Finance and Economics Discussion Series
Divisions of Research & Statistics and Monetary Affairs
Federal Reserve Board, Washington, D.C.

Fiscal Policy and Aggregate Demand in the U.S. Before, During and Following the Great Recession

David Cashin, Jamie Lenney, Byron Lutz, and William Peterman

2017-061

Please cite this paper as:
Cashin, David, Jamie Lenney, Byron Lutz, and William Peterman (2017). "Fiscal Policy and Aggregate Demand in the U.S. Before, During and Following the Great Recession," Finance and Economics Discussion Series 2017-061. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2017.061.

Fiscal Policy and Aggregate Demand in the U.S. Before, During and Following the Great Recession

David Cashin, Jamie Lenney, Byron Lutz and William Peterman

Board of Governors of the Federal Reserve

April 14th 2017

Abstract

We examine the effect of federal and subnational fiscal policy on aggregate demand in the U.S. by introducing the fiscal effect (FE) measure. FE can be decomposed into three components. Discretionary FE quantifies the effect of discretionary or legislated policy changes on aggregate demand. Cyclical FE captures the effect of the automatic stabilizers—changes in government taxes and spending arising from the business cycle. Residual FE measures the effect of all changes in government revenues and outlays which cannot be categorized as either discretionary or cyclical; for example, it captures the effect of the secular increase in entitlement program spending due to the aging of the population. We use FE to examine the contribution of fiscal policy to growth in real GDP over the course of the Great Recession and current expansion. We compare this contribution to the contributions to growth in aggregate demand made by fiscal policy over past business cycles. In doing so, we highlight that the relatively strong support of government policy to GDP growth during the Great Recession was followed by a historically weak contribution over the course of the current expansion.

Introduction

Changes in government spending and taxes can have significant effects on economic growth over the course of the business cycle: Government outlays are often increased in the wake of an economic slowdown in an explicit attempt to buttress economic activity, and taxes and transfer programs (e.g. unemployment insurance) dampen swings in output by automatically expanding and contracting over the course of the cycle. In this paper, we develop a new measure, Fiscal Effect (FE), to precisely quantify the direct effect of changes in government spending and taxes on aggregate demand; as such, it can be viewed as measuring the overall stance of fiscal policy at any given time.

Our analysis focuses primarily on the period during and following the Great Recession. Precisely quantifying the stance of fiscal policy over this period is important given the magnitude of the fiscal stimulus enacted in the wake of the severe economic downturn and the period of fiscal consolidation which followed several years later. Moreover, with monetary policy constrained by the zero lower bound over this time span, activist fiscal policy was arguably necessary for the U.S. economy to achieve potential levels of output and employment (e.g. Ball, DeLong, and Summers 2014; Bernanke, 2014). Looking forward, FE is likely to remain highly relevant. In particular, if equilibrium interest rates remain low by historical standards, monetary policy may again be constrained by the zero lower bound in the future (Laubach and Williams, 2016). Accordingly, fiscal policy may have a crucial role to play in attaining full employment following future economic downturns.

In terms of methodology, FE is a bottom–up approach that involves developing a measure that aggregates each major type of fiscal policy—for example, a discretionary cut in personal taxes or a cyclical increase in unemployment insurance claims—into a single fiscal indicator that quantifies the first-round, or direct, contribution to growth in real GDP coming from *changes* in spending and revenue. To construct it, we first decompose all changes in government spending and revenue into discretionary, cyclical, and residual components.[1] The federal discretionary component is estimated relying primarily on the detailed collection of legislative budgetary scoring by organizations such as the Congressional Budget Office (CBO).

[1] The term discretionary should not be confused with discretionary spending consistent with the federal government's unified budget accounting. For example, a legislated change to a mandatory spending program such as OASDI would be scored as a discretionary policy change under the FE measure.

For the subnational discretionary component, we use the NIPA-based measures of discretionary policy change developed in Follette and Lutz (2010). The cyclical component is constructed by developing measures of how tax and transfer programs systematically respond to the business cycle. For instance, it captures the decline in tax receipts induced by a recession. The residual component captures changes related to neither discretionary policy changes nor the business cycle, such as the secular increase in transfer payments due to the aging of the population.[2] With estimates of all fiscal policy changes in hand, we then quantify the effect of these changes on real GDP growth. We do so using guidance from the extensive empirical literature on the response of households and businesses to fiscal policy changes and the FRB/US macro model maintained by the staff of the Federal Reserve Board.

FE is arguably the most detailed and comprehensive measure available of the stance of U.S. fiscal policy in relation to aggregate demand. It is related to the Fiscal Impetus (FI) measure that previous research has used to quantify the effect of discretionary government policy actions on aggregate demand growth (e.g. Follette and Lutz, 2011).[3] Relative to FI and other fiscal policy metrics such as cyclically-adjusted budget deficits, FE has several advantages. For one, it is significantly broader than many other metrics as it captures almost all types of fiscal policy actions and provides a decomposition into the discretionary, cyclical, and residual components. Moreover, it also includes all levels of government, including the states and localities, whereas many measures capture only the federal government. Another advantage is that FE is constructed in a bottom-up fashion, which incorporates fine-grained detail on legislative budget actions over time and allows for differential responses of households and businesses to different types of fiscal policies.

Over the period 1970-2015, we find that changes in government spending and taxes boosted growth in real GDP by approximately 0.3 percentage point annually on average.[4] Moreover, FE has a clear counter-cyclical pattern, as changes in outlays and receipts boosted aggregate demand by 1½ percentage points during contractions, which was more or less evenly divided between discretionary policy actions and the impact of cyclical changes in taxes and

[2] The residual component can also capture measurement errors in the discretionary and cyclical components.
[3] In these past papers, the measure was termed Fiscal Impetus (FI). Discretionary FE and FI are equivalent, save for the change in terminology. Total FE is a broader concept than FI, as it captures the effect of cyclical and residual changes in taxes and spending in addition to discretionary changes.
[4] Growth in total U.S. GDP averaged 2¾ percent over the same period.

transfers. Relative to the FI measure documented in previous research, we observe several periods for which the broader FE measure diverges significantly (e.g. the mid- to late-1990s). As such, there are periods where the FI measure indicates fiscal policy provided a boost to aggregate demand, whereas FE indicates a fiscal drag (or vice versa).

We also find that FE during the Great Recession and subsequent recovery differed markedly from previous contractions and expansions. Our estimate of FE indicates historically large contributions of fiscal policy to aggregate demand during the Great Recession. In contrast, we estimate FE to be negative in the years following the Great Recession, whereas it had been positive on average during prior expansions. Specifically, we find that FE over this period fell short of its historic norm by ¾ percentage point of GDP. The unusual restraint from policy was primarily due to discretionary policy actions. These estimates can be seen as providing precise empirical grounding for the claim that fiscal policy was not playing its typical role during this period and contributed to the unusually sluggish expansion (Bernanke, 2014). In order to provide a rough, but easily interpreted, sense of the tradeoff involved in the historically weak contribution of fiscal policy to aggregate demand during this time frame, we provide a counterfactual exercise: Under the assumption that FE during the recovery (through mid-2015) had equaled its average during previous expansions, we show that GDP growth would have been 0.6 percentage points higher per year on average, while the debt-to-GDP ratio would be six percentage points higher (as of mid-2015).

The paper is structured as follows. The next section outlines our methodology for FE, discusses limitations and uncertainty associated with FE, and provides a comparison of FE with other measures of fiscal policy such as narrative-based measures of fiscal policy change (e.g. Romer and Romer 2010). The following section presents the results and the final section concludes.

Methodology

FE captures the effect of fiscal policy on aggregate demand at all levels of government, including federal, state, and local, and is based upon estimates of quarterly government revenues and expenditures in the National Income and Product Accounts (NIPA). FE is a partial equilibrium concept. By design, it only accounts for the direct, or first-round change in aggregate demand arising from fiscal policy. In particular, it does not account for follow-on, or

multiplier, aggregate demand effects that may result from the first-round changes in aggregate demand, monetary policy responses or general equilibrium effects such as supply-side reactions (e.g. labor supply adjustments caused by a tax change). The FE methodology draws heavily from past work on discretionary fiscal effects of Follette and Lutz (2011) and Follette, Kusko, and Lutz (2008), as well as work on the cyclical component of fiscal policy changes discussed in Cohen and Follette (1999) and Follette and Lutz (2010).

FE is constructed in three stages. First, we decompose the total quarterly change in taxes, transfers, and government purchases into discretionary, cyclical, and residual components. Second, we estimate the effect of these changes in outlays and revenues on aggregate demand. To do so, we must make assumptions with respect to both the magnitude and timing of the effect. We develop these assumptions using guidance from the FRB/US model and from empirical research about the response of consumers and businesses to changes in fiscal policy.[5] Thus, FE is model dependent; different modeling approaches might incorporate different behavioral responses which would result in different estimates of FE. Third, we aggregate the effects from the second step into a single measure.

Before discussing the specifics of the methodology, it is helpful to provide a precise statement of the counterfactual baselines implicitly used to define each of the components of FE. Discretionary FE can be viewed as estimating the effect of a discretionary – or legislated – change in government policy (e.g. a personal income tax cut) on aggregate demand versus a counterfactual in which the change in discretionary policy did not occur; cyclical FE as estimating the effect on aggregate demand of a cyclical swing in outlays and revenues against a counterfactual in which outlays and revenues do not respond to the business cycle; and finally, residual FE can be viewed as estimating the effect on aggregate demand of a change in real revenues and outlays not attributable to either discretionary actions or to swings in the business cycle against a counterfactual in which these residual changes did not occur. For instance, the secular increase in Social Security payments due to the aging of the population is captured by residual FE. In this case, the counterfactual is constant real outlays for Social Security – e.g. outlays which are not influenced by the aging of the population. Finally, total FE can be viewed as estimating the effect of the real change in expenditures and revenues against a counterfactual of no change in real outlays or real receipts.

[5] For information on the FRB/US model, see Brayton, Laubach and Reifschneider (2014) and the references therein.

Decomposing Changes in Taxes and Non-Interest Spending

The first step in estimating FE is to decompose quarterly changes in real outlays and revenues into their discretionary, cyclical, and residual pieces. Any measurement error in estimating the discretionary or cyclical component will generally appear as part of the residual.

Discretionary Fiscal Policy Changes

Starting with government purchases, we consider all changes in real purchases to be discretionary. As the purchase of goods and services by governments is generally controlled by an annual, discretionary appropriations process, this is a straightforward assumption.

The calculation for tax and transfer series is more involved. Discretionary tax and transfer changes at the national level are estimated using a wide variety of sources, including the scoring estimates of legislation by the CBO and Joint Committee on Taxation (JCT), as well as estimates constructed by the BEA. For instance, if Congress legislates a change in the tax code, the JCT produces estimates of the expected change in tax revenue.[6] At the subnational level, we use the data collected by the National Association of State Budget Officers (NASBO) to measure state government discretionary revenue changes. We lack data sources for discretionary changes in either local revenues or for state or local transfer expenditures; instead, we use the NIPA-based measures of discretionary policy change developed in Follette and Lutz (2010) for these revenues and outlays. For instance, with regard to property taxes, our policy indicator is the ratio of NIPA property tax receipts to nominal potential GDP, which we dub the effective property tax rate. When this effective tax rate is constant from one year to the next, policy is defined as being constant. Movements in the effective tax rate are interpreted as changes in discretionary policy.[7]

[6] There is both an art and science aspect of constructing these estimates from a number of sources. First, JCT reports fiscal year estimates of the policy changes on a unified budget basis. We create seasonally-adjusted quarterly figures from these estimates. In addition, we look at BEA estimates that are, in part, based on information provided by the OMB and the Treasury to create their seasonally-adjusted quarterly figures. Sometimes BEA reports the policy effect embedded in its estimates and we will use those figures. Also, we examine IRS tax data to adjust the original JCT/OMB estimates. For some spending programs such as Emergency Unemployment Compensation benefits, or the initial years of Medicare Part D, we sometimes use actual budget data or BEA's estimates.

[7] Movements in the effective tax rate generally reflect localities making adjustments to their statutory tax rates or a change in average property assessments which differs from the rate of overall inflation (as measured by the GDP price index). Accordingly, when property values increase rapidly and local governments do not offset the increase with a decrease in the statutory tax rate, we score the change in revenue as a policy-induced tax increase.

Cyclical Fiscal Policy Changes

To identify changes in government revenues and expenditures which occur as a result of the business cycle – the so-called automatic stabilizers – we use the high-employment budget framework. Our implementation is based on the methodology developed for the federal budget by Frank de Leeuw et al (1980), refined by Cohen and Follette (1999) and Follette and Lutz (2010), and subsequently applied to the state and local sector by Knight, Kusko, and Rubin (2003), as well as Follette, Kusko, and Lutz (2008). It is quite similar to the high-employment methodology currently used by the CBO to produce cyclically-adjusted federal budget deficit estimates – i.e. the deficit that would prevail given current policy if GDP equaled its potential (Russek and Kowalewski, 2015). Here we provide an overview of our high-employment approach and refer those interested in additional details to the above works.[8]

We estimate the size of the cyclical response for the following categories of federal receipts: personal and corporate income taxes, FICA (i.e. Social Security and Medicare payroll tax), SECA (i.e. Social Security and Medicare self-employed tax), production and import taxes, and unemployment insurance taxes. At the state and local level, we estimate cyclical responses for personal and corporate income taxes and sales taxes. Property taxes are assumed to have no cyclical component.[9]

In nearly all cases, we identify the cyclical component of receipts using a three-step process: [10]

i. The ratio of each NIPA tax base, B_t, to CBO's measure of potential GDP, $POTGDP_t$ (where *t* indexes quarter), is estimated as a function of a time trend and the GDP Gap:

[8] Hines (2010) also explores the cyclical response of federal, state, and local revenues and expenditures using NIPA data. The conclusions reached are broadly similar to those produced by the methodology used in this paper (and presented in Follette and Lutz 2010). Hines (2010) further explores heterogeneity in the cyclical response of state governments.

[9] Property tax collections are sensitive to movements in the market value of housing, albeit with a significant lag (Lutz 2008). At a national level, the market value of housing has typically not displayed strong evidence of cyclicality (at least prior to the housing boom and bust of the 2000s). Thus, we consider the property tax to be acyclical. See Lutz, Molloy, and Shan (2011) for evidence on the response of property tax receipts to the housing boom and bust of the 2000s.

