The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

Working Papers

www.cesifo.org/wp

Revisiting the Narrative Approach of Estimating Tax Multipliers

Shafik Hebous
Tom Zimmermann

CESIFO WORKING PAPER NO. 5040
CATEGORY 6: FISCAL POLICY, MACROECONOMICS AND GROWTH
OCTOBER 2014

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 5040*

Revisiting the Narrative Approach of Estimating Tax Multipliers

Abstract

A number of recent studies regress a "narratively" identified measure of a macroeconomic shock directly on an outcome variable. In this note, we argue that this approach can be viewed as the reduced-form regression of an instrumental variable approach in which the narrative time series is used as an instrument for an endogenous series of interest. We construct confidence bands for the case in which the narrative shock and the endogenous variable of interest are only weakly correlated. We apply the method to four narrative tax measures recently constructed by Romer and Romer (2010), Cloyne (2013), and Mertens and Ravn (2012). These variables turn out to be weak instruments for cyclically adjusted tax revenues. Compared to the single-equation estimation, we find that using any of the considered narrative tax measures as an instrument for cyclically adjusted tax revenues yields estimates of multipliers that are statistically indistinguishable from zero after correcting the confidence bands for weak instruments.

JEL-Code: E620, H300, E690.

Keywords: narrative approach, fiscal stabilization, multiplier, weak instruments.

Shafik Hebous
Faculty of Economics & Business Administration / Goethe University
Germany – 60323 Frankfurt / Main
hebous@wiwi.uni-frankfurt.de

Tom Zimmermann
Department of Economics
Harvard University
USA - Cambridge, MA 02138
tzimmerm@fas.harvard.edu

July 9, 2014

1 Introduction

The effect of a discretionary change in taxes or government spending on aggregate output is traditionally called "the multiplier". Estimating the multiplier is well-known to be a challenging task. Recent intense empirical scrutiny by economists has proposed a number of identification strategies and reported a variety of estimates. Romer and Romer (2010) suggest an identification approach that relies on extracting the exogenous component that is uncorrelated with the error term from the total tax series using published information in official policy documents ("narrative records"). Romer and Romer (2010), hereinafter referred to as R&R, identify all significant legislated tax changes after World War II in the US using documents such as the *Economic Report of the President* and classify them as exogenous or endogenous changes, and estimate a peak cumulative tax multiplier of 3.

The narrative approach of R&R has gained increasing popularity. It was employed in several subsequent studies to estimate tax multipliers for subcategories of total taxes or for other countries, and was embraced in other contexts such as estimating the government spending multiplier (Ramey, 2011), the effects of social security transfers on output (Romer and Romer, 2013), and the effects of risk premia on macroeconomic aggregates (Bahaj, 2014). Table 1 provides a summary.

Studies that use the narrative approach typically specify a model in which the exogenous narrative variable is regressed directly on the outcome variable. The model can be a linear specification estimated by OLS (e.g., R&R, 2010) or a vector autoregression model with a narrative measure added as an exogenous variable (e.g., Cloyne, 2013).[1] In this note, we revisit this approach and underscore that the validity of a linear regression of the narrative measure on the outcome variable crucially depends on the relationship between the endogenous and exogenous series.

We show that such a "reduced" form specification implies that the ratio of the covariance between an exogenous narrative measure and its underlying endogenous series over the variance of the exogenous measure should equal one. This condition can directly be mapped to a first-stage Instrumental Variable (IV) regression as this covariance-variance ratio is also the estimated coefficient of the instrument when regressed on the instrumented endogenous fiscal variable. Consequently, we argue in favor of viewing a narrative measure as an instrument for the fiscal series of interest. Our suggested IV estimation is an extension of the direct projection method developed by Jordà (2005).

As a specific application, we closely reexamine four narrative tax variables: All legislated

[1] Mertens and Ravn (2013) use the narrative measure as an instrument for the series of reduced form innovation shocks obtained from a vector autoregression model.

tax changes in the US by R&R, two subset variables by Mertens and Ravn (2012) distinguishing between anticipated and unanticipated tax changes, and the measure of all legislated tax changes in the UK by Cloyne (2013). These variables provide a homogenous context and were all regressed directly on output changes in the corresponding studies.

We document two empirical observations. First, these narrative variables tend to be weakly correlated with cyclically adjusted tax revenues, and the above mentioned cov-var ratio is not equal to one (and rather small).

Second, we find several confounding factors indicating that a number of macroeconomic variables tend to change in tandem with a narrative tax shock in the US. We control for these differences in the estimation. This observation is consistent with that of Jordà and Taylor (2013) for episodes of fiscal consolidation identified in Devries et al. (2011) and Guajardo et al. (forthcoming).

Our results show that F-statistics of first-stage regressions are smaller than 10 and the associated values of R^2 tend to be very low suggesting that available narrative tax measures can only be viewed as weak instruments for cyclically adjusted tax series. We, therefore, correct the confidence bands of the estimated coefficients for the weakness of the instruments as suggested by Mikusheva (2010) and Moreira (2003).

The IV estimation results indicate that the estimated effect of any of the considered narrative tax measures on output growth is insignificant when we use them as an instrument for the ratio of real cyclically adjusted tax revenues. Further, we provide results using as endogenous series all legislated tax changes; i.e. the sum of changes that are categorized by the original authors as endogenous or exogenous. Compared to the series of cyclically adjusted taxes, the correlation between this series and the associated exogenous measure is higher for both R&R and Cloyne (2013). Remarkably, we find that the exogenous measure of R&R gives significant estimates consistent with the original results of R&R, even with 95 percent weak-IV robust confidence bands. However, using anticipated or unanticipated tax changes, constructed in Mertens and Ravn (2012), as an instrument for all legislated tax changes of R&R, we obtain estimates of tax multipliers that are statistically indistinguishable from zero.

Our contribution stresses the issue of the relevance of the narrative measure; i.e., the correlation between the narrative measure and its endogenous series. As such, it is related to the external instruments approach of Stock and Watson (2012) and the discussion of weak external instruments in a VAR setup in Montiel-Olea, Stock, and Watson (2012). Another distinct point that complements our discussion is examining the exogeneity of a narrative variable. This route was taken by Jordà and Taylor (2013) arguing that narratively identified episodes of fiscal consolation are not random events, and hence they are correlated with the

error term.[2] The issues of relevance and exogeneity, together, give a general guide of how to view the narrative identification for estimating macroeconomic effects.

The structure of this paper is as follows. Section 2 explains the link between the reduced form narrative identification approach and the IV estimation. In section 3, we describe the considered narrative tax variables and provide estimation results from an IV model. Section 4 concludes.

