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A counterfactual analysis

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Abstract

The Structural Vector Auto-regression (SVAR) approach to estimating fiscal multipliers, following the seminal paper by Blanchard and Perotti (2002), has been widely applied in the literature. In our paper we discuss the interpretation of these estimates and suggest that they are more useful for forecasting purposes than for policy advice. Our key point is that policy instruments often react to each other. We analyze a data set from the US and document that these interactions are economically and statistically significant. Increases in spending have been financed by subsequent increases in taxes. Increases in taxes have been complemented by additional spending cuts in subsequent quarters. In a counterfactual analysis we report fiscal multipliers that abstract from these dynamic responses of policy instruments to each other.

Keywords: Fiscal policy, government spending, net revenues, structural vector autoregression

JEL: E62, H20, H50

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1. Introduction

The structural VAR approach to estimating the fiscal multipliers developed by Blanchard and Perotti (2002) has been applied widely in the literature in recent years.[2] It was the first analysis that solved the identification problem, associated with earlier stylized facts on the co-movement of spending, taxes and income. In the present paper we argue that while the identification of contemporaneously correlated shocks has been achieved, the approach neglects the dynamic interaction among policy instruments. The derived multipliers are therefore best characterized as *forecasting multipliers* and should not directly be used for policy advice, or be interpreted as a test of the Keynesian model.[3]

We start our analysis by illustrating that there exists a significant and economically sizeable effect of a shock in expenditure on net taxes and vice versa. The effect of a shock in expenditure on net taxes is positive, i.e. expenditures today tend to be financed by tax increases in the immediately following quarters. In the estimation of the spending multiplier, this will have a dampening effect on GDP. With regard to taxes, we have the opposite finding. After a standard positive shock to net taxes, there is a significant response of expenditure which is negative. This implies that an average tax shock will have a stronger negative impact on GDP, because expenditure is also reduced in subsequent quarters.

In order to isolate the effects of a pure spending and pure tax shock, we implement the following counterfactual analysis: We first estimate the model using the Blanchard and Perotti (2002) approach. When computing the impulse response functions, however, we shut down the channel that captures the interaction among policy instruments (i.e. set coefficients to zero).[4] The main result of our analysis is that the *counterfactual multiplier* - that abstracts from the interaction of policy instruments – is substantially larger than the *forecasting multiplier* from standard SVAR estimates. The opposite effect is found for net taxes. The multiplier for net taxes is substantially lower in the counterfactual simulation, as the overall fiscal tightening is not amplified by the additional contraction of expenditure.

We investigate the sensitivity of our findings in several robustness regressions. First, we extend the analysis to a 5-variable VAR, including inflation and interest rate as additional control variables. Secondly we exclude the post financial crisis time period from our sample, and also estimate the regressions in the original Blanchard and Perotti (2002) sample. Furthermore, we add a dummy variable, capturing the 1975Q2 tax cut period. Finally, we also extend the lag length of the VAR and control for the level of public debt. Overall the differences between the *counterfactual* and the *forecasting multipliers* remain remarkably robust across these different specifications.

Our analysis does not imply that the Blanchard and Perotti (2002) procedure is incorrect or yield biased results. We do argue however that it must be interpreted with caution whenever there is a sizeable interaction among policy instruments. If the dynamic response of net taxes to expenditure is strong, the Blanchard and Perotti multiplier must be interpreted as a forecast of the future reaction of GDP. If the aim is to use the results for policy consulting, it may not be as useful, however. From a

[2] See Ramey (2011a) for an overview.

[3] As a forecasting tool, the procedure has recently been evaluated by Blanchard and Leigh (2013).