[10] Unemployment insurance, production (excise), and import taxes follow a different process (see Russek and Kowalewski, 2015).

$$\frac{B_t}{POTGDP_t} = c + \alpha_t + \sum_{j=0}^{4} \beta_j GDPGAP_{t-j} + \varepsilon_t \quad (1)$$

where $GDPGAP = \frac{POTGDP-GDP}{POTGDP}$ and α_t is a linear time trend which varies by business cycle. Estimates of β_j for each tax base are shown in table 1.

ii. The cyclically-adjusted base, B_t^C, is then estimated as:

$$B_t^C = POTGDP_t \left(\frac{B_t}{POTGDP_t} - \sum_{j=0}^{4} \beta_j GDPGAP_{t-j}\right) \quad (2)$$

iii. Finally, cyclically-adjusted tax receipts are estimated by applying the elasticity of tax receipts with respect to the tax base, δ_t, to the difference in the observed and cyclically-adjusted base and multiplying by observed NIPA receipts R_t:

$$R_t^C = R_t \cdot e^{\delta_t \left(\ln \frac{B_t^C}{B_t}\right)} \quad (3)$$

The elasticity δ_t is defined as the product of two separate elasticities: the elasticity of tax receipts with respect to changes in taxable income, δ_{tr}, and the elasticity of taxable income with respect to the NIPA tax base, δ_{tu}, that captures the fact that the IRS measure of personal income deviates from the NIPA-based measure in a cyclical fashion. To estimate these elasticities, we follow Cohen and Follette (1999) for federal receipts and Follette and Lutz (2011) in the case of state and local receipts. In general, we do not estimate δ_t using simple time-series regressions because movements in tax receipts include frequent and sometimes substantial policy changes. Rather, we take a more nuanced approach and construct the tax elasticities using detailed information about the tax code, its changes over time, and a variety of auxiliary regressions. In order to provide an example, the procedure for estimating δ_t in the case of federal personal income taxes—the largest of the automatic stabilizers—is detailed in the appendix. Table 2 details the average values for these elasticities over the period 1970-2015.

Table 1: Estimates β_j of sensitivity of tax base to the business cycle

Base	GDP GAP				
	t	t-1	t-2	t-3	t-4
Wages & Salaries	-0.2771	-0.1630	-0.0172	-0.0202	-0.1912
Proprieters Income	-0.1249	0.0101	-0.0029	-0.0547	0.0442
Rental Income	0.0122	0.0041	-0.0074	-0.0008	0.0384
Dividend Income	-0.0471	-0.0279	-0.0121	0.0219	0.0065
Interest Income	0.0293	-0.0514	-0.0211	-0.0174	-0.0764
Corporate Profits	-0.6066	0.2677	0.0906	-0.0161	0.3354

Note: Data sourced from BEA and fit over period 1960-2015. The time-weighted averaged is displayed. The corporate profits coefficient is time-varying with breaks at 1986 and 2005. Wages and salaries coefficient is time-varying with break at 1986. Dividend income is time-varying with break at 1995. Corporate profits excludes Federal Reserve net income and Rest of the World.

Table 2: Elasticity of cyclically-sensitive taxes to their base

Tax		NIPA Base	Average Elasticity (δ)		
			Tax Base to NIPA (u)	Taxes to Tax Base (r)	Total
Federal	Personal	Personal Income*	1.06	1.53	1.61
	Corporate	Corporate Profits	0.82	1.00	0.82
	FICA	Wages and Salaries	0.84	1.00	0.84
	SECA	Proprieters Income	0.87	1.00	0.87
	Production and Import	GDP	1.00	1.00	1.00
State and Local	Personal	Personal Income*	1.06	1.28	1.36
	Corporate	Corporate Profits	0.82	1.00	0.82
	Sales	Personal Consumption	1.00	1.00	1.00

* The personal income tax base is equal to the sum of wages/salaries, single proprietor's income, dividend income, rental income, and interest income. Average elasticities are calculated over the period 1970 to 2015.

Cyclical transfers, which are generally much smaller in absolute value than cyclical receipts, are calculated as a function of changes in the unemployment rate. Based on our estimates for the period 1970 to 2015, 60 percent of the cyclical component of government transfers is due to federal unemployment insurance. Cyclically-adjusted unemployment insurance is derived according to the following process:

i. The change in the ratio of non-discretionary unemployment benefits, UI, to potential wages and salaries, POTWS , is estimated as: [11,12]

$$\Delta \frac{UI}{POTWS} = c + \sum_{j=0}^{3} \beta_j \Delta URGAP_{t-j} + \varepsilon_t \quad (4)$$

where $URGAP = UR - POTUR$ is the difference between the Bureau of Labor Statistics' Unemployment Rate and CBO's measure of the natural rate of unemployment. The cyclically-adjusted level of unemployment insurance, UI_t^C, is then estimated as:

$$UI_t^C = POTWS_t \left(\frac{UI_t}{POTWS_t} - \sum_{j=0}^{3} \beta_j URGAP_{t-j} \right) \quad (5)$$

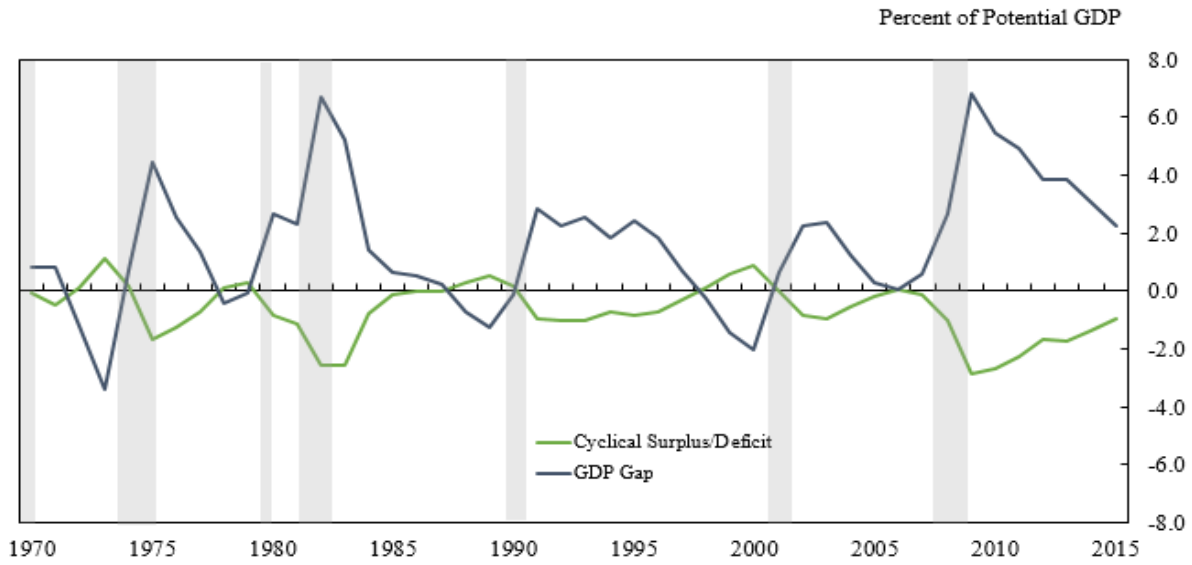
where β = {0.143,0.085,0.022,-0.122} after 1984 and β = {0.198,0.127,0.061,-0.090} before.[13]

The estimation for food stamps (SNAP) and Federal Medicaid also follows the procedure detailed above with β = {0.027, 0.006, 0.003, 0.0129} for SNAP and β = {0.31,-0.138} for Federal Medicaid grants. All other transfer programs such as Social Security and Medicare display little cyclicality and are therefore assumed to be acyclical.

Figure 1 plots the cyclical deficit—the cyclical portion of revenues minus the cyclical portion of expenditures—over the period 1970-2015. The cyclical deficit moves counter to the GDP gap and the relationship is fairly tight. Overall, on average for every 1 percent increase in the GDP Gap, there is an increase of 0.42 percentage points in the cyclical deficit of the government sector as a percent of potential GDP.[14]

[11] Potential wages and salaries are calculated using equation (2) and the coefficients from Table 1.
[12] Emergency Unemployment Compensation (EUC) benefits are excluded from our calculation of cyclical UI because they are set on a discretionary basis and are therefore scored as a discretionary change in fiscal policy. The tiny, permanent extended UI benefits are included in the cyclical portion.
[13] Many states increased employer taxes and some tightened benefit eligibility and disqualification provisions in efforts to maintain or restore the solvency of their unemployment insurance programs in the wake of the early 1980's recessions.
[14] Based on regressing the GDP Gap on the Cyclical Deficit over the period 1970-2015.

Figure 1: Cyclical Deficit



Note: Cyclical Deficit is the cyclical portion of tax collections in each year minus the cyclical portion of transfers in each year as a percent of Potential GDP

Residual Fiscal Policy Changes

The residual change in taxes is calculated as simply the difference between the total change in taxes and the sum of the discretionary change in taxes and the cyclical change in taxes. The residual change in purchases and transfers are calculated in the same manner.

Response to Fiscal Policy Changes

After decomposing the fiscal policy changes, it is necessary to determine their effect – both the magnitude and timing – on aggregate demand. We calculate this effect by applying estimates of the marginal propensity to consume (MPC) of households and businesses to the revenue and expenditure changes calculated in the first stage of the FE procedure. These estimates are discussed in the following subsections and are displayed in Table 3.

Before embarking on this discussion, however, a few general points about our MPC estimates should be made. First, the estimates are informed by FRB/US, a macroeconomic model used by the Federal Reserve Board staff, and the relevant empirical literature including macro time-series and microeconometric studies. Second, the MPCs are allowed to vary across each major type of revenue and outlay, as well as the type of fiscal policy change. For instance, a discretionary change in personal income taxes and a cyclical change in transfer payments have

specific MPCs assigned. Third, we also distinguish between temporary and permanent fiscal policy changes. We assign MPCs to permanent fiscal policy changes that are at least as large as the MPCs assigned to temporary changes (see Jappelli and Pistaferri, 2010). Fourth, we assume that consumers and businesses respond to a change in fiscal policy when it is realized, not when it is announced (see Poterba, 1988).[15] Related to this assumption, we allow for considerable lags following implementation of a fiscal policy change before consumers fully adjust their spending, which is consistent with time-series evidence and is often attributed to a combination of habit persistence, myopia, and rule-of-thumb behavior (see Davis and Palumbo, 2001; Mankiw 2000; Campbell and Mankiw, 1989).[16] Finally, despite our reliance on the FRB/US model and existing empirical literature, considerable uncertainty remains over the appropriate MPC to apply to each type of fiscal policy change. As a result, we examine the sensitivity of our FE estimates to alternative MPC choices in the Appendix.

MPCs for Discretionary Policy Changes

We assume that changes in government purchases affect aggregate demand on a one-for-one basis and hence have an MPC of 1: a $1 million increase in purchases immediately boosts demand by $1 million. This assumption is consistent with the BEA's accounting of government purchases in which a change in government purchases maps one-for-one into a change in GDP in the NIPA accounts. However, it is worth noting that the initial increase in demand could be met out of inventories and the actual increase in GDP may be smaller than that of purchases.

[15] It is our judgment that the empirical literature finds relatively little support for quantitatively important announcement effects on aggregate demand. Poterba (1988) and Watanabe et al. (2001) examine consumption responses to several U.S. and Japanese tax policy changes, respectively, and find little evidence that consumption responded to announcement of the policy changes. Furthermore, the consumption literature generally finds that consumers respond to changes in disposable income when the changes occur, even when the changes were predictable (e.g. Wilcox 1999, Shea 1995, Stephens 2008; see Jappelli and Pistaferri 2010 for a review). Many of these studies which conclude that consumption responds to changes in disposable income exploit tax changes – e.g. Shapiro and Slemrod (1995); Parker (1999); Souleles (1999); Johnson, Parker, and Souleles (2006); Agarwal, Liu and Souleles (2007); Johnson, Parker, Souleles, and McClelland (2013); and Broda and Parker (2014). Moreover, the recent literature on fiscal multipliers has tended to find that output responds to a tax change at the time of implementation, but not at the time of announcement (e.g. Romer and Romer 2010 and Perotti 2012).

[16] Alternatively, there is some empirical support for a more rapid response. In a comment on Davis and Palumbo (2001), Lettau, Ludvigson, and Barczi (2001) employ a different statistical methodology and obtain results that suggest consumption responds to movements in wealth and income not over periods of many quarters, but rather within roughly one quarter.

For discretionary permanent personal income tax changes, we use an MPC of -0.7 phased in over two years following the tax policy change.[17] Thus, a $1 billion personal income tax cut—which increases the disposable income of households—would be scored as boosting the level of GDP by $700 million by the end of two years. Our choice is broadly consistent not only with the dynamic MPCs generated by FRB/US (see Appendix Table A.1), but also the evidence from time-series macroeconometric studies (e.g. Davis and Palumbo, 2001) and microeconometric studies (see Jappelli and Pistaferri [2010] for a review).[18] Nonetheless, because standard theory predicts an MPC out of a permanent income shock of 1 and a few studies using non-U.S. data estimate an MPC out of a permanent income shock of 1, we test the sensitivity of our results to an MPC of 1 in the Appendix.[19]

For temporary personal income tax changes, such as a one-time income tax rebate, we choose an MPC of -0.5. This choice is a midpoint for the evidence presented in recent studies. Johnson et al. (2006) and Parker et al. (2013) find that the MPC out of the 2001 and 2008 income tax rebates was -0.1 to -0.4 for nondurable goods and services. However, when durable spending is included, Parker et al. (2013) find that the MPC was between -0.5 and -0.9. Because durables are a component of personal consumption expenditures, it seems prudent to choose an MPC that takes them into account. Hence, we choose a baseline MPC of -0.5.[20]

Our baseline MPC out of permanent corporate income tax changes is -0.5; it captures a business investment response and a household consumption response which reflects a stock market wealth effect. It is worth noting there is a considerable amount of uncertainty over this MPC choice due to a lack of consensus over the effects of taxation on corporate finance and investment decisions, as well as the extent to which corporate tax changes are capitalized into stock valuations.

---

[17] For discretionary changes in property and sales taxes, we use the same MPCs that we chose for personal income tax changes. Note that the MPC is negative because a tax increase should reduce consumption, and vice versa.
[18] Jappelli and Pistaferri's (2010) survey highlights two studies in particular – Pistaferri (2001) and Blundell et al. (2008) – that find the MPC out of a permanent income shock is roughly 0.7.
[19] Using Italian household survey data, Jappelli and Pistaferri (2006, 2008) find the MPC out of a permanent income shock is approximately 1. Cashin and Unayama (2016) exploit an unanticipated VAT rate increase in Japan and find that household consumption fell in proportion to this particular permanent income shock upon its announcement.
[20] However, given that most estimates from the literature focus on non-durables only and find MPC estimates smaller than 0.5 (e.g. Poterba, 1988; Sahm et al. 2010), and the fact that the FRB/US estimate of the MPC out of a transitory personal income tax shock is close to zero, we examined the sensitivity of our FE results to a smaller MPC out of temporary tax changes of 0.25 (not shown). The effect on our FE estimates was trivial.