2 The Narrative Approach and an IV Perspective

2.1 Conceptual Framework

Our starting point is the conceptual framework that was introduced in R&R. Consider a simple regression of changes in a fiscal variable (ΔT_t), e.g., a measure of tax receipts, on changes in output (Δy_t):

$$\Delta y_t = \alpha + \beta \Delta T_t + \epsilon_t. \tag{1}$$

The contemporaneous marginal multiplier is: $\frac{\partial \Delta y_t}{\partial \Delta T_t} = \beta$. A dynamic analysis often includes lagged values of the fiscal variable. Then, the cumulative multiplier is the sum of the coefficient associated with contemporaneous ΔT and the coefficients on the included lagged values of ΔT. A simple regression of changes in output on changes in taxes yields biased results because ΔT_t is correlated with ϵ_t due to reverse causality or omitted variable bias.

Changes in the variable T_t can be viewed as containing two components. The first component of ΔT captures exogenous discretionary fiscal policy actions, which is what researchers are ultimately interested in. The second component of ΔT includes non-fiscal policy effects and automatic changes in the fiscal series over the business cycle without any explicit policy intervention.

The literature mainly uses two different approaches to identify the causal effect of tax changes on output. One strand uses structural vector autoregressions models and imposes timing assumptions on the macroeconomic process. For example, Blanchard and Perotti (2002) motivate their identification by decision and implementation lags of fiscal policy arguing that taxes do not react to output within a quarter. The ability of this approach to identify a tax policy effect is debated.[3]

The second strand of the literature was pioneered by R&R and attempts to directly identify the exogenous discretionary component in the tax series. The idea can be demonstrated

[2]The exogeneity aspect of narrative variables was also debated in the context of monetary policy shocks (Leeper, 1997; and Romer and Romer, 1997).

[3]Hebous (2011)provides a comprehensive review of the literature.

as follows. Let ϵ_t be the sum of all endogenous disturbances in a quarter t, i.e., $\epsilon_t = \sum_{i=1}^{K} \epsilon_t^i$. Changes in taxes can be decomposed into two parts,

$$\Delta T_t = \sum_{i=1}^{K} b_t^i \epsilon_t^i + \sum_{j=1}^{L} \omega_t^j. \tag{2}$$

The first term on the right-hand side of equation (2) depicts endogenous changes of ΔT_t and the second term depicts exogenous fiscal changes constructed using the narrative approach. Denoting the exogenous tax changes as $\omega_t \equiv \sum_{j=1}^{L} \omega_t^j$, plugging equation (2) in equation (1), and re-arranging terms yields

$$\Delta y_t = \alpha + \beta \omega_t + u_t, \tag{3}$$

where $u_t = \sum_{i=1}^{K} (1 + \beta b_t^i) \epsilon_t^i$.

With an accurate measure of ω_t at hand, the causal effect of tax changes on output changes can be identified from estimating equation (3). This is the central insight of R&R. In careful work, they construct a measure of such discretionary exogenous tax changes from official sources (the *narrative records*) that helps to categorize the motivation behind each single reported tax change. The constructed series is then used directly as a measure of tax changes in equation (3).

2.2 Narrative Measures as Instruments

The simple linear decomposition in equation (2) has the straightforward implication that

$$\begin{aligned} Cov(\Delta T_t, \omega_t) &= Cov(\epsilon_t + \omega_t, \omega_t) \\ &= Cov(\epsilon_t, \omega_t) + Var(\omega_t), \end{aligned} \tag{4}$$

and, therefore,

$$\frac{Cov(\Delta T_t, \omega_t)}{Var(\omega_t)} = \frac{Cov(\epsilon_t, \omega_t)}{Var(\omega_t)} + 1. \tag{5}$$

Proposition 1 *If exogenous tax changes are accurately identified and if equation (2) holds,*

$$\frac{Cov(\Delta T_t, \omega_t)}{Var(\omega_t)} = 1. \tag{6}$$

Proof. The first term on the right-hand side of equation (5), $\frac{Cov(\epsilon_t, \omega_t)}{Var(\omega_t)}$, is zero if exogenous tax changes are accurately identified. The result follows directly. ■

This result is nothing more than an identity if the measure of total taxes is constructed as the sum of endogenous and exogenous tax changes. However, this conceptual framework explicitly motivates viewing the narrative approach through the lens of IV estimation. Consider the two-stage least-squares estimator:

$$\Delta T_t = \delta_0 + \delta_1 \omega_t + \nu_t \tag{7}$$

$$\Delta y_t = \alpha + \beta \widehat{\Delta T}_t + e_t, \tag{8}$$

where $\widehat{\Delta T}_t$ are the predicted values of ΔT_t obtained from the first-stage regression in equation (7). Comparing equation (3) with the system of equations (7) and (8) clarifies that equation (3) is a reduced-form equation in the sense that the instrument is *directly* regressed upon the dependent variable of interest.

The immediate connection between Proposition 1, the narrative approach, and the IV approach is the first-stage regression. To see this, note that an estimate of the coefficient δ_1 in regression (7) is given by

$$\delta_1 = \frac{Cov(\Delta T_t, \omega_t)}{Var(\omega_t)}, \tag{9}$$

which is the left-hand side of equation (6). Thus, Proposition 1 asserts that the narrative approach implies that the coefficient in the first-stage regression $\delta_1 = 1$. Clearly, this relates to the issue of the relevance of the instrument; that is, to which extent can the exogenous narrative measure explain the endogenous variable? We will come back to the empirical content of this discussion and present first-stage results in section 3.1.1.

2.3 The Implementation of IV Estimation in a Dynamic Setting

To implement the IV estimator, we build upon the work of Jordà (2005) who presented the estimation of Impulse Response Functions (IRFs) using the method of local direct projections of the form

$$Y_{t+h} = a^h + b^h \omega_t + \sum_{j=0}^{K} \phi_j^h \Delta Y_{t-j} + u_t^h, \forall h \in \{0, \ldots, H\}. \tag{10}$$

The reduced form IRF is then directly given by the set of coefficients $\{b^h\}_{h=0}^H$. Jordà (2005) shows that the resulting IRF from (10) is identical to that obtained from autoregressive models. One advantage of the local direct projections representation is its straightforward extension to an IV model by considering the form

$$Y_{t+h} = \alpha^h + \beta^h \Delta T_t + \sum_{j=0}^{K} \gamma_j^h \Delta Y_{t-j} + e_t^h, \forall h \in \{0, \ldots, H\}, \tag{11}$$

where the exogenous narrative tax measure is used as an instrument for ΔT as we motivate in equation (7):

$$\Delta T_t = \delta_0 + \delta_1 \omega_t + \nu_t. \tag{12}$$

The IV IRF is then directly given by the set of coefficients $\{\beta^h\}_{h=0}^H$. Comparing (10) with (11) and (12) clarifies that equation (10) corresponds to a reduced-form regression in the sense that the instrument is regressed directly on the outcome variable instead of using it for predicting values of the endogenous variable in a first-stage regression. As we will see in the next section, the empirical results suggest that, depending on the endogenous measure of tax changes, narrative measures tend to be weakly correlated with the endogenous regressor. Therefore, we compute weak-IV robust confidence intervals which are constructed by inverting a test that has the correct size even when instruments are weak. In particular, we follow Mikusheva (2010) in presenting robust confidence intervals based on inverting a Conditional Likelihood Ratio test.[4]