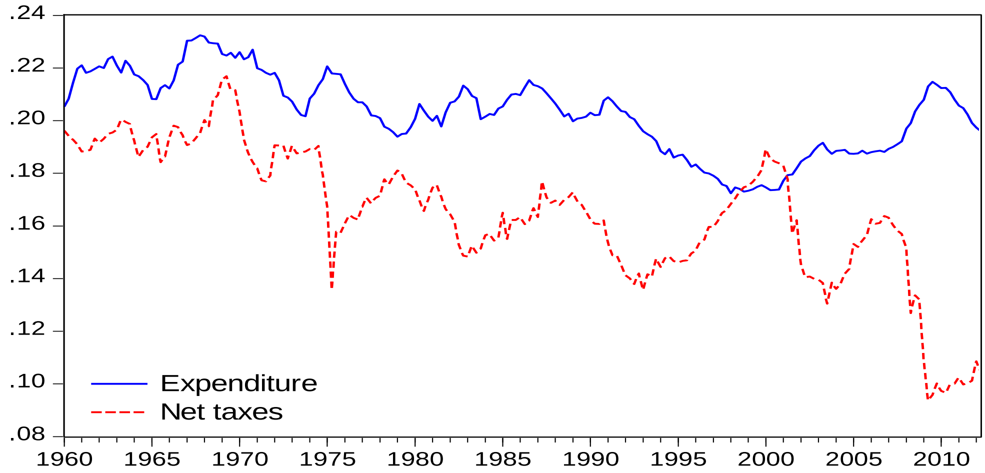
[4] The same argument has been made in the context of monetary policy by Ramey (1993). In her paper, she isolates the credit channel of monetary policy by shutting down the Policy-Velocity channel when computing impulse response functions. Our analysis translates this idea to the context of fiscal policy and the discussion on the size of fiscal multipliers. See also the working paper version of Blanchard and Perotti (2002), who already raise this issue in the extended version of their paper.

policy perspective one would like to ask the question: What is the effect of an additional Dollar spent on future GDP, letting other instruments unchanged? To assess this question, and to move the analysis closer to the Keynesian model, with its various crowding-out effects, we highlight the importance of a counterfactual analysis in our paper.

2. Data and preliminary analysis

We start our analysis by plotting the data of expenditure and net taxes as a percentage of GDP. The solid line in figure 1 traces the expenditure /GDP ratio and the dotted line, net taxes/GDP.[5] The years from 1960 to 1997 are familiar from the Blanchard and Perotti (2002) article. In the past years, especially since 2007/2008, there has been a widening gap between expenditure and net taxes. This gap reflects the expansionary fiscal policy in response to the financial crisis. Initially both instruments have been used, as expenditure goes up and net taxes go down – a process that has been gradually reversed in the last 4 years of the sample period. In order to abstract from this exceptional period, we conduct the later analysis also in a reduced sample that stops in 2006Q4, the year before the crisis.

Figure 1: Expenditure and net taxes to GDP ratios



In the appendix of the paper, we report the unit root test statistics. Applying the Augmented Dickey-Fuller (ADF) as well as the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, we find that all variables have a unit-root in levels and are stationary in 1st differences. Furthermore, the test statistics in the appendix show that the three variables are not cointegrated. We therefore estimate the dynamic interactions between the variables in a VAR in 1st differences.

[5] See appendix for data sources and definitions.

3. Results

The forecast multipliers

In this section, we estimate the impulse response patterns of a shock in expenditure and net taxes on GDP, using the Blanchard and Perotti (2002) identification procedure.[6] Figure 2 displays the point estimates and standard errors, which contain the familiar result that spending has a positive and significant impact on GDP, while taxes have a negative impact. Table 1 contains information on the exact qualitative impact. The magnitude of the multipliers is comparable to those that have been reported in the literature.