Starting with the investment response to a corporate tax change, in his survey of the literature on the effects of taxation on corporate finance and investment decisions, Sinn (1991) shows that if the marginal dollar of investment is derived from new equity issuance, then investment should respond positively to a reduction in the corporate tax rate (known as the "old" view). And indeed, several studies (e.g. Cummins, Hassett, and Hubbard, 1994) have found that changes in tax policy have a strong effect on investment. In their survey of the extant empirical literature, Hassett and Hubbard (2002) conclude that the elasticity of investment with respect to the user cost of capital (which is a positive function of corporate tax rates) is between -0.5 and -1. On the other hand, Sinn (1991) demonstrates that investment should be neutral with respect to corporate tax changes if debt is the marginal source of finance and nearly neutral if retained earnings are the marginal source of finance (the "new" view). Several studies accord with this view as well. Chirinko, Fazzari, and Meyer (1999), who use microdata similar to Cummins et al. (1994) but employ a different empirical approach, find a much smaller elasticity of investment with respect to the user cost of capital (-0.25) and conclude that cutting corporate tax rates would have a trivial effect on the long-run capital stock. More recently, Yagan (2015) tests whether the 2003 dividend tax cut stimulated corporate investment by comparing the investment responses of C-corporations to S-corporations, the latter of which are not subject to dividend taxation. He finds no evidence of a differential response for C-corporations despite the fact that the tax cut was one of the largest reforms ever to a U.S. capital tax rate. Given the clear lack of consensus in the corporate tax literature over the marginal source of finance, and in turn, the sensitivity of investment to permanent corporate tax changes, we choose a marginal propensity to invest that falls in between the estimates of the two "views" of -0.25 per dollar of tax increase.

The consumption response to a corporate tax change depends on the extent to which the tax change is capitalized into stock valuations, as well as the propensity of households to consume out of changes in stock valuations. Formally,

$$MPC = \frac{\Delta C}{\Delta R} = \frac{\Delta C}{\Delta W} \cdot \frac{\Delta W}{\Delta R} = \frac{\Delta C}{\Delta W} \cdot \frac{W}{R} \cdot \epsilon_{W\tau}, \quad (6)$$

where C is household consumption, W is household wealth in the U.S. stock market, R is corporate tax revenue, and $\epsilon_{W\tau}$ is the elasticity of W with respect to a change in the effective

corporate tax rate, τ.[21] We set $\frac{\Delta C}{\Delta W}$ to 0.03 based on the estimates of Davis and Palumbo (2001). At the end of 2016, $W \approx$ \$16 trillion and $R \approx$ \$0.3 trillion.[22] Regarding the response of W to a change in τ, empirical evidence appears to be consistent with equity prices that capitalize at least a portion of a corporate tax change (Lang and Shackelford, 2000). Given this finding, but lacking empirical estimates of $\epsilon_{W\tau}$, we derive the elasticity using the Gordon growth model, which determines the value of equities as a function of dividends that are assumed to grow at a constant rate. We calculate the effect of a "persistent" (rather than permanent) cut in the effective corporate tax rate on stock market returns so that roughly one half of the corporate tax change is capitalized into share prices.[23] Doing so, our estimate of $\epsilon_{W\tau}$ is -0.16, and thus the marginal propensity to consume is approximately -0.25 All told, our total MPC out of permanent corporate tax changes – that is, including both the investment and consumption responses - is -0.5.

Given the manner in which temporary corporate tax changes have typically been implemented, the incentive channel, rather than the income channel, should dominate. Consequently, we rely on the results from the literature examining the investment response to temporary partial expensing (i.e bonus depreciation) and expansion of net operating loss (NOL) carryback windows, both of which represent an intertemporal transfer of tax benefits rather than a cash windfall. As with other types of corporate tax changes, the evidence for their effect on investment is somewhat mixed. Cohen and Cummins (2006) find little support for the effectiveness of bonus depreciation. Conversely, House and Shapiro (2008), and more recently Zwick and Mahon (2016), find that bonus depreciation has a substantial effect on investment.[24] Examining a different type of temporary corporate tax change that granted additional tax refunds to firms that sustained net operating losses in 2002 and 2009, Dobridge (2016) finds that after

[21] To obtain $\frac{W}{R} \cdot \epsilon_{W\tau}$ from $\frac{\Delta W}{\Delta R}$, note that $\frac{\Delta W}{\Delta R} = \frac{\Delta W}{\Delta(\tau\pi)} = \frac{1}{\pi} \cdot \frac{\Delta W}{\Delta \tau}$, where π is corporate profits. Further note that $\epsilon_{W\tau} = \frac{\Delta W}{\Delta \tau} \cdot \frac{\tau}{W}$, so it follows that $\frac{\Delta W}{\Delta \tau} = \epsilon_{W\tau} \cdot \frac{W}{\tau}$. We are left with $\frac{\Delta W}{\Delta R} = \frac{1}{\pi} \cdot \frac{\Delta W}{\Delta \tau} = \frac{1}{\pi} \cdot \epsilon_{W\tau} \cdot \frac{W}{\tau} = \frac{W}{\tau\pi} \cdot \epsilon_{W\tau} = \frac{W}{R} \cdot \epsilon_{W\tau}$.

[22] The value of household wealth in the U.S. stock market comes from the *Financial Accounts of the United States: Fourth Quarter 2016*. Corporate tax revenue for 2016 is reported by the Congressional Budget Office.

[23] Specifically, we estimate the effect on share prices of a 30-year reduction in the effective corporate tax rate with quarterly dividend payments equal to 0.5 percent of the share price, annual dividend growth of 3.6 percent, and a discount rate equal to 5.77 percent.

[24] House and Shapiro (2008) argue that Cohen and Cummins (2006) fail to find a strong investment response to bonus depreciation because their chosen treatment group, seven-year capital, did not sufficiently benefit from bonus depreciation.

passage of the 2002 policy, firms allocated $0.40 of every refund dollar to investment in the year they received the refund, but did not increase investment in response to the 2009 policy. Given the mixed empirical evidence from this literature and keeping in mind our principle of applying smaller MPCs to temporary tax changes, our baseline choice for the MPC out of a temporary tax change is -0.2.[25, 26]

Turning to transfer payments, examples of transfers include emergency unemployment compensation (EUC), old-age programs such as Old-Age and Survivors Insurance (OASI), and programs targeted at low-income households such as the Supplemental Nutrition Assistance Program (SNAP). For permanent changes to transfers, we use an MPC of one. We do so because aggregate consumption models tend to obtain higher MPCs on transfer income than wages, low-income recipients are likely to be "hand-to-mouth" (HtM) households, and retired households are in the dissaving portion of the life cycle. Misra and Surico (2014) find that HtM households have an MPC out of temporary income changes that exceeds one-half and for some HtM households exceeds one. Despite its temporary nature, we also apply an MPC of one to EUC because the households receiving it are likely to be liquidity constrained and thus HtM consumers. Finally, we apply an MPC of 0.5 to temporary legislative changes to non-EUC transfers. In recent years, such legislative changes have focused on retired households (e.g. the 2009 economic recovery payments to retirees). An MPC of 0.5 seems appropriate because on the one hand, retired households are dissaving and have a shorter time horizon, which would argue for an MPC closer to one. On the other hand, the transfer is temporary and retired households are much less likely to be HtM consumers than the rest of the population (Kaplan and Violante, 2014), which would suggest an MPC out of a temporary transfer that is close to zero.

[25] Nevertheless, as is clear from the above discussion, there is a fair amount of uncertainty over the appropriate MPC to apply to temporary corporate tax changes, and our choice of 0.2 may very well overstate the effect given the estimates of revenue changes to which they are applied. For example, applying an MPC of 0.2 to BEA's estimate of the reduction in corporate tax liability resulting from bonus depreciation likely overstates the effect of the policy's contribution to GDP growth because firms that would have made investments in the absence of bonus depreciation still benefitted from its passage in the form of lower tax liabilities. Given this possibility, we perform a robustness check where we set the MPC out of a temporary corporate tax change to 0 (not shown). Doing so does not materially affect our FE results.

[26] Temporary corporate tax changes may also have large, but transitory effects on investment which fully offset each other over time. For example, just prior to the completion of a period of temporary partial expensing, one might expect to observe a surge in investment that unwinds in the next period, as businesses alter only the timing of their investments as opposed to the level.

Table 3: MPC Selections

Component	Type		Duration	*t*	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*	*t+6*	*t+7*	Total
Discretionary	Taxes	Household	Permanent	-0.25	-0.15	-0.15	-0.05	-0.03	-0.03	-0.03	-0.03	-0.70
			Temporary	-0.28	-0.18	-0.04						-0.50
		Corporate	Permanent	-0.06	-0.06	-0.06	-0.06	-0.06	-0.05	-0.05	-0.05	-0.50
			Temporary	-0.11	-0.07	-0.02						-0.20
	Transfers	Unemployment Insurance		0.50	0.50							1.00
		Other	Permanent	0.25	0.20	0.15	0.05	0.05	0.05	0.05	0.05	1.00
			Temporary	0.28	0.18	0.04						0.50
Automatic stabilizer	Taxes	Household	Temporary	-0.28	-0.18	-0.04						-0.50
		Corporate	Temporary	-0.11	-0.07	-0.02						-0.20
	Transfers	Unemployment Insurance	Temporary	0.50	0.50							1.00
		Other	Temporary	0.28	0.18	0.04						0.50
Residual	Taxes	Household		-0.25	-0.15	-0.15	-0.05	-0.03	-0.03	-0.03	-0.03	-0.70
		Corporate		-0.06	-0.06	-0.06	-0.06	-0.06	-0.05	-0.05	-0.05	-0.50
	Transfers	Unemployment Insurance		0.50	0.50							1.00
		Other		0.25	0.20	0.15	0.05	0.05	0.05	0.05	0.05	1.00

Note: Household taxes include personal income, social insurance, property, sales, and excise taxes. Transfers include all domestic social benefits. Patterns can extend out to 12 quarters.

Cyclical MPCs

Cyclical changes in taxes and transfers are by definition temporary. For this reason, we set the MPCs in the cyclical category equal to their corresponding temporary MPCs from the discretionary category.[27]

Residual MPCs

The MPCs that we apply to residual changes in taxes and transfers are the MPCs applied to permanent discretionary changes. To understand why, consider the following thought experiment for the 'Other transfers' category. Residual changes in this category consist primarily of secular growth in OASI and Medicare due to an aging population. Suppose that there is a switch from the current regime in which these payments rise in the aggregate with the

[27] While 'Other Transfers' is primarily comprised of programs for retired households, the cyclical portion of this category is comprised of Medicaid and SNAP, programs that are targeted primarily at low-income households. Misra and Surico (2014) find that low-income households have an MPC out of the 2001 and 2008 tax rebates (which were temporary) of roughly 0.5. Accordingly, we apply an MPC of 0.5 for cyclical 'Other Transfers', which coincidentally is equal to the MPC for discretionary temporary 'Other Transfers'.

aging of the population to a regime in which the aggregate payment is fixed in real terms. Such a change would be tantamount to a sudden and permanent reduction in payments for program recipients, and consequently we apply the same MPC we assigned to a discretionary and permanent change in 'Other Transfers'.

Aggregating the Effects into a Single Measure

Having categorized changes in government expenditures and revenues as discretionary, cyclical and residual, as well as having selected our MPC's, we can now calculate FE. Starting with the contribution to growth from government purchases:[28]

$$Purchases\ FE = \frac{\Delta G_i}{GDP_{t-1}} \tag{7}$$

where G_i is the real level of a government purchase (e.g. defense spending).

The calculation of FE for tax and transfer series, T_t, is performed over five steps:

i. The real cyclically-adjusted level of T_t is estimated as T_t^C and the cyclical change is then defined as $\Delta C_t = \Delta(T_t - T_t^C)$.
ii. The discretionary change in T_t is estimated and denoted ΔD_t.
iii. Any change in taxes or transfers, ΔT, which has not been defined as either discretionary or cyclical is assigned to the residual category, ΔR_t, such that

$$\Delta R_t = \Delta T_t - (\Delta C_t + \Delta D_t) \tag{8}$$

iv. MPCs are applied to estimate the magnitude and timing of the effect on GDP in each quarter t (with j indexing the MPC quarterly lag structure):

$$\Omega_t = \sum_{j=0}^{n} \Delta C_{t-j} mpc_{C,j} + \Delta D_{t-j} mpc_{D,j} + \Delta R_{t-j} mpc_{R,j} \tag{9}$$

v. Finally, we calculate the effect on aggregate demand of taxes and transfers as:

[28] The contribution to GDP growth is calculated on chain-weighted basis consistent with BEA methodology.

$$Taxes\ and\ Transfers\ FE = \frac{\Omega_t}{GDP_{t-1}} \quad (10)$$

FE estimates for each purchase, tax, and transfer series are then aggregated to produce a single measure of FE.

Uncertainty and Limitations

There are at least three important sources of uncertainty surrounding the FE measure. The first arises from the MPC estimates used to construct FE. There is uncertainty with regards to both the size and the timing of the response to a fiscal policy change. We note a number of instances where the MPC estimates are uncertain in the section above. However, in the Appendix we provide sensitivity analyses in which we vary the MPC estimates and find that our overall conclusions generally hold.

The second source of uncertainty arises from our estimates of the magnitude of discretionary policy changes. While we generally obtain these estimates for federal fiscal policy changes from organizations well equipped to conduct such budget scoring—e.g. the Congressional Budget Office (CBO) and Joint Committee on Taxation (JCT)—they are subject to error. Moreover, for the subnational discretionary component, we use the NIPA-based measures developed in Follette and Lutz (2010), which are also subject to error.

Third, our estimates of the cyclical component of government taxes and transfers are subject to significant uncertainty owing to use of unobserved potential GDP, the complexity and noise surrounding the cyclical elasticities of taxes and transfers, and the presence of phenomena that may have some cyclical component, but do not move in lockstep with the business cycle, such as financial markets or the housing market.

In addition to the uncertainty, there is a limitation to the FE methodology that is worth highlighting. FE may fail to capture some fiscal policy changes that influence aggregate demand. For instance, it has been argued that federal credit policies (e.g. student loans) provided substantial support to aggregate demand in the period during and following the financial crisis of 2008 when private credit markets were impaired (Lucas 2016). However, the NIPA, by design,

does not capture the financial flows that result from the credit programs.[29] Thus, FE fails to account for these types of effects.

Related Measures of Fiscal Policy Change

The most closely related alternative to FE is the Fiscal Impetus measure (e.g. Follette and Lutz, 2011) and the Fiscal Impact measure (Sheiner, 2014). Fiscal Impetus captures a subset of FE, as it is limited to only discretionary fiscal policy changes. In contrast, FE incorporates all aspects of fiscal policy. Fiscal Impact is conceptually similar to FE, though it is constructed in a much less nuanced manner: It is calculated using only the aggregate changes in total taxes, transfer and purchases (as opposed to the more disaggregated approach taken here), does not distinguish between temporary and permanent changes in taxes and transfers, and employs only three MPCs (a single one each for taxes, transfers and purchases). Moreover, it cannot be decomposed into discretionary, cyclical, and residual components.

It is also instructive to compare and contrast FE to two alternative measures of fiscal policy changes as well as to the literature on fiscal multipliers. Perotti (2012) provides a useful decomposition of the log change in government revenues (expenditures) which facilitates these comparisons:

$$s_t = d_{t/t} + \eta y_t + \mu_t \qquad (11)$$

where s_t is the log change in tax revenue at time t, $d_{t/t}$ is a discretionary change in taxes, y_t is the log change in output, η is the elasticity of tax revenue to output, and μ is a random error term (i.i.d., mean 0). In terms of FE, $d_{t/t}$ captures discretionary changes, ηy_t captures the automatic stabilizers and μ_t captures residual policy changes.