3 Empirics

3.1 Empirical Regularities

We consider four recently constructed narrative tax variables: The seminal measure of R&R capturing all exogenous legislated tax changes in the US, two subset variables by Mertens and Ravn (2012) that distinguish between anticipated and unanticipated tax changes in the US by labeling a tax liability change as unanticipated if the implementation lag does not

[4]For a detailed treatment of statistical inference in the presence of weak instruments, see Andrews et al. (2006), Mikusheva (2010), and Moreira (2003).

exceed 90 days, and the measure of all exogenous legislated tax changes in the UK by Cloyne (2013). All data are described in detail in appendix C.

3.1.1 Instrument Relevance

Table 2 reports estimates of the covariance ratio in Proposition 1 for all four narrative tax measures. For each of the considered narrative exogenous variable, we examine two different endogenous series: The series of all legislated tax changes that are identified based on the narrative records (i.e., the sum of endogenous and exogenous legislated tax changes as classified by the original authors) and the ratio of real cyclically adjusted revenues to GDP.[5] According to the results in table 2, if we consider the endogenous series to be changes in real cyclically adjusted revenues as a percent of real GDP, the measure of R&R is the best performing among the considered variables with a value of 0.52.

Still, the ratio is visibly below 1 for all variables. For example, in the case of the unanticipated tax changes the ratio is only 0.2. These results are not in line with the suggested decomposition given by equation (2). However, when considering all legislated tax changes as the underlying endogenous series, the ratio for the variable of Cloyne (2013) is exactly 1 and for R&R very close to one. The variables of Mertens and Ravn (2012) give small ratios.

Deviations of the covariance-variance ratio from 1 can be interpreted in different ways. Notably, the shocks ω_t might not be precisely measured or the proposed decomposition of total taxes given in equation (2) might not hold; for instance, changes in ω_t might not translate one-to-one into total tax changes ΔT_t. The most serious concern would be that the narrative series are not related to the endogenous series of interest. However, the point that we prefer to emphasize is that the simple decomposition in (2) might not capture some aspects of the data. Therefore, there might be concerns with the interpretation of results obtained from equation (3).

Additionally, table 2 reports the first-stage regression results of a dynamic model including lagged output, lagged values of the exogenous narrative measure and covariates such as the policy rate as we will discuss in the next subsection. The sample period differs for the dynamic models due to the inclusion of 12 lags and the availability of the policy rate for the US (starting from 1954q2). The estimated coefficients on the excluded instrument (the exogenous tax measure) are rather similar to those obtained from the model without accounting for confounders. As a rule of thumb, if the $F-$statistic of the first-stage regression is below 10 then the set of instruments is considered to be weak (Staiger and Stock, 1997).

[5] In the case of anticipated and unanticipated tax changes, the series of all legislated tax changes is that of R&R since the episodes are a subset of the original R&R narrative variable.

Table 1 shows that the $F-$statistics when we use cyclically adjusted revenues in the first-stage are all smaller than 10 except for R&R's exogenous variables (11.9). The $F-$statistic is greater than 10 for all variables when we use the narrative endogenous series in the first-stage except for the case of the anticipated tax measure.

3.1.2 Potential Confounders

Thus far, the discussion has focused on the relevance of the instrument. As is well-known, a valid instrument has to be both relevant and valid (i.e., $corr(\omega_t, \epsilon_t) = 0$). Since we only have one instrument (the exogenous tax measure) for one endogenous variable, it is not possible to statistically test the validity of the exogeneity assumption. Still, a good instrument should be "as-if" randomly assigned across periods. Therefore, a simple informative test is whether the distribution of covariates significantly differs between episodes with and without exogenous tax changes. This idea mirrors the insights from the literature on estimating a (micro) treatment effect. As in many microeconometric applications, one way to address concerns regarding the exogeneity of the treatment is by conditioning on observables; that is checking for possible imbalances of the covariate distributions in the treatment and the control group. With some caveats about how to apply these concepts in a longitudinal setting, one can label episodes with exogenous tax changes as *treated* and those without exogenous tax changes as *control*. We apply this test in the appendix. Table 4 reveals that the normalized differences are larger than 0.25 standard deviations for a number of variables in the US such as monetary policy rate and AAA corporate bond rate. Looking at Cloyne (2013)'s measure for the UK, table 4 shows that all considered covariates do remarkably well in this regard. Normalized differences in covariates' average values are rather small.

3.2 IV Estimation Results

Figure (1) plots the IRFs of output following a tax shock identified based on narrative measures and using our IV method in equations (11) and (12). We emphasize that the gray regions present the *95%* confidence bands corrected for the weakness of the instrumental variable as described above. All estimations include 12 lags. All regressions for the US control for the monetary policy rate, AAA corporate bond rate, corporate spread, defense spending, and the unemployment rate. We plot the IRFs obtained from the reduced form equation (10) for comparison, with the corresponding 95% confidence bands shown as dotted lines.

The findings are summarized as follows. First, using R&R exogenous variable as an instrument for all legislated tax changes yields a similar pattern to the original results reported

in R&R. The IRF is (weakly) significant at the 95% confidence level for intermediate horizons of three to six quarters. Using the UK data of Cloyne (2013), the upper bound of the confidence intervals runs through the zero line implying a lower significance level than that of R&R. The striking results are that unanticipated and anticipated legislated tax changes are insignificant due to their weakness as instruments for the series of all legislated tax changes. Using the narrative variables as instrument for the cyclically adjusted tax revenues yields insignificant results for all variables. This is a clear indication that narrative measures tend to be very weakly correlated with observable changes in tax revenues.

4 Concluding Remarks

We have reexamined the notion of identifying macroeconomic effects using the narrative approach taking as an application the estimation of tax multipliers.

Our analysis emphasized that the narrative research design requires not only constructing an exogenous measure but also has to specify the underlying endogenous series of interest. It can be the case that a narrative measure is exogenous with respect to the outcome variable of interest. However, it is essential to understand what the narrative measure really explains and with what variable it is ultimately correlated.