Figure 2: Response of GDP

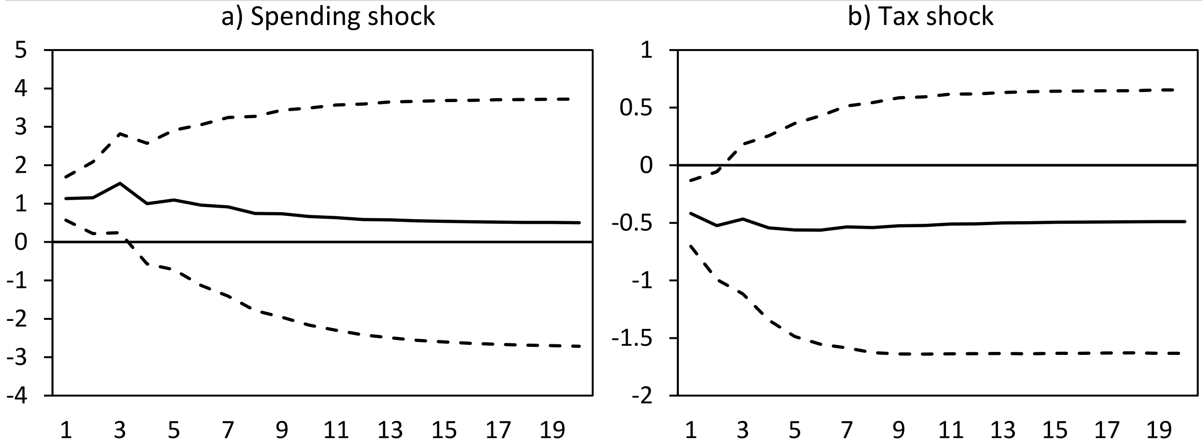


Table 1: Response of GDP

	Q1	Q2	Q4	Q6	Q8	Q12	Q14	Q18	Q20	Peak
EXP	1.131	1.152	1.000	0.962	0.745	0.587	0.551	0.513	0.504	1.530 (3)
	(0.28)	(0.47)	(0.79)	(1.05)	(1.26)	(1.50)	(1.57)	(1.59)	(1.61)	(0.64)
TAX	-0.418	-0.524	-0.544	-0.563	-0.541	-0.509	-0.499	-0.491	-0.489	-0.563 (6)
	(0.14)	(0.23)	(0.40)	(0.50)	(0.54)	(0.56)	(0.57)	(0.57)	(0.57)	(0.50)

Note: The table displays output multipliers with respect to government spending (EXP) and tax (TAX) shocks. Corresponding standard errors are shown in parentheses.

Interaction among policy instruments

Standard estimations of the Keynesian multiplier typically include the dynamic interactions among the policy instruments, i.e. the reaction of net taxes to expenditure is included, when simulating the impact of expenditure on GDP. In figure 3, we show that these interactions among the policy variables are economically sizeable and statistically significant. Table 2, again, reports the exact corresponding values of the point estimates and confidence intervals. We find that in our sample period, there has been a significant positive response of taxes to a change in expenditure which implies that an increase in spending has been financed by subsequent increase in net taxes. This response of the taxes clearly reduces the impact of expenditure on GDP.

[6] Following the methodology of Blanchard and Perotti (2002), we calculate for the updated data set a net tax elasticity to GDP of 2.76.

Similarly there is also a significant negative reaction of expenditure to a shock in net taxes. This means that, on average, an increase in net taxes has been associated with a subsequent decrease in expenditure. The forecasted impact of net taxes on GDP is therefore likely to be lower than it would have been, if this effect on expenditure would not be included.