A common approach to construct a measure of discretionary changes in fiscal policy is to adjust revenues and expenditures for the cyclical component by removing ηy_t (e.g. CBO 2016 and OECD 2016). Notice, though, that this method, unlike FE, cannot separately identify $d_{t/t}$ and μ_t. As a result, cyclically-adjusted revenues are highly imperfect measures of policy-induced changes in revenues (Auerbach 2000). In particular, cyclically-adjusted revenues often include significant effects from non-legislated sources such as robust capital gain realizations in

[29] In general, these financial flows are instead captured in the Financial Accounts of the U.S. The NIPA does, though, capture some aspects of government credit programs – e.g. it books interest payments from the student loan program as federal receipts.

the mid to late-1990s and bracket creep in the late-1970s (Romer and Romer 2010). Moreover, depending upon on how ηy_t is estimated, it may erroneously capture discretionary changes which are correlated with the business cycle – e.g. the tendency to enact discretionary stimulus spending during a recession. Finally, many measures of cyclically-adjusted policy only capture policy at the federal level, whereas FE captures both federal and state and local government changes. [30]

Narrative measures of discretionary policy changes have been widely used in empirical research in recent years, perhaps most prominently in the work of Romer and Romer (2010) and Ramey (2011).[31] These measures are conceptually similar to the discretionary component of FE in that they are calculated based on the detailed examination of budget scoring documents and other similar sources. There are, however, three important differences, especially with respect to measuring the fiscal stance of the economy. First, FE captures all discretionary changes in revenues, purchases and transfers and is thus much more comprehensive than the narrative measures, which usually focus on a single type of policy change (e.g. military spending or tax changes). The narrow focus of the narrative measures is a significant limitation (Auerbach and Gorodnichenko 2012). Second, the narrative measures only capture changes in policy which are exogenous to current economic conditions. In contrast, discretionary FE includes the effect on aggregate demand from discretionary changes in taxes and spending which are both exogenous and endogenous to the business cycle. In the terminology of Romer and Romer (2010), discretionary FE includes all "legislated" changes in policy. Third, discretionary FE explicitly distinguishes between temporary and permanent policy changes because this distinction likely mediates the response of households and businesses to these changes. The narrative method typically does not measure along this dimension. Finally, the narrative method does not allow for distinguishing between the automatic stabilizers, ηy_t, and the residual component, μ_t (Perotti 2012).

Turning to the fiscal multiplier literature, a principal difference between FE and fiscal multiplier estimates is that FE, by design, only captures the first-round effect of policy changes

[30] See Follette and Lutz (2011) for an exception.

[31] Additional papers using the Romer and Romer (2010) narrative tax shock measure include Perotti (2012), Favero and Giavazzi (2012), Mertens and Ravn (2012), and Zidar (2015). Ramey and Shapiro (1998) develop a narrative measure of military buildups; the measure was subsequently used by multiple authors including Edelberg, Eichenbaum and Fisher (1999), Burnside, Eichenbaum and Fisher (2004), and Cavallo (2005).

on aggregate demand. In contrast, fiscal multipliers generally also incorporate any follow-on (or second round) boost to aggregate demand arising from the first round effect. Fiscal multipliers can also capture aggregate supply effects such as labor supply responses to changes in tax rates. Finally, much of the VAR-based literature on fiscal multipliers—e.g. the classic paper by Blanchard and Perotti (2002)—implicitly uses a form of cyclically-adjusted revenues (expenditures) as a measure of discretionary policy changes. Thus, these papers constrain $d_{t/t}$ and μ_t to have the same effect on output.[32]

Results

Given that it has been the focus of many past analyses, we start with discretionary fiscal policy changes. Figure 2 displays our estimates of discretionary FE from 1970 to the present. The second column of Table 4 shows the average contribution to GDP growth from discretionary policy actions over different parts of the business cycle. Positive values indicate that discretionary actions are stimulating the growth of aggregate demand, while negative values suggest that policy is restraining growth in demand.

Table 4: Fiscal Effects over the Cycle (1970-2015)

	Total	Discretionary	Cyclical	Residual
All	0.29	0.38	0.03	-0.12
Expansion	0.03	0.31	-0.13	-0.15
Contractions	1.59	0.75	0.82	0.02

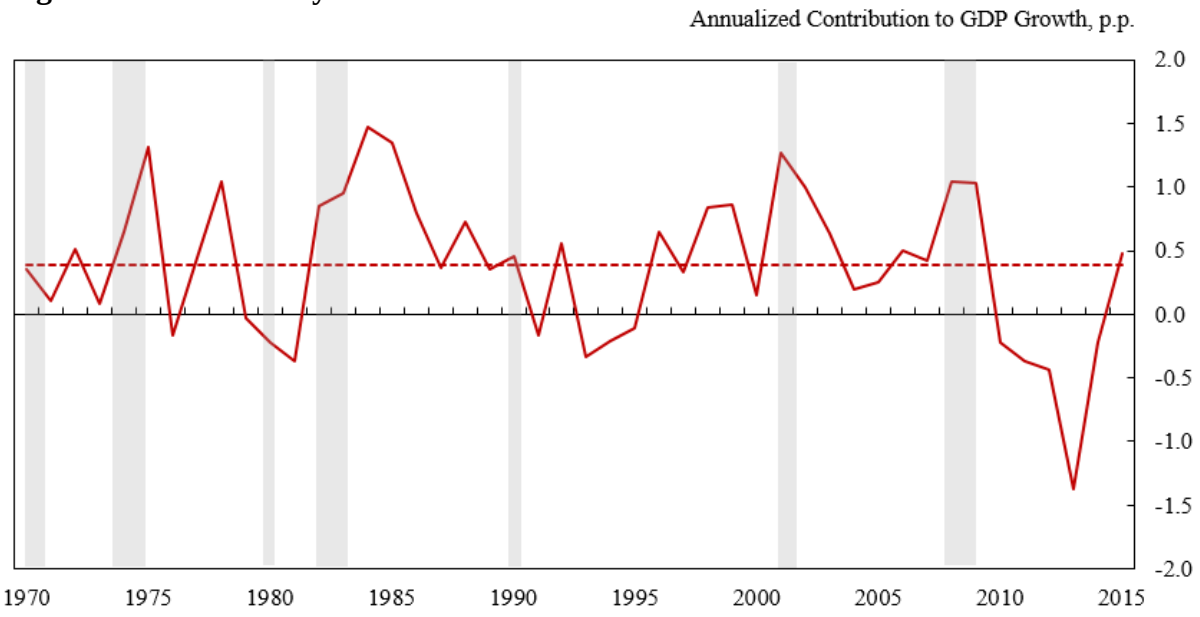
Note: Annualized contribution to GDP Growth

Several observations jump out. First, discretionary policy is typically stimulative, boosting GDP growth by around 0.40 percentage point per year, on average, over this period. Moreover, discretionary fiscal policy tends to be more stimulative during and shortly after contractions than during expansions. The level of stimulus from discretionary policy during and immediately following the Great Recession was not extraordinary; discretionary FE in this period was broadly similar to that in the early 2000s and is lower than in the early 1980s.

[32] See Perotti (2012) for an extended discussion.

Finally, the duration and depth of fiscal restraint from discretionary policy over the last several years has been extraordinary.

Figure 2: Discretionary Fiscal Effect



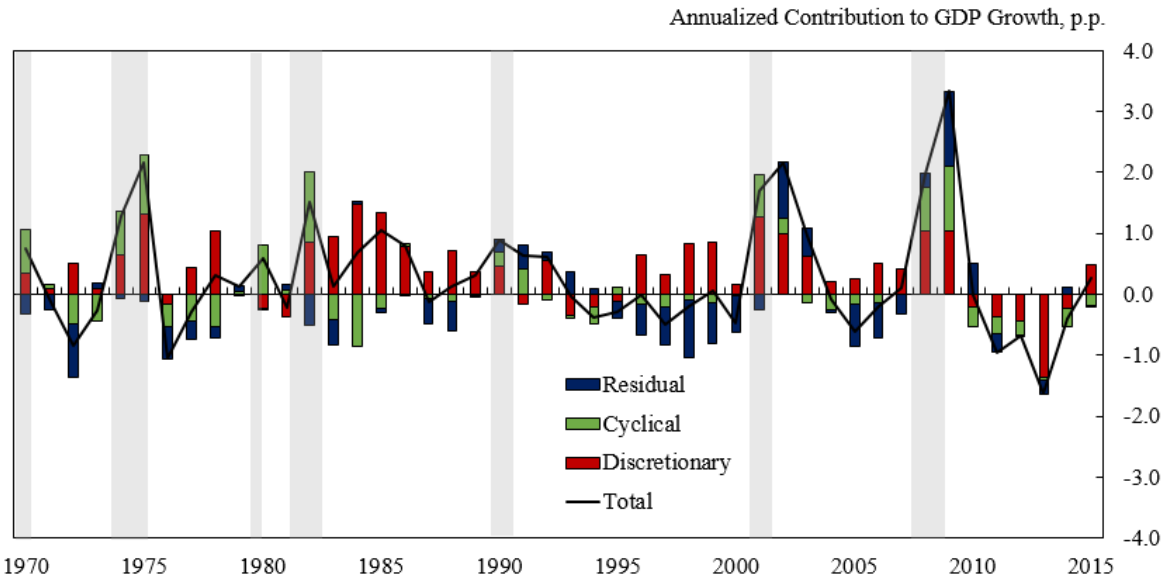
Note: The dashed line is average discretionary FE from 1970-2015. The grey vertical lines indicate contractionary periods as defined by the National Bureau of Economic Research.

Next, we examine total FE, which includes the effects of not only discretionary policy changes, but also cyclical and residual fiscal policy changes. Figure 3 plots total FE and its components. Table 5 lists the correlations between the individual components of FE. Three observations are worth noting when comparing total and discretionary FE. First, total FE is less stimulative than discretionary FE, boosting GDP growth by 0.30 percentage points per year, on average, over this period (see Table 4).[33] Total FE is smaller than discretionary FE because, on average, the residual component exerts a drag on GDP growth of around -0.10 percentage points over this period (mainly due to a secular increase in tax collections), while the cyclical component is approximately neutral.[34] Second, total FE tends to be more countercyclical than discretionary FE. The difference is primarily due to cyclical policy effects that provide a large boost during recessions and a small drag during recoveries. Finally, there are periods where the stance of discretionary FE and total FE differ, such as during the mid to late

[33] It is possible for FE to be positive with a balanced budget over an extended period since the MPC on government purchases is one and the MPC on taxes is generally less than one.
[34] In addition to the drag from the secular increase in taxes, residual FE will also pick up the boost to aggregate demand from the secular increase in transfers. We find that the former dominates.

1990's or mid 2000's, where discretionary policy alone would indicate a stimulative stance but Total FE, a neutral or slightly negative stance, primarily due to rising tax revenues. Thus, relying only on discretionary FE may not provide an accurate description of the total effect of fiscal policy on GDP.

Figure 3: Total Fiscal Effect



Note: Grey vertical lines indicate contractionary periods as defined by the National Bureau of Economic Research.

Table 5: Correlation between Components of Fiscal Effect

	Discretionary	**Cyclical**	**Residual**
Discretionary	1.00	-	-
Cyclical	0.18	1.00	-
Residual	-0.02	0.26	1.00

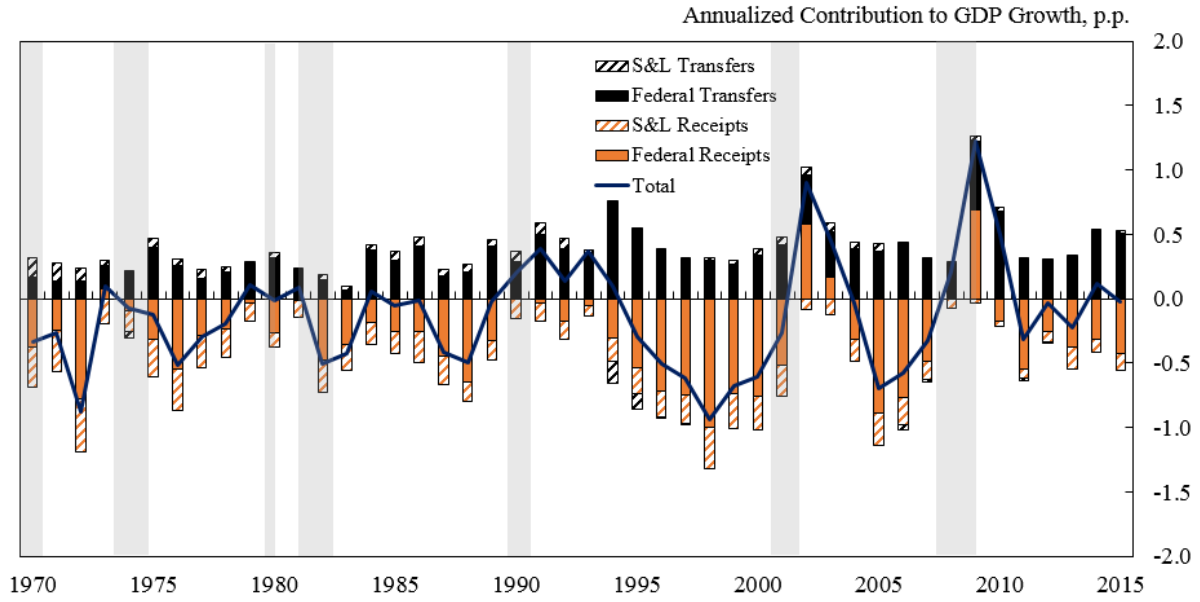
Residual FE

Given that the economic determinants of residual FE are opaque, in this section we explore residual FE. In particular, we examine why residual FE has been negative on average, why it exhibits some countercyclicality, and whether measurement error in the other components of FE may be responsible for a portion of the observed variation in residual FE.

We begin by examining the major components of residual FE and their contributions to its magnitude over time, which are displayed in Figure 4. Provided that we accurately estimate

discretionary and cyclical FE, we would expect that residual FE captures secular trends such as the secular growth in real incomes, which bumps up tax receipts, and the secular growth in entitlement spending due to the aging of the population. We would also expect that residual FE captures swings in tax receipts and transfers that are not due to discretionary policy action and do not necessarily move in lock step with the business cycle, such as capital gains realizations.

Figure 4: Residual Fiscal Effect



Note: Grey indicates contractionary periods as defined by the National Bureau of Economic Research.

In general, transfers have boosted residual FE since 1970, while tax receipts have restrained it. The fact that residual transfers have had a positive effect on GDP growth is consistent with increased mandatory outlays by the government on public pensions and health care for an expanding elderly population. Similarly, the negative contribution of tax receipts is consistent with secular real income growth and bracket creep pushing up tax collections. We find that the tax receipts effect has dominated, and thus residual FE has been slightly negative on average.