Furthermore, we have pointed out a simple validity condition for checking the adequacy of regressing the narrative measure directly on the outcome variable. The reduced-form model assumes that the ratio of the covariance between the endogenous series and the exogenous narrative measure over the variance of the exogenous narrative measure is equal to one. This condition straightforwardly reconciles the reduced form narrative approach with the instrumental variable approach as this covariance-variance ratio is an estimate of the coefficient of the narrative variable in a first-stage regression of the underlying endogenous series on the corresponding narrative measure.

We considered four different recently published narrative tax series; three of which are constructed for the US and one for the UK. We documented two empirical regularities with regard to the considered measures suggesting that: 1) Narrative tax measures tend to be weakly correlated with cyclically adjusted tax revenues, 2) changes in the narratively identified legislated tax variables tend to occur in episodes that seem to be different in dimensions other than tax changes from other episodes.

We argued in favor of using an IV procedure based on direct projection. First-stage F-statistics indicate that available tax narrative measures are weak instruments for cyclically adjusted tax revenues. Confidence bands that are robust in the presence of weak instruments

suggest that available narrative measures do not yield significant estimates of tax changes on aggregate output changes in the US or in the UK. There is, however, one notable exception. Using the exogenous narrative tax series of Romer and Romer (2010) as an instrument for all identified legislated tax changes reported in their study yields robust results in line with the original findings.

References

Alesina, A., Favero, C., and Giavazzi, F. (2014), The Output Effect of Fiscal Consolidation Plans, Mimeo.

Andrews, D.W.K. , Moreira, M., and Stock, J. (2006), Optimal Two-Sided Invariant Similar Tests for Instrumental Variables Regression, *Econometrica* 74 (3), 715–752.

Bahaj, S. A. (2014), Systemic Sovereign Risk: Macroeconomic Implications in the Euro Area, Mimeo, University of Cambridge, UK.

Blanchard, O. and Perotti, R. (2002), An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output, *Quarterly Journal of Economics* 117 (4), 1329–1368.

Bluedorn, J., and Leigh, D. (2011), Revisiting the Twin Deficits Hypothesis: The Effect of Fiscal Consolidation on the Current Account, *IMF Economic Review* 59 (4), 603–629.

Cloyne, J. S. (2013), Discretionary Tax Changes and the Macroeconomy: New Narrative Evidence from the United Kingdom, *American Economic Review* 103 (4), 1507–28.

Devries, P., Guajardo, J., Leigh, D., and Pescatori, A. (2011), A New Action-based Dataset of Fiscal Consolidation, IMF Working Paper No. WP/11/128.

Dominguez, K., and Shapiro, M. D. (2013), Forecasting the Recovery from the Great Recession: Is This Time Different? *American Economic Review Papers and Proceedings* 103(3): 147–152.

Feyrer, J., and Shambaugh, J. (2012), Global Savings and Global Investment: The Transmission of Identified Fiscal Shocks, *American Economic Journal: Economic Policy* 4 (2), 95–114.

Guajardo, J., Leigh, D., and Pescatori, A. (forthcoming), Expansionary Austerity: New International Evidence, *Journal of the European Economic Association* .

Hayo, B., and Uhl, M. (2014), The Macroeconomic Effects of Legislated Tax Changes in Germany, *Oxford Economic Papers* 66 (2), 397–418.

Hebous, S. (2011), The Effects of Discretionary Fiscal Policy On Macroeconomic Aggregates: A Reappraisal, *Journal of Economic Surveys* 25 (4), 6747–707

Jordà, O. (2005), Estimation and Inference of Impulse Responses by Local Projections, *American Economic Review* 95 (1), 161–182.

Jordà, O. and Taylor, A. M. (2013), The Time for Austerity: Estimating the Average Treatment Effect of Fiscal Policy, NBER Working Paper No. 19414.

Leeper, E. (1997), Narrative and VAR Approaches to Monetary Policy: Common Identification Problems, *Journal of Monetary Economics* 40 (3), 641–57.

Mertens , K., and Ravn, M. (2013), The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States, *American Economic Review* 103 (4), 1212–47.

Mertens , K., and Ravn, M. (2012), Empirical Evidence on the Aggregate Effects of Anticipated and Unanticipated US Tax Policy Shocks, *American Economic Journal: Economic Policy* 4 (2), 145–81

Mikusheva, A. (2010), Robust Confidence Sets in the Presence of Weak Instruments, *Journal of Econometrics* 157 (2), 236–247

Montiel-Olea, J., Stock J. and Watson M., (2012), Inference in Structural VARs with External Instruments, *Mimeo*

Moreira, M. (2003), A Conditional Likelihood Ratio Test for Structural Models, *Econometrica* 71 (4), 1027–1048.

Perotti, R. (2012), The Effects of Tax Shocks on Output: Not So Large, but Not Small Either, *American Economic Journal: Economic Policy* 4 (2), 214–237.

Ramey, V. (2011), Identifying Government Spending Shocks: It's all in the Timing, *Quarterly Journal of Economics* 126 (1), 1–50.

Romer, C., and Romer, D. (2013), Transfer Payments and the Macroeconomy: The Effects of Social Security Benefit Changes, 1952-1991, Mimeo, University of California, Berkeley.

Romer, C., and Romer, D. (2010), The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks, *American Economic Review* 100 (3), 763–801.

Romer, C., and Romer, D. (1997), Identification and the Narrative Approach: A Reply to Leeper, *Journal of Monetary Economics* 40(3), 659–65.

Staiger, D., and Stock, J. (1997), Instrumental Variables Regression with Weak Instruments, *Econometrica* 65 (3), 557–586.

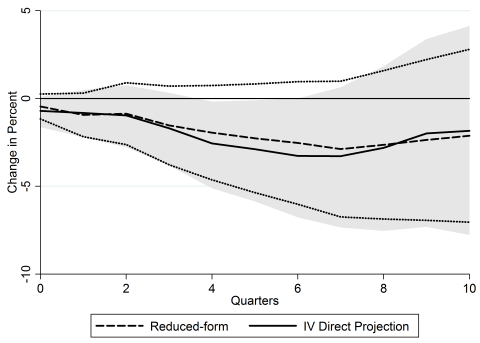
Stock, J. and Watson, M. (2012), Disentangling the Channels of the 2007-09 Recession, *Brookings Papers on Economic Activity*, Spring 2012.

Stock, J., Wright, J., and Yogo, M. (2002), A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments, *Journal of Business & Economic Statistics* 20 (4), 518–29.

