. Corporate income taxes also fall, but the effect is very small.

Government consumption expenditures show very little response to a recessionary shock to income. There is an initial small increase in expenditures and the effect dies out quickly. Interestingly the response is largest in response to a shock at the lowest income level. The response to government investment expenditures is almost zero. It is interesting that the fiscal policy shown to be most

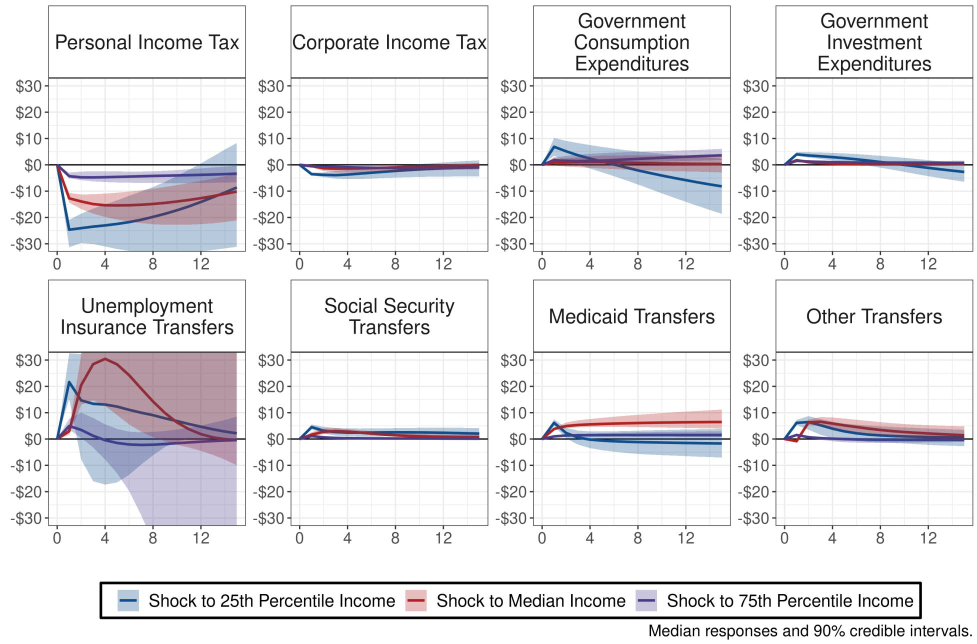


Figure 14: Fiscal Responses to $100 Negative Income Shocks at Each Quantile

impactful for stimulating labor market income is also used very little as a business cycle stabilizer.

Despite the countercyclical scatterplots shown earlier in Figure 5, Social Security, Medicaid, and other social benefits transfer payments have small and short-lived positive responses to decreases in income. The responses are larger for decreases in income at the 25th and 50th percentiles.

4.3 Distributional Effects of Labor Income Shocks

Finally, I turn to look at the impact that labor income shocks at each quartile can have on the other labor market income quartiles. There are multiple reasons that a unique shock to only one quartile of the labor market distribution should affect the other labor income quartiles. The first is a Keynesian expenditure multiplier effect. An increase in income should lead to an increase in demand for goods and services, and therefore an increase in labor demand. Secondly, fiscal and monetary policy may respond. An expansionary shock at one end of the income distribution can lead to fiscal and monetary policy contractions, potentially leading to a decrease in income for the earners at the other quartiles that did not experience a positive income shock.

Figure 15 shows the impact of a positive $100 shock to labor income at each quartile for each of the other income quartiles. The plots along the diagonal represent the impact of the shock to the variable on itself, and as expected show income increasing and gradually returning to previous