While the average contribution of the major components of residual FE matches our priors, we nonetheless observe some countercyclicality, which could be due to measurement error – that is, discretionary or cyclical policy changes incorrectly allocated to the residual category. To determine whether this may be the case, we examine the correlations between residual, discretionary, and cyclical FE, shown in Table 5. Residual FE is uncorrelated with

discretionary FE, but we find some correlation between residual and cyclical FE, and the correlation is significant based on a standard right tail t-test with a p-value of 0.04. A closer look at Figure 4 reveals two large positive outliers in residual FE in 2002 and 2009, which when removed reduce the correlation to an insignificant 0.08 (p-value 0.30). Comparing federal receipts in 2002 and 2009 to other years we observe dramatically sharper falls in receipts compared to previous episodes. In particular, one component that could have contributed significantly to the residual in these years is capital gains realizations (See Appendix, Figure A.3). In most years, capital gains realizations made a small and negative contribution to GDP growth. In contrast, capital gains realizations in 2002 and 2009 fell sharply, resulting in lower tax receipts and a relatively large positive contribution to GDP growth. Analyzing the magnitude of changes in capitals gains and assuming none of these extraordinary movements in 2002 and 2009 were picked up in our cyclical adjustment indicates capital gains realizations can explain up to 50 percent and 33 percent of the boost to GDP growth from residual federal receipts in 2002 and 2009, respectively.

We believe that the declines in capital gains realizations in 2002 and 2009 were related to the cycle, but our current approach of modeling capital gains realizations jointly with personal income may not adequately capture these potential cyclical effects. In particular, our procedure is likely ill-suited to dealing with the relatively strong correlation between capital gains realizations and economic activity over the last two cycles if we interpret the extraordinary swings in receipts as cyclical.[35]

Overall though, the contributions of the components that comprise residual FE are consistent with our beliefs about the secular trends that have affected fiscal policy since 1970. Although residual FE is correlated with the cycle, it is only slightly countercyclical. Moreover, the year-to-year variation in total FE is not primarily driven by the residual component.

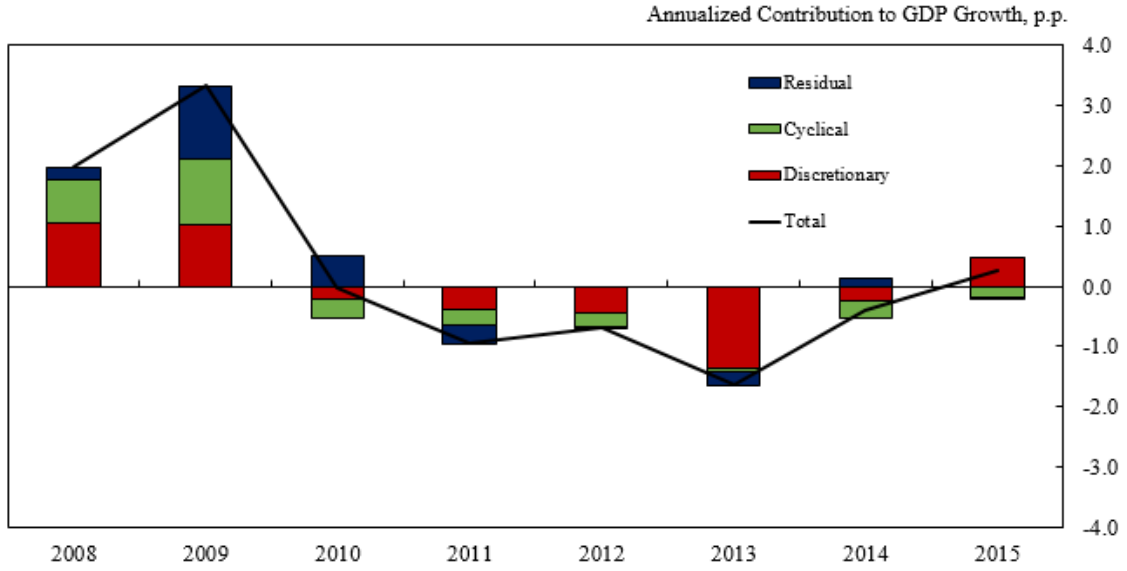
Fiscal Effect During the Current Cycle

Next, we examine the effects of fiscal policy on aggregate demand during the current cycle. Figure 5 breaks out the effects of the three channels of total FE. As indicated by the black line, total FE swings from positive in 2008-2009 to neutral in 2010, and then to negative over the

[35] One reason capital gains were more cyclical during the last two recessions is that these recessions were associated with larger equity price movements.

next several years. This contour reflects the contributions from both discretionary and cyclical policy.

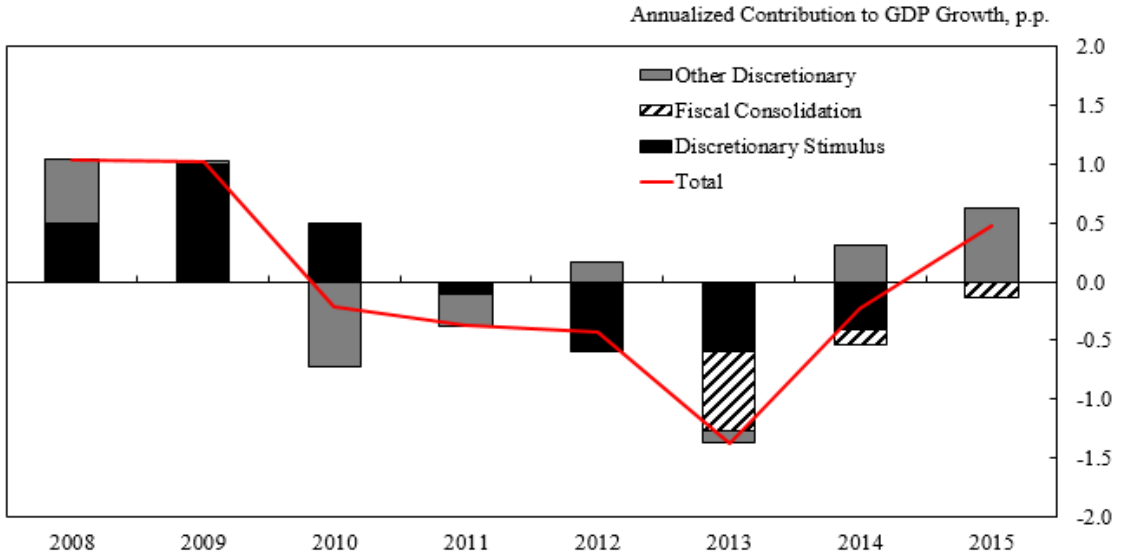
Figure 5: Fiscal Effect



Starting with discretionary FE, Figure 6 demonstrates that its contour can be attributed largely to two factors.[36] First, discretionary "stimulus" policies boosted GDP growth from 2008 to 2010, but then became a source of restraint starting in 2011, as they began to expire. These "stimulus" policies include fiscal policy changes that were enacted at the federal level to explicitly provide short-term, temporary support to the economy, such as the 2009 American Recovery and Reinvestment Act (ARRA).[37] Second, the discretionary fiscal "consolidation" yielded a notable drag on GDP growth in 2013 and then a more subdued drag in 2014. "Consolidation" includes a number of policies at the federal level that were enacted to reduce the deficit, in particular spending cuts associated with the Budget Control Act (BCA) of 2011 and tax increases enacted as part of the "fiscal cliff" budget agreement in 2013. As the restraint from the consolidation policies and the expiration of the stimulus policies waned, discretionary FE provided a boost to GDP growth in 2015.

[36] The "other" category in Figure 6 captures all other discretionary policy actions. Most notably over this period they include budget actions at the state and local level and the drawdown of overseas military operations.
[37] These policies include the 2008 Economic Stimulus Act; 2009 American Recovery and Reinvestment Act; and the 2010 Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act.

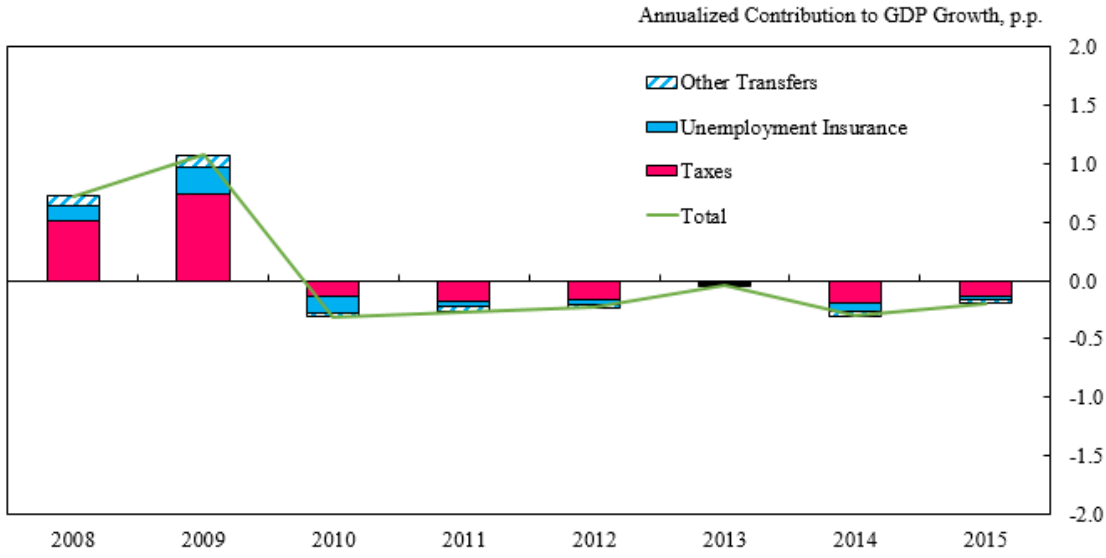
Figure 6: Discretionary Fiscal Effect



Note: Stimulus includes the effects of the 2008 Economic Stimulus Act, 2009 American Recovery and Reinvestment Act and the 2010 Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act.

As shown in Figure 7, cyclical policies also boosted GDP growth during the contraction in 2008 and 2009, with most of the contribution derived from a cyclical decline in tax receipts. For transfers, note that a significant portion of the contribution was driven by the non-discretionary portion of the increase in unemployment insurance. During the recovery, on the other hand, cyclical FE had a small negative effect on growth.

Figure 7: Cyclical Fiscal Effect



Now we turn to the question of whether the effects of fiscal policy during the current cycle are similar to other episodes. Figure 8 examines our estimates of FE during the contraction and in the subsequent years after the trough. The left panel displays the average over previous contractions and recoveries since 1970, while the right panel displays the most recent contraction and recovery.

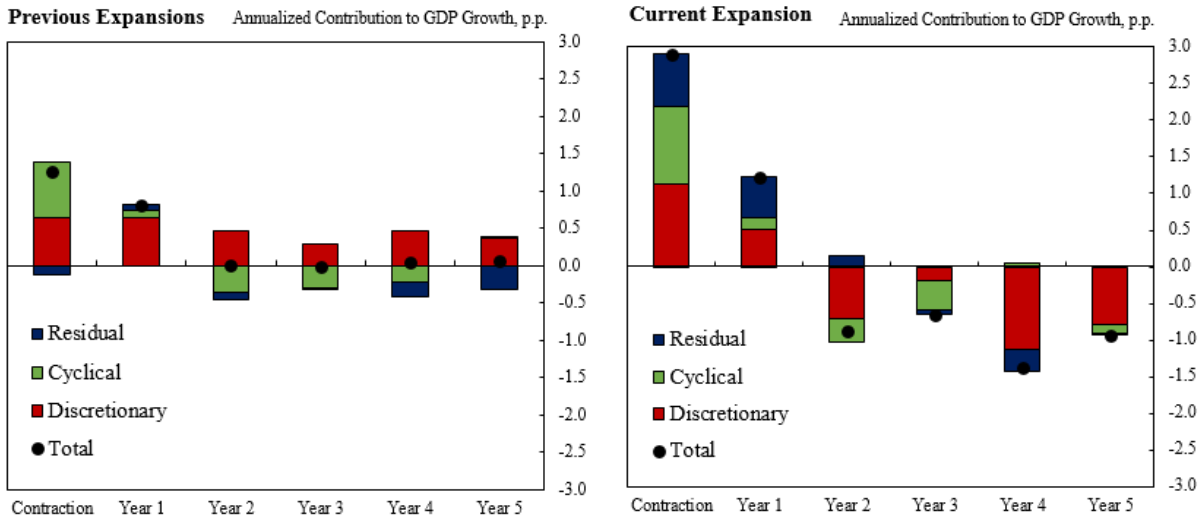
Focusing on the contractions, total FE was significantly stronger during the most recent recession compared to previous recessions, reflecting all three components of FE. Although the effect of discretionary policies was not extraordinary during the Great Recession—see Figure 2—it was nonetheless above average relative to past contractions.[38] The large and positive residual component also played an important role in the comparatively large total FE reading during the most recent recession. As discussed above, though, a large portion of residual FE in this period is associated with the collapse in federal individual income tax receipts, which could be viewed as a cyclical phenomenon. However, we don't see this positive support unwinding during the recovery to the same extent as the cyclical support, indicating some persistence. Finally, the cyclical component was moderately larger during the Great Recession than in prior downturns.[39]

Moving on to the post-recession recoveries, the difference between the current and past expansions is stark. Although total FE in the first year of the current expansion was similar to the historical average, in the following four years it was substantially below the historical norm. Total FE was neutral in years two through five of past expansions. By contrast, over the same time span during the current expansion, fiscal policy changes *restrained* real GDP growth by an average of around 1 percentage point. Thus, we estimate that fiscal policy changes over years two through five contributed around 1 percentage point less to the growth in real GDP per year than they did on average in earlier periods, and roughly ¾ percentage point less over years one through five . The differences in years two through five are driven largely by discretionary policy.

[38] The support is even less extraordinary when one factors in the size of the contraction. For example, the size of the contraction in GDP was more than twice as large during the Great Recession as the average in the previous recessions.

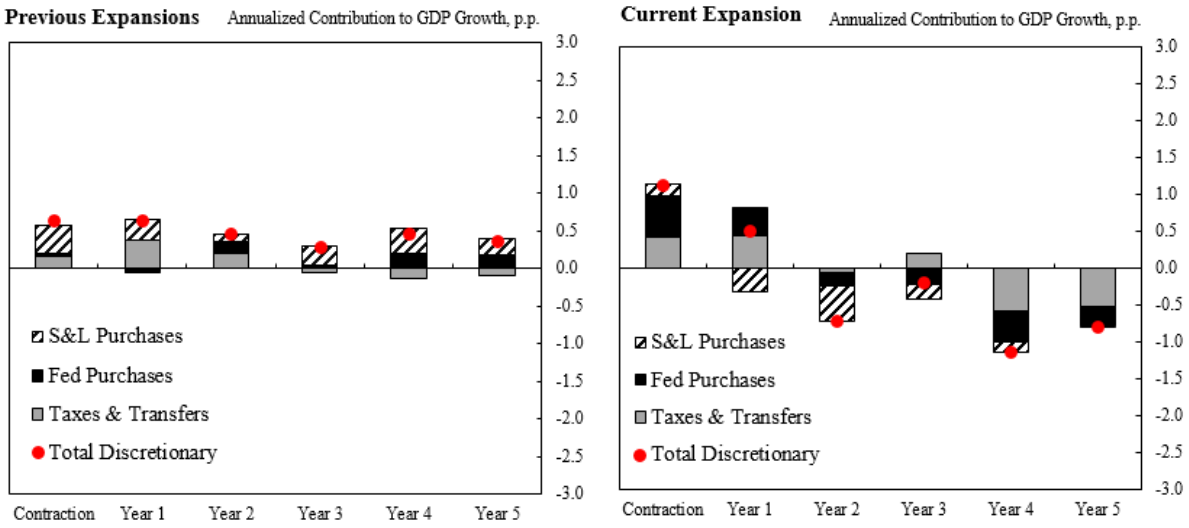
[39] The cyclical effect was somewhat dampened relative to the severity of the contraction due to the fact that potential GDP fell by more in the most recent cycle than it did on average in previous cycles.