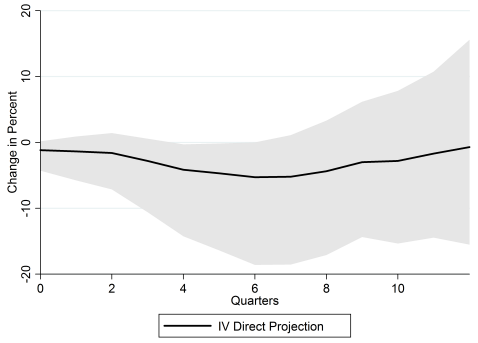
A Figures

Figure 1: The IRFs of Output Growth to Various Narrative Tax Changes

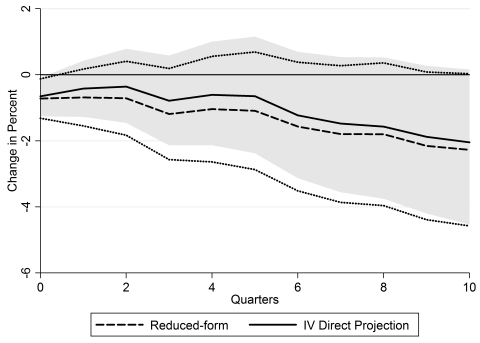
(a) R&R Exo. as IV for RR All



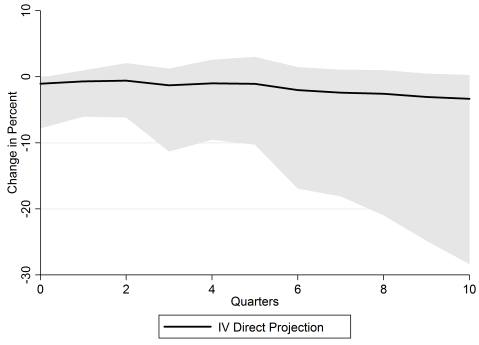
(b) R&R Exo. as IV for Cyc. Adju.



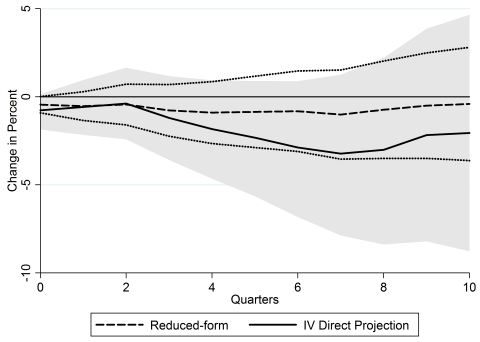
(c) Cloyne Exo. as IV for. Cloyne All



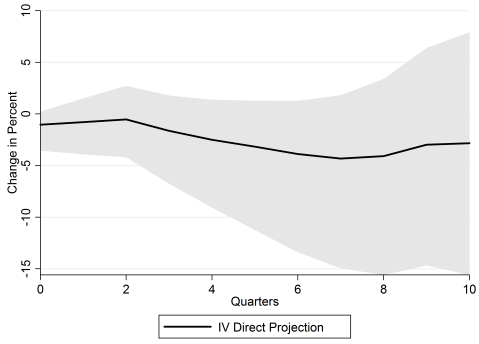
(d) Cloyne Exo. as IV for Cyc. Adj.



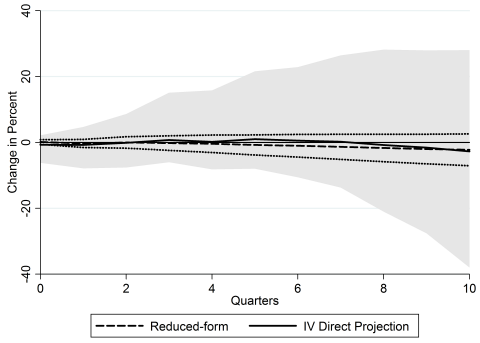
(e) M&R Unanti. as IV for RR All



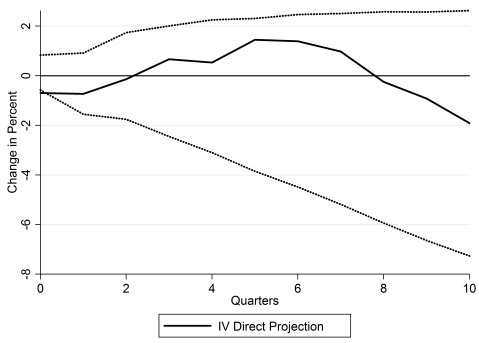
(f) M&R Unanti. as IV for Cyc. Adj.



(g) M&R Anti. as IV for RR All



(h) M&R Anti. as IV for Cyc. Adj.



Note: IV IRFs are based on equations (11) and (12) whereas reduced form IRFs are based on equation (10). Grey regions are 95% confidence bands corrected for the weak instrument problem. Dotted curves are reduced form 95% confidence bands."RR Exo." denotes the exogenous variable of R&R (2010). "Cyc. Adj." denotes the ratio of real cyclically adjusted revenues. "Cloyne Exo." denotes the exogenous variable of Cloyne (2013). "M&R Unanti." and "M&R Anti." stand for unanticipated and anticipated legislated tax changes of Mertens and Ravn (2012), respectively.

B Tables

Table 1: Summary of Recent Studies that Use Narrative Measures

Studies that construct a narratively identified variable			
Study	Exogenous Narrative Variable	Country	Sample Period
Studies on tax multipliers			
Romer and Romer (2010)	all legislated taxes	US	1945-2006
Clyone (2013)	all legislated taxes	UK	1948-2009
Mertens and Ravn (2012)	unanticipated taxes	US	1947-2006
Mertens and Ravn (2012)	anticipated taxes	US	1947-2006
Mertens and Ravn (2013)	personal taxes	US	1950-2006
Mertens and Ravn (2013)	corporate taxes	US	1950-2006
Hayo and Uhl (2014)	all legislated taxes	Germany	1974-2010
Guajardo et al. (forthcoming)	all fiscal consolidation actions	panel of 17 OECD countries	1978-2009
Other studies			
Bahaj (2014)	sovereign risk premia	Eurozone countries	2009-2013
Dominguez and Shapiro (2013)	policy and financial shocks	US and EU	2008-2012
Ramey (2011)	defense spending news	US	1939-2008
Romer and Romer (2013)	social security transfers	US	1952-1991

Studies that use an existing narratively identified variable in their applications		
Study	Used Variable	Application
Feyrer and Shambaugh (2012)	Romer and Romer (2010)	effects of tax policy on the current account
Perotti (2012)	Romer and Romer (2010)	compare automatic stabilizers and discretionary policy effects
Bluedorn and Leigh (2011)	Guajardo et al. (forthcoming)	effects of fiscal consolidation on the current account
Alesina et al. (2014)	Guajardo et al. (forthcoming)	effects of multiple-period fiscal consolidation on output

Note: This table lists a number of recent studies that use the narrative approach to identify macroeconomic effects, and is not meant to be an exclusive survey of the literature. The upper group of studies constructs variables from the narrative records to estimate effects on output and other macroeconomic aggregates. The lower-panel group of studies readily uses existing narrative variables in their applications.