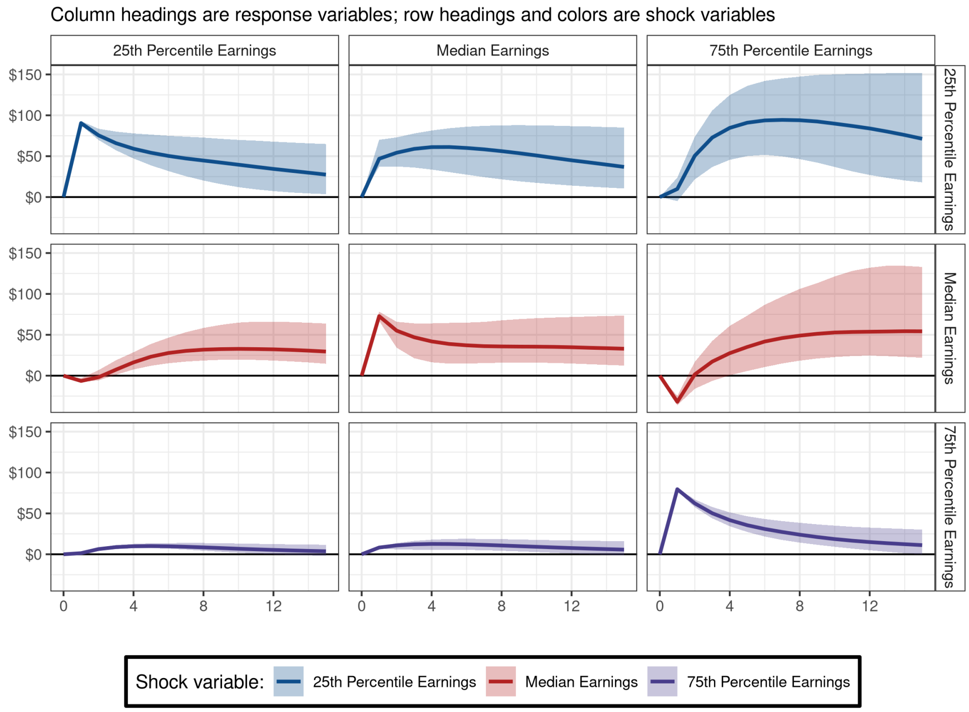


Figure 15: Impact of $100 Expansionary Shocks to Income Quantiles

levels.

The top three plots in Figure 15 show the impact of a unique positive shock to income at the lowest quartile. Improving the situation of the lowest end of the income distribution leads to an improvement for all income earners.

The same cannot be said for a unique positive shock to labor income at the top quartile. This benefits mostly the people at the top quartile. There are relatively very small positive increases in labor income at the first and second quartiles. As a result, positive labor income shocks at the top of the distribution tend to worsen labor income inequality.

5 Conclusion

I show visual evidence that recessions tend to to have a larger contractionary effect the lower end of the labor income distribution and lead to worsening inequality that takes years to recover from. Even economic recovery is asymmetric. Earners at the lower end of the income distribution experience delays in beginning recovery and recovery takes longer.

Given the asymmetric effect recessions have, this paper examines whether there is asymmetry in fiscal policy actions and impact. Using a structural VAR, this paper estimates fiscal policy behavior and the impact on labor income at the lower quartile, median, and upper quartile, focusing on eight fiscal policy variables, including corporate tax receipts, personal tax receipts, government consumption, government investment, and four transfer payments including unemployment benefits, social security benefits, Medicaid payments, and other social benefit payments.

I find the most effective fiscal policies for stimulating labor income are the least responsive to the business cycle. Furthermore, the fiscal policies most effective for stimulating income at the lowest quartile are also highly effective for stimulating income at the highest income quartile, and so also have the effect of worsening income inequality. Expansion to unemployment benefits are shown to have small positive impacts to labor market earnings, leading to the conclusion that Keynesian multiplier effects from extending unemployment benefits outweigh any work disincentive effects.

Finally, I find unique positive shocks to labor market earnings at the lowest quartile lead to as large increases in labor income across all income quartiles. The same is not true at the higher end. Unique positive shocks to labor market earnings at the highest quartile primarily only benefit those at the highest quartile.

Taken altogether, recessions, recoveries, and even most fiscal policy responses to recessions tend to worsen income inequality. The paper identifies fiscal policies that can most effective for stimulating the economy and most effective specifically for the lowest income earners.

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