Figure 8: Fiscal Effect Over the Business Cycle



Note: Previous Expansions includes expansions following the 1970, 1975, 1980, 1982 and 2001 troughs as defined by the National Bureau of Economic Research (NBER). Contraction values are the geometric average of the annualized quarterly values over the length of the contraction. The right panel in Figure 8 differs from Figure 5 in that it does not cover calendar years. Rather, the FE measure during the "Contraction" is a geometric average of quarterly annualized FE estimates during the Great Recession (2008:Q1 through 2009:Q2), while the Year 1 FE estimate is a geometric average of quarterly annualized FE estimates in the four quarters following the

Figure 9: Discretionary Fiscal Effect Over the Business Cycle



Note: Previous Expansions includes expansions following the 1970, 1975, 1980, 1982 and 2001 troughs as defined by the National Bureau of Economic Research. Contraction values are the geometric average of the annualized quarterly values over the length of the contraction.

The atypical restraint from discretionary fiscal policy largely reflects three factors. The first two, the expiration of the stimulus policies and fiscal consolidation at the federal level, were

discussed above. The third factor is a sharp reduction in state and local government purchases in the first four years of the expansion. By contrast, state and local government purchases provided significant impetus to aggregate demand in past expansions. This can be seen in the black and white striped bars in Figure 9.

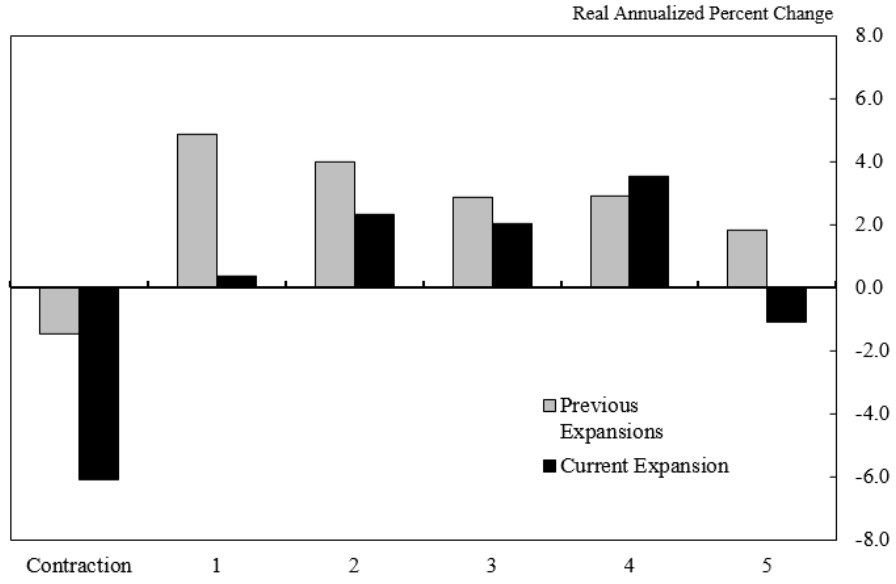
The unusual behavior of state and local governments in the current cycle primarily reflects the steep deterioration in their tax receipts during the Great Recession and anemic growth in receipts thereafter. This can be seen in Figure 10, which contrasts the changes in state and local tax receipts in the current cycle to those in previous episodes. The weakness in receipts over the current cycle primarily reflects the depth of the recession and sluggish recovery which followed. Moreover, state and local revenues have become more cyclically sensitive in recent years. The increased cyclicality reflects a secular shift toward relatively more cyclical revenue sources (e.g. personal income taxes) and away from relatively less cyclical revenue streams (e.g. property taxes). In addition, some revenue sources appear to have become more cyclical (e.g. over the last two cycles the boom and boost in capital gains realizations has made personal income tax collections more cyclical – see Mattoon and McGranahan 2012 and Kodrzycki 2014).

State and local governments operate under relatively binding balanced budget rules. While they have some ability to smooth through revenue shocks using reserve funds and other techniques, their balanced budget rules require them to bring operating expenditures into line with revenues over time. Thus, at the state and local level, the shortfall in revenues caused by the Great Recession required either spending cuts and/or tax increases. In practice, budget shortfalls were mostly closed by reducing purchases of goods and services, particularly state and local government payrolls and construction outlays.[40] Once state and local budgets were no longer facing shortfalls, revenue growth was generally anemic which restrained the rise in purchases that generally occurs during an expansion. Moreover, a large share of revenue growth was dedicated to shoring up pension funding (Boyd and Dadayan 2016).[41]

[40] The FE methodology defines all changes in state and local purchases as discretionary as these outlays are generally determined by annual legislation. However, a reasonable alternative would be to allow non-capital purchases to be partially cyclical. (Capital expenditures are not subject to balanced budget constraints, can be funded by debt, and are therefore more unambiguously discretionary.) Specifically, any changes in non-capital purchases that arise due to cyclical changes in tax revenues interacting with binding balance budget constraints could be defined as cyclical. However, the appropriate way to identify the cyclical component of non-capital purchases is unclear.

[41] Annual pension funding affects the net savings of state and local governments in the NIPA, but does not affect purchases, taxes or transfers. Thus, the boost in pension funding does not boost FE.

Figure 10: State and Local Tax Receipts



Source: Bureau of Economic Analysis
Note: Previous Expansions includes expansions following the 1970, 1975, 1980, 1982 and 2001 troughs as defined by the National Bureau of Economic Research. Contraction values are the geometric average of the annualized values over the length of the contraction. Deflated by BEA Price Deflator for S&L consumption and investment.

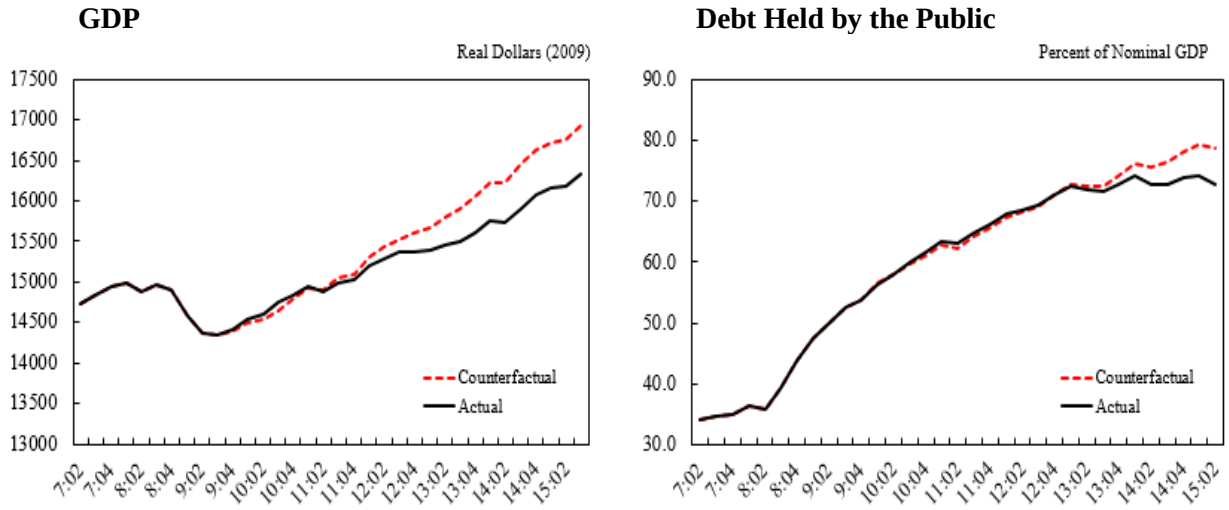
Given this atypical restraint from fiscal policy, it is natural to consider what would happen if the United States government sector had contributed to aggregate demand similarly to previous recoveries. To analyze this question, we construct a simple counterfactual. Specifically, we calculate counterfactual GDP and Federal Debt under the assumption that FE in the current recovery equaled its average in past recoveries. We assume that the gap between our counterfactual and actual GDP is achieved by increasing discretionary federal purchases financed by debt, thus affecting GDP one-for-one.[42] Furthermore, we assume that private investment is not crowded out through interest rate or other effects, which would reduce GDP and increase the debt-to-GDP ratio relative to the counterfactual estimates we present below. Finally, we do not account for any boost to government revenue resulting from the additional GDP growth (which would lower debt) or positive follow-on multiplier effects. We also do not

[42] We assume that this debt is issued at the average interest rate and duration and that the counterfactual fiscal policy changes have no effects on these rates. Moreover, we do not account for any changes to the tax base or transfer spending due to the additional growth in GDP.

allow for possible supply-side effects that would further boost GDP growth over the medium-term (see DeLong, Summers, and Ball 2014). In other words, we simply assume no follow-on multiplier such that FE equals the total (or "all in") fiscal multiplier. Additional details on this calculation and its assumptions are available in the Appendix.

In this counterfactual experiment, we find that GDP growth in the current recovery (2009Q3 – 2015Q2) would have averaged 2.80 percent per year, 0.6 percentage points higher per year on average, resulting in a level of GDP around 3.5 percent higher at the end of the sixth year of the recovery (See Figure 11.). Conversely, debt as a percentage of GDP would have been 79 percent, six percentage points greater than what was observed in 2015Q2. Overall, this counterfactual exercise provides some perspective on the tradeoffs between increased debt issuance and GDP growth that policy makers faced during the recent recovery.

Figure 11: Counterfactual Fiscal Policy



Source: Bureau of Economic Analysis, Department of Treasury, authors' calculations

Conclusion

This paper develops a comprehensive framework for assessing the contribution of fiscal policy to growth in aggregate demand. We find that over the period 1970-2015 there was an average annual contribution of 0.3 percentage points to GDP growth (on a Q4 over Q4 basis). We find that FE is stronger during and immediately following contractions. Finally, we note that FE during the Great Recession was significantly stronger than in previous contractions, reflecting all three components of FE: discretionary, cyclical, and residual. However, total FE

has exerted a noticeable drag on GDP growth in the current expansion. In contrast, FE was modestly stimulative in previous expansions. We find that this large difference is primarily due to discretionary policy actions. The contractionary stance of fiscal policy over this period is notable given that some economists (e.g. Bernanke 2014 and Summers 2014) were actively calling for expansionary fiscal policy to address a shortfall in aggregate demand. Finally, there are numerous possible avenues for future work. For instance, MPCs may systematically vary in magnitude over the course of the business cycle (Gross, Notowidigdo, and Wang 2016). The FE methodology could easily accommodate such variable MPCs.

References

Agarwal, Sumit, Chunlin Liu, and Nicholas S. Souleles (2007) "The Reaction of Consumer Spending and Debt to Tax Rebates—Evidence from Consumer Credit Data." *Journal of Political Economy* 115 (6): 986–1019.

Auerbach, Alan. (1988). "Capital Gains Taxation in the United States." *Brookings Papers on Economic Activity* 2, 595–631.

Auerbach, Alan J. (2000). "Formation of Fiscal Policy: The Experience of the Past Twenty-Five Years." *Federal Reserve Bank of New York Economic Policy Review*, 6(1): 9–23

Auerbach, Alan J. (2003). "Fiscal Policy, Past and Present," Brookings Papers on Economic Activity, 1, pp. 75-122.

Auerbach, Alan J. and Yuriy Gorodnichenko (2012). "Measuring the Output Responses to Fiscal Policy," *American Economic Journal: Economic Policy*, 4(2), 2012.

Bernanke, Ben S. (2014). "The Federal Reserve: Looking Back, Looking Forward." Speech at the Annual Meeting of the American Economic Association, January 3, Philadelphia, PA.

Blanchard, Olivier and Roberto Perotti (2002). "An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output," *The Quarterly Journal of Economics*, Oxford University Press, 117(4):1329-1368.

Blundell, Richard, Luigi Pistaferri, and I. Preston (2008). "Consumption Inequality and Partial Insurance," *American Economic Review*, 98, 1887-1921.

Boyd, Don and Lucy Dadayan (2016). "Slow tax revenue growth, rising pension contributions, and Medicaid growth lead state and local governments to reshape their finances," Rockefeller Institute of Government, working paper, November 4.

Brayton, Flint, Thomas Laubach, and David Reifschneider, "The FRB/US Model: A Tool for Macroeconomic Policy Analysis", FEDS Notes, April 2014.

Broda, Christian and Jonathan A. Parker. (2014). The Economic Stimulus Payments of 2008 and the aggregate demand for consumption, *Journal of Monetary Economics*, 68.

Burnside, Martin Eichenbaum, and Jonas Fisher. (2004). "Fiscal Shocks and their Consequences," *Journal of Economic Theory*, 115.

Campell, John and N. Gregory Mankiw. (1989). "Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence," in *NBER Macroeconomics Annual*, Volume 4, Olivier J. Blanchard and Stanley Fischer, eds.

Cavallo, Michele, (2005). "Government Employment Expenditure and the Effects of Fiscal Policy Shocks,"Federal Reserve Bank of San Francisco Working Paper.

Cashin, David and Takashi Unayama (2016). "The Impact of a Permanent Income Shock on Consumption: Evidence from Japan's 2014 VAT Increase," Discussion Paper 16052, Research Institute of Economy, Trade, and Industry (RIETI).

CBO, "The Budget and Economic Outlook: 2016 to 2026," January 25, 2016.

Chirinko, Robert S., Steven M. Fazzari, and Andrew P. Meyer (1999). "How Responsive is Business Capital Formation to its User Cost? An Exploration with Micro Data," *Journal of Public Economics*, 74:53-80.

Cohen, Darrell S. and Jason G. Cummins (2006). "A Retrospective Evaluation of the Effects of Temporary Partial Expensing," *FEDS Working Paper No. 2006-19.*

Cohen, Darrell S. and Glenn Follette (1999). "The Automatic Fiscal Stabilizers: Quietly Doing Their Thing," *FEDS Working Paper No. 1999-64,* published as The Automatic Fiscal Stabilizers: Quietly Doing Their Thing," *Economic Policy Review*, April 2000, Federal Reserve Bank of New York.