Table 2: Statistics from First-Stage Regressions

Endogenous Series	Specification	Sample Period	ΔT_t is Cyclically Adj. Taxes $\frac{Cov(\Delta T_t,\omega_t)}{Var(\omega_t)}$	$t-stat.$ $(prob>t)$	R^2	$F-stat.$	ΔT_t is: All Legislated Changes $\frac{Cov(\Delta T_t,\omega_t)}{Var(\omega_t)}$	$t-stat.$ $(prob>t)$	R^2	$F-stat.$
R&R (2010)	No controls	1947q2-2007q4	0.502	3.45	0.07	11.90	0.958	26.93	0.360	725.34
				(0.00)				(0.00)		
	Controls	1957q3-2004q3	0.542	2.85	0.45	8.48	0.861	7.72	0.70	71.42
				(0.00)				(0.00)		
Clyone (2013)	No controls	1955q2-2009q4	0.432	1.40	0.01	1.96	1	5.4	0.24	29.10
				(0.16)				(0.00)		
	Controls	1958q2-2006q4	0.631	2.24	0.18	5.16	1.02	7.37	0.29	57.05
				(0.027)				(0.00)		
MR (2012), Unanticipated	No controls	1947q2-2006q4	0.198	2.21	0.03	4.88	0.417	8.52	0.20	72.50
				(0.02)				(0.00)		
	Controls	1957q3-2004q3	0.339	2.96	0.46	9.59	0.473	6.7	0.67	47.53
				(0.00)				(0.00)		
MR (2012), Anticipated	No controls	1947q2-2006q4	0.332	2.31	0.02	5.35	0.451	2.67	0.06	7.11
				(0.02)				(0.02)		
	Controls	1957q3-2003q3	0.371	1.88	0.44	3.10	0.292	2.15	0.55	5.91
				(0.06)				(0.03)		

Note: The variable ω_t is the narrative variable that is labeled as *exogenous* in the corresponding study given in the first column of this table. The variable ΔT_t is the endogenous series. We consider two potential endogenous series. 1) *Cyclically Adj. Taxes*: The real cyclically adjusted tax revenues as a percent of real GDP. 2) *All legislated tax changes* as identified by the narrative approach (i.e., endogenous legislated changes plus exogenous legislated changes). The $t-stat.$ is the estimated δ_1 divided by its standard error from the first-stage regression (12). the values of R^2 and $F-stat.$ correspond to the first-stage regression (12). Specifications without controls do not include any lagged values of the narrative variable any covariates whereas specifications with controls are dynamic models including 12 lags as described in (11) and (12), and in the case of the US include the following controls: The monetary policy rate, AAA corporate bond rate, corporate spread, defense spending, and the unemployment rate.

C Appendix

C.1 Summary of Considered Narrative Measures

Figure 2 plots the considered narrative variables. Since legislated tax changes are by construction discrete events, these tax series include a number of zero-observations indicating no tax actions in these quarters. Table 3 in the appendix reports means and standard deviations of these variables.

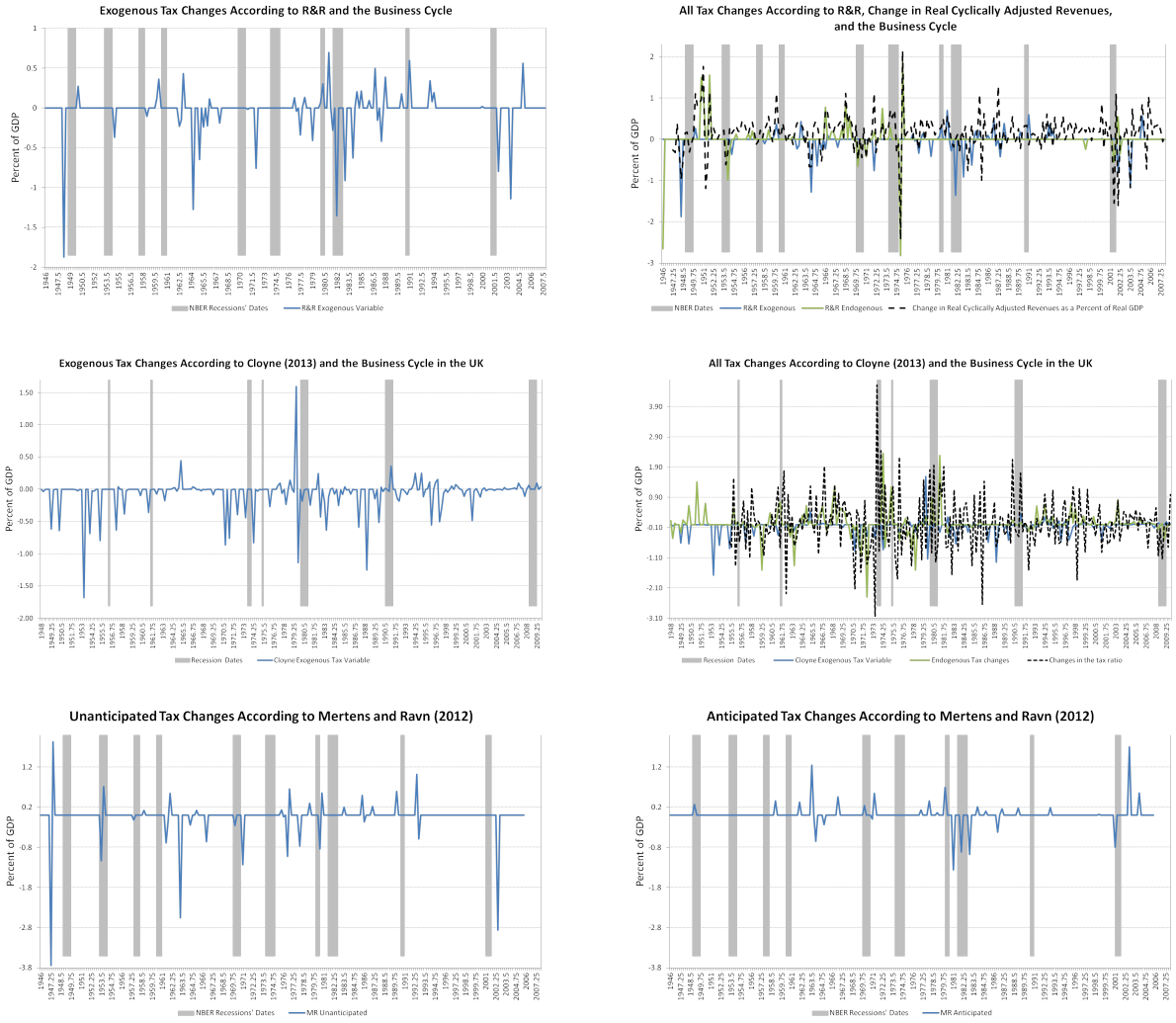
In the specific context of tax multipliers the ultimate endogenous series of interest can be debated. Alesina and Ardagna (2010) use cyclically adjusted tax series, which arguably offers a clear observable tax measure. Others argue against it without providing an alternative endogenous series; e.g., IMF WEO (2010).[6] Several studies that use the narrative identification approach refrain from clearly defining the underlying endogenous series. R&R and Cloyne (2013) are exceptional with this regard, and therefore we present our idea using their variables. Thus, we use two different variables as the underlying endogenous series of tax changes: The sum of all legislated tax changes and the series of real cyclically-adjusted tax revenues. Our aim is to provide a general message, not specific to the context of taxes, stating that the endogenous series is an essential part of a meaningful narrative identification approach.