Figure 3: Interaction among policy instruments

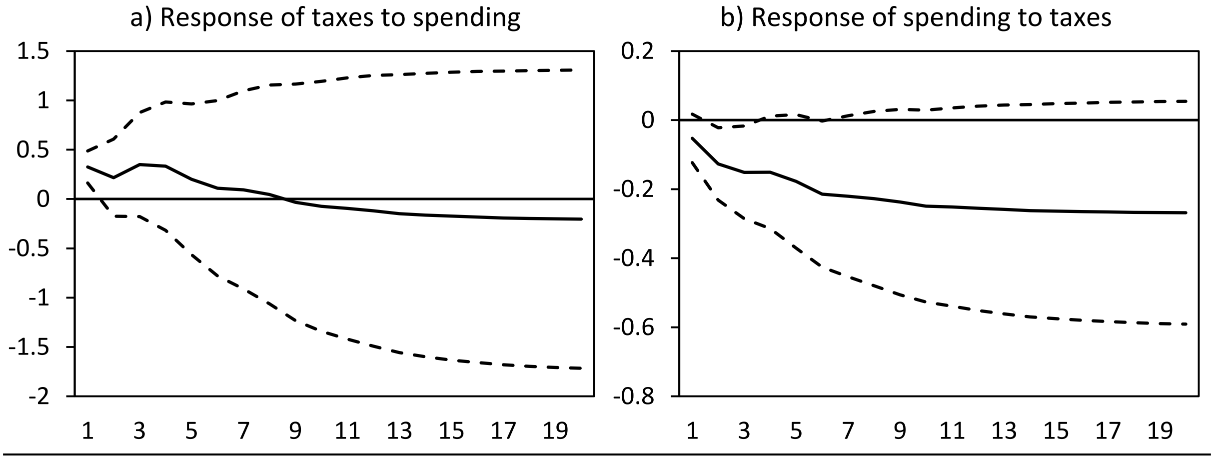


Table 2: Interaction among policy instruments

	Q1	Q2	Q4	Q6	Q8	Q12	Q14	Q18	Q20	Peak
EXP→TAX	0.326 (0.08)	0.216 (0.20)	0.333 (0.33)	0.110 (0.44)	0.047 (0.55)	-0.119 (0.69)	-0.163 (0.72)	-0.197 (0.75)	-0.204 (0.76)	0.349 (3) (0.26)
TAX→EXP	-0.053 (0.04)	-0.127 (0.05)	-0.151 (0.08)	-0.214 (0.11)	-0.227 (0.13)	-0.255 (0.15)	-0.262 (0.15)	-0.267 (0.16)	-0.268 (0.16)	0.268 (20) (0.16)

Note: The table displays tax and expenditure multipliers with respect to government spending and tax shocks. Corresponding standard errors are shown in parentheses.