Cummins, Jason G., Kevin A. Hassett, and Glenn R. Hubbard (1994). "A Reconsideration of Investment Behavior Using Tax Reforms as Natural Experiments," *Brookings Papers on Economic Activity,* 2:1-74

Davis, M. A., Palumbo, M. G., & Board of Governors of the Federal Reserve System (U.S.). (2001). "A primer on the economics and time series econometrics of wealth effects". Washington, D.C: Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board.

deLeeuw, Frank, Thomas Holloway, Darwin Johnson, David McClain, and Charles Waite (1980). "The High-Employment Budget: New Estimates, 1955-1980." *Survey of Current Business* (November): 13-43.

DeLong, Brad, Larry Summers, and Laurence Ball (2014). "Fiscal Policy and Full Employment," Center on Budget and Policy Priorities: Policy Futures.

Dobridge, Christine L. (2016). "Fiscal Stimulus and Firms: A Tale of Two Recessions," *FEDS Working Paper No. 2016-013.*

Edelberg, Wendy, Martin Eichenbaum, and Jonas D. M. Fisher. (1999). "Understanding Shock to Government Purchases," *Review of Economic Dynamics*.

Favero, Carlo and Francesco Giavazzi (2012). "Measuring Tax Multipliers: The Narrative Method in Fiscal VARs," *American Economic Journal: Economic Policy*, 4(2), 2012.

Follette, Glenn, Andrea Kusko and Byron Lutz (2008). "State and Local Finances and the Macroeconomy: The High–Employment Budget and Fiscal Impetus", *National Tax Journal*, Vol. LXI, No. 3, September 2008.

Follette, Glenn, and Byron Lutz (2011). "Fiscal Policy in the United States: Automatic Stabilizers, Discretionary Fiscal Policy Actions, and the Economy," Fiscal Policy: Lessons from the Crisis vol. Feb. Perugia: Banca d'Italia, 2011.

Gross, Tal, Matthew J. Notowidigdo, and Jialan Wang (2016). "The Marginal Propensity to Consume Over the Business Cycle" NBER Working Paper No. 22518, August.

Hassett, Kevin A. and R. Glenn Hubbard (2002). "Tax Policy and Business Investment," *Handbook of Public Economics*, 3.

Hines, James R., "State Fiscal Policies and Transitory Income Fluctuations," Brookings Papers on Economic Activity, Fall 2010.

House, Christopher L. and Matthew D. Shapiro (2008). "Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation," *American Economic Review, 98(3):736-768.*

Jappelli, Tulio and Luigi Pistaferri (2006). "Intertemporal Choice and Consumption Mobility," *Journal of the European Economic Association*, 4:75-115.

Jappelli, Tulio and Luigi Pistaferri (2010). "The Consumption Response to Income Changes," *Annual Review of Economics*, Annual Reviews, vol. 2, no. 1, pages 479-506.

Jappelli, Tulio and Luigi Pistaferri (2011). "Financial Integration and Consumption Smoothing," *The Economic* Journal, 121:678-706.

Johnson, David S., Jonathan A. Parker, and Nicholas S. Souleles. (2006). "Household Expenditure and the Income Tax Rebates of 2001." *American Economic Review*, 96(5): 1589–610.

Kaplan, Greg, Giovanni L. Violante, and Justin Wiedner (2014). "The Wealthy Hand-to-Mouth," Brookings Papers on Economic Activity, Spring 2014, pages 77-153.

Kodrzycki, Yolanda K. (2014). "Smoothing State Tax Revenues over the Business Cycle: Gauging Fiscal Needs and Opportunities," Federal Reserve Bank of Boston, WP 14-11.

Lang, Mark H. and Douglas A. Shackelford (2000). "Capitalization of capital gains taxes: evidence from stock price reactions to the 1997 rate reduction," *Journal of Public Economics*, 76(1), pp. 69-85.

Laubach, T., & Williams, J. C. (2016). Measuring the natural rate of interest redux. Business Economics, 51(2), 57-67.

Lucas, Deborah, "Credit Policy as Fiscal Policy", Brookings Papers on Ec4onomic Activity, BPEA Conference Draft, March 10-11, 2016.

Lutz, Byron, "The Connection Between House Price Appreciation and Property Tax Revenue," National Tax Journal, LXI, No. 3, Sept. 2008

Lutz, Byron, Raven Molloy and Hui Shan "The Housing Crisis and State and Local Government Tax Revenue: Five Channels," Regional Science and Urban Economics, July 2011.

Mankiw, N. Gregory. (2000). "The Savers–Spenders Theory of Fiscal Policy, *American Economic Review*, 90(2).

Mertens, Karel and Morten O. Ravn. (2012). "Empirical Evidence on the Aggregate Effects of Anticipated and Unanticipated US Tax Policy Shocks," *American Economic Journal: Economic Policy*, 4(2), 2012.

Miller, Preston and Larry Ozanne (2000). "Forecasting Capital Gains Realizations," Technical Paper Series 2000-5, Congressional Budget Office.

Misra, Kanishka and Paolo Surico (2014). "Consumption, Income Changes, and Heterogeneity: Evidence from Two Fiscal Stimulus Programs," *American Economic Journal: Macroeconomics*, vol. 6, no. 4, pages 84-106.

Mattoon, Richard and Leslie McGranahan (2012), "Revenue Bubbles and Structural Deficits: What's a State to Do?," Federal Reserve Bank of Chicago, WP 2008-15.

OECD, "Economic Outlook," June 2016.

Parker, Jonathan A. (1999). "The Reaction of Household Consumption to Predictable Changes in Social Security Taxes." *American Economic Review*, 89(4): 959–73.

Parker, Jonathan A., Nicholas Souleles, David S. Johnson, and Robert McClelland (2013). "Consumer Spending and the Economic Stimulus Payments of 2008," *American Economic Review*, vol. 103, no. 6, pages 2530-2553.

Patel, Elena, Nathan Seegert, and Matthew Grady Smith (2015). "At a Loss: The Real and Reporting Elasticity of Corporate Taxable Income," Available at SSRN: http://ssrn.com/abstract=2608166.

Perotti, Roberto. (2012). "The Effects of Tax Shocks on Output: Not So Large, But Not Small Either." *American Economic Journal: Economic Policy*, 4(2), 2012.

Pistaferri, Luigi (2001). "Superior Information, Income Shocks, and the Permanent Income Hypothesis," *The Review of Economics and Statistics*, 83(3), 465-476.

Ramey, Valerie. (2011), "Identifying Government Spending Shocks: It's All in the Timing," *Quarterly Journal of Economics*, 126:1.

Ramey, Valerie and Matthew Shapiro. (1998). "Costly Capital Reallocation and the Effects of Government Spending," *Carnegie-Rochester Conference Series on Public Policy*, 48.

Romer, Christina and David Romer, (2010). "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks." *American Economic Review*, 100.

Russek, Frank and Kim Kowalewski (2015). ”How CBO Estimates Automatic Stabilizers,” CBO Working Paper Series.

Sahm, Claudia R., Matthew D. Shapiro, and Joel Slemrod (2010). "Household Response to the 2008 Tax Rebate: Survey Evidence and Aggregate Implications.” *Tax Policy and the Economy*, 24(1).

Shapiro, Matthew D. and Slemrod, Joel. (1995). “Consumer Response to the Timing of Income: Evidence from a Change in Tax Withholding.” *American Economic Review*, 85(1), pp. 274–83.

Shea, John. (1995). “Union Contracts and the Life-Cycle/Permanent-Income Hypothesis.” *American Economic Review*, 85(1), pp. 186–200.

Sheiner, Louise (2014). “The Hutchins Center’s Fiscal Impact Measure.” Retrieved from URL https://www.brookings.edu/research/the-hutchins-centers-fiscal-impact-measure/.

Sinn, Hans-Werner (1991). “Taxation and the Cost of Capital: The “Old” View, the “New” View, and Another View,” Chapter in *Tax Policy and the Economy*, Volume 5, pages 25-54, National Bureau of Economic Research.

Souleles, Nicholas S. (1999). “The Response of Household Consumption to Income Tax Refunds.” *American Economic Review*, 89(4): 947–58.

Summers, Lawrence H. (2014). “U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound,” *Business Economics*, Vol. 49, No. 2, pp. 65-73.

U.S. Congressional Budget Office (2011). “Improving CBO’s Methodology for Projecting Individual Income Tax Revenues,” Washington D.C.

U.S. Congressional Budget Office (2016). The Budget and Economic Outlook. Washington D.C.

Wilcox, David. (1989). “Social security benefits, consumption expenditure, and the life cycle hypothesis.” *Journal of Political Econo*my, 97:288–304.

Yagan, Danny (2015). "Capital Tax Reform and the Real Economy: The Effects of the 2003 Dividend Tax Cut,” *American Economic Review*, 105(12): 3531-3563.

Zidar, Owen. (2015). “Tax Cuts for Whom? Heterogeneous Effects of Income Tax Changes on Growth and Employment,” NBER Working Paper #21035.

Zwick, Eric and James Mahon (Forthcoming). “Tax Policy and Heterogeneous Investment Behavior,” *American Economic Review.*

Appendix

FRB/US Estimates of MPCs

Table A.1 presents marginal propensity to consume (MPC) estimates obtained by introducing exogenous fiscal shocks into the FRB/US model. These estimates were generated with monetary policy held constant – i.e. monetary policy is not allowed to offset the fiscal shocks. Our baseline MPCs were informed by the estimates in Table A.1.

Table A.1: FRB/US Estimates of Marginal Propensity to Consume Out of Permanent Shocks

MPC	t	t+1	t+2	t+3	t+4	t+5	t+6	t+7	Total
Personal Income Tax	0.23	0.16	0.10	0.05	0.04	0.03	0.02	0.02	0.70
Social Benefit Tax	0.21	0.14	0.09	0.05	0.04	0.02	0.03	0.01	0.67
Transfers	0.25	0.19	0.13	0.08	0.08	0.04	0.04	0.04	0.96

Alternate MPC Selections

One of the most pronounced sources of uncertainty for the FE measure are the judgmental MPC selections. To test the sensitivity of FE to alternate MPC selections we run our FE apparatus using a simplified MPC selection, consistent with Davis and Palumbo (2001). Davis and Palumbo estimate the long-run cointegrated relationship in the NIPAs between consumption, income and wealth and provide a framework to forecast quarterly movements in consumption based on deviations of the series from their long-run trends. The MPC's produced through this procedure are shown in Table A.2 and are not differentiated by discretionary, cyclical and residual categories as in our benchmark methodology, nor is there a distinction between temporary or permanent changes.

Table A.2: Alternate MPC Selection from David and Palumbo (2001)

MPC	Year			
	1	2	3	4
Income	0.25	0.41	0.50	0.56
Transfers	0.40	0.64	0.78	0.87

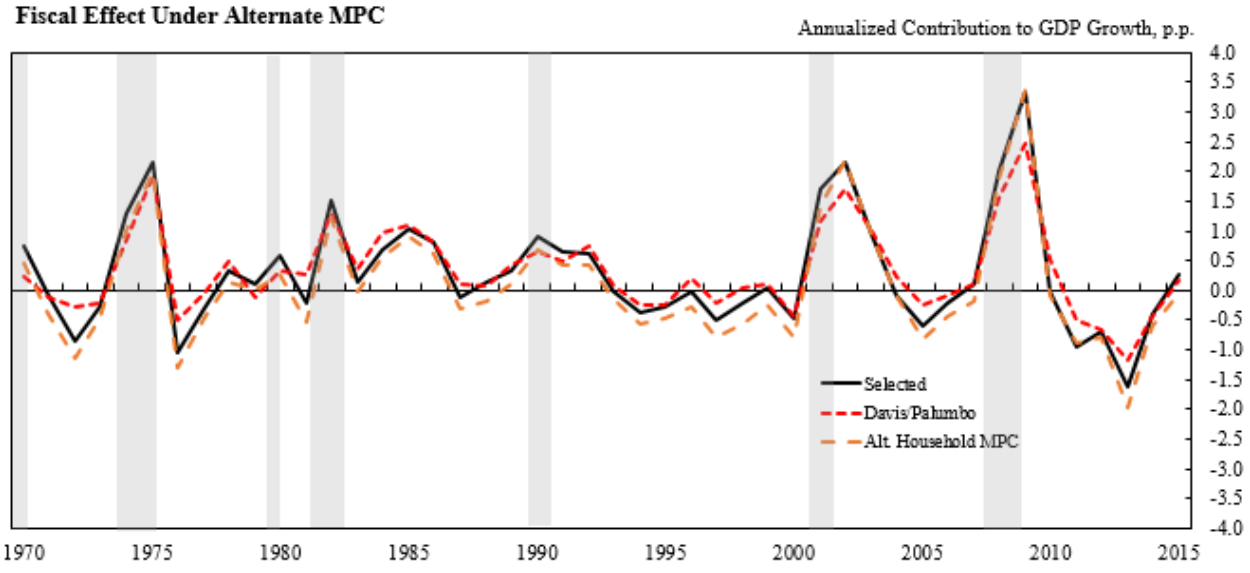
Using the MPC's from table A.2 does not dramatically affect our aggregate results as illustrated in Table A.3 and Figure A.1 where we see similar average results and contour over the period 1970-2015.

As standard theory predicts an MPC out of a permanent income shock of 1 and a few studies using non-U.S. data estimate an MPC out of a permanent income shock of 1, we also test the sensitivity of our results to changing the MPC selection from 0.7 to 1 for all permanent household changes. The main effect of this change is to induce moderately more drag in the residual category; leaving us with lower FE on average over the period 1970-2015. However, overall, as can be seen in Figure A.1 (Alt. Household MPC row), the contour of FE is unchanged.

Table A.3: Comparison of Fiscal Effect

	Total	Discretionary	Cyclical	Residual
Selected	0.29	0.38	0.03	-0.12
Davis/Palumbo	0.33	0.37	0.04	-0.08
Alt. Household MPC	0.09	0.37	0.03	-0.30

Figure A.1



Cyclical Elasticities Example: Federal Personal Income Tax (δ_t)

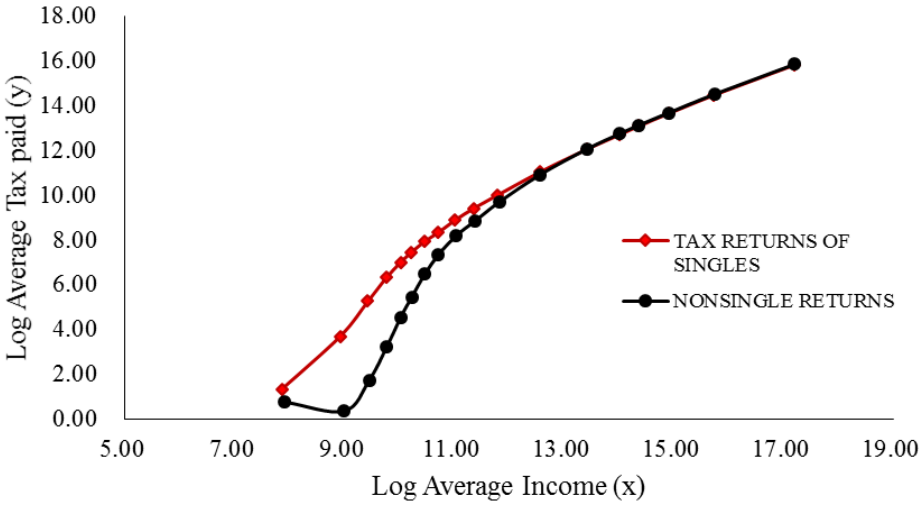
The elasticity of taxes to changes in AGI, δ_{tr} , is calculated as the income tax weighted average of δ_{trg}, the elasticity of each AGI income group g denoted in the Statistics of Income (SOI) summary tables for federal personal income taxes. δ_{trg} is calculated as follows:

$$\delta_{trg} = \frac{x_{g+1}-x_g}{x_{g+1}-x_{g-1}} \times \frac{y_g-y_{g-1}}{x_g-x_{g-1}} + \frac{x_g-x_{g-1}}{x_{g+1}-x_{g-1}} \times \frac{y_{g+1}-y_g}{x_{g+1}-x_g} \quad \text{(A1)}$$

where x is the log of average income, y is the log of average tax paid and g is SOI income bin (indexed from lowest to highest).[43] Essentially we calculate the local elasticities of the slopes illustrated in figure A.2 and then aggregate to one elasticity δ_{tr}; this process is calculated for single and non-single returns and repeated for each year.