Further, figure 2 presents the narrative measures of Mertens and Ravn (2012). These measures addresses the challenge that there often exists a lag between the announcement of fiscal policy changes and the date of implementation. The implementation lag enables agents in the economy to anticipate the fiscal action and react immediately at the announcement date and before the implementation. If the announcement is in t and the implementation in $t+1$ or $t+2$, this can trigger a change in Δy at time t even though the change in T has not yet occurred and will actually occur in the data in a later period. Therefore, anticipation of fiscal actions makes an OLS estimate of β biased because the fiscal variable will be correlated with future values of the error term. Mertens and Ravn (2012) distinguish between anticipated and unanticipated legislated tax changes in the US (the last two panels of figure, 2) by labeling a tax liability change as unanticipated if the implementation lag does not exceed 90 days.

In addition to the narrative series, we use a number of additional macroeconomic time series as control variables for the US.

[6] Alesina, A., and Ardagna, S. (2010), Large Changes in Fiscal Policy: Taxes vs. Spending. *Tax Policy and the Economy* 24, 35–68.
IMF WEO, World Economic Outlook (2010), Recovery, Risk, and Rebalancing, Chapter 3, International Monetary Fund, September, 2010, Washington DC.

Figure 2: Narrative Tax Changes



Note: Exogenous tax changes are legislated tax changes that are identified by the narrative records and classified as exogenous by the original authors (i.e, Romer and Romer, 2010, for the US, and Cloyne, 2013, for the UK). Endogenous tax changes are legislated tax changes that are identified by the narrative records and classified as endogenous by the original authors. Unanticipated and anticipated legislated tax changes are taken from Mertens and Ravn (2012). The gray bars indicate episodes of recessions. US dates of recessions are taken from the NBER whereas the dates for the UK are based on authors' own calculation and defined as two consecutive quarters of negative economic growth.

C.2 Additional Variables

The sources of the narrative variables are: Romer and Romer (2010) for exogenous and endogenous legislated taxes changes in the US. Cloyne (2013) for exogenous and endogenous legislated taxes changes in the UK. Mertens and Ravn (2012) for unanticipated and anticipated legislated taxes

Table 3: Summary of Considered Narrative Measures

Study	Measure	No. of Non-zero Observations	Mean (SD)
Romer and Romer (2010)	all legislated taxes	45	-0.03 (0.24)
Romer and Romer (2010)	all exogenous legislated taxes	69	-0.02 (0.41)
Clyone (2013)	all legislated taxes	124	-0.06 (0.25)
Clyone (2013)	all exogenous legislated taxes	171	-0.02 (0.47)
Mertens and Ravn (2012)	unanticipated taxes	31	-0.04 (0.42)
Mertens and Ravn (2012)	anticipated taxes	27	0.01 (0.22)

Note: All listed tax variables are constructed based on the narrative records. The studies of Romer and Romer (2010) and Mertens and Ravn (2012) are for the US whereas Cloyne (2013) is for the UK. The variables are expressed as a percent of GDP. In the econometric analysis, the sample in Romer and Romer (2010) spans from 1947q1 to 2006q4 whereas the sample in Cylone (2013) spans from 1955q1 to 2009q4.

changes in the US.

Concerning the macroeconomic data for the US, the change in real GDP is taken from Romer and Romer (2010). The variable house prices is taken from FRED: ASPUS. The CPI is taken from FRED: CPIAUCSL. Government spending is real federal spending expressed as the change from the last quarter and it is taken from Ramey (2011). Defense spending is real defense spending expressed as the change from the last quarter and it is taken from Ramey (2011). News spending is the nominal present value of the news variable of Ramey (2011). The variable Debt/GDP is the ratio of public debt to GDO obtained from FRED: GFDEGDQ188S. The policy rate is obtained from FRED: FEDFUNDS. The short-term government bond rate is from FRED: TB3MS whereas the long-term government bond rate is from FRED: GS10. AAA corporate bond rate is from FRED: AAA whereas BAA corporate bond rate is from FRED: BAA. SP500 is the stock price index taken from FRED: SP500. SPXD is a stock price index obtained from Global Financial Data (ticker: SPXD). Consumer confidence index is taken form FRED: UMSCENT & UMSCENT1.

For the UK, real GDP is taken from ONS as in Cloyne (2013). The policy rate is taken from Cloyne (2013). The corporate bond yield is taken from Global Financial Data (ticker: INGBRW). The financial index FTASD is taken from Global Financial Data (ticker: FTASD). The long-term government bond rate is obtained from Global Financial Data: 20 year government bond yield (ticker: IGGBR20D). The short-term government bond rate is obtained from Global Financial Data: 3-month treasury bill yield (ticker: ITGBR3D). Government spending is the variable: Government final consumption expenditure, volume; obtained form the OECD Economic Outlook vol. 93. Regarding the global variables, the first oil price index is Brent crude oil taken from Global Financial

Data (ticker: BRT_D). The second oil price index is WTI index obtained from Global Financial Data (ticker: WTC_D).

C.3 Potential Confounding Factors

One concern for the estimation is that there might be differences, in terms of other macroeconomic variables, between episodes of exogenous tax policy actions (treatment group) and episodes without these actions (control group).