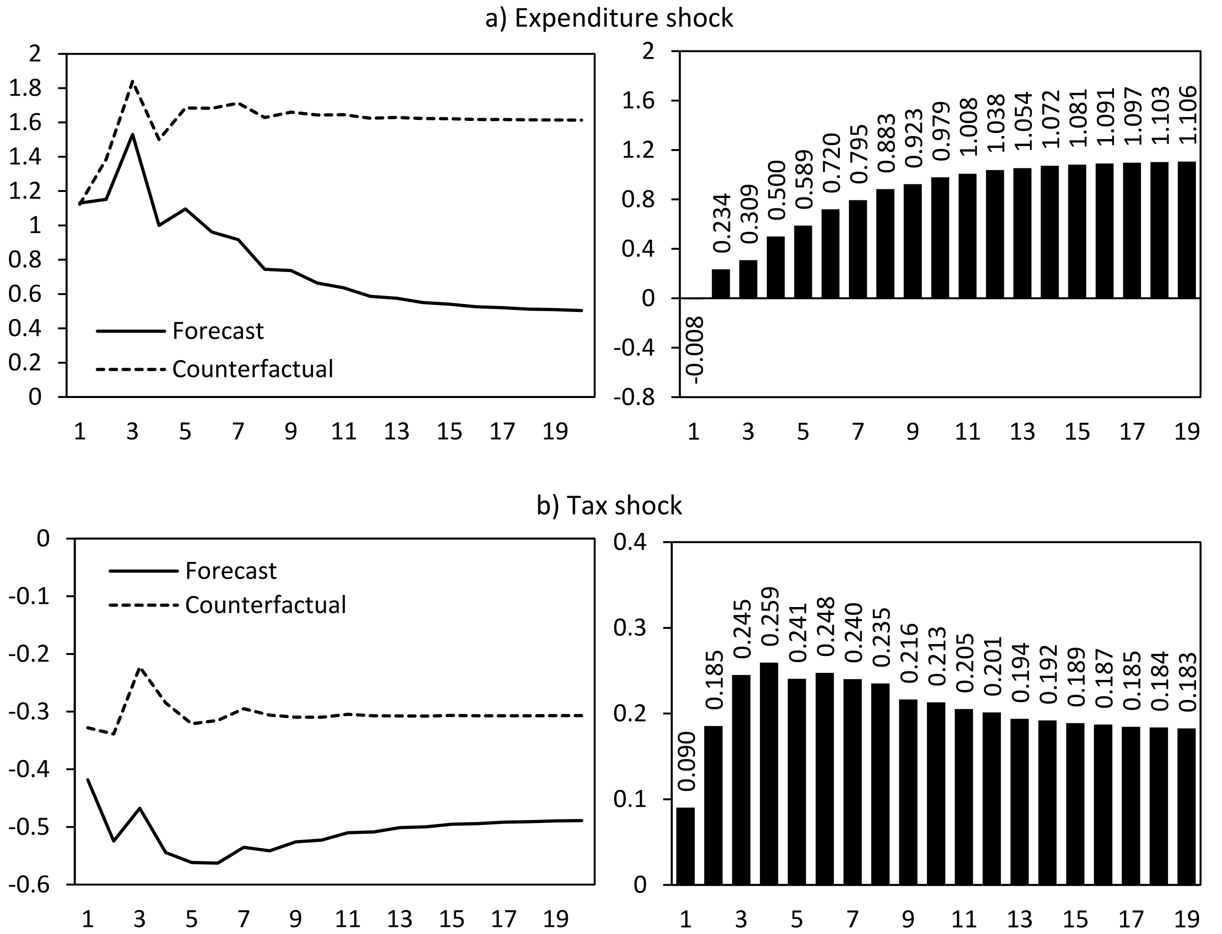
Counterfactual multipliers

In figure 4 we show that the difference between the forecast and the counterfactual multiplier is sizeable and economically important. The counterfactual multiplier is computed from a simulation where the interaction among policy variables is switched off by setting the corresponding coefficients to zero.[7] The dotted line in figure 4 shows the response of GDP to a shock in expenditure and net taxes, respectively. For comparison, the solid line traces the forecast multiplier from figure 3. We find that in the case of the expenditure multiplier, the effect on GDP is larger, and in the case of the tax multiplier, it is lower than the forecasting multiplier.

The total difference of the estimates is also displayed on the right hand side of figure 4. The peak of this difference is equal to 1.106 after five years (20 periods) for the expenditure multiplier and 0.259 after one year (4 periods) for the tax multiplier. The cumulative effect after one year (4 periods) is 0.50 larger for the expenditure multiplier and 0.259 smaller for the tax multiplier.

[7] Additionally, we set in the counterfactual exercise the structural correlation between taxes and spending in both directions equal to zero.

Figure 4: Difference between Forecast and Counterfactual Multipliers



Note: The left panel shows the forecast and counterfactual multipliers to a one standard deviation shock of expenditures and taxes, respectively. The right panel displays the difference between the forecast and the counterfactual multiplier.

Sensitivity analysis

We investigate the robustness of our findings in a set of sensitivity tests that are summarized in table 3. The rows in segment (1) of the table report the results of the baseline regression. In segment (2), we display the results for a VAR that is estimated with five variables, instead of three. The 5-variable VAR includes the interest rate and the price level as additional variables, as for instance in Perotti (2005). Although at longer horizons the fiscal multipliers are smaller for both, expenditure and taxes, the importance of the counterfactual analysis remains clearly visible. Both multipliers are substantially larger if the interaction of policy variables is eliminated. In segment (3) and (4) of table 4, we reduce the sample to exclude the last years of the global financial and economic crisis, and also replicate the original Blanchard and Perotti (2002) sample. In this reduced sample, the multipliers are lower than in the full sample but again the effect of the counterfactual analysis remains substantial.

Further robustness test include a current dummy as well as four lags of a dummy variable for the net tax cut 1975Q2 period in segment (5), choosing a higher lag order in segment (6) and controlling for a possible debt feedback, segment (7), by including the levels of public debt as an additional control variable (see Favero and Giavazzi (2007)). In all specifications, the differences of running a counterfactual regression display some variance with regard to the magnitude. But overall, size and direction of the effect remains remarkably robust.