Figure A.2

Slope of Average Log Taxes to Average Log Income by AGI Group in 2013



Source: IRS Statistics of Income Table 1.2

The elasticity of AGI to changes in the NIPA measure of personal income, δ_{tu} is calculated by regressing the log difference of annual NIPA income against the log difference of

[43] The income bins can be seen in the SOI summary tables and range from $1-$5,000 through to $10,000,000 or more with the largest group by income being non-single returns $100,000-$200,000 in 2013.

AGI while controlling for major tax events in 1986, 2001, 2002, 2008 and 2013. The elasticities indicated by these regressions are shown in table A.4.

Table A.4: Elasticity of AGI to NIPA Personal Income

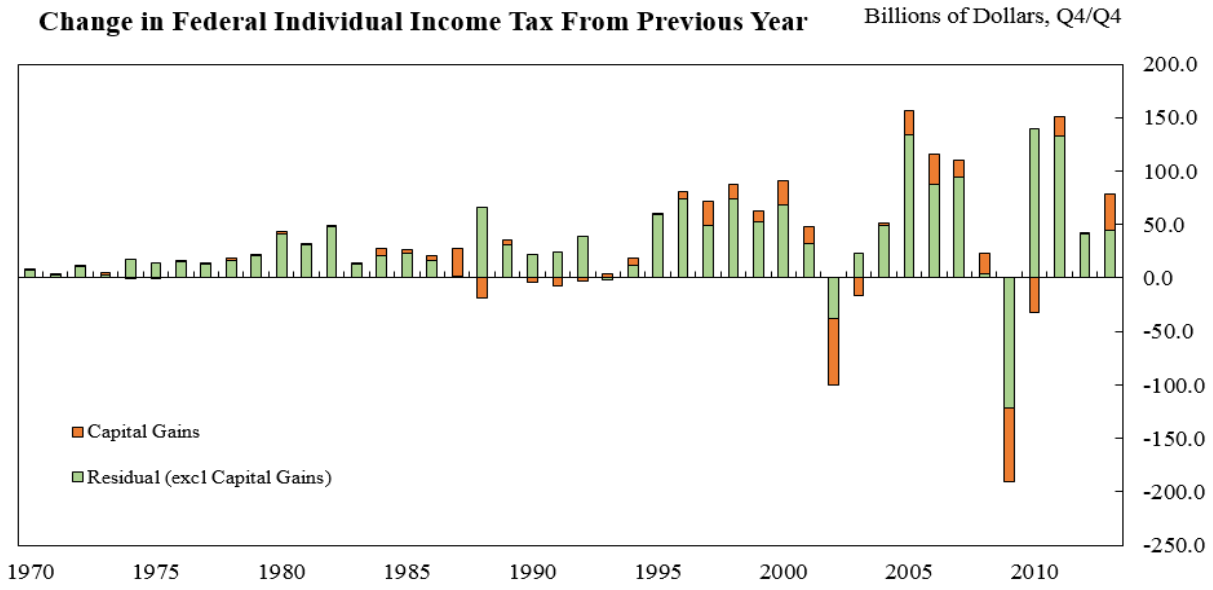
Filers	**Pre 1986 Tax Reform**	**Post 1986 Tax Reform**
Single	1.39	1.15
Non Single	0.85	1.11

Finally the elasticity δ_t is calculated in each year by multiplying δ_{tu} and $\delta_{tu}$and weighting between non-single and single filers based on taxes paid.

Capital Gains and Residual FE

Figure A.3 illustrates the possible share of capital gains in the residual change in individual income tax collections under the strong assumption that our cyclical measure does not pick up any of the cyclical effect of capital gains. In reality, however, we are likely picking up some of the cyclical movements in capital gains through our elasticity of AGI to NIPA income.

Figure A.3



Source: U.S. Department of the Treasury, Office of Tax Analysis, author calculations.

Note: It is assumed capital gains are paid in the calendar year following the year in which tax liability is incurred.

Counterfactual GDP

In order to consider the impact of fiscal consolidation on GDP and Public Debt we construct a simple counterfactual whereby the government follows fiscal policy in line with previous recoveries. In order to do this we assume a fiscal multiplier of 1.0 such that our counterfactual GDP growth $\widetilde{gdp_t}$ is calculated as follows:

$$\widetilde{gdp_t} = gdp_t - FE_t + FEprior_t \quad \text{(A2)}$$

Where gdp_t is actual GDP growth and $FEprior_t$ is average FE at the same point in time relative to the trough in prior expansions (1970-2007) as illustrated in figure 8. We assume this additional FE is produced through discretionary purchases financed through newly issued Federal Public Debt. We calculate counterfactual borrowing in each quarter in the recovery as the change in actual debt ($\Delta debt_t$) plus the difference in counterfactual and observed nominal GDP ($\widetilde{NGDP_t} - NGDP_t$), and assume the GDP deflator is unchanged. Finally we assume the interest rate on our counterfactually issued debt (c_t) is issued at the average quarterly market yield on five year[44] constant maturity treasury securities at the time, giving us a new Federal debt $\widetilde{debt_t}$ calculated as follows:

$$\widetilde{debt_t} = \widetilde{debt_{t-1}} + \Delta debt_t + (\widetilde{NGDP_t} - NGDP_t) + \sum_i c_{t-i} \quad \text{(A4)}$$

Where *c* is interest payments or interest savings on the counterfactual borrowing due to the different level of GDP in previous periods. The results and major assumptions are detailed in Table A5.

[44] Roughly the average weighted maturity of treasury debt at the time.

Table A5: Counterfactual GDP and Public Debt

Year of Recovery	Actual			Counterfactual			
	FE	GDP Growth	Debt to GDP	FE	GDP Growth	Debt to GDP	Interest Rate
1	1.22	2.72	57.95	0.81	2.31	57.93	2.36
2	-0.87	1.65	62.99	0.01	2.53	62.59	1.76
3	-0.65	2.49	68.54	0.00	3.13	68.54	0.95
4	-1.38	1.04	72.02	0.06	2.48	72.89	0.77
5	-0.93	2.44	72.71	0.06	3.44	75.79	1.55
6	0.04	2.98	72.62	0.03	2.96	78.94	1.57

Source: Bureau of Economic Analysis, Department of Treasury.

Note: Recovery begins in 2009Q3 and therefore GDP Growth is on a Q2/Q2 basis. Debt to GDP is the value in the ending quarter of each year.

Subcomponents of Fiscal Effect

Table A6: Total Fiscal Effect

Type	Series	Fiscal Effect								
		2008	2009	2010	2011	2012	2013	2014	2015	Average 1970-2015
Purchases	Federal Defense	0.45	0.19	0.11	-0.23	-0.20	-0.35	-0.18	0.02	0.02
	Federal Non Defense	0.17	0.13	0.17	-0.12	0.03	-0.18	0.09	0.09	0.07
	State and Local	0.03	0.17	-0.52	-0.29	-0.27	-0.01	0.15	0.27	0.21
Taxes	Federal Individual Income	0.12	1.17	-0.26	-0.60	-0.15	-0.46	-0.38	-0.41	-0.15
	Federal Socal Insurance	-0.01	0.05	-0.07	0.38	0.03	-0.52	-0.23	-0.16	-0.16
	Federal Corporate	0.29	0.15	-0.05	-0.11	-0.08	-0.04	-0.07	-0.02	-0.01
	Federal Production and Import	0.02	0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.02	-0.01
	State and Local Individual Income	0.01	0.13	-0.04	-0.07	-0.07	-0.07	-0.04	-0.05	-0.05
	State and Local Social Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Corporate	0.03	-0.02	-0.02	0.01	0.00	0.00	-0.01	0.00	-0.01
	State and Local Property	-0.01	-0.08	0.02	0.03	0.02	0.00	0.01	0.00	-0.04
	State and Local Production and Import (excl Property)	0.08	0.11	-0.07	-0.06	-0.04	-0.08	-0.07	-0.05	-0.08
Transfers	Federal Unemployment Insurance	0.20	0.57	-0.15	-0.19	-0.16	-0.12	-0.15	-0.01	0.01
	Federal Medicaid	0.03	0.21	0.12	-0.11	0.01	0.00	0.22	0.19	0.06
	Federal Transfers (other)	0.56	0.63	0.73	0.34	0.13	0.16	0.29	0.37	0.34
	State and Local Medicaid	-0.02	-0.13	0.00	0.11	0.09	0.08	0.00	0.05	0.03
	State and Local Transfers Other	0.02	0.03	0.02	-0.02	-0.02	-0.01	0.00	0.00	0.02
Total		1.98	3.33	-0.02	-0.95	-0.69	-1.64	-0.41	0.27	0.29

Table A7: Discretionary Fiscal Effect

Type	Series	Fiscal Effect								
		2008	2009	2010	2011	2012	2013	2014	2015	Average 1970-2015
Purchases	Federal Defense	0.45	0.19	0.11	-0.23	-0.20	-0.35	-0.18	0.02	0.02
	Federal Non Defense	0.17	0.13	0.17	-0.12	0.03	-0.18	0.09	0.09	0.07
	State and Local	0.03	0.17	-0.52	-0.29	-0.27	-0.01	0.15	0.27	0.21
Taxes	Federal Individual Income	0.01	0.17	-0.16	-0.13	0.13	-0.17	-0.07	-0.01	0.06
	Federal Socal Insurance	-0.01	-0.01	0.00	0.45	0.09	-0.47	-0.09	0.00	-0.06
	Federal Corporate	0.04	-0.02	0.02	0.02	-0.05	-0.01	0.00	0.00	0.00
	Federal Production and Import	0.00	-0.02	0.00	0.00	0.00	-0.02	-0.10	-0.07	-0.02
	State and Local Individual Income	0.00	-0.02	-0.02	-0.01	-0.01	0.00	0.00	0.00	-0.01
	State and Local Social Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Corporate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Property	-0.01	-0.02	0.03	0.04	0.04	0.04	0.04	0.04	0.01
	State and Local Production and Import (excl Property)	0.07	0.06	-0.01	-0.02	-0.01	0.00	0.00	0.01	0.00
Transfers	Federal Unemployment Insurance	0.10	0.36	-0.02	-0.13	-0.08	-0.08	-0.11	0.00	0.00
	Federal Medicaid	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.09	0.00
	Federal Transfers (other)	0.21	0.19	0.21	-0.07	-0.19	-0.17	-0.05	0.01	0.03
	State and Local Medicaid	0.00	-0.14	-0.01	0.11	0.08	0.06	-0.01	0.03	0.04
	State and Local Transfers Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		1.04	1.03	-0.22	-0.37	-0.43	-1.37	-0.23	0.48	0.38

Table A8: Cyclical Fiscal Effect

Type	Series	Fiscal Effect								
		2008	2009	2010	2011	2012	2013	2014	2015	Average 1970-2015
Purchases	Federal Defense	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Federal Non Defense	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taxes	Federal Individual Income	0.20	0.39	-0.02	-0.06	-0.10	0.01	-0.10	-0.09	0.01
	Federal Socal Insurance	0.08	0.16	-0.03	-0.09	-0.03	0.01	-0.03	-0.02	0.00
	Federal Corporate	0.10	0.01	-0.03	-0.01	0.00	-0.02	-0.01	0.00	0.00
	Federal Production and Import	0.01	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Individual Income	0.05	0.12	-0.01	-0.02	-0.02	-0.01	-0.03	-0.02	0.00
	State and Local Social Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Corporate	0.03	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Property	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Production and Import (excl Property)	0.06	0.05	-0.03	-0.01	-0.01	-0.01	-0.02	-0.01	0.00
Transfers	Federal Unemployment Insurance	0.12	0.23	-0.14	-0.04	-0.04	-0.01	-0.07	-0.03	0.01
	Federal Medicaid	0.07	0.07	-0.03	-0.03	-0.02	-0.01	-0.03	-0.02	0.00
	Federal Transfers (other)	0.01	0.03	0.00	-0.01	-0.01	0.00	-0.01	-0.01	0.00
	State and Local Medicaid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Transfers Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		0.73	1.08	-0.31	-0.27	-0.23	-0.05	-0.30	-0.19	0.03

Table A9: Residual Fiscal Effect

Type	Series	Fiscal Effect								
		2008	2009	2010	2011	2012	2013	2014	2015	Average 1970-2015
Purchases	Federal Defense	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Federal Non Defense	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taxes	Federal Individual Income	-0.08	0.61	-0.09	-0.41	-0.17	-0.30	-0.21	-0.32	-0.22
	Federal Socal Insurance	-0.08	-0.10	-0.04	0.02	-0.03	-0.05	-0.11	-0.15	-0.10
	Federal Corporate	0.16	0.16	-0.04	-0.12	-0.04	-0.01	-0.06	-0.02	-0.02
	Federal Production and Import	0.01	0.02	-0.01	-0.04	-0.02	-0.01	0.07	0.05	0.02
	State and Local Individual Income	-0.04	0.04	0.00	-0.04	-0.04	-0.07	-0.02	-0.03	-0.05
	State and Local Social Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	State and Local Corporate	0.01	-0.02	0.00	0.01	0.01	0.00	0.00	0.00	-0.01
	State and Local Property	0.01	-0.06	-0.01	-0.01	-0.02	-0.04	-0.03	-0.04	-0.06
	State and Local Production and Import (excl Property)	-0.05	0.00	-0.03	-0.03	-0.02	-0.06	-0.05	-0.05	-0.07
Transfers	Federal Unemployment Insurance	-0.03	-0.02	0.00	-0.02	-0.04	-0.02	0.03	0.02	0.00
	Federal Medicaid	-0.04	0.14	0.15	-0.08	0.03	0.01	0.14	0.12	0.05
	Federal Transfers (other)	0.34	0.41	0.53	0.42	0.33	0.34	0.35	0.37	0.30
	State and Local Medicaid	-0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.00
	State and Local Transfers Other	0.02	0.03	0.02	-0.02	-0.02	-0.01	0.00	0.00	0.02
Total		0.21	1.23	0.50	-0.31	-0.03	-0.22	0.12	-0.02	-0.12