We compute average values and standard deviations of a number of potential covariates for the treatment and control groups as identified by R&R, and report the differences between the means. Table 4 displays the results. We note that in such an exercise, the t-statistic is not an informative indicator since it is partially driven by the sample size. Instead, we document normalized mean differences in the last column. While a larger t-statistic could reflect larger sample size, a larger normalized difference unambiguously indicates a more unbalanced covariate distribution between the two groups. As a rule of thumb, a difference between average covariates values of 0.25 standard deviations or more suggests a violation of the exclusion restriction.

Table 4 reveals that financial conditions tend to be different depending on the type of the episode. The normalized differences are larger than 0.25 standard deviations in the case of the SP500 index, AAA and BAA corporate bond rates, and long-term and short-term government bond yields. The monetary policy rate appears to be similar. Among the considered macroeconomic variables, the difference in normalized means of changes of the unemployment rate is visibly large (0.4 standard deviations). Also, some fiscal variables such as the federal debt ratio and changes in defense spending tend to be different depending on the treatment status. The spending news variable of Ramey (2011) seems balanced between both types of periods, though.

Looking at Cloyne (2013)'s measure for the UK, table 4 shows that all considered covariates do remarkably well in this regard. Normalized differences in covariates' average values are rather small.

Additionally, table (4) shows that differences between episodes of anticipated tax changes and no anticipated tax actions as identified by the narrative measures of Mertens and Ravn (2012) are pervasive. For example, normalized differences are above 0.5 standard deviations in the case of long-term government bond rate and AAA and BAA corporate bond rates. Overall, with the exception of Cloyne (2013), the results of this exercise suggest that episodes of tax changes are generally different in some aspects from episodes of no tax changes. This means that unless the research design takes differences in the economic environment into account, there is no guarantee that the obtained results apply in other macroeconomic configurations (e.g., low unemployment, low bond spread). We therefore include variables that display large imbalances as control variables in our empirical framework.

Table 4: Confounding Factors

	Romer and Romer (2010)					Cloyne (2013)				
	Tax Changes		No Tax Changes			Tax Changes		No Tax Changes		
Variable	*Mean*	*SD*	*Mean*	*SD*	*diff/SD*	*Mean*	*SD*	*Mean*	*SD*	*diff/SD*
Financial Variables										
SP500 / FTASD for Cloyne (2013)	1.02	0.47	0.88	0.38	**0.34**	0.02	0.08	0.03	0.11	-0.11
SPXD	0.03	0.07	0.02	0.08	0.13					
AAA corporate bond rate	7.70	3.33	6.41	2.81	**0.44**	8.87	3.32	8.56	3.56	0.09
BAA corporate bond rate	8.71	3.73	7.29	3.09	**0.44**					
Long-term gov. bond rate	7.05	3.39	5.63	2.76	**0.49**	7.60	3.20	7.39	3.50	0.06
Short-term gov. bond rate	5.52	3.54	4.39	2.78	**0.38**	6.86	3.59	6.27	3.80	0.16
Policy rate	6.15	3.97	5.59	3.14	0.17	7.31	3.54	6.80	3.58	0.14
Macroeconomic Environment										
Real GDP per captia	0.01	0.01	0.00	0.01	0.15	0.01	0.01	0.01	0.01	0.00
Inflation	0.01	0.01	0.01	0.01	0.08	5.43	4.61	5.91	5.08	-0.10
House prices	0.02	0.02	0.02	0.03	0.13	8.29	8.48	8.62	10.09	-0.04
Unemployment rate	6.16	1.38	5.47	1.50	**0.46**	5.42	3.19	4.29	3.07	0.36
Consumer confidence	88.60	12.34	88.06	11.06	0.05					
Fiscal Variables										
Debt/GDP	43.32	11.36	47.70	12.71	**-0.35**					
News spending	8.33	66.99	6.19	69.98	0.03					
Defense spending	0.00	0.02	0.01	0.04	**-0.28**					
Government spending	0.00	0.02	0.01	0.03	**-0.24**	0.00	0.01	0.00	0.01	0.00
Global Variables										
Oil price index 1	0.01	0.10	0.02	0.10	-0.13					
Oil price index 2	0.00	0.03	0.01	0.05	-0.17					

	Mertens and Ravn (2012), Unanticipated					Mertens and Ravn (2012), Aanticipated				
	Tax Changes		No Tax Changes			Tax Changes		No Tax Changes		
Variable	*Mean*	*SD*	*Mean*	*SD*	*diff/SD*	*Mean*	*SD*	*Mean*	*SD*	*diff/SD*
Financial Variables										
SP500	0.97	0.46	0.90	0.40	0.16	1.04	0.48	0.90	0.39	**0.34**
SPXD	0.05	0.07	0.02	0.07	**0.38**	0.02	0.06	0.02	0.08	-0.10
AAA cor. bond rate	6.96	3.26	6.76	2.87	0.07	8.13	3.24	6.62	2.83	**0.52**
BAA cor. bond rate	7.94	3.65	7.67	3.17	0.08	9.16	3.65	7.52	3.13	**0.51**
Long-term gov. bond rate	6.36	3.34	6.00	2.83	0.13	7.41	3.32	5.87	2.80	**0.53**
Short-term gov. bond rate	4.71	3.16	4.74	2.90	-0.01	5.92	3.70	4.59	2.79	**0.46**
Policy rate	5.35	3.55	5.78	3.33	-0.13	6.55	4.13	5.60	3.23	**0.28**
Macroeconomic Environment										
Real GDP per captia	0.00	0.01	0.01	0.01	-0.04	0.01	0.01	0.00	0.01	**0.36**
Inflation	0.01	0.01	0.01	0.01	0.08	0.01	0.01	0.01	0.01	0.03
House prices	0.02	0.02	0.02	0.02	0.13	0.02	0.02	0.02	0.02	**0.28**
Unemployment rate	6.03	1.27	5.55	1.54	**0.32**	6.06	1.45	5.55	1.51	**0.33**
Consumer confidence	87.41	11.04	88.39	11.43	-0.09	89.05	13.17	88.15	11.11	0.08
Fiscal Variables										
Debt/GDP	41.56	11.46	47.15	12.48	**-0.45**	42.91	10.92	47.02	12.64	**-0.33**
News spending	-8.62	47.02	5.43	51.72	**-0.27**	17.75	85.11	1.83	45.23	**0.31**
Defense spending	-0.01	0.02	0.01	0.04	**-0.33**	0.00	0.02	0.01	0.04	**-0.28**
Government spending	0.00	0.02	0.01	0.03	-0.17	0.00	0.02	0.01	0.03	**-0.35**
Global Variables										
Oil price index 1	0.00	0.03	0.01	0.04	**-0.30**	0.01	0.02	0.01	0.04	0.13
Oil price index 2	0.00	0.08	0.02	0.10	-0.24	0.02	0.10	0.02	0.10	0.01