Table 3: Output multiplier with respect to government spending and tax shocks

		Q1	Q2	Q3	Q4	Q6	Q8	Q10
(1) Baseline regression								
EXP	FC	1.131*	1.152*	1.530*	1.000	0.962	0.745	0.664
	Δ(CF)	-0.008	0.234	0.309	0.500	0.720	0.883	0.979
TAX	FC	-0.418*	-0.524*	-0.468	-0.544	-0.563	-0.541	-0.523
	Δ(CF)	0.090	0.185	0.245	0.259	0.248	0.235	0.213
(2) 5-VAR								
EXP	FC	1.066*	1.121*	1.321*	0.663	0.480	0.087	-0.114
	Δ(CF)	-0.033	0.147	0.207	0.367	0.570	0.714	0.793
TAX	FC	-0.368*	-0.386	-0.218	-0.189	-0.057	0.025	0.055
	Δ(CF)	0.079	0.167	0.188	0.179	0.147	0.121	0.089
(3) Sample: 1960Q1-2006Q4								
EXP	FC	1.064*	0.951	1.324*	0.871	1.020	0.919	0.935
	Δ(CF)	-0.018	0.263	0.365	0.471	0.445	0.477	0.463
TAX	FC	-0.522*	-0.589*	-0.625	-0.858	-1.018	-1.041	-1.025
	Δ(CF)	0.068	0.109	0.168	0.203	0.195	0.191	0.174
(4) BP Sample: 1960Q1 – 1997Q4								
EXP	FC	1.226*	1.154	1.576	1.109	1.425	1.316	1.360
	Δ(CF)	-0.043	0.200	0.272	0.337	0.175	0.178	0.146
TAX	FC	-0.117	-0.194	-0.165	-0.412	-0.557	-0.545	-0.528
	Δ(CF)	0.013	0.047	0.056	0.084	0.068	0.073	0.061
(5) Dummy: 1975Q2								
EXP	FC	1.102*	1.148*	1.544*	1.079	1.051	0.839	0.732
	Δ(CF)	-0.016	0.183	0.261	0.431	0.687	0.895	1.038
TAX	FC	-0.507*	-0.550*	-0.466	-0.417	-0.414	-0.354	-0.326
	Δ(CF)	0.130	0.228	0.300	0.267	0.283	0.269	0.254
(7) VAR(8)								
EXP	FC	1.138*	1.011*	1.151	0.416	0.772	1.287	0.987
	Δ(CF)	-0.022	0.246	0.388	0.681	0.971	0.919	0.910
TAX	FC	-0.435*	-0.523*	-0.456	-0.578	-0.474	-0.536	-0.612
	Δ(CF)	0.131	0.219	0.296	0.334	0.413	0.554	0.536
(8) Debt feedback								
EXP	FC	1.336*	1.204*	1.421	0.878	0.977	0.796	0.757
	Δ(CF)	-0.034	0.197	0.294	0.507	0.710	0.869	0.946
TAX	FC	-0.332*	-0.363	-0.332	-0.459	-0.434	-0.416	-0.398
	Δ(CF)	0.036	0.117	0.175	0.235	0.226	0.222	0.204

Note: The first row displays the response of GDP to a spending (EXP) and tax (TAX) shock in a scenario where all transmission channels are open (Forecast multiplier (FC)). The second row presents the change of these output responses in a scenario where the expenditure-tax channel is closed (Counterfactual Multiplier (CF)). The symbol * indicates that the reactions are statistically different from zero.

4. Related literature and conclusions

The issue of dynamic interaction among policy instruments has been first raised in the working paper version of Blanchard and Perotti's (2002) seminal paper.[8] They report that multipliers are slightly higher when they set the reaction of the respective other policy instrument to zero. However, they do not display impulse response functions or discuss the significance of this observation. Also in the shorter 2002 QJE publication, this discussion has been omitted. Our analysis elaborates on this point and illustrates the significance of the discussion in an updated data set. When we replicate our exercise in their sample period, the differences are indeed somewhat smaller. Apparently this is an additional identification issue that has grown in importance over time.

More recently, the size of the multiplier has also been investigated from different angles. Ilzetzki et al. (2013) for instance perform a large cross-country analysis and show that the size of the multiplier depends on several country-specific characteristics, including the state of development, the exchange rate regime and indebtedness. Ramey (2011b) furthermore highlights the importance of the exact timing of the spending shocks. Hall (2009) and Christiano et al. (2011) point out that multipliers are larger when interest rates are close to their zero-lower band. Finally, Auerbach and Gorodnichenko (2012) show that fiscal multipliers differ in different stages of the business cycle and are substantially larger in recessions. They also document that the nature of spending matters and further control variables are needed.

Overall, there is both, renewed academic interest in the size and estimation of fiscal multipliers, as well as an increased policy relevance. While Keynesian policies have not been explicitly used for several years and sometimes decades in many countries, the 2007/8 financial crisis has seen a revival of stabilization policies. Our contribution is intended to further refine the literature such that gives better guidance for the optimal use of fiscal policy instruments, and illustrate the limits of conventional SVAR estimates of fiscal multipliers for concrete policy advice.

[8] See also Perotti (2005). In a recent paper, Mountford and Uhlig (2009) have proposed an alternative approach to the common Blanchard and Perotti (2002) SVAR setup that is built on long-run identifying restrictions. In this paper, the authors also close the interaction channel among policy instruments.

5. Appendix

List of variables and data sources

All the data unless otherwise noted, are from the National Income and Product Accounts collected by the Bureau of Economic Analysis (BEA).

Table A1
Data definitions and sources

Variable		Definition	Data Code
3-VAR			
Government expenditure (EXP)		Federal government consumption expenditure and gross investment	A823RC1
	+	State and local government consumption expenditure and gross investment	A829RC1
Net taxes (TAX)		Federal current receipts	W005RC1
	+	State and local current receipts	W023RC1
	-	Federal grants-in-aid to state and local governments	B089RC1
	-	Federal current transfer payments to persons	B087RC1
	+	Federal current transfer receipts from persons	B233RC1
	-	Government social benefit payments to persons	B109RC1
	-	Federal interest payments	A091RC1
	+	Federal interest receipts	B094RC1
	-	State and local interest payments	B111RC1
	+	State and local interest receipts	B112RC1
	+	Federal dividends	W053RC1
	+	State and local dividends	B081RC1
Output (GDP)		Gross Domestic Product	A191RC1
5-VAR			
Price index		GDP deflator	B191RG3
Interest rate[9]		3-Month Treasury Bill: Secondary Market Rate	TB3MS

[9] Source: Board of Governors of the Federal Reserve System

Table A2
Data for the calculation of the exogenous elasticities

Variable	Definition	Data Code
Indirect taxes	Taxes on products and imports	W056RC1
Personal income taxes	Income taxes	B245RC1
Social security taxes	Contributions for government social insurance	W782RC1
Corporate income taxes	Taxes on corporate income	W025RC1
Transfers	Federal current transfer payments + State and local current transfer payments	A063RC1
Corporate profits	Corporate Profits with Inventory Valuation Adjustment (IVA) and Capital Consumption Adjustment (CCAdj)	CPROFIT
Earnings	Compensation of Employees: Wages & Salary Accruals	WASCUR
Employment[10]	All Employees: Total nonfarm	PAYEMS

Table A3
Net tax elasticities

	$\tau_{\text{tax,base}}$	$\tau_{\text{base,GDP}}$	weighted elasticity
Indirect taxes	1	1	1.05
Personal income taxes	1.50	0.11	0.05
Social security taxes	0.94	0.11	0.10
Corporate income taxes	0.85	3.93	1.23
Transfers	-0.2	1	-0.33
Net tax elasticity			**2.76**

Note: Author's calculation based on Blanchard and Perotti (2002) and Girouard and André (2005). The net tax elasticity to GDP of category i is calculated as the product of the tax elasticity to its own tax base ($\tau_{\text{tax,base}}$) and the elasticity of the tax base to output ($\tau_{\text{base,GDP}}$). The overall net tax elasticity is then calculated by the sum of every tax elasticity weighted by the share of each tax component in the sum of all tax revenues.

[10] Source: U.S. Department of Labor: Bureau of Labor Statistics

Table A4

Unit-root results

	ADF		KPSS	
	Level	1^{st} difference	Level	1^{st} difference
GDP	-1.848	-6.813***	1.829***	0.299
EXP	-1.947	-12.702***	1.775***	0.178
TAX	-2.169	-13.004***	1.305***	0.139

Note: The Augmented Dickey-Fuller (ADF) as well as the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test are calculated including a constant in the test equation. The lag length of the ADF tests is selected by SIC while the bandwidth for the KPSS test is selected based on Newey-West using Bartlett Kernel. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% level.

Table A5

Cointegration tests

	Johansen Test		Engle-Granger Test	
	Trace	Max-Eigen.	Dependent	z-statistic
r=0	36.82685	17.50796	GDP	-12.21631
r≤1	19.31889	13.61043	TAX	-13.52620
r≤2	5.708457	5.708457	EXP	-11.31151

Note: The Johansen as well as the Engle-Granger cointegration test allows for a constant and a trend in the cointegration space